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Amity University Haryana

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Advancements & Modern Innovations in Engineering and Technology (AMIET 2020)
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Editors

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Message from Patron-in-Chief

Dr. Aseem Chauhan
Chancellor, Amity University Haryana
Additional President, RBEF

Research and Innovation are the pillars that lay down the foundation of academic excellence and technological advancements at the Amity University Haryana. The exclusive engagement of all the students and staff in cutting-edge innovations and path-breaking research is the backbone of our University. Undoubtedly, the spread of the novel COVID-19 pandemic has severely affected the conventional methods of the conduct of academics activities, it has not shaken down the zest and zeal of Amity University Haryana in pursuing new milestones in the field of academics and research.

Towards that end, it is a matter of sheer proud and delight to proclaim that Amity School of Engineering & Technology, Amity University Haryana (AUH) is organizing the First National Virtual Conference on **"Advancements & Modern Innovations in Engineering and Technology (AMIET-2020)"** on the auspicious occasion of India's Engineers' Day i.e. 15th of September, 2020.

AMIET-2020 is one amongst the numerous undertakings by Amity School of Engineering & Technology toward its incessant approach to accomplish academic excellence. Amid the ongoing pandemic and in reverence of the imposed social distancing norms, AMIET-2020 aims to facilitate a virtual gathering of academicians, scholars and industry stakeholders and thereby providing a digital platform for dissemination and exchange of information amongst the pool of intellectuals from different domains of Engineering and Technology. The conference will enable technological advances though deliberations and discussions on inter-disciplinary and multi-disciplinary facets of Engineering and Technology.

I am certain that AMIET-2020 will facilitate a multilateral forum for all concerned to expand their acquaintance sphere and to debate, deliberate and exchange novel and innovative ideas, practices and developments in the various themes of Engineering and Technology.

I congratulate and offer my wholehearted greetings to all national researchers, scholars, delegates, speakers, industry leaders, chairs and co-chairs of AMIET-2020 for their valued participation in the conference. I acknowledge and compliment the notable hard work of the various organizing committees and their members in the successful conduct of the conference on the digital platform. My heartiest congratulations are with all concerned for their sincerest efforts to accomplish the success of the conference.

Message from Patron

Prof. (Dr.) P.B. Sharma
Vice Chancellor
Amity University Haryana

It is a matter of immense pleasure to acknowledge that Amity School of Engineering & Technology, Amity University Haryana (AUH) is organizing First National Virtual Conference on **"Advancements & Modern Innovations in Engineering and Technology (AMIET-2020)"** on 15th September 2020. The ongoing time is unprecedented and it has certainly changed the conventional processes, procedures and outlook of the whole world for almost everything. The imposed restrictions on maintaining social distancing to curb the spread of COVID-19 has subsequently boosted the application of digital platforms and the education sector is no different. I am pleased to convey that the students and faculty members of Amity University Haryana have successfully and efficiently adopted the practice of e-learning to continue the dissemination of knowledge through concerted efforts.

The organization and conduct of the virtual national conference by Amity School of Engineering & Technology is an additional vibrant step in the direction of achieving academic rigour, excellence and innovation. I am of the strong belief that this virtual gathering of researchers, academicians, scientists and industry stakeholders from across the nation will nurture ground-breaking research ideas, industry-academia connects, gratifying research prospects for scholars and new landscapes of accomplishments in terms of the conference outcomes.

Amity University Haryana has achieved astounding benchmarks of research and innovations in multiple domains of Engineering and Technology through incessant efforts of the members of its fraternity. The untiring efforts of Amity University Haryana to pursue excellence in its every endeavour, is driven by the mission of our Hon'ble Founder President – Dr. Ashok Chauhan and our Hon'ble Chancellor – Dr. Aseem K. Chauhan to make India a superpower by 2030.

I am assured that this conference will certainly attain success and would be rewarding for the participants and the organizers. This conference will establish itself as the perfect platform which may lead to the conception of everlasting connects between intellectuals from diverse domains and will inspire inter- and multi-disciplinary innovations and research collaborations.

With great pleasure, I convey my earnest felicitations to the chairs, co-chairs, eminent delegates, learned speakers and members of various organizing committees and welcome all the participants to a prolific event.

Message from Patron

Prof. (Dr.) Padmakali Banerjee
Pro-Vice Chancellor
Amity University Haryana

It is my great privilege and pleasure to welcome you all to First National Virtual Conference on **"Advancements & Modern Innovations in Engineering and Technology (AMIET-2020)"** on 15th September 2020, organized by Amity School of Engineering & Technology, Amity University Haryana (AUH). The notion of AMIET-2020 as a virtual conference aptly facilitates the continuance of the endeavours towards research and innovations while strictly adhering to the norms of maintaining social distancing during the COVID-19 global outbreak.

A conference of learned participants is essentially a productive platform for fruitful unification of researchers, academicians and industrialists belonging to diverse fields and domains of engineering and technology. The ongoing pandemic has challenged the world and has forced the expansion of technological innovations and advancements. The agenda of AMIET-2020 is driven by the need of the hour to provide digital channels and mediums to the intellectual for discussing and nurturing innovative philosophies and prospects.

The conference has received an awe-inspiring response in terms of the participation and submission of research articles by the scholars of various domain of Engineering and Technology. A great response to AMIET-2020 has been received from the academicians as well to share their treasured lookouts and modern advances with the fellow members of the scientific community. We are honoured to have eminent academicians and industrial representative as session chairs and keynote speakers, enlightening the congregation.

It is a sheer delight to recognize and acknowledge the unwavering and rigorous efforts of the members of various committees that are put in organizing a gathering of learned members and facilitating a virtual forum for deliberation and exchange of valuable ideas on modern-day concerns and necessities.

Last but not the least, on behalf of the entire AUH fraternity I would like to extend my heartfelt welcome to all the learned participants of AMIET-2020 and I wish them inspiring interactions during the conference paving pathways to scientific breakthroughs and innovations.

Message from Patron

Maj. Gen. B.S. Suhag
Deputy Vice Chancellor
Amity University Haryana

I am delighted to acknowledge and share that Amity School of Engineering & Technology (ASET), Amity University Haryana (AUH), is organizing its 1st National Virtual Conference on **"Advancements & Modern Innovations in Engineering and Technology (AMIET-2020)"** on 15th September 2020. The ongoing SARS-CoV2 pandemic has undoubtedly affected the ways of our lives, our functioning, and thinking. Amity has always been at the forefront of cutting-edge innovations and novel researches, and this vision and mission of Amity has not changed in these difficult times. All of the academic institutions worldwide are shifting to digital mode of delivery of academic instructions to minimize the loss of knowledge to the student's community. The same change in the modes of delivery and exchange of ideas is being seen between the congress of academicians, scholars, researchers, and industry experts.

AMIET-2020 is one such thoughtful effort by ASET in the direction of providing a common platform and discussion forum for all stakeholders. The online conference ensures that research and innovation continue but without breaking any social distancing norms laid down as per the guidelines issued by various state governments and health organizations. AMIET-2020 provides a channel to continue the quest for interdisciplinary, multidisciplinary, and translational research. This online conference aims to gather a pool of intellectuals from different domains and streams of science and technology and facilitate the exchange of novel and innovative ideas that may be of utmost interest to industry and society.

I feel genuine pleasure in inviting all the creative and innovative minds of the academia and industry to come forward and brainstorm together and engage themselves in our common continuous pursuit of promoting and reaching excellence. I congratulate all the organizing chairs, and team members for their hard work and consistent efforts in organizing this conference, and I wish the conference to be a great success.

Message from Conference Chair

Prof. (Dr.) S.N. Sridhara
Director
Amity School of Engineering & Technology
Amity University Haryana

We are pleased to present the proceedings and book of abstracts of the First National Virtual Conference on **"Advancements & Modern Innovations in Engineering and Technology (AMIET-2020)"** scheduled on the 15th of September 2020. AMIET-2020 is being organized on 'Engineers Day' which is commemorated to pay tribute to Bharat Ratna Sir M. Visvesvaraya, a great engineer of the century that India has produced, on his birthday, i.e., the 15th of September.

The main objective of this conference is to provide a platform for the research scholars, faculty, and working professionals to meet virtually and exchange their innovations, research outputs, and new learnings through the presentation of research papers and posters. Research papers related to engineering and technological innovations in all subdivisions of engineering were invited from across the country. A good response was received from all corners of the nation, and more than 150 papers submissions were received. The received papers were scrutinized for assessing the similarity content and were subjected to a blindfolded double peer-review process. Finally, 69 research papers, which incorporated the review suggestions, were accepted for presentations and to be included in the proceedings of the conference.

The conference is being organized through online presentations and discussions to facilitate connection even during the pandemic time of COVID-19. The quality and wide range of the topics of the papers to be presented in this virtual conference are the indicators of the spirit of Indian Scholars, who made the best use of unprecedented lockdowns to keep creativity at peak.

Founder President - Dr. Ashok K. Chauhan and Hon'ble Chancellor – Dr. Aseem Chauhan have been constant sources of inspiration for all the innovative works carried out at AUH. Hon'ble Vice-Chancellor, Prof. (Dr.) P. B. Sharma, Deputy Vice-Chancellor, Maj. Gen. B. S. Suhag (retd.), Pro-Vice-Chancellor Prof. (Dr.) Padmakali Banerjee and Dean of Research, Prof. (Dr.) Rajendra Prasad were highly supportive, and their valuable suggestions have been instrumental in the success of this conference.

My appreciations are to the members of the organizing committee of AMIET-2020 for their dedicated services and involvement in giving a professional touch to the entire process of organizing the conference. The panel of the advisory board was instrumental in uplifting the quality of the forum. I thank all the authors and presenters of research papers for their enthusiastic participation in the conference.

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S.N.Sridhara, Rajesh Arora, Akshat Agrawal, Anuj Kr. Singh, Manish Kr. Bharti
(Editors)

Contents

Track 4 - Advances in Electrical and Electronics Engineering

Track 1

Advances in Aerospace and Mechanical Engineering

Performance Analysis of Shell and Tube Type Heat Exchanger

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Abstract: The main focus of our research is on the performance analysis of STHXs- that is the fluid flow and heat transfer for shell side inside the segmental and disc baffles in shell and tube heat exchanger respectively. Regular tubes and elliptical tubes are employed in segmental and disc baffles of shell and tube heat exchanger (STHXs) and their performance is analysed and then compared with each other as well as the already calculated experimental data. All these simulations are performed in ANSYS FLUENT (ver.16.0).The shell-side pressure drop of STHX-DB elliptical is found to be maximum but the maximum heat transfer coefficient so far has been shown by STHX-SB elliptical tubes. Thus the overall performance of STHX-SB elliptical tubes is found to be very efficient and better.

Keywords: STHX-SB, Heat exchangers, STHX-DB, Elliptical tubes, Segmental baffles, Disc baffles, ANSYS FLUENT.

Introduction: The Heat exchangers play a really important role within the fields of heat and mass transfer. Shell-and-tube heat exchangers are mostly oftenly used heat exchangers. Master et al. [1] studied "the STHX and it was found that there are more than 35-40% of heat exchangers are shell-and-tube exchangers". Mass flow rate greatly affects the heat transfer coefficient. The fluid flow and heat transfer of water in the STHX-SB regular tubes, STHX-DB regular tubes. STHX-SB elliptical tubes and STHX-DB elliptical tubes are simulated in ANSYS Fluent software and the various performance parameters are analysed and compared with each other. Sanden [2] studied the shell-and-tube-heat exchangers and concluded that there are three models that will be needed to study the CFD analysis of heat exchangers. There are disadvantages associated with the STHXSs-SB as"(i) On shell side the fluid is suddenly compressed and expanded while entering the baffles compartments and due to this there is a very high pressure drop;(ii) Stagnant fluid flow due to the formation of dead zones behind the segmental baffles, which leads to low heat transfer efficiency;(iii) leakage between the shell wall and the baffles, there is low mass velocity on the shell side of STHXs and;(iv)The vibrations that are due to the flow from housing side which is normal for tubes leads to shorter life span of STHXs[3,4].Because of these limitations, pressure drop is higher at the same heat transfer rate and in order to overcome this a pump with higher power is required.

Objectives: The main objectives of these studies are as follows:

  i.   To develop computational models of STHXs (regular and elliptical tubes with segmental and disc baffles) in Ansys Fluent.

  ii. To analyse the effect of baffles viz; segmental and disc baffles with elliptical tubes bundle on shell side pressure drop and heat transfer rates.

  iii. To obtain pressure, velocity and temperature contours of different types of baffle and tubes arrangement for evaluating the performance of STHE.

  iv. Validate the simulated results of these models by comparing them with previous literature.

Mathematical Modelling

Physical Model: The size of STHXs is considered small so as to reduce the computational load of modelling.. The material used for body and tube is aluminium, and water is the flowing fluid. The basic characteristics are kept as they are from the previous models, some assumption is considered:

- The wall is kept at a temperature of 277K.
- No leakage between the walls and baffles, shell and baffles and baffle and tube connections.

Governing Equations: Water with constant thermal physical properties and a Newtonian incompressible fluid is taken into consideration. A hydrodynamic model of the final volume of an unstructured mesh is developed by using ANSYS Fluent software. This model considers the following equations for simulation which are momentum, continuity and energy equations.

Continuity:

$$\frac{\partial}{\partial x_i}(\rho u_i) = 0 \qquad\qquad (1)$$

Momentum:

$$\frac{\partial}{\partial x_i}(\rho u_i u_j) = -\frac{\partial P}{\partial x_i} + \frac{\partial}{\partial x_i}\left(\mu \frac{\partial u_k}{\partial x_i}\right) \qquad\qquad (2)$$

Energy:

$$\frac{\partial}{\partial x_i}(\rho u_i T) = \frac{\partial}{\partial x_i}\left(\frac{\partial T}{\partial x_i}\frac{k}{C_P}\right) \qquad\qquad (3)$$

Turbulence model: The k-ε turbulence model predicts the heat transfer rates of fluid flow. It introduces two types of transport equations and two dependent variables-turbulent dissipation rate and kinetic energy denoted by ε and k respectively. The Energy equation and Reynolds averaged Navier-Stokes equation with the transport equation (k & ε) is expressed as-

Turbulent kinetic energy:

$$\frac{\partial}{\partial x}(\rho k) + \frac{\partial}{\partial x_i}(\rho \mu_i k) = \frac{\partial}{\partial x_i}\left\{\left[\mu + \frac{\mu_i}{\sigma_k}\right]\frac{\partial k}{\partial x_i}\right\} + S_K \qquad\qquad (4)$$

Turbulence dissipation energy:

$$\frac{\partial}{\partial x_i}(\rho \varepsilon) + \frac{\partial}{\partial x_i}(\rho u_i \varepsilon) = \frac{\partial}{\partial x_i}\left\{\left[\mu + \frac{\mu_t}{\sigma_\varepsilon}\right]\frac{\partial \varepsilon}{\partial x_i}\right\} + S_\varepsilon \qquad\qquad (5)$$

The heat flux is given as

$$q_i = \left(\frac{\mu}{P_r} + \frac{\mu_t}{\sigma_c}\right)\frac{\partial h}{\partial x_i} i = 1,2,3 \qquad\qquad (6)$$

Calculations for heat transfer dand pressure drop

The heat transfer for shell side is given by:

$$\dot{Q} = \dot{m}C_{ps}(T_{s,in} - T_{s,out}) \qquad\qquad (7)$$

Heat transfer coefficient of shell side flow is given by the following equation

$$h_s = \frac{\dot{Q}}{A_O \Delta T_m} \qquad\qquad (8)$$

$$\Delta T_m = \frac{\Delta T_{max} - \Delta T_{min}}{\ln\left(\Delta T_{max}/\Delta T_{min}\right)} \quad\text{- logarithmic mean temperature difference}$$

$$\Delta T_{max} = T_{s,in} - T_w \; ; \Delta T_{min} = T_{s,out} - T_w$$

The performance evaluation criterion PEC is used to compare the performance of STHX-SB, STHX-DB with regular and elliptical tubes. Nusselt numbers and friction factors are used for the calculation of PEC as :

$$PEC = \frac{Nu/Nu_n}{\left(f/f_n\right)^{\frac{1}{3}}} \;,$$

The basic geometric parameters are STHXs is given as: Shell dia=90mm, Tube dia=15mm, No. of tubes=7, Length of Heat Exchanger=600mm,Shell dia in=30mm. Shell dia out=30mm,Baffle cut=36%, Baffle pitch=86mm, Disc baffle dia=56mm, Ellipse major radii=7.5mm, Ellipse minor radii=3.5mm.The inlets are specified as velocity inlet with a velocity magnitude of 0.5m/s and cold water inlet temperature is 277K and hot water is at a temperature of 400K.The outlets are specified as pressure outlet with a gauge pressure of 0 Pa.

The mesh details for the geometries are as:

Type	Number of nodes	Number of elements
STHX-SB Regular tube	214879	1061327
STHX-DB Regular tube	136159	644631
STHX-SB Elliptical tube	184719	9874125
STHX-DB Elliptical tube	843443	4387994

Results and discussion

Pressure drop: Figure 1.1(a, b, c, d) shows the contours of the velocity of various type of baffles with a velocity = 0.5 m / s at the inlet of shell and tube. Also, the fluid flow of the liquid here water increases within the direction of the baffles Higher the maximum velocity, more the dead zones and recirculation zones of increases the pressure drop on friction. This analysis follows the order of decreasing the differential pressure as follows: STHX-DB regular tubes, STHX-SB regular tubes, STHX-DB elliptical tubes, and STHX-SB elliptical tubes.
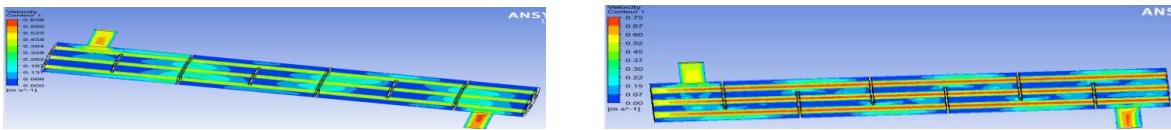
Fig 1.1(a, b): Velocity contours at the centre of shell side heat exchanger STHX-DB regular tube & STHX-SB regular tube

Fig 1.1(c, d): Velocity contours at the centre of shell side heat exchanger STHX-DB elliptical tube & STHX-SB elliptical tube

Temperature Contours: Fig 1.2(a, b, c, d)shows the temperature distribution and temperature contours of STHX-SB, STHX-DB with regular and elliptical tubes with the cold water inlet at 277K and hot water inlet at 400K. These figures represent the coefficients of heat transfer of shell-sides casings for heat exchangers. The heat transfer coefficient from the shell side h_s is increasing as mass-flow rate increases from the shell-side. h_s for STHX-SB elliptical tubes are higher on average than h_s for other STHX-DB elliptical tubes, STHX-SB regular tubes and STHX-DB regular tubes, respectively.

Fig 1.2(a, b) Temperature contours at the centre of shell side heat exchanger STHX-SB regular tube & STHX-DB regular tube
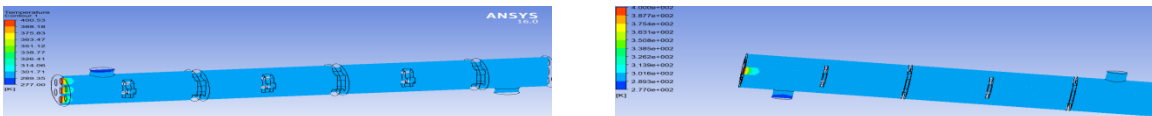
Fig 1.2(c, d) Temperature contours at the centre of shell side heat exchangers STHX-DB elliptical tube & STHX-SB elliptical tube

Velocity Contour: The course of fluid flow is shown by the path lines and it depends on the direction and baffle configuration. In STHX-SB, the fluid flows in a zigzag fashion, which creates dead spots, vortex creation and back mixing of fluid particles. Thus, heat transfer cannot occur efficiently. It also adds up in pressure drop, which also leads

to additional energy consumption. This type of problem will be solved by using another type of baffle. And due to this, the thermal characteristics of STHX are significantly improved.
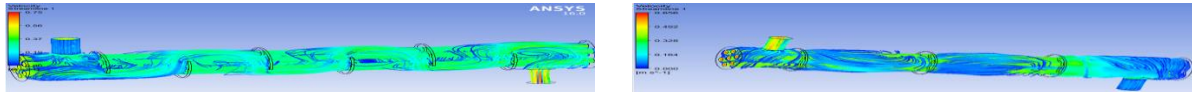
Fig 1.3(a, b) Velocity streamline of STHE-SB with regular tube & STHE-DB with regular tube
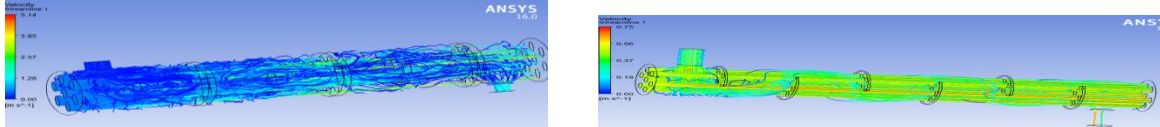
Fig1.3 (c, d) Velocity streamline of STHE-DB with elliptical tube & STHE-SB with elliptical tube

Result Validation: The present data is validated with the already available CFD and Experimental data of the previous papers titled as "Shell -and -tube heat exchanger optimization using `new baffles and tube configuration" published in "Applied Thermal Engineering"157(2019) by A.A Abbasian Arani et al.

The following data from the previous data is given in the form of table and also it is compared with the present data.

Parameters	Present study				A.A Abbasian Arani et al
Q	STHX-SB regular tube	STHX-DB regular tube	STHX-SB elliptical tube	STHX-DB elliptical tube	84,494
	78,987	74,581	98,741	85,241	
p	1167.18	928.589	1876.25	1285.08	1457
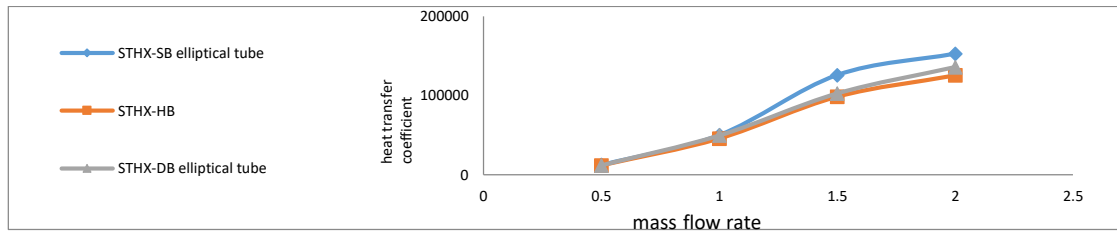
Fig 1.4: Heat transfer and mass flow rate for various baffles

Conclusion: In this study, a model is used to calculate and then compare the thermo-hydraulic characteristics of STHXs with various baffles - segmental and disk with different tube geometries- regular and elliptical tubes. The velocity analysis flows distribution on the shell side shows a more homogenous and uniform behavior in the STHX-SB elliptical tube. This leads to a reduction in dead zones and thus reduces pressure drop. STHX-DB with regular and elliptical tubes and STHX-SB with elliptical tubes significantly reduces pressure drop than regular STHX-SB tubes. Heat transfer also increases in STHX elliptical tubes. Among the proposed combination of STHX-SB with elliptical tubes shows the best performance. Segmental type of baffle with elliptical tube configuration is a very good choice rather than STHX-SB and STHX-DB with regular tubes.

References
[1] B. I. Master, K. S. Chunangad and V. Pushpanathan, "*Fouling Mitigation Using Helixchanger Heat Exchangers,*" in Proceedings of the ECI Conference on Heat Exchanger Fouling and Cleaning: Fundamentals and Applications, (2003) pp. 317–322.
[2] Sunden, B., Computational Fluid Dynamics in Research and Design of Heat Exchangers, Heat Transfer Engineering, vol. 28, no. 11, (2007) pp. 898–910
[3] P. Stehlik, J. Němčanský, D. Kral, L. Swanson, Comparison of correction factors for shell-and-tube heat exchangers with segmental or helical baffles, Heat Transfer Eng. 15 (1) (1994) 55–65.

 [4] Q.Wang, Q.Chen, G.Chen, M.Zeng, Numerical investigation on combined multiple shell-pass shell-and-tube heat exchangers with continuous helical baffles, Int.J. Heat Mass Transfer 52 (5–6) (2009) 1214–1222.
[5] A.A Abbasian Arani et al. "Shell -and -tube heat exchanger optimization using `new baffles and tube configuration" published in "Applied Thermal Engineering"157(2019)

CFD based Performance Analysis of Counter Flow Heat Exchanger using Various Turbulent Models

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Abstract: An extensive computational thermodynamic analysis of counter flow heat exchanger (CFHE) under numerous operating and geometric conditions is presented in this paper. A three-dimensional heat exchanger model of 100 cm length and 1.27 cm diameter is designed in ANSYS[14.0] using different turbulence models to analyze the heat transfer. Moreover, the computational results are compared with existing experimental data [8]. With changing flow direction, the heat exchanger yields a better result with an average computational error of 1.140% in RNG k-ε while step changing the cold fluid temperature and 0.403% while altering the hot fluid temperature. Similarly, by applying k-ω Std. and SST, the average error for the cold fluid temperature variation is 1.233% and 1.288%, respectively. In addition to that, for varying hot fluid temperatures, the average error to be 0.786% and 0.789%, respectively. The outcome of all the results shows the RNG k-ε model predicts better performance of the heat exchanger (HE).

Keywords: Counterflow heat exchanger, RNG k-ε, k-ω Standard, SST models.

Introduction

Today's demand for higher energy consumption and reduced availability of fossil fuel resources increases the impact of the effectiveness of heat exchanger gradually. These heat exchangers are broadly used in the industries and energy conversion systems. Heat exchangers are very effective for the transfer of heat from one medium to another without even intermixing of one fluid with another. Typically, in a heat exchanger, two segregated fluids at different temperatures with a solid boundary exchange thermal energy from one fluid to another via surface without even intermixing. In context with the flow configuration, there exist three primary types for heat transfer: parallel, counter & crossflow. Following Fourier for the conduction states more the area of the heat exchanger, more will be the heat transfer rate. According to the second law of thermodynamics, only the transfer of sensible heat occurs in the heat exchanger. By using aluminum as a material of construction for heat exchanger and making enhanced wall treatment, the heat transfer rate increases. Time and cost being the predominant factors for conducting experiments on heat exchanger, CFD simulation studies yields thus nearly practical and better behavior profile in less computation time.

An investigation was conducted using ceramics to check the effectiveness and temperature difference of the heat exchanger [2] because the ceramics withstand the high temperature and enables the higher temperatures in chemical reactors. A review has been presented on the heat exchanger [3], inserting twisted tape for the enhancement of heat transfer with less expense of pumping power. For achieving the enhancement in the heat transfer, there are some modifications made; different methods have adopted with less damaging the overall performance. An analysis of the absorber tube in a parabolic solar collector [3] using CFD code Ansys CFX 12.0 has been stipulated. As the paper suggests, the overall surface area directly influences efficiency. A computational simulation approach [4] made to verify the effects of sudden expansion in a discoid passage with a heat flux approach. The study shows fluid flow along the length of the pipe reduces the temperature up to a minimum point. Flow velocity also affected by sudden expansion and Nusselt number increases with increasing the Reynolds number. A CFD analysis has been conducted [13,14] to predict the conjugate transfer of heat and mass across the air to air membrane heat exchanger. A 3-D steady-state laminar flow model has developed using CFD software to examine the consequences of fluid flow on the effectiveness of the heat exchanger. Taking cold and hot fluid at different sides, the efficacy of the heat exchanger was evaluated by varying flow direction, channel height, Reynolds number. [7] made a design, operational control and simulation of crossflow heat exchanger to analyze the LMTD. A feedback control device with a sensor at the input is implemented in the heat exchanger. The shell and tube heat exchanger with and without baffles were analyzed with the commercial CFD code in OpenFOAM 2.2.0, considering a varying mass flow rate [10]. The authors found using the standard k – ε model yields the best result for the velocity profile and heat transfer. A practical comparison was presented between [12] shell and double tube concentric heat exchanger and shell & tube heat exchanger using ANSYS Fluent[14]. An investigation of the [8] counter flow heat exchanger along the pipe length was investigated by step altering the fluid inlet temperature. The authors have used both MATLAB and ANSYS for analysis and validation. The

hydrodynamic behavior [1] of water-argon nanofluid was observed in a microchannel using the finite volume method (FVM) under constant heat flux. Effectiveness best describes [4] of the dew point evaporative cooler introducing the counter flow technique under different tests such as log mean temperature difference and humidity method. The effect of variation in the fluid flow was [5] analyzed in a tube with a small insert. The purpose of the inserting is to enhance the rate of heat transfer and alongside the thermal capacity. A 3-D systematic approach to analyze the counter flow heat exchanger was conducted using RNG k-epsilon turbulence models [6]. The authors found the prediction by the RNG k-epsilon model in agreement with the experimental results, but no comparative study of other turbulence models was provided.

This paper aims to investigate the CFHE by varying the fluid temperature to ascertain the thermo-hydraulic performance inside the flow domain. The foremost motive of the present research is to extend the current work [6] on the heat exchanger using various two-equation models so that the viability could be substantiated. In view of this, the authors have designed a computational model and investigated the effects of various design parameters on the thermodynamic performance of counter flow heat exchanger with different turbulence models using commercial CFD software ANSYS[14].

Mathematical Modelling

The selection of the suitable turbulent model is very crucial for fluid flow analysis in fluent and it is highly associated with the momentum equation. The governing equation is modified in accordance with the condition of simulation. However, the problem is associated with time-dependent and steady the equations for the CFHE is described as follows.
Continuity equation:

$$\frac{\partial \rho}{\partial t} + \frac{\partial \rho U_1}{\partial x_1} + \frac{\partial \rho U_2}{\partial x_2} + \frac{\partial \rho U_3}{\partial x_3} = 0 \tag{1}$$

Momentum equation:

$$\rho\left(u\frac{\partial U}{\partial x} + v\frac{\partial V}{\partial x}\right) = -\rho g - \frac{\partial p}{\partial x} + \mu\frac{\partial^2 y}{\partial x^2} \tag{2}$$

Energy equation:

$$\rho Cp\left(u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y}\right) = k\frac{\partial^2 T}{\partial y^2} \tag{3}$$

To balance the energy at both (cold and hot) the inlets the equation could be given as

$$(m_c \times C_{pc})\frac{dT_{cout}}{dt} = \left(T_{cin} \times C_{pc} \times \dot{m}_h\right) - \left(T_{cout} \times C_{pc} \times \dot{m}_c\right) + (h \times A \times (T_{hout} - T_{cout})) \tag{4}$$

$$(m_h \times C_{ph})\frac{dT_{hout}}{dt} = \left(T_{hin} \times C_{ph} \times \dot{m}_h\right) - \left(T_{hout} \times C_{ph} \times \dot{m}_h\right) + (h \times A \times (T_{hout} - T_{cout})) \tag{5}$$

Numerical approach

The 3-D computational model working based on the first principle, which shows the fluid flow inside the two concentric pipes, is established on the laws of mass and momentum conservation. In the present study, the same simulations were run on progressively finer grids by changing the local refinement. Three different mesh sizes of 97833, 153962 and 200000 elements were selected for the grid independency test. Given that the solution would not seems to be varying after changing the grid size from medium to fine. It was found the medium size mesh gives better accuracy in conjunction with other mesh sizes. That is why the medium size meshing has been chosen for further analysis. The use of an appropriate turbulence model and discretization is crucial in numerical simulation. SIMPLE algorithm is used for P-V coupling. The momentum was discretized using the QUICK scheme and PRESTO was used for pressure. The second-order upwind scheme was implemented for the turbulent kinetic energy(T.K.E) and dissipation. A mass flow rate boundary condition was used for inlet feed and pressure outlet opted at both the outlets. No-slip boundary condition was used for wall boundary and standard wall function used for near-wall treatment.

Results and discussion

For obtaining the temperature profile for the first iterative method, proper selection of the mathematical model and implementation of the adequate boundary conditions is taken into consideration by setting temperatures at 293K and 343K respectively for the cold and hot inlet. The primary purpose of this paper is to validate the heat transfer simulation results of counter flow heat exchanger. For accomplishing the validation, the predicted results are compared with the published experimental results [8]. Figure 1 shows the effects of altering the fluid temperature by applying different models. Figure 1 demonstrates the validation of simulation results with the experimental data. After comparing both

the results, the numerical error is found to be at an average of 0.83% in k-ε RNG while step changing the fluid temperature. By applying the k-ω Standard, the average error that comes out for the temperature variation is 0.87%. Lastly, it can be determined that the average error for temperature change comes out to be 0.80% by using the k-ω SST turbulence model.

(a)

(b)

(c)
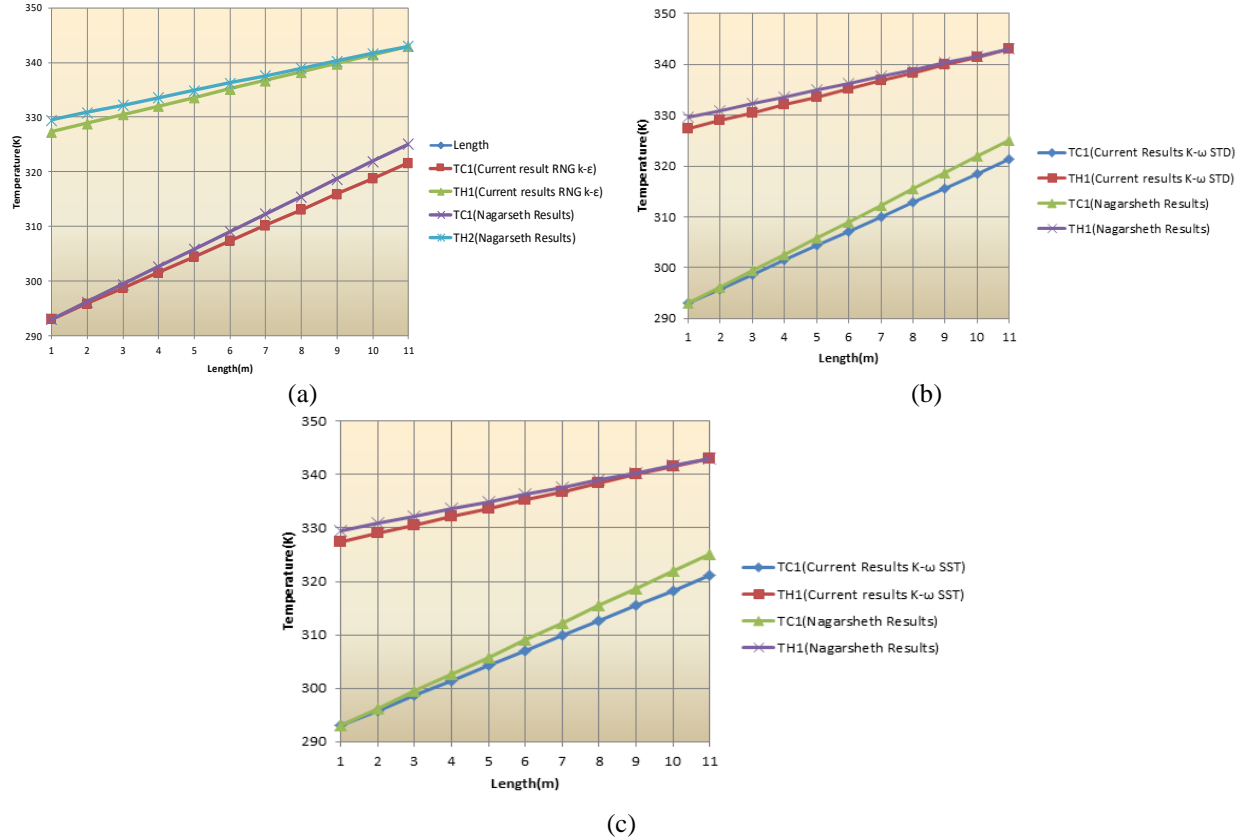
Figure 1. Validation of result considering temperature using a) RNG $k - \varepsilon$, b) $k - \omega$ Standard and c) $k - \omega$ SST model.

The Table 1 best describes the outcome of all the turbulence models, and it shows how the result variation comes out with a small numerical error. It also depicts that the RNG $k - \varepsilon$ model gives the unsurpassed outcome among the three models. It can be seen from Table 1 the RNG $k - \varepsilon$ model does not over predict the outlet temperatures in contrast to the other turbulence models because RNG turbulence closure renormalizes N-S equation and accounts for the effect of small scale motion. Although these model predictions are not very diverging from the existing results [8] but for accurate prediction, the $k - \omega$ and SST models require more potential near-wall treatment based on the grid spacing.

Table 1. Results of different models

Hot and cold fluid temperature (K) variation	Cold fluid temperature $T_{Cout}(K)$				Hot fluid temperature $T_{Hout}(K)$			
	RNG k−ε results	k − ω Standard	SST	Nagarseth et al. [8]	RNG k−ε results	k − ω Standard	SST	Nagarseth et al. [8]
T_{C1}=293	321.66	321.30	321.09	325.13	327.33	327.40	327.43	329.53
T_{C2}=298	323.80	323.47	323.28	327.45	328.90	328.96	328.99	331.49
T_{C3}=303	325.93	325.64	325.47	329.77	330.46	330.52	330.55	333.44
T_{C4}=308	328.06	327.81	327.66	332.10	332.03	332.08	332.10	335.40
T_{H1}-343	321.66	321.30	321.30	322.10	325.33	327.40	327.40	325.40
T_{H2}-348	324.53	324.13	323.89	324.77	327.33	330.84	330.88	328.44
T_{H3}-353	327.40	326.96	326.96	327.45	329.20	334.29	334.29	331.49
T_{H4}-358	330.26	329.79	329.79	330.13	332.63	337.73	337.73	334.53

9

Conclusion

The CFHE investigation has been conducted employing CFD analysis. The heat transfer and flow distribution of the 3-D counter flow heat exchanger CFHE are discussed in detail and compared with the existing literature considering variation in the inlet feed temperatures. The improved design of the heat exchanger(HE) yields better results in contrast to the published results [8]. Applying the RNG $k - \varepsilon$ model as the cold fluid temperature goes down, steady-state conditions for heat transfer was achieved at a faster rate. Correspondingly the heat exchanger attains an optimum hot outlet temperature with a marginal error of 0.40%. Although with the $k - \omega$ Std. and SST models, the temperatures were predicted are very close while step changing the hot fluid temperature but not accurate enough when cold fluid temperatures were varied. However, the $k - \omega$ Standard and SST model predictions are not very much improved when it was compared with the $k - \varepsilon$ RNG model because all variants of $k - \omega$ require accounts of the mesh resolution near the wall boundary. Indeed, with the improved grid for these issues could be overcome. Among the three models, the RNG $k - \varepsilon$ model provides meritoriously accurate results for the transfer of heat.

References

[1] Behnampour, A., Akbari, O. A., Safaei, M. R., Ghavami, M., Marzban, A., Shabani, G. A. S., & Mashayekhi, R. (2017). Analysis of heat transfer and nanofluid fluid flow in microchannels with trapezoidal, rectangular and triangular shaped ribs. *Physica E: Low-Dimensional Systems and Nanostructures*, *91*, 15-31.

[2] Kee, R. J., Almand, B. B., Blasi, J. M., Rosen, B. L., Hartmann, M., Sullivan, N. P., ... & Martin, J. L. (2011). The design, fabrication, and evaluation of a ceramic counter-flow microchannel heat exchanger. *Applied Thermal Engineering*, *31*(11-12), 2004-2012.

[3] Kumar, C. N., & Murugesan, P. (2012). Review on twisted tapes heat transfer enhancement. *International Journal of Scientific and Engineering Research*, *3*(4), 1-2.

[4] Lin, J., Bui, D. T., Wang, R., & Chua, K. J. (2018). On the fundamental heat and mass transfer analysis of the counter-flow dew point evaporative cooler. *Applied Energy*, *217*, 126-142.

[5] Mahfouz, A. E., Abdelmaksoud, W. A., & Khalil, E. E. (2018). Heat Transfer and Fluid Flow Characteristics in a Heat Exchanger Tube Fitted with Inserts. *Journal of Thermal Science and Engineering Applications*, *10*(3).

[6] Mohanty, S., Arora, R., & Parkash, O. (2019). Performance prediction and comparative analysis for a designed, developed, and modeled counterflow heat exchanger using computational fluid dynamics. *Computational Thermal Sciences: An International Journal*, *11*(5).

[7] Nagarsheth, S., Pandya, U., & Nagarsheth, H. (2014). Control Analysis Using Tuning Methods for a Designed, Developed and Modeled Cross Flow Water Tube Heat Exchanger. *International journal of Mechanical, Aerospace, Industrial and Mechatronics Engeering, World Academy of Science and Technology*, *8*(12), 1889-1894.

[8] Nagarsheth, S. H., Bhatt, D. S., & Barve, J. J. (2017, January). Temperature profile modelling, simulation and validation for a counter flow water tube in tube heat exchanger. In *2017 Indian Control Conference (ICC)* (pp. 163-169). IEEE.

[9] Oon, C. S., Togun, H., Kazi, S. N., Badarudin, A., & Sadeghinezhad, E. (2013). Computational simulation of heat transfer to separation fluid flow in an annular passage. *International communications in heat and mass transfer*, *46*, 92-96.

[10] Pal, E., Kumar, I., Joshi, J. B., & Maheshwari, N. K. (2016). CFD simulations of shell-side flow in a shell-and-tube type heat exchanger with and without baffles. *Chemical Engineering Science*, *143*, 314-340.

[11] Raj, R. T. K., Srinivas, T., Natarajan, M., Kumar, K. A., Chengappa, A., & Deoras, A. (2013, April). Experimental and numerical analysis using CFD technique of the performance of the absorber tube of a solar parabolic trough collector with and without insertion. In *2013 International Conference on Energy Efficient Technologies for Sustainability* (pp. 550-556). IEEE.

[12] Shahril, S. M., Quadir, G. A., Amin, N. A. M., & Badruddin, I. A. (2017). Thermo hydraulic performance analysis of a shell-and-double concentric tube heat exchanger using CFD. *International Journal of Heat and Mass Transfer*, *105*, 781-798.

[13] Al-Waked, R., Nasif, M. S., Morrison, G., & Behnia, M. (2013). CFD simulation of air to air enthalpy heat exchanger. *Energy conversion and Management*, *74*, 377-385.

[14] Rafat, A. W., Nasif, M. S., Morrison, G., & Behnia, M. (2015). CFD simulation of air to air enthalpy heat exchanger: Variable membrane moisture resistance. *Applied Thermal Engineering*, *84*, 301-309.

Modification and Analysis of Parabolic Leaf Spring

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Abstract: Parabolic leaf spring is a type of spring used in heavy load suspension system as an energy absorbing device. In commercial vehicles leaf spring has shown an increasing interest in easy manufacturing cost and more load carrying capacity. This paper investigates a better design for the parabolic leaf spring on the purpose of reduction in bending stress and to increase the life of the leaf spring with appropriate materials. The solid model of the leaf spring has been developed with the use of SolidWorks 2016 and the Finite Element Analysis has been carried out using ANSYS 16.0 to determine the better material. This approach of modified design leads us to reduce Von-Mises stress to 4% at the area of eye contact of the master leaf and also derives that the Alloy-Steel (55Si2Mn90) material is better than other two materials with better results.

Keywords: Parabolic Leaf Spring, Bending stress, Deflection, SolidWorks, ANSYS.

Introduction
Leaf spring is a conventional type of suspension system which is mostly used in heavy-duty vehicles presently. The suspensions avoid damages to vehicles by absorbing the shocks produced during the vibrations in the system caused by improper road conditions. The automotive industry is exploring composite materials for structural components to replace of the conventional material for better performance, in the reduction of weight and cost. This paper use a parabolic suspension system due to its universal use in light and heavy commercial vehicles to store and absorb more amount of strain energy for the comfortable suspension system.

Danish khan et al. [1] analyzed a model of leaf spring with the use of various composite materials to identify the better material for the designed leaf spring model. MD Tahsin [2] provided a better result between two designs of leaf spring with considering different number of leaves and also used different type of steel material to find out the better material for the Leaf spring. P. Jiashi w. et al. [3] described the nature of fabricated composite leaf spring and also compare the experimental results and analytical results of the adopted design. Hardial Singh et al. [4] performed a finite element analysis on the Lower control arm of the four-wheeler suspension system to find out the safe limits of the structure with validating experimental structure. Hardial Singh et al. [5-6] approached a modified design of spur gear in order to achieved better results with varying fillet radius on the root of the spur gear with composite material.

Design of Parabolic Leaf Spring
Design of leaf spring depends on the load carrying capacity and deflection of the spring [7,8, and 9]. After considering the various type of vehicles that have leaf spring, these double eye parabolic leaf spring design parameters have calculated according to the VB Bhandari [10]. This study presented two types of designs one is simple leaf spring as shown in **Figure 1.** and another is with an extension of (10mm both side) on the master leaf of the spring which has shown in **Figure 2.** The Design parameter of Leaf spring has shown in **Table 1.** Three types of materials have been considered SAE-AISI 5160, Carbon/Glass Epoxy Composite and 55Si2Mn90 composite as shown in **Table 2.**

Table 1. Design Parameter of Leaf Spring

Parameter	Value(mm)	Parameter	Value(mm)
Total length of Span (Eye to Eye Distance)	1000	Thickness of Master Leaf	10
Number of Full Length	1	Width of Master Leaf	50
Number of Graduated leaves	5	Length of Rebound Clip	52.50
Length of 1st Graduated Leaf	1020	Width of Rebound clip	15
Length of 2nd Graduated Leaf	1010	Eye Diameter	41.08
Length of 3rd Graduated Leaf	9541.20	Bolt	90×10
Length of 4th Graduated Leaf	879.05	Thickness of graduated Leaves	10
Length of 5th Graduated Leaf	803.64	Width of Graduated Leaves	50
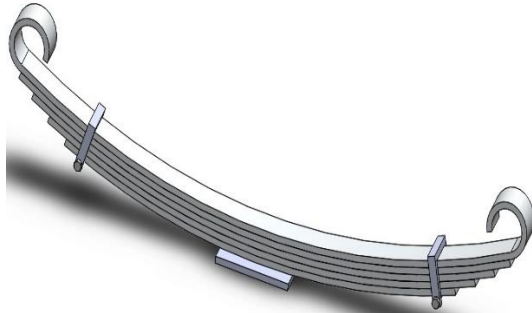
Figure 1. Leaf Spring of width 50 mm**[L1]**   **Figure 2.** Leaf Spring of width 50 mm with an extension of 10 mm both sides **[L2]**
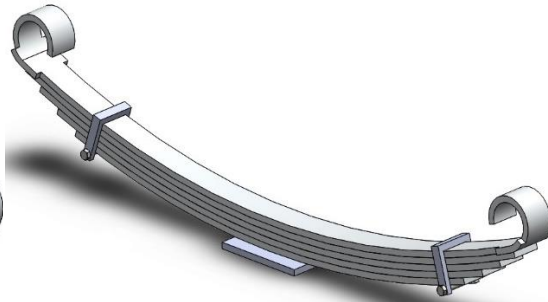
After initiation of rudimentary design, the solid model of the two leaves has completed with the use of SolidWorks 2016. SAE-AISI 5160, Carbon/Glass Epoxy Composite and 55Si2Mn90 have considered for the Finite element analysis for both the designs, that is understandable in **Table 2**.

Table 2. Material properties

Material	SAE-AISI 5160	Carbon/Glass Epoxy Composite	55Si2Mn90	Unit
Density	7850	1672	7850	Kg/m^3
Poisson's Ratio	0.266	0.275	0.3	
Young's Modulus	2.07×10^5	1.34×10^5	200×10^3	N/mm^2
Yield tensile Strength	1070	280	1500	Mpa
Ultimate Tensile Strength	1550	300	1962	Mpa

Static structural analysis

The ANSYS software has used to provide the solution of static structural analysis for the different models with various material properties. The 3D Solid models have imported into the ANSYS Workbench in the format of STEP. Both the models have fine quality tetrahedral meshing. the number of nodes and elements are shown in **Table.3**. **Figure 3.** and **Figure 4.** that shows the finely meshed profile of both Leaf spring models.

Table 3. Number of Nodes and Elements of the Leaf springs

	Leaf Spring [L1]	Leaf Spring [L2]
NO. OF NODES	113890	115021
NO. OF ELEMENTS	61453	62941
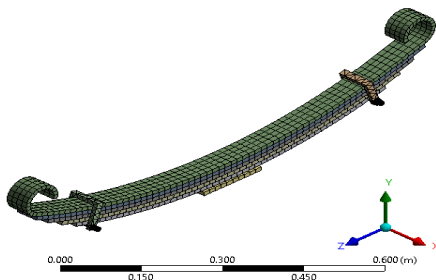
Figure 3. Leaf Spring of width 50 mm**[L1]**   **Figure 4.** Leaf Spring of width 50 mm with an extension of 10 mm both sides **[L2]**
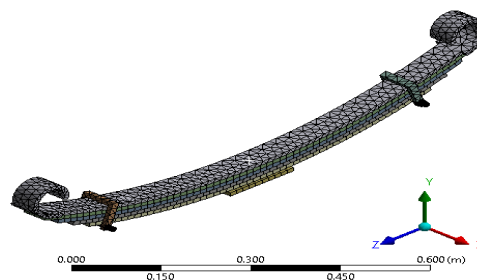
As this leaf spring is a part of an automobile, the boundary conditions have given to the left-side eye of the master leaf as fixed support and right-side eye of the master leaf to be remote displacement. Leaf Spring used to absorb

12

damping force which is happened to be 6000 N approximately as per the Vehicle weight, the force 600 N applied on the center of the Leaf Spring.

From the above material selection, the simulation has done with the result that Alloy-Steel (55Si2Mn90) material provides lesser Von-Mises stress, stain and Total deformation among the other two materials. **Figure 5, Figure 7, and Figure 9** Show the Maximum values of Von-Mises stress, Von-Mises stain and Total deformation of the simple leaf spring. In **Figure 6, Figure 8, and Figure 10** Shows the Minimum values which have reduced with the modified design consideration.
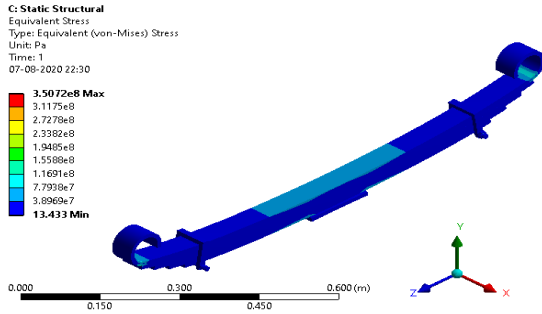
Figure 5. Leaf Spring of width 50 mm**[L1]**
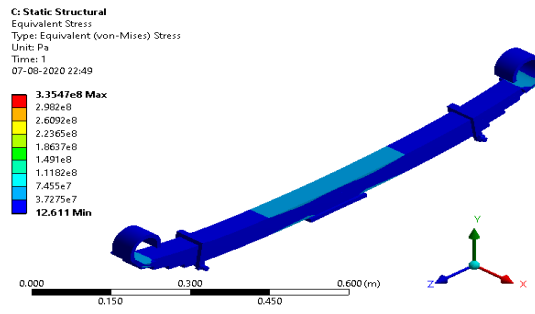
Figure 6. Leaf Spring of width 50 mm with an extension of 10 mm both sides **[L2]**
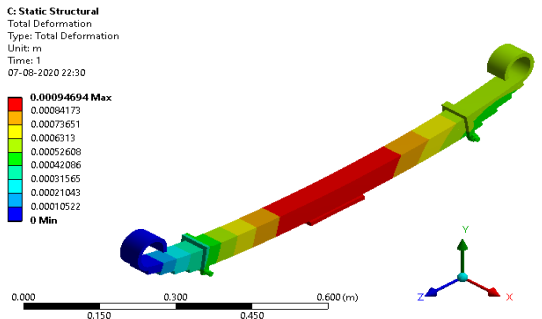
Figure 7. Leaf Spring of width 50 mm**[L1]**
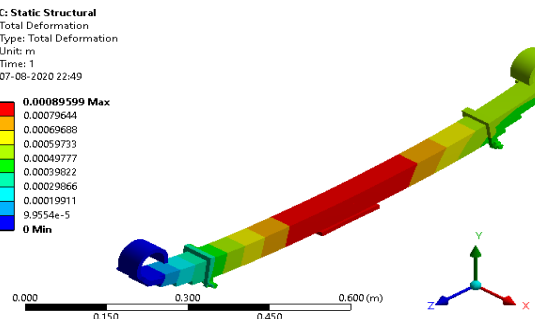
Figure 8. Leaf Spring of width 50 mm with an extension of 10 mm both sides **[L2]**
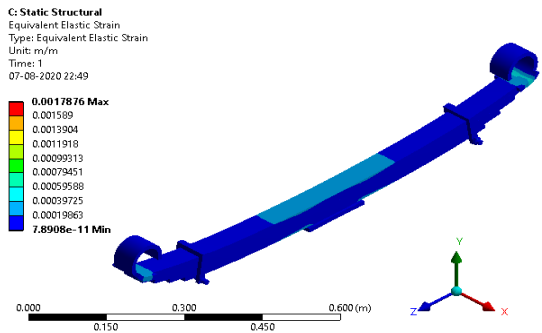
Figure 9. Leaf Spring of width 50 mm**[L1]**
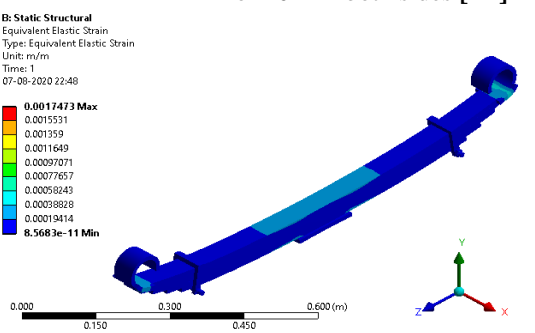
Figure 10. Leaf Spring of width 50 mm with an extension of 10 mm both sides **[L2]**

Results and discussion

The Modification in design can lead to better results of the simulation as per **Figure 5.** It observed that the maximum Von-Mises stress obtains at the eye contact area of the Master Leaf. The Design of Leaf Spring in **Figure 2** has purposed to reduce the Von-Mises stress, strain and Total Deformation.

Table 4 describes the better design as Leaf spring of width 50 mm with an extension of 10 mm both sides, the extended material reduces the Von-Mises stress, strain and also reduce the material cost and material Alloy steel 55Si2Mn90 found to be better as compared to other materials as we can see the minimum Von-Mises stress found to

13

be 3.5072 Mpa, Von-Mises strain is 0.0018 and Total deformation is 0.009.

Table 4. Stress, Strain and Total Deformation values of different material with the comparison of different Design Leaf Springs

Materials	Leaf Spring[L1]			Leaf Spring[L2]		
	Von-Mises stress (Mpa)	Von-Mises strain	Total Deformation (m)	Von-Mises stress (Mpa)	Von-Mises strain	Total Deformation (m)
SAE-AISI 5160	3.536	0.0020	0.0010	3.3828	0.0026	0.0013
Carbon/Glass Epoxy Composite	3.5283	0.0016	0.0012	3.018	0.0017	0.0013
55Si2Mn90	3.5072	0.0018	0.0009	3.3547	0.0017	0.0008

Conclusion

Results can be expressed as a recommendation to be considered for standardization purposes for bending stress which could be enunciated as follows:

- This simulation provides a better design concept of Master leaf of the Leaf Spring for better results.
- There is 4 % of reduction in Von-Mises stress with the use of modified Leaf Spring as a benefit, the life of Leaf spring would be more as compare to simple Leaf spring.
- The composites materials are used in Leaf spring for weight reduction purpose, due to more value of Von-Mises stress Alloy-Steel material considered to be better than composite materials.

Acknowledgement

References

[1] Khan, Danish, G. Kesheorey, and Manish Shah. "Design, Simulation and Analysis of Leaf Spring." International Journal for Research & Development in Technology 9: 187-193.

[2] Ishtiaque, Md Tahsin, and Sung-Hwan Joo. "Optimized modelling and fabrication of a parabolic leaf spring with finite element analysis." ASME International Mechanical Engineering Congress and Exposition. Vol. 58448. American Society of Mechanical Engineers, 2017.

[3] Wang, Jiashi, Zaike Li, and Qibin Jiang. "The analysis of composite leaf spring by finite element method and experimental measurements." Proceedings of the FISITA 2012 World Automotive Congress. Springer, Berlin, Heidelberg, 2013.

[4] Singh, Hardial, and Gian Bhushan. "Finite Element Analysis of a Front Lower Control Arm of LCV Using Radioss Linear." National conference in NCAMT-2012 held in NITTTR, Chandigarh, NITTTR, Chandigarh. 2012.

[5] Krup Kumar, Hardial Singh. "Increasing Bending Strength of Aluminium Silicon Carbide Metal Matrix Composite Spur Gear by Increasing Fillet Radius."

[6] Parkash, Om, and Hardial Singh. "Optimization of Connecting Rod of U650 Tractor Using ANSYS." National conference in NCAMT-2013 held in NITTTR, Chandigarh, NITTTR, Chandigarh.

[7] Gaffar Abbas, M. Kamaleldin, et al. "Design and numerical analysis of leaf spring using composite materials." Key Engineering Materials. Vol. 723. Trans Tech Publications Ltd, 2017.

[8] Jenarthanan, M. P., et al. "Analysis of leaf spring using Carbon/Glass Epoxy and EN45 using ANSYS: A comparison." Materials Today: Proceedings 5.6 (2018): 14512-14519.

[9] Jayakanth, J. J., et al. "Design and analysis of commercial vehicle leaf spring using AISI1008 carbon steel composite material." ARPN Journal of Engineering and Applied Sciences, 2016 11 (17), 10387 10391 (2006).

[10] Bhandari, V. B. Design of machine elements. Tata McGraw-Hill Education, 2010.

Numerical Estimation of Pressure and Velocity Variation on Stepped Pipe

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Abstract
The present work deals with the numerical estimation of pressure and velocity variation due to sudden contraction on stepped pipe. The detailed and sequential analysis of flow are carried out through pipe as well as losses in head for dissimilar geometry is work out with the use of ANSYS FLUENT software. The numerical mechanism which is used for turbulent flow is standard k-ξ model. The outcome of velocity and pressure contour is revealed in this paper.
Keywords: Sudden contraction, standard k-ξ model, ANSYS

1.Introduction
A medium to transport fluid and gas under pressure is known as pipe. While transporting fluid through the pipe it always subjected to resistance which acts between the fluid particles themself due to shear force resulting from the viscosity of the fluids. The resistance which acts between the flowing fluid is known as frictional resistance. There must be some loss of energy seen in the direction of flow due to these frictional resistances, which however depends on the type of flow [1].

The efficiency of the flowing fluid depends on minimizing the losses in fluid flow. Pipe comprise of bends, expansion, contraction, elbows, T-junction and many additional components. The losses of energy are progressed in terms of height of the fluid is known as the head loss. The losses are categorized into two types the minor loss and the major loss. In order to attain complete and overall formulation of head loss many researchers work on it time to time [2].

The concept of head loss was firstly given by Weisbach [3] with the help of this formulas one can easily find the accurate formulas for measuring the friction loss in the pipe. Meanwhile it is also difficult to find other friction formulas [3].

This paper consists of analysis which is being conducted on very small area and the familiar part of pipe network that is sudden contraction of pipes. The key objectives of this project are to developed a 3D CFD modelling of water-liquid flow through horizontal stepped pipe. And to determine the velocity profile, pressure drop along horizontal stepped pipe by CFD simulation.

2.Mathimatical Modelling
In this paper, the simulated outcomes are obtained to simulate a 2-D steady state turbulent flow in computational model with the help of ANSYS FLUENT. The finite volume method is used to set algebraic equation by reducing the governing partial differential equation of a CFD problem. Segregated equation along with iterative matrix solver is used by ANSYS FLUENT for solving the equation iteratively until convergence is gained. The viscous turbulent model is used to solve the problems.

2.1 Governing Equation
The governing equations used for the 2-D geometry for solving the mass, momentum and Bernoulli's equation are described below.

Continuity Equation
$$\rho AV = constant \tag{1}$$
For incompressible Fluid,
$$AV = constant \tag{2}$$
Momentum equation
$$dp/\rho + udu + gdz = 0 \tag{3}$$
Bernoulli's equation
$$\Delta p/\rho + \Delta u^2/2 + \Delta Zg = 0 \tag{4}$$
To describe the behavior of turbulent flows the Kappa-Epsilon model is used.
$$\delta(pk)/\delta t + div(\rho KU) = div\ [\mu_t/\sigma_k\ grad\ (k)] + 2\mu_t S_{ij} - \rho_\varepsilon \tag{5}$$
$$\delta(p\varepsilon)/\delta t + div(\rho\varepsilon U) = div\ [\mu_t/\sigma_\varepsilon\ grad\ (\varepsilon)] + C_{1\varepsilon}\varepsilon/k\ 2\mu_t S_{ij} - C_{2\varepsilon}\ \rho\varepsilon^2/k \tag{6}$$

3. Results and Discussion

15

Results shows the velocity and pressure changes for different sections as diameter of pipe changes. Due to sudden contraction, flow separation in region of the contractions plane give rise to an increase in pressure loss which in turn influence rate of erosion, heat and the rate of mass transfer in the regions. Due to change in pressure as depicted in Fig.1. It is found that the pressure is maximum in first two cross-sections of the stepped pipe as the cross-section of the stepped pipe decreases gradually pressure of the fluid flow start decreasing and it will becomes almost diminished in the last cross-section that is outlet of the stepped pipe.
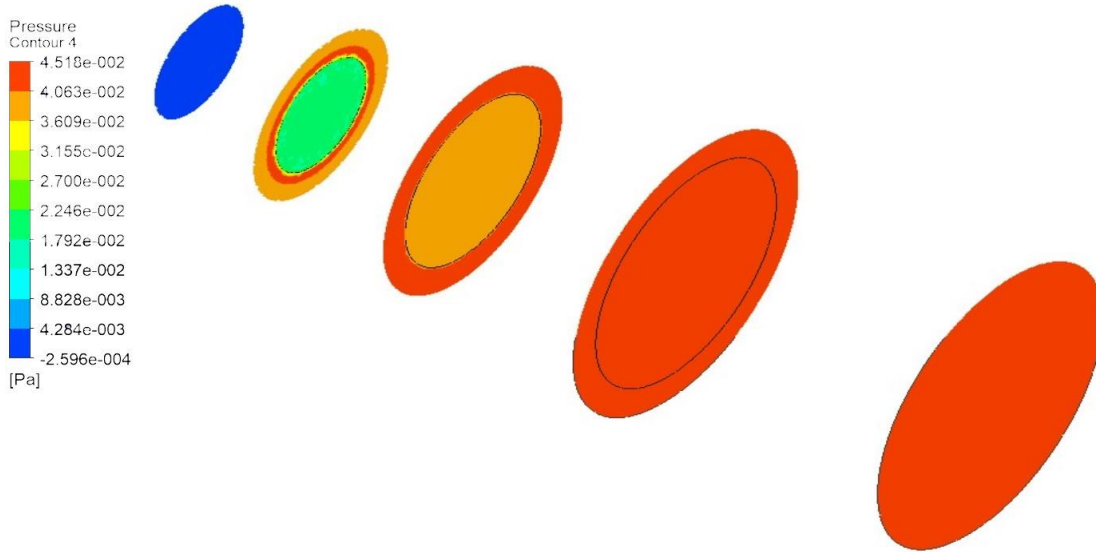
Figure 1. Pressure variation contour in stepped pipe

Due to sudden contraction, flow separation in region of the contractions plane give rise to an increase in velocity. Fig.2 depicts the velocity contours at different cross- section of the pipe at different diameter. It is found that the velocity is minimum at the inlet of the cross-section of the stepped pipe as the cross-section of the stepped pipe decreases gradually velocity of the flowing fluid start increasing and it will become maximum at the outlet of the cross-section of the stepped pipe.
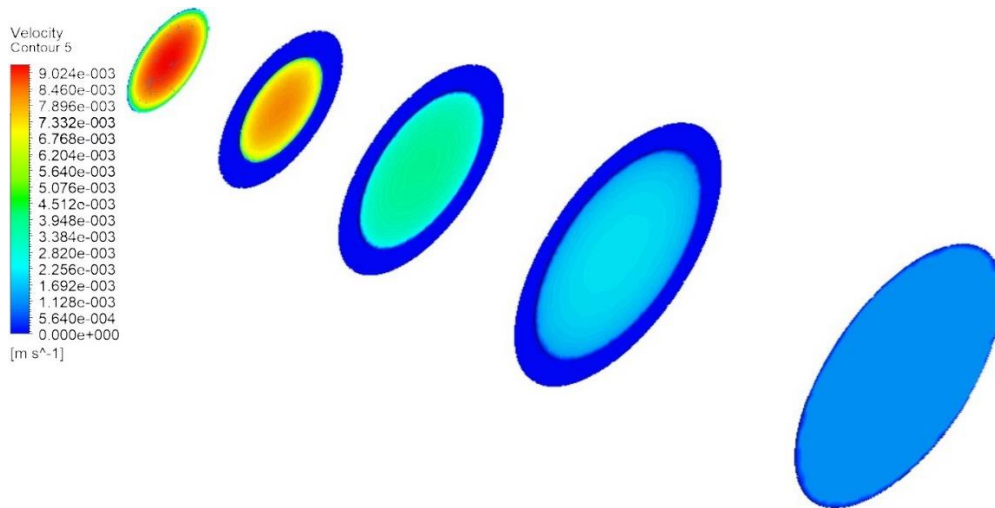
Figure 2. Velocity variation contour in stepped pipe

Fig.3 depicts the flow field of fluid at different section of the pipe at different diameter with the help of streamline. The streamline is showing the flow behavior of the fluid flow how the fluid flow is taking place as the cross-section of the stepped pipe is changing. It is found that the streamline of flowing fluid gets denser as it passes through different cross-section of the stepped pipe. It is found that the velocity is minimum and pressure is maximum at the inlet and second cross-section of the stepped pipe therefore it will show laminar flow behavior of the fluid. As the cross-section of the stepped pipe is changing, velocity of the flowing fluid will increase and pressure will decrease and finally the

16

velocity will reach to maximum at the end of the cross-section and pressure will become minimum therefore at the end of cross-section it will show turbulent flow behavior of the fluid.
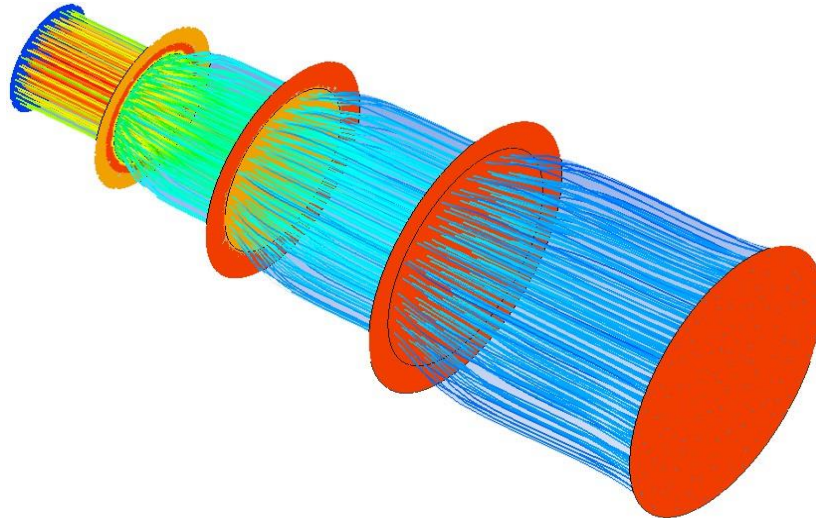
Figure 3. The flow field of fluid at different section of pipe at different diameter

4.Conclusion

The following conclusions have been drawn on the basis of above results.

- It is found that the pressure is maximum in first two cross-sections of the stepped pipe as the cross-section of the stepped pipe decreases gradually pressure of the fluid flow start decreasing and it will becomes almost diminished in the last cross-section that is outlet of the stepped pipe.
- It is found that the velocity is minimum at the inlet of the cross-section of the stepped pipe as the cross-section of the stepped pipe decreases gradually velocity of the flowing fluid start increasing and it will become maximum at the outlet of the cross-section of the stepped pipe.
- Sequential analysis of flow is carried out through pipe as well as losses in head for dissimilar geometry is work out with the use of ANSYS FLUENT software.
- If the diameter of the pipe changes gradually instead of sudden change then we can obtain the minimum loss.
- The main motive of present work is to give an elaborate explanation of Bernoulli's equation over the behavior of fluid experience sudden contraction.

References

[1] P.N. MODI and S.M. SETH, Hydraulic and Fluid Mechanics, A.D. Computers, New Delhi (2002).

[2] Lahiouel Y., Haddad A., Chaoui K., "Evaluation of head losses in fluid Transportation networks

Sciences & Technologies B – N°23, juin (2005), pp. 89-94.

[3] R.K. Bansal, Fluid mechanics and hydraulic machines. Laxmi publication (p) ltd, (2010).

[4] H.K. Versteeg and W Malalasekera, An Introduction to Computational Fluid Dynamics, Pearson Education Limited, England (2007)

[5] P. R. Bhave, "Analysis of flow in water distribution networks", pp.25-68 Technomic Pub. Co., Inc., USA, (1991).

[6] L.F. Moody, "Friction Factors for Pipe Flow", Trans. American Society of Mechanical. Engineers.No.66, (1944), pp. 671-684.

[7] Jia Jun Lim1, How Tion Puay1* and Nor Azazi Zakaria, "A Fundamental Study of Supercritical Flow at Sudden Expansion Structure by Using Numerical Model,2018, doi.org/10.1051/e3sconf/20186507004.

[8] Raghav Mundhra, Experimental Investigation of Turbulent Flow in a Sudden Expansion,2019, dOI: 10.32622/ijrat.ICIMCE-49

A Study on Wind Load Calculations for Solar Photovoltaic Structure & Power Plants

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Abstract
Solar photovoltaic plants are installed on the commercial, residential and ground mounted scale in order to fulfil the demands of the energy. As per the current scenario and the environmental changes due to the cyclones etc., it has become mandatory to calculate the wind pressure according to the site condition on the solar photovoltaic structure and power plants.It is found that the wind uplift pressure & wind down lift pressure depends on the angle of structure.It is also studied that the pressure co-efficient of mono slope roof also plays very important role in designing a solar structure.In this paper, the wind pressure at different heights from ground as well as the behavior on uplift and down lift pressure on the basis of different angles of the solar photovoltaic structure are studied. Rooftop Structuredesign needs more attentionas theheight of the buildings varies from 10 m to 100 m to sustain the solar structure in all the environmental conditions. It is further studied that appropriate steel material with less weight and high strength and corrosion resistance needs to be selected for solar structure designing.

Keywords: Solar Structure design, Material comparison, Solar Wind load calculation.

Introduction
Due to the quickly expanding worldwide utilization of Solar power plant on the commercial and residential sectors. Its necessary to provide the solution that can sustain for lifecycle of the solar power plant for that wind loads on the solar structure investigation and proper structure steel material is important. The third most significant sustainable energy from nature subsequently wind energy and hydro energy , The commission of the solar photovoltaic plants on the rooftop residential and industrial roof is very critical to install and need to Plan of such structure's dependent on lacking information or rearrangements frequently brings about unsafe or uneconomic outcomes [1] .This paper concentrated on detailed discussion around introducing and contrasting outcomes from past examinations which manage wind loads applied on sunlight-based boards, the cases considered sun powered boards situated on level or pitched structure rooftops. The examination detailed in this paper has done a broad overview of concentrates in the open writing managing wind loads on sun-based boards on rooftops. Results have been communicated regarding net differential weight coefficients for correlation purposes [2].This exploratory investigation traces a strategy to figure the plan the wind load on the single axis type structure that changes the angle from -45 to + 45 degree the wind forces calculated using wind tunnel [3].The paper represent the wind speed is very important and the effect on the wind speed during thunderstorm recorded also check with the computational fluid dynamics study and the wind tunnel study carried to provide the exact proportion of the wind speed with the site data [4]. The study also carried of the wind impact on the power grid, the seasonal changes in the wind speed as per the environmental condition [5].

Methodology andWind Load Calculations
Uplift and down lift Wind pressure calculations are done as per IS 875 (PART 3):2015 & Comparison of different materials like, Posmac, Galvanized, Galvalume, Hot dipped galvanized have been carried out. The different steps to be followed are summarized as below:
Step 1: Calculate the fundamental wind speed (V_b) of the project as per the location of the Project (Refer figure 1).
Step 2: Calculate the probability factor (K_1) as per basic wind speed, generally solar plant designed for 25 years (Refer TABLE 1).
Step 3: Calculate the Terrain factor (K_2) based on location and height of Buildings (Refer TABLE 2).
Step 3a. Select the Category as per the location of PV plant.
Category 1: If the ground uncloses with no blocks or some blocks with height less than 1.5 m, Then the structure comes under category 1.Category 2:If the ground unclose with blocks with height comes under 1.5 m to 10 m, Then the structure comes under category 2.Category 3: If the ground with some block's eccentric height comes up to 10 m, Then the structure comes under category 3. Category 4: If the ground and nearly eccentric blocks, Then the structure comes under category 4.
Step 4: Calculate the topography factor(K_3), generally where the undulation is more than 3 degree then the value of factor varies from 1 to 1.36 for RCC and industrial shed projects the value is 1. The importance factor (K_4) ,The

18

location comes under the 60 km from the seashore for that's the importance factor need to consider , The structure comes under if after the hurricane also that's weighty the factor 1.3 ,Mechanical structure 1.15 for rest 1.0 .

Step 5: Calculate the design wind speed (V$_Z$), Vz = Vb x K1 x K2 x $K3$ x $K4$ …………………………………………1

Step 6: Calculate the Wind Pressure (P$_Z$) , Pz= 0.6 x Vz^2 ………………………………………………………….2

Step 7: Calculate Kd , Ka , Kc the wind directionality factor (K$_d$) , For solar structure we may use 0.9 factor but for hurricane areas we need to be taken as 1.0 . The area averaging factor (K$_a$), The decrease in pressure because of the larger area may be considered, If the tributary area below or equal to 10 m^2 then the value area averaging factor 1.0 ,If the tributary area below 25 m^2 then the value area averaging factor 0.9 ,If the tributary area more than or equal to 100 m^2 then the value area averaging factor 0.8 The combination factor (Kc), Generally for the building the behaviors of wind as a push and pull at inward and outward of the building, If at the same time both effect consider then we can take combination factor 0.9.

Step 8: Calculate the design wind Pressure (P$_d$) , Pd = Pz x Kd x Ka x Kc…………………………………………….3

Step 9 : : Calculate the pressure co-efficient for monoslope free roofs as per the angle of structure. (Refer TABLE 3) Solidity ratio $\emptyset$, Generally below the solar photovoltaic modules the area not covered with any blocks in that case we can consider the solidity ratio $\emptyset$ = 0, But if you covered the area with some blocks then in that case we need to consider overall pressure co-efficient of solidity ratio $\emptyset$ = 1 .

Step 10: Calculate the Wind negative / upward Pressure. & positive / downward Pressure

As per the requirement of the industry and expected design life , Indian standard 875 provided the factor for the different wind zones of India , The zones divided into 6 parts on the basis of preliminary wind speed of that zones varies from 33m/s to 55 m/s . Table 1 gives the factor for design life of solar structure for different wind zones. Building heights also plays an very important role for wind pressure calculation because as per the height the wind pressure increases, The pressure factors for the different heights from the historical & experimental data calculated as per Indian standard that mentioned in the Table 2.

Table 1. Probability Factor

Class of structure	Mean Probable life of Structure	K1 factor for Basic Wind Speed (m/s)					
		33	39	44	47	50	55
Buildings and structures presenting a low degree of hazard to life and property in the event of failure, such as isolated towers in wooded areas, farm buildings other than residential buildings.	25 years	0.94	0.92	0.91	0.90	0.90	0.89

Table 2. Terrain Height Factor

Height (z)	Terrain & Height Multiplier (K2)			
	Category 1	Category 2	Category 3	Category 4
10	1.05	1.0	0.91	0.80
15	1.09	1.05	0.97	0.80
20	1.12	1.07	1.01	0.80
30	1.15	1.12	1.06	0.97
50	1.20	1.17	1.12	1.10
100	1.26	1.24	1.20	1.20

Table 3. Pressure co-efficient for monoslope free roof.

Roof Angle	Negative (uplift) Overall pressure co-efficient for Ø = 0	Positive (down lift) Overall pressure co-efficient for Ø = 0
0	0.5	0.2
5	0.7	0.4
10	0.9	0.5
15	1.1	0.7
20	1.3	0.8.
25	1.6	1.0
30	1.8	1.2

Residential and industrial roof have different angles of inclination and also to get the maximum benefit of generation

19

we need to install solar system with the angle that gives the maximum generation for that location, the pressure factor because of the angle of structure plays an important role. So, for wind uplift and down lift pressure calculation we need to increase the pressure as per the mono slope roof factors as per Table 3 .

Results and discussion

As per the Indian standard IS 875 (PART 3):2015(Part 3) :2015, India map divided in to 6 different wind zones from the preliminary wind speed , zone 1 - 33 m/s, zone 2 - 39 m/s , zone 3- 44 m/s ,zone 4- 47 m/s , zone 5- 50 m/s &zone 6 - 55 m/s . In this paper the authors calculated the wind uplift pressure and wind down lift pressure based on standard parameters from all the Indian standard codes.

Figure 1. Wind Uplift &Down lift Pressure, As Per India Different Wind Zones and Building Height 30 M From Ground With Different Angles.

In the figure 1 all the uplift and down lift pressure co-efficient calculated for zone 1 to zone 6 , The building height from ground 30 m & the structure angle considered 10,15,20 & 25 degree .The maximum wind pressure uplift observed in zone 1 – 1.04 KN/m^2 for 25 degree angle and down lift observed for 25 degree angle 0.72 KN/m^2. The maximum wind pressure uplift observed in zone 6 – 4.88 KN/m^2 for 25-degree angle and down lift observed for 25-degree angle 3.35 KN/m^2.The minimum wind pressure uplift observed in zone 1 – 0.59 KN/m^2 for 10-degree angle and down lift observed for 10-degree angle 0.33 KN/m^2. The minimum wind pressure uplift observed in zone 6 – 2.74 KN/m^2 for 10-degree angle and down lift observed for 10-degree angle 1.52 KN/m^2.

In the figure 2 all the uplift and down lift pressure co-efficient calculated for zone 1 to zone 6, The building height from ground 15 m & the structure angle considered 10, 15, 20 & 25 degree .The maximum wind pressure uplift observed in zone 1 – 0.92 KN/m2 for 25 degree angle and down lift observed for 25 degree angle 0.63 KN/m2. The maximum wind pressure uplift observed in zone 6 – 4.29 KN/m2 for 25-degree angle and down lift observed for 25-degree angle 2.95 KN/m2. The minimum wind pressure uplift observed in zone 1 – 0.52 KN/m2 for 10-degree angle and down lift observed for 10-degree angle 0.29 KN/m2. The minimum wind pressure uplift observed in zone 6 – 2.41 KN/m2 for 10-degree angle and down lift observed for 10-degree angle 1.34 KN/m2.

The availability of the trading solar material types and its composition in the TABLE 4 , Before 5-10 years mostly all the solar companies used hot dipped galvanized structure because of the unavailability of the high grade and high strength materials also for hot sipped galvanization restrictions on the thickness of material use for solar structure, But now the different material with difference thickness and high yield strength available in the market that tabulated in TABLE 5 , With the help of this we can optimized the structures as per the industry demand.

Conclusion

The wind load calculation is very crucial for solar structure designing. With the help of the study it's easy to understand the wind effect on the different zones of the India as per the preliminary wind speed also the effect of the structure angles on the wind speed also plays an important role. With the help of this study we can primarily decide the wind uplift pressure and wind down lift pressure for the building heights of 15 m and 30 m from the ground also we can decide how much wind pressure coming of the solar photovoltaic structure for the angles 10 degree, 15 degree, 20 degree & 25 degree with the respective heights, Also with this study it's easy to find out the high strength material &

thickness availability that can be utilize for structure optimization.

Table 4. Different solar Materials and Its composition.

Material	Producer	Composition
POSMAC	POSCO	Zn – 3% + Mg – 2.5% +Al
GALVALUME	JSW,TATA,ARCELOR MITTAL,BHUSHAN , etc.	Zn – 41-43% + Al – 55-58% +Si – 1.5-2%
MAGNELIS	ARCELOR MITTAL	Zn + Mg – 3% +Al – 3.5%
ZAM	NISHIN	Zn + Mg – 3% +Al – 6%
HDG	Many small and big vendors available	Zn coating mainly.

Uplift Preesure (kN /M2)	0.52	0.63	0.74	0.92	0.69	0.84	1.00	1.23	0.86	1.05	1.24	1.53	0.96	1.17	1.38	1.70	2.04	2.49	2.94	3.62	2.41	2.95	3.48	4.29
Downlift Pressure (kN /M2)	0.29	0.40	0.46	0.63	0.38	0.54	0.61	0.84	0.48	0.67	0.76	1.05	0.53	0.75	0.85	1.17	1.13	1.58	1.81	2.49	1.34	1.88	2.14	2.95
Strucutre Angle (Degree)	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25	10	15	20	25
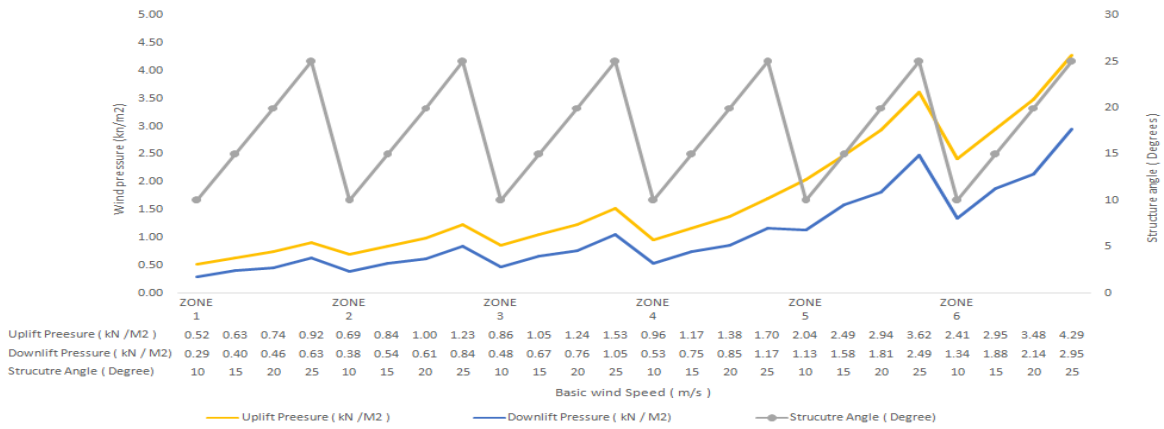
Figure 2. Wind Uplift & Down lift Pressure, As per India Different Wind Zones and Building Height 15 M from Ground with Different Angles

Table 5. Different material thickness and yield strength of material

Material	Thickness (mm)	Yield Strength (MPa)
POSMAC	0.4mm to 4.5mm	340 to 700
GALVALUME	0.1mm to 2mm	205 to 550
MAGNELIS	0.45mm to 2mm	220 to 550
ZAM	0.45mm to 2.3 mm	265 to 560
HDG	1.2mm to 3.2 mm	120 to 365

References

[1] Cao, J., Yoshida, A., Saha, P.K. and Tamura, Y. (2013) Wind loading characteristics of solar arrays mounted on flat roofs. Journal of Wind Engineering and Industrial Aerodynamics, 123, pp.214-225
[2] Stathopoulos, T., Zisis, I., Xypnitou,E.,(2012).Wind loads on solar collectors :a review.In:Proceedings of Structures Congress 2012,ASCE.pp.1169–1179.
[3] Matthew J. Emes,&Azadeh Jafari (2019) A method for the calculation of the design wind loads on heliostats in AIP Conference Proceedings.
[4] Giovanni Solari& Massimiliano Burlando (2020)Detection, Simulation, Modelling And Loading Of Thunderstorm Outflows To Design Wind-Safer And Cost-Efficient Structures , Elsevier.
[5] Shuang Han & Luna Zhang (2020) A Data Sample Division Method For Wind Power Prediction Based On China's 24 Solar Terms , Wiley

Design and Analysis of Conical Helical Spring Using FEA Tool

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Abstract: Spring is a mechanical component which is used in automobile industries and many other applications like as in some types of pen mechanism for writing. In the present study the finite element analysis of helical conical spring is carried out using ANSYS 15 and spring steel material according to specification of ISO 4454 Grade 3. Conical Compression Springs are the cone shaped springs, designed to provide constant spring rate and a solid height lower than a normal spring. The numerical simulation results for deformation and analytical stress are calculated under various loading conditions. It was found that that the simulated results for deformation and stress shows the good agreement with the available experimental data.

Keywords: Helical spring, FEM analysis, Stress analysis, Fatigue strength.

Introduction

A coil spring, also known as a helical, is a mechanical part used for storing energy and subsequently release after certain time in order to absorb shock and to maintain a contact surface force. Springs are usually made up of an elastic material formed into helix shape which returns to its natural spare when unloaded. Mechanical spring is a kind of elastic body which distorted its shape or deflected under a load condition (to absorb energy) and after removing the load condition it regain its original shape [1]. Further he goes to classify the main functions of spring as one of the four things which was to apply force, to provide load control, to support the structure, to absorb the shock. Coil springs are also be utilizes as a torsion spring, in this special case the spring is subjected to torsion moment about its own helical axis. Therefor the spring materials are subjected into bending moment while reducing and increasing helix radius. Structure like Lath Martensitic usually have higher strength and required toughness [2]. Coil springs are most commonly used into vehicle suspensions. The shape and size of the compression spring are strongly depending upon its applications. Coil springs are mounted into two manner i.e. alongside shock absorber or mounted separately. The residual compressive stresses can fade during cycling due to domination of the surface stress concentration than the residual, which allows the initiation of the fatigue cracks [3-6]. The surface coating on component is also used to increase the fatigue strength.

Material and Methodology

Material Properties

Structural Steel material is been utilized for front axle. Material properties of the multiple materials used for study are as follows:

Table 1. Mechanical Properties of Spring Material

Properties	55SiMn90 (Steel)	65Si7/SUP9	Carbon Epoxy	High Carbon Steel	Low Carbon Steel	Steel	Structural Steel
Young's Modulus (GPa)	210	210	70	210	200	270	210
Poisson's Ratio	0.3	0.266	0.3	0.29	0.3	0.3	0.3
Yield Strength (MPa)	1470	1158	1680	505	205	370	250

CAD Model

A 3D model of the conical spring has been made through SOLIDWORKS 2016 edition software. For appropriate analysis, load must be distributed uniformly over the spring. That is why, a seat base is used at the both sides of spring

see Figure 1.
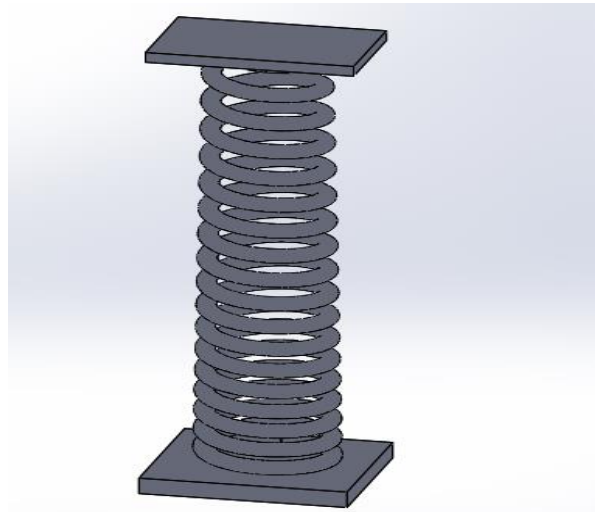
Figure 1. 3D CAD Model of Helical Conical Spring with Seats

Meshed Model and Boundary Condition

FEA code Ansys has been utilized for analyzing the spring. For analysis, firstly spring is converted into IGES format and then analysis on spring is done into static Workbench code of ANSYS 15 edition. Under this, the fine mesh generation is selected which is depicted into Figure 2.
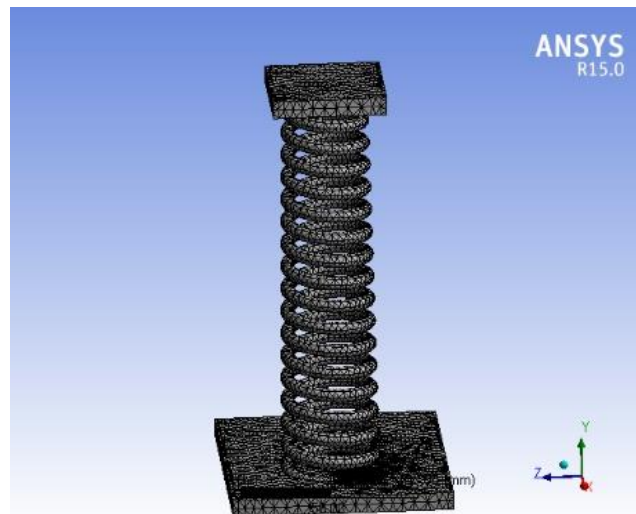
Figure 2. Meshed Model of Spring

The number of nodes and elements for the conical spring are 54419 and 29093 respectively. The bottom side plate is fixed for providing the resistance and force applied on the top seat of spring. Present analysis consists 6 loading condition, which are tabulated into Table 2.

Results and Discussion

After applying all required inputs into the analysis with materials properties of 55SiMn90 (Steel), the solving process starts. Under the load of 372.4 N, the maximum von mises stress and deflection are 259.55MPa and 14.643 mm respectively as shown in Figure 3.

Table 2. Force applied on Spring

Load. No.	Force (N)
1	372.4
2	744.8
3	1302.42
4	1461.2
5	1822.8
6	2175.6
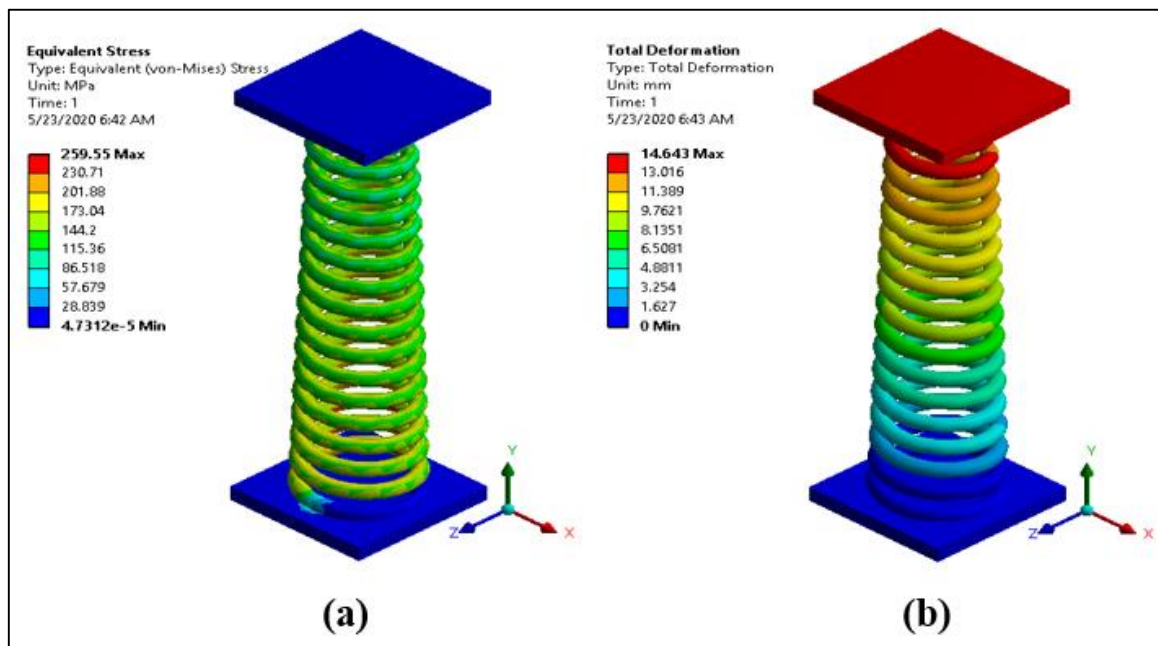
Figure 3. Spring Material 55SiMn90 (Steel), (a) Von Mises Stress, (b) Deflection.

Now we find the deflection result by analytical method with the help of deflection formula of conical spring:[7]

$$\delta = = \frac{2wn(D_1{}^2 + D_2{}^2)(D_1 + D_2)}{Gd^4}$$

Where;
D_1 = small mean coil diameter of spring and D_2 = large mean coil diameter of spring.
δ= deflection of conical spring
W= load applied
d= diameter of wire
n= number of active coil turns

For present analysis of 55SiMn90 (Steel) spring through ANSYS we get results as depicted into Figure 4. Deflection corresponding to applied force are tabulated into Table 3.

Conclusion

Under this work, there are following results are been concluded:
- The percentage error is going to decrease as input load increase up to the limit of 1461.8N by FEM and after it is increased.

24

- The percentage error is also going to decrease as input load increase but up to limit 1822.8N

The overall work shows that our estimating results are closed to available experimental results with the under considering of safe design of spring.

Table 3. Load Vs Deformation for 55SiMn90 (Steel)

Load Number	Load (N)	Max. Von-Mises Stress (MPa)	Deflection (mm) by FEM Method
1	372.4	259.55	14.643
2	744.8	519.11	29.286
3	1302.42	907.75	51.213
4	1461.18	1018.4	57.455
5	1822.8	1270.4	71.674
6	2175.6	1516.3	85.547
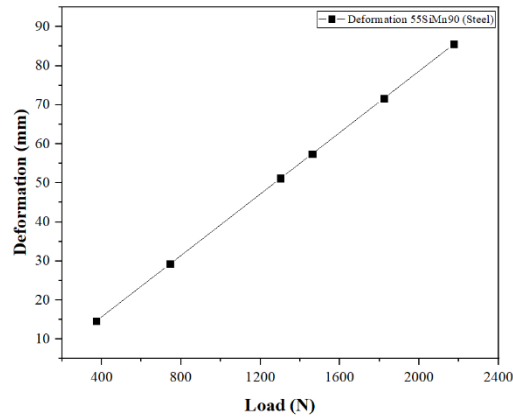
Figure 4. Deflection of Conical Spring vs Applied Load

References

[1] Singh N. General review of mechanical springs used in Automobiles suspension system. Int. J. Adv. Engg. Res. Studies/III/I/Oct.-Dec. 2013;115:122.

[2] Sanij MK, Banadkouki SG, Mashreghi AR, Moshrefifar M. The effect of single and double quenching and tempering heat treatments on the microstructure and mechanical properties of AISI 4140 steel. Materials & Design. 2012 Dec 1;42:339-46.

[3] J.E.Hoffman, D.Lohe, E.Macherauch, Influence of shot peening on the bending fatigue behaviour of notched specimens of Ck 45, in V.Wohlfahrt, H.Kepp, O.Vohringer (Eds). Proceedings ICSP-3, Garmisch-Partenkirchen, DGM Informationsgesellschaft, Verlag, Oberursel, Germany;1987: 631-38

[4] H.Guechichi, L.Castex, Fatigue limits prediction of shot peened materials in International Scientific Conferences on Shot Peening, ICSP-9, Paris, International Scientific Committee for Shot Peening, Mishawaka, Indiana, USA; 2005: 221-28.

[5] D.Eifler, D.Lohe, B.Scholtes, Residual Stresses and Fatigue of Metallic Materials, in V.Hauk, H.Hougardy, E.Macherauch (Eds). Residual Stresses, Measurement, Calculation Evaluation, DGM Informationsgesellschaft, Verlag, Oberursel, Germany; 1991: 157-66.

[6] Wang S, Li Y, Yao M, Wang R. Fatigue limits of shot-peened metals. Journal of Materials Processing Technology. 1998 Jan 1;73(1-3):57-63.

[7] Dasari Ashok Kumar, "Design, Analysis and Comparison between the Conventional Materialswith Composite Material of Leaf Springs," Ph.D dissertation, Dept. Mechanical Engineering.,Univ.JNTU,Kakinada and vijaywada,2016.

Study on the Design of Foldable Electric Scooter

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Abstract: The idea of the Foldable Electric Scooter model comes from the daily routine where a person goes for a shopping, his work or is travelling a long distances where one cannot carry his or her vehicle to shops, inside the malls or to the trains or planes. So the concept of foldable electric scooter comes with the advantage that a rider can ride the scooter and well as can carry it along with ease. It is best for all age group of people. Apart from the basic needs, it is less polluting, easy to handle, no issue for storage, can be lifted a long way, light-weight, easy to carry. When folded, the scooter looks like a suitcase, which can easily be lifted or dragged. It is comfortable and easy to ride. It runs on battery which can be charged at home at a low cost. It requires no license to ride.

Introduction

The world is facing a continuous problem of exhaust emissions and global warming. It has led researchers and academician to find out the alternate solutions [1, 2]. The traffic on the road is also increasing day-by-day which has led to chaos and lots of accidents on the roads. Since 1960, a lot of work and research was done for manufacturing the electric scooter and the same is being continued [1]. The first electric vehicle was built by A L Ryker and William Morrison in 1895. The quest to build the electric scooter has not stopped and is gaining more and more attention. The biggest advantage of manufacturing the electric scooter is that it comes without any harmful emissions and keeps the air clean. As most of the vehicles used since ages are running on petrol, diesel and CNG and all these lead to the emission of particulate matter (PM) which leads to respiratory problems, skin diseases and increased temperature [1,3]. Indian two-wheeler industry has incorporated the idea of electric bikes and scooters. Apart from India it is becoming common as a means of personal conveyance in the countries like America, Japan and China. Three-wheeled or two-wheeled electric scooters can be easily used in the densely populated cities. The three-wheeled can also be used by the people with walking disabilities very easily. Foldable Electric Scooter (FES) are a sub-class of bikes used and prevalent in towns, small and big cities. Generally, there are many scooters present on roads but the foldable electric scooter is different from the rest used since many ages [4]. It can be folded as a suitcase and we can carry it along with us. It runs on battery that can be easily charged at home. They are light in weight with good durability and have less power demand. It is cost-effective also [6,7,8]. The maintenance charges for the FES is comparatively less than the conventional vehicles running on petrol. Middle class man can easily charge the FES at home or any charging station which are gradually coming up. The FES is soon going to see a dawn in the two-wheeler industry, not only because it is electric but also it is foldable and portable.

Very recently two-wheeler industry has received a major setback due to increased prices by the Organization of Exporting Countries (OPEC) [9]. Due to this, it has opened up a way for FES or simply electric scooters which are commonly known as E-mopeds. Also, there is no need to get a license to drive the same. Its folding technique has also helped riders to get over the problem of parking [2]. For longer distances wherein they have to travel from one state to another, they can easily carry it along with them in their transit and use as per their convenience in another place. This makes people independent and they can completely rely on their FES.

Foldable Electric Scooter

A Foldable Electric Scooter is a battery operated scooter which is mounted on a motor and motor is connected to a rear Wheel. As if now, it has a capacity of one person. It is specially designed for those who have difficulty in walking or have tiredness to move from one place to another place [3]. It's utility is both for indoors and outdoors. The FES can reach a speed of 35 to 40 km/hr. The same can be increased by installing double battery. The control console that has been used and designed for this model is reliable and easy to operate. The brake system used are advanced which

makes its operation easy. There are many similar scooters which have the parking brake. The brakes are applied smoothly by simply pressing the throttle [10].

The objective of the paper is to build the FES so as to astound the shortage of parking space in the industries, companies, shopping malls etc [2,3]. It was also necessary to check the time it takes to assemble and disassemble the model. Time required for assembly and disassembly should be as less as possible. Weight of the FES should be less maintaining its durability and strength so that it will be easy for commuters to carry it. Maintaining the suitcase for a longer period of time was also one of the major focus [11-13]. Since the FES will be used by one person who will be driving it and at the same time, carrying it, so the comfort of the driver cannot be overlooked. It is designed in such a way that it can be carried in a transit through airplane, train, boat, bus etc. Apart from this, there should be zero harmful emissions.

M.Johnson et.al., Folding scooter, had the handle bar which operated in two different ways solving two purposes. The upright handle bar was used to hold it as a handle while riding and the folded handle bar was used to store the FES. For this two locking mechanism were used. S.Achari et.al., focused on the possibility of using and designing the tri-scooter. They used the experiment analysis for designing. To have no emissions they operated it on the DC motor which also solved the fuel consumption problem. They also worked on the cost factor so as to make it pocket friendly. Frame was built in mild steel.

Components of FES

As it's been mentioned as foldable which indicates that it been folded into three parts i.e. the handle which is been bent in such a way that the front tyre will get inside the main body region of the chassis, which becomes safe in between which is being locked using a simple lock to the alloy wheel as a notch, which holds it as a lock. Secondly second fold will be the seat i.e. the seat which the rider sit's upon will be bent and made sit on the rare wheel. Here the seat gets stuck on the rare wheel which makes it lock at the front wheel. It does not rotate as free. Lastly when these folds are made it becomes a single line as horizontal. Now this is being lifted as holding the handle which we ride, this can be carried as trolley and carried over. Once this mechanism is done, it need's be opened in a riding position from the folded form. Then this foldable scooter needs to accelerate as similar to other vehicles, it moves with the help of the brushless DC electric motor which is directly coupled in rare wheel hub. To run the motor we use the electric current, it can be produced by using the lithium batteries which is being placed inside the riders seat. The controlling of the motor is usually done by the throttle. This throttle is connected to a speed controller which regulates it, which is placed inside the seat. If any obstacles is seen front forth there is been brake system being implemented. This implementation is being done within the motor, which is a usually the drum brake system. The working principle of drum brake system is similar that of the brake system which is being used in other scooters.

E- bike Frames

It is most important part for any vehicle because all the parts are linked with frame. Its sturdiness plays a major role as it will define its light weight structure as well as its capability to carry a driver.

Motor

Motor is the power supply of an e-bike. BLDC hub motor for this scooter. This motor efficiency is up to 84%. They can be cooled by conduction so, no airflow required for cooling. The motor is entirely enclosing and protected from dirt or other foreign matter.
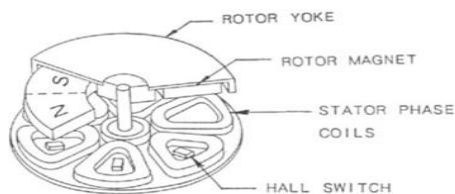
Figure. 1. Cross-sectional view of Hub motor

Controller

The controller is the heart of the electric vehicle. It decides the performance, speed, driving range etc for any electrical vehicle. The controller connects the power source (battery) to the actual motor. It controls speed and direction and optimizes energy conversion. Controller generally controls the ratio between torque and speed. Torque and speed is controlled by armature current and voltage respectively. It is usually observed that controllers have high efficiencies and can go upto 90%.

Battery

The battery is said to be the most important factor when comparing high-quality e-bike with a low-quality one [4]. Alkaline batteries could have been used for our vehicle's electric motor. They have high capacity than their respective counterparts as well as small in size. Since motor was of 24 V and 14.7 A, two batteries of 12 V were sufficient to use. Various batteries that can be used are lead-acid battery, alkaline and lithium battery.

Throttle

An effective throttle can increase or decrease the power of an engine [13]. Usually it is used to decrease it. Thumb throttle, half twist throttle and full twist throttle are considered the best choices for modern e-bikes.

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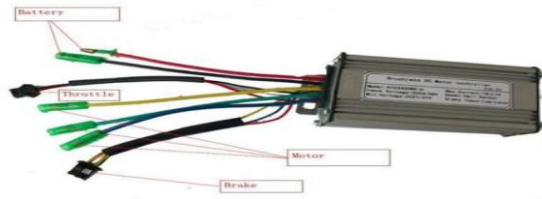
Figure 2. Controller
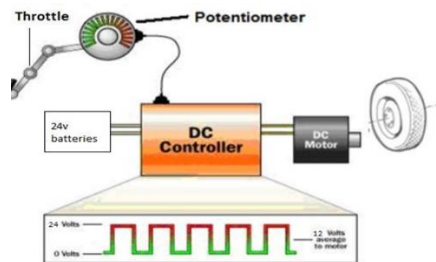
Figure 3. Working Diagram of electric vehicle

Charger

Charger is the life-line of the FES. Charger is used to charge battery after usage so it should be appropriate and depend on battery's power. Now a days, advanced chargers are used which can charge the battery quickly in less time.

Brakes

The main function of the brake system is to decelerate or decrease the speed of a vehicle. By stepping on the brake pedal, the brake pads compress against the rotor attached to the wheel, which then forces the vehicle to slow down due to friction. Brakes have used to stop the vehicle.

Figure 4. Mechanical Brakes

Steering

The primary purpose of the steering system is to allow the driver to guide the vehicle. As the vehicle is not too heavy so a simple steering mechanism. Following things were mounted on steering handle.

- Handle Driven Single Wheels
- Brakes on handle
- Throttle on handle

Chassis

28

A perimeter type chassis frame which provides more space and area for mountings. It is also the internal part of vehicle. It also helps in distributing space equally over the vehicle. We have manufactured the chassis in two different parts which can be assembled by an intermediate member.

Wheel

Two wheels for the vehicle. Out of these three wheels, one wheel at front steering handle and other two wheels used with shafts at rear of the vehicle for propulsion purpose. These wheels are made up of hard rubber which will help in transferring weight to the roads. Due to their smaller size and high weight handling capacity they are best for use.
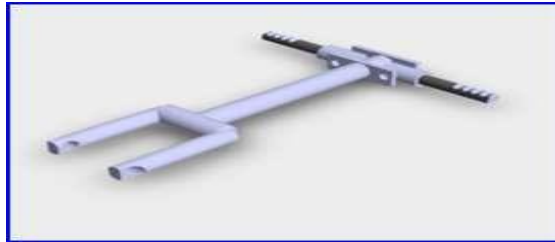
Figure 5. Steering Handle

Table 1. Wheel Specifications

Component	Parameters	Specifications
Front wheel and Rear Wheel		
	Quantity	1
	Size	8"

3-D Model of FES

Results and Discussions

A foldable scooter is a type of scooter with an attached electric motor with smooth folding mechanism and used to move fast in closer areas. The function of the scooter is to move from one place to another place with ease without combustion. This scooter design helps peoples those who are participated in social activities and physical challenge for their daily activity. This device is not designed essentially for speed but can run quicker. Main aim of this project was to design a portable automobile which is easy to handle by both the gender and should be very easy to carry as well as easy to handle with ease. The main was also that it should be environmentally friendly and should be non-polluting.

Conclusion

From this project one can conclude that the eco-friendly foldable scooter has top karts speed varies from 20 -25km/hr and this scooter had speed of 13-17km/hr and is folded within a minute. This foldable scooter had a lithium ion battery

which can be charged by outlet given. Calliper brakes on each wheel and a display on the handlebar that's shows the remaining battery percentage and speed. At the end of the ride, locking mechanism in the seat and released to collapse the seat support down towards the back wheel (while raising the footrests at the same time) and allows frond wheel and handlebars to fold into the body of the scooter or below the seat when folded it looks similar to a size of traveller's luggage which can be lift easily. This foldable scooter can be used when there is traffic. As it can be dragged it can be taken anywhere, such as in malls, hospitals, airports etc. As it consists of brushless DC motor it is eco-friendly battery oriented running scooter which is environment friendly.

References

1. Judkoff, R., & Neymark, J. (1995). *International Energy Agency building energy simulation test (BESTEST) and diagnostic method* (No. NREL/TP--472-6231). National Renewable Energy Lab..

2. Shukla, P. R., Dhar, S., Pathak, M., & Bhaskar, K. (2014). Electric Vehicles Scenarios and a Roadmap for India.

3. Hertach, P., Uhr, A., Niemann, S., & Cavegn, M. (2018). Characteristics of single-vehicle crashes with e-bikes in Switzerland. *Accident Analysis & Prevention*, *117*, 232-238.

4. Hassan, N. M., Ali, N. O., & Radzak, M. Y. (2014). Development and installation of battery-powered electric vehicle wiring system. *International Journal of Scientific & Technology Research*, *3*(11), 10-14.

5. Kartha, B. N., Gopal, V. K., Narayanan, A., Suresh, S., & Jayaprakash, V. (2014, November). A Review of Hybrid Electric Vehicles (HEV). In *ASME International Mechanical Engineering Congress and Exposition* (Vol. 46613, p. V012T15A013). American Society of Mechanical Engineers.

6. Larminie, J., & Lowry, J. (2012). *Electric vehicle technology explained*. John Wiley & Sons.

7. Chan, C. C., & Chau, K. T. (2001). *Modern electric vehicle technology* (No. 47). Oxford University Press on Demand.

8. Wang, Q., & DeLuchi, M. A. (1992). Impacts of electric vehicles on primary energy consumption and petroleum displacement. *Energy*, *17*(4), 351-366.

9. Tseng, L. Y. (1998). I-Ho li,"Hub motor development of electric vehicles,". *EVS-15 at Brussels, Belgium*.

10. Jamerson, F., & Benjamin, E. (2005). Electric bicycle world report 7th edition with 2005 update.

11. Ramli, A. H. (2008). *Design and Development of Single Seater Electric Scooter for Short Distance Application* (Doctoral dissertation, UMP).

12. Holms, A., & Argueta, R. (2010). A Technical Research Report: The Electric Vehicle. *Argueta–6-7, March*, *11*.

13. Lee, D. T., Shiah, S. J., Lee, C. M., & Wu, C. H. (2002, October). Intelligent control of electric scooters. In *Proc. 5th IASTED Int. Conf. Intell. Syst. and Control* (pp. 63-69).

Computational Fluid Dynamics Analysis of Heat Transfer and Fluid Flow in Mixing Elbow

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Abstract: The objective of this paper is to investigate two-dimensional incompressible heat transfer and fluid flow behavior in the mixing elbow. In the present work, k-ε turbulence model is used to study the mixing fluid flow behavior at different sections of upstream and downstream locations of the elbow. Flow modelling was analysed using the finite volume method based computational fluid dynamics (CFD) solver, ANSYS Fluent. In order to investigate the proper mixture output, the flow speed and diameter of the elbow are varied. Plots of velocity profile and temperature profile are shown in the flow domain. It is found that with the increase of velocity at smaller diameter inlet, the mixed temperature distribution in the mixing fluid effectively shows higher heat transfer rate. This provides a good idea about the distribution and fluid flow behavior that can be used for an efficient design of elbow.

Keywords: Elbow, Computational Fluid Dynamics, Velocity profile, Temperature profile.

Introduction

Mixing elbow is a device used in piping systems to transfer and mix hot and cold fluids which may be of similar or dissimilar type. This type of mixing finds its application in many industries such as polymer and food processing. The geometry of mixing usually comprises of a larger diameter 90 degree elbow with a tangentially attached smaller tube as shown in Figure 1. The mixing characteristics are usually studied through the velocity and temperature contours in the flow field inside the elbow across the mixing region of elbow [1-5]. Both computational and experimental techniques are employed [1-13] to predict and observe the fluid flow patterns and temperature profiles across the flow path. The computer simulations have proven to be predicting the flow pattern in the mixing elbow to the near perfection [6, 8, 10]. The observed simulated flow patterns are discussed in the light of physics of fluids in the literature [4, 5, 13].

The numerical methods involve solving Navier-Stokes equations with suitable turbulence model in both rectangular and curvilinear coordinates [4-9]. The results are usually shown as variation of flow pattern and temperature distribution against Reynold's number of flow. In the flow field, pressure drops at two locations respectively in upstream and downstream region in 90 degree elbow are observed by studies made by Mazumdar Q.H. for multiphase flow [4]. In another study same author has continued showcase increase in pressure at the elbow geometry with decreasing pressure as fluid leaves from the elbow at different locations [5]. The swirl intensity defined in terms of area averaged tangential velocity is shown to decrease [6] exponentially along the flow in the downstream region of elbow, which dissipates soon after as the radius of the elbow curvature is larger. A good agreement between the CFD predictions with RANS turbulence model and experimental results are established by Andreas Swienty et al., [7].

P. L. Spedding et al., [8] made a study on flow through the 90 degree elbow with horizontal elbow and vertical adjoint entry pipe. This study showcased an improvement in the mixing parameters..The turbulent flow of single phase incompressible fluid through 90° pipe bend was simulated numerically by P. Dutta et al., [9] using k-ε turbulent model. The validation of 3D models used for this study was found in good agreement with experimental reports. In another investigation [10] the adoption of RNG k-ε turbulence model based on the renormalization group method to close the RANS equations of the internal flow field of the pipe.

Literature review reveals many related investigations where in fluid flow and heat transfer characteristics of flow behaviour in the elbow region have been discussed in detail. The objective of this paper is to analyze the velocity and temperature profile in the mixing elbow of a particular geometry, which has not been reported in the literature.

Mathematical formulation

The present analysis use computational fluid dynamics (CFD) solver, ANSYS Fluent to solve the discretization equation, using a finite volume approach with semi-implicit method for pressure linked equations (SIMPLE) algorithm. The governing equations for incompressible fluid flow applies:

$$\frac{\partial u_i}{\partial x_i} = 0 \qquad (1)\, \frac{\partial u_i}{\partial t} + u_j \frac{\partial u_i}{\partial x_j} = f_i - \frac{1}{\rho}\frac{\partial p}{\partial x_i} + \nu \frac{\partial^2 u_i}{\partial x_j \partial x_j} \qquad (2)$$

Equations (1) and (2) are respectively called conservations of mass and momentum, f_i is a vector representing external forces and ν is the kinematic viscosity.

Turbulence model

The standard κ-ε turbulent model is adopted for the present study. In this model, the turbulent kinetic energy (k) and the turbulence dissipation rate(ε) have the following form
For turbulent kinetic energy k,

$$\frac{\partial(\rho k)}{\partial t} + \frac{\partial(\rho k u_i)}{\partial x_i} = \frac{\partial}{\partial x_j}\left[\frac{u_t}{C_\mu}\frac{\partial k}{\partial x_j}\right] + 2\mu_t E_{ij}E_{ij} - \rho\epsilon \qquad (3)$$

For dissipation ϵ

$$\frac{\partial(\rho\varepsilon)}{\partial t} + \frac{\partial(\rho\epsilon u_i)}{\partial x_i} = \frac{\partial}{\partial x_j}\left[\frac{u_t}{\sigma_\epsilon}\frac{\partial\epsilon}{\partial x_j}\right] + C_{1\epsilon}\frac{\varepsilon}{k}2\mu_t E_{ij}E_{ij} - C_{2\epsilon}\rho\frac{\varepsilon^2}{k} \qquad (4)$$

Where u_i represents velocity component in corresponding direction
$\qquad E_{ij}$ represents component of rate of deformation
$\qquad \mu_t$ represents eddy viscosity
The equations (3) and (4) consist of some adjustable constants [14]. These are as follows

$$\mu_t = \rho C_\mu \frac{k^2}{\epsilon}\, C_\mu = 0.09,\quad \sigma_\epsilon = 1.00\,,\quad \sigma_\epsilon = 1.30\,,\quad C_{1\epsilon} = 1.44,\; C_{2\epsilon} = 1.92$$

Schematic geometry of the problem

Figure 1 and figure 2 shows a geometry of the elbow which is used for CFD simulation and unstructured mesh. The problem is stated as the cold water of temperature 290K enters through the inlet of large diameter with the velocity of 0.2 m/s while the hot water having temperature 310K enters through the inlet of small diameter with velocity differs from 1m/s to 5m/s.

y

x

Inlet-1

Inlet-2
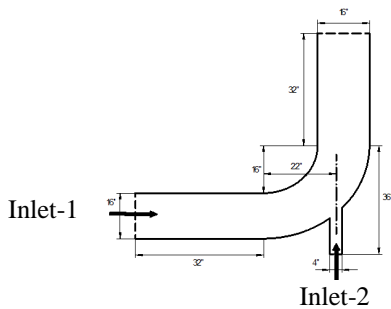
Figure 1.Geometry of the elbow   **Figure 2**.Elbow mesh
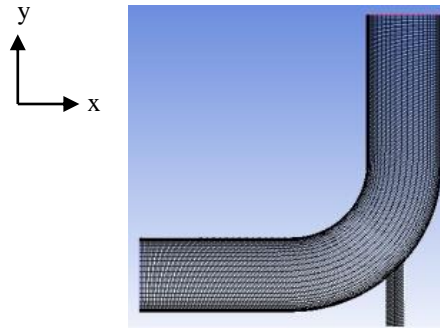
Results and discussions

CFD results presented in this paper are velocity profile and temperature profile as validated against the available literature.

Velocity profile of the mixing elbow

The velocity profiles of inlet-1 at 0.2m/s and different three velocities of inlet-2 are shown in figure 3. For velocity inlet-1at 0.2m/s, the simulation was performed using turbulence model. By referring below flow diagram, due to the venturi effect near to the inlet-2, the velocity slightly fluctuates and shifts upward due to the faster moving of the fluid. This shows exact requirement of the mixing of hot and cold water.
Figure 4 shows the graph of velocity profiles at different sections from inlet to outlet of the elbow. As fluid enters in the elbow through inlet-1 with a uniform velocity at 0.2m/s, near the wall the velocity is essentially zero due to the shear stress with no slip boundary condition and slightly increases further away from the wall and becomes flatter at section-1 and section-2 due to mixing in radial direction.

The layers of velocity in a fluid at the center of the elbow the velocity increases to remunerate for the reduced velocities of layer of the fluid near the wall surface. This emerges a velocity gradient across the cross section of the elbow.The

32

region very near to the wall exhibits nearly linear velocity profile in the turbulence and is completely dominated by viscous effect.

(a) Inlet-2 velocity: 1m/s   (b) Inlet-2 velocity: 2.8m/s   (c) Inlet-2 velocity: 5m/s
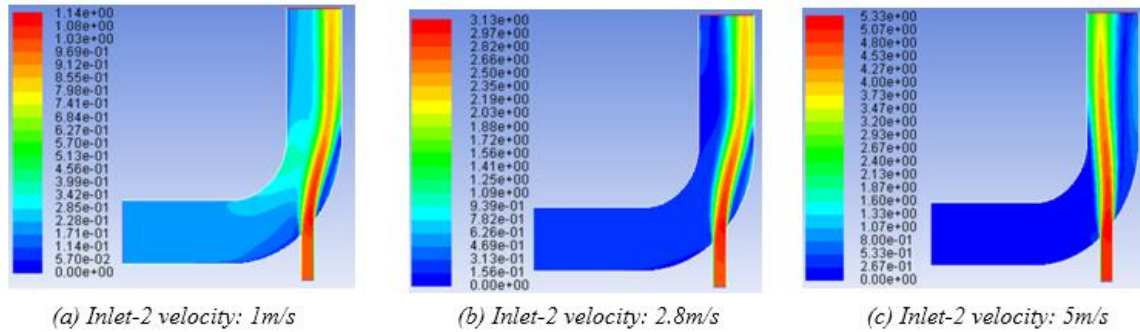
Figure 3.Velocity profiles in elbow at different velocities

(a) Inlet-2 velocity: 1m/s   (b) Inlet-2 velocity: 2.8m/s   (c) Inlet-2 velocity: 5m/s   (d)Different sections in elbow
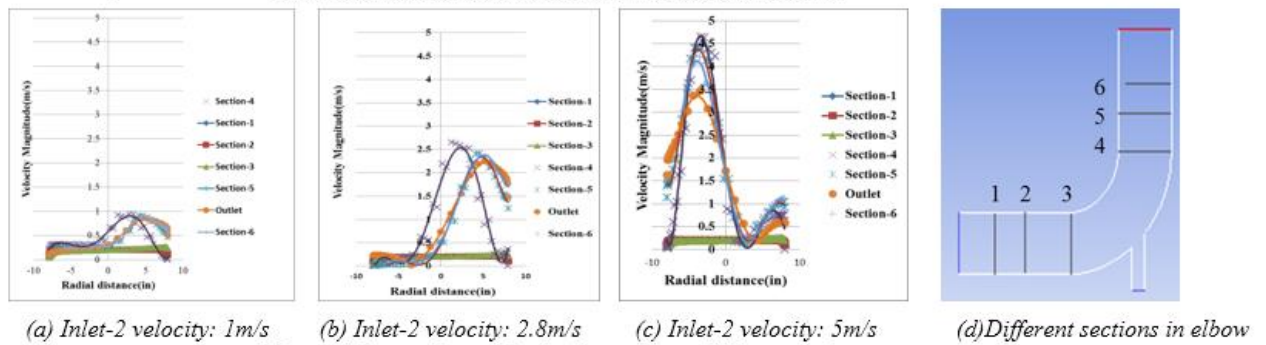
Figure 4.Comparisons of velocity profile at different sections

Temperatue Profile of the mixing elbow

(a) Inlet-2 velocity: 1m/s   (b) Inlet-2 velocity: 2.8m/s   (c) Inlet-2 velocity: 5m/s
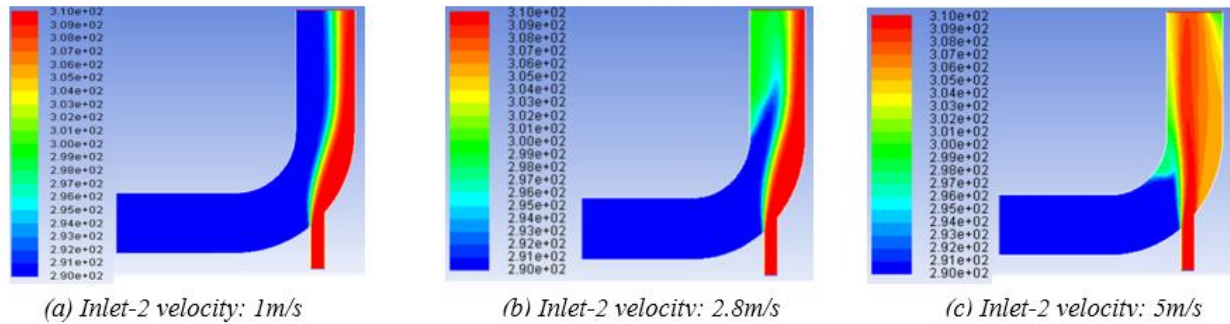
Figure 5.Temperature profile in elbow at different velocities

The temperature profile is the second important profile to consider apart from the velocity profile. The temperature contour of the mixing elbow is shown in Figure 5. It is noticed that the proper mixing flow happens at upstream elbow near to the outlet.

Figure 6 shows the graph of temperature profiles at different sections from inlet to outlet of the elbow. The cold fluid having temperature 290K enters through the inlet of large diameter with the velocity of 0.2 m/s while the hot fluid of temperature 310K enters through the inlet of small diameter and mixes with the turbulence nature of the flow. The temperature distribution undulates the surface of the fluid. Despite the viscosity of the fluid and the

properties of the mixing elbow, the shear stress on the wall is important because it determines the temperature profile.

Conclusions

In this work, Fluent 14.0 software was used to study the turbulence flow of incompressible fluid through mixing elbow which has been numerically stimulated by using k-ε turbulent model. The following conclusions were drawn

33

- It is found that the velocity at inlet -1, the velocity profile at the center of the elbow recovered its fully developed shape of turbulence.
- It was found that with the increase in velocity at inlet-2 for various values such as 1m/s, 2.8m/s and 5m/s, the temperature distribution in the mixed fluid effectively showed higher heat transfer rate.

(a) Inlet-2 velocity: 1m/s *(b) Inlet-2 velocity: 2.8m/s* *(c) Inlet-2 velocity: 5m/s*
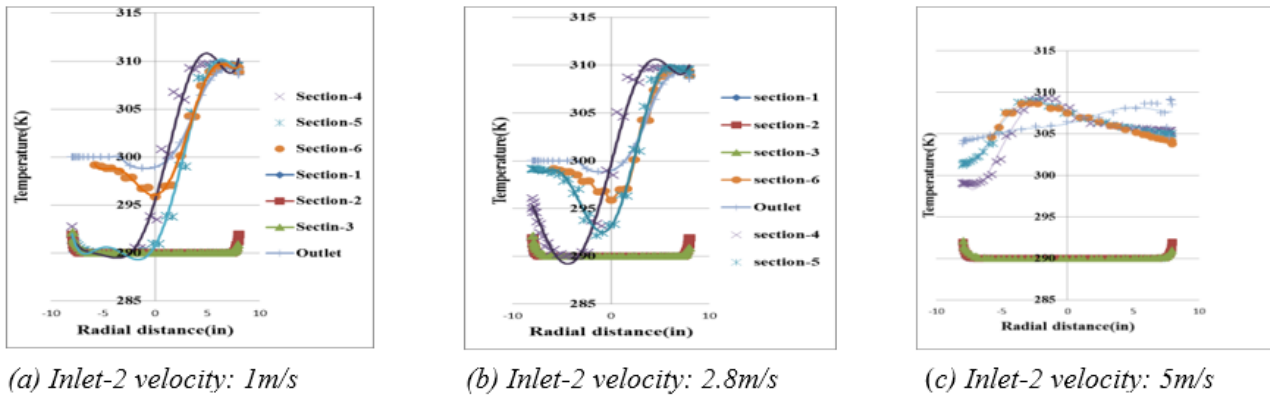
Figure 6.Comparisons of temperature profiles at different sections

References

[1] Dutta, P., & Nandi, N. (2015). Study on pressure drop characteristics of single phase turbulent flow in pipe bend For high Reynolds number *10*(5), 7.

[2] Kalpakli, A., &Örlü, R. (2013). Turbulent pipe flow downstream a 90° pipe bend with and without superimposed swirl. *International Journal of Heat and Fluid Flow*, *41*, 103–111.

[3] Daneshfaraz, R., Rezazadehjoudi, A., & Abraham, J. (2018). Numerical investigation on the effect of sudden contraction on flow behavior in a 90-degree bend. *KSCE Journal of Civil Engineering*, *22*(2), 603–612.

[4] Mazumder, Q. H. (2012). CFD Analysis of Single and Multiphase Flow Characteristics in Elbow. *Engineering*, *04*(04), 210–214.

[5] Mazumder, Q. H. (2012). CFD Analysis of the Effect of Elbow Radius on Pressure Drop in Multiphase Flow. *Modelling and Simulation in Engineering*, *2012*, 1–8.

[6] Kim, J., Yadav, M., & Kim, S. (2014). Characteristics of Secondary Flow Induced by 90-Degree Elbow in Turbulent Pipe Flow.*Engineering Applications of Computational Fluid Mechanics*, *8*(2), 229–239.

[7] Andreas Swienty, Raja AbouAckl, & Paul Uwe Thamsen. (2015). Numerical Prediction of Flow Patterns after Various Pipe Fittings. Journal of Mechanics Engineering and Automation 5 (10), 542-548.

[8] Spedding, P. L., Benard, E., & Crawford, N. M. (2008). Fluid flow through a vertical to horizontal 90° elbow bend III three phase flow. *Experimental Thermal and Fluid Science*, *32*(3), 827–843.

[9]Dutta, P., Saha, S. K., Nandi, N., & Pal, N. (2016). Numerical study on flow separation in 90° pipe bend under high Reynolds number by k-ε modelling. *Engineering Science and Technology, an International Journal*, *19*(2), 904–910.

[10] Zhang, J., Huang, H., Hu, K., & Zhang, P. (2020). Analysis of Elbow Effect on the High Pressure Gas Pipe.*Journal of Physics: Conference Series*, *1600*, 012087.

[11] Liu, X., Gong, C., Zhang, L., Jin, H., & Wang, C. (2020). Numerical study of the hydrodynamic parameters influencing internal corrosion in pipelines for different elbow flow configurations.*Engineering Applications of Computational Fluid Mechanics*, *14*(1), 122–135.

[12] Mazumder, Q. H., Hassn, K., Kamble, A., &Nallamothu, V. T. (2021). Characterization of particulated flow induced erosion in elbow geometry. *Experimental and Computational Multiphase Flow*, *3*(2), 100–107.

[13] Sedrez, T. A., Shirazi, S. A., Rajkumar, Y. R., Sambath, K., &Subramani, H. J. (2019). Experiments and CFD simulations of erosion of a 90° elbow in liquid-dominated liquid-solid and dispersed-bubble-solid flows. *Wear*, *426–427*, 570–580.

[14] Versteeg, H. K., &Malalasekera, W. (2007). *An Introduction to Computational Fluid Dynamics: The Finite Volume Method*. Pearson Education Limited.

Numerical Study of Forced Convection Heat Transfer through Perforated Fins

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Abstract : In the present work, computational analysis is performed to analyze the enhancement of heat transfer for a 3D flow over a flat plate fitted with square cross-section fins without and with perforation in a rectangular domain. Flow and heat transfer characteristics were presented for Reynolds number from 13500 to 41000 and Prandtl number 0.71. The height of the fin and the inter-fin spacing ratio (Sy/D) were considered to be 75 mm and 1.944 respectively. Incompressible air is considered as the working fluid with constant properties and k-ϵ is turbulent model is used to predict the characteristics of turbulent parameters. Numerical analysis are validated with experimental studies and reasonably fair agreements were observed. Results show that the fins with two perforations have significant heat transfer enhancement

Keywords: Heat transfer enhancement, turbulence model, perforated fins.

Introduction

Extended surfaces usually termed as fins are generally and extensively used to transfer the heat from the primary source or surface to the surrounding fluid. Several types of fins such as cylindrical fin, tapered fin, annular fin, pin fins etc. are used. These fins extend from a base which may be rectangular or cylindrical in cross section. A pin fin is commonly used for exchanging the heat. These pin fins are classified as short fin and long fin based on height-to-diameter (H/d) ratio. If the H/d is ranging from 0.5 to 4, they are termed as short pin fin, and H/d exceeding 4 are termed as long pin fins.

Many investigations were carried out to know the heat transfer and pressure drop in channels with pin fins. Fatima Zohra Bakthi and Mohamed Si-Ameur [1] numerically investigated the effect of mixing of nano fluids by varying the volumetric concentration in heat sinks with perforated fins for a low Reynolds number ranging from   100 – 400. They selected Tio_2, Al_2O_3 and Cu dispersed in pure water as the base fluid. Results showed that by mixing nano particles, the pumping power and friction factor increase with increase in Re and further increases with addition of nano particles. Thamir et al. [2] investigated both experimentally and numerically the effect of perforation in a heat sink. Their results show that perforations in heat sinks gives better heat transfer rate compared to solid fins and the pumping power required will be reduced with increase in perforation. Liang Hueng et al. [3] studied the performance of tube with different shaper pin fins experimentally for turbulent flow covering a wide range of Reynolds number from 0.5×10^5 to 4.1×10^5. The heat transfer performance of tubes with different pin fin shapes such as circular, elliptical and drop-shaped were used for the study. Their results show that the drop-shaped fins show excellent improvement on the heat transfer and reduced pressure drop. Huizhu Yang et al.[4] used R113 for assessing the effect of types of fin on the performance of a plate-fin heat exchanger. They considered 3 types of fins such as plain fin, serrated fin and perforated fin. The Colburn factor *j* and friction factor *f* were found to be the critical parameters that affect the performance of heat exchanger. The criteria for assessing the performance used were j/f, $j/f^{1/2}$, $j/f^{1/3}$. In all the cases, the serrated fins appears to be the best followed with the perforated fins and plain fin. Susmitha et al. [5] experimentally and numerically investigated the performance of radial heat sink for a cylinder fitted with perforated fins under natural convection and radiation. The perforated staggered arrangement reduced the thermal resistance compared with non-perforated staggered arrangement found to be small in perforated heat sink geometry. Cheng-Hung Haung and Po-Wei Tung [6] analyzed experimentally and numerically and proposed an optimal shape of a wavy shaped heat sink. M. R Shaeri and Richard W. Bonner [7] proposed an analytical model to predict average Nusselt number of laterally perforated-finned heat sinks for laminar flows. The model agreed with experiments with an absolute error less than 5%. Thamir K et al. [8] studied the effect of square perforations under forced convection in a heat sink. They concluded that heat dissipation rates were higher for perforated fins compared to solid fins and increases further by increasing the number of perforations. This also resulted in reduced friction factor and reduced

pumping power. Ramin Karami and Babak Kamkari [9] experimentally investigated to analyze the perforamance of tube latent heat energy storage devices and the effect of perforated fins of vertical shells. Lauric acid was used as the phase change material. They found that the instantaneous heat transfer rates for solid fins were higher than perforated finned heat exchangers and vice-versa during convection dominated melting. González A. M. et al [10] studied numerically and experimentally the performance of heat exchangers under forced convection for three materials and found that the overall heat transfer coefficient is higher for materials having higher thermal conductivity. Shaeri and Yaghobui [11] numerically analyzed the heat transfer characteristics in array of perforated fins. They found that the total drag is highest for the solid fins and increases with increasing perforations. Also the effectiveness is high for perforated fins compared with solid fins and increases with increasing perforations. M. R. Shaeri and M. Yaghoubi [12] studied numerically the performance of perforated heat sinks for a laminar flow. Higher performance such as heat transfer rates and effectiveness were observed for perforated fins and increased by increasing the number of perforations. Bayram Sahin and Alparslan Demir [13] investigated experimentally for an optimized orthogonal array for a Reynolds number ranging from 13500 to 42000. Their research concluded that the most effective parameters for heat transfer and friction factor was found to be Reynolds number and fin height respectively.

The aim of the present study is to determine the heat transfer characteristics of the square fins with circular perforations and compare the results with and without fins for the same boundary conditions. For this purpose, a 3D turbulent fluid flow and heat transfer around a flat surface, an array of solid fins attached on to a flat surface, fins with 1 and 2 circular perforations is considered for the study.

Problem Description

Typical models used in this study are shown in *Figure* 1 as per the dimensions given by Bayram and Sahin[13]. The flow of air is considered to be steady and incompressible. The effect of natural convection and radiation is neglected. The fin material is considered to be Aluminum with constant thermal conductivity (k = 202 W/m-K).

The base plate assumed to be same as the fin material having dimensions 250 mm long, 250 mm wide and 6 mm thick. The fins had a cross section of 15 mm X 15 mm and height 51 mm were modeled on the top surface of the base plate and is shown in *Figure* 2. The fins are arranged uniformly on the base plate with a constant spacing of 18.125 mm in the span wise direction and 22.86 mm in the stream wise direction. Circular perforation is made in the fin at a distance 17 mm from the upper surface of the base plate of 8 mm diameter. The second perforation is made at a distance 17 mm from the first perforation

Computational domain and boundary conditions

Figure 2 shows the computational domain. It consists of an inlet and outlet. The fin base considered as a heat source. For the plane abcd, velocity inlet boundary condition is used and for the plane efgh, pressure outlet boundary condition is used. For the planes dcgh and abfe, wall boundary condition are used. The free stream temperature is assumed to be 25°C.

Governing equations for the 3-Dimensional incompressible fluid flow for steady state and k-ε turbulence modeling is used for the present study. The governing equations are discretized using finite volume procedure. The second order upwind scheme is used for calculating momentum and energy equations.

The heat transfer coefficient ($\overline{h}$) and Nusselt number (Nu) are calculated by the equations:

$$\overline{h} = \frac{\dot{Q}}{A_T(T_b - T_\infty)} \quad (1)$$

$$\overline{Nu} = \frac{\overline{h}D_h}{k} \quad (2)$$

A_T = LW + 4NHD + πNp [dD – 0.5d²], where L is the length of the base plate, W is the width of the base plate, N is the number of fins, H is the height of the fin and D is the thickness of the fin, d is the diameter of perforations.

Np is the number of perforations. $\dot{Q}$ is the rate of heat transfer, T_b is the base temperature, T_∞ is the free stream temperature of the fluid, D_h is the hydraulic diameter based on the duct dimension given in [13] and k is the thermal conductivity of the fluid.

Grid generation

The grid structure for the selected models are shown in *Figure* 3. Several grids structures were studied to see that the results are independent of the grid.

(a) Flat surface

(b) Array of Solid fins

(c) Array of fins with 1 Perforation

(d) Array of fins with 2 Perforations
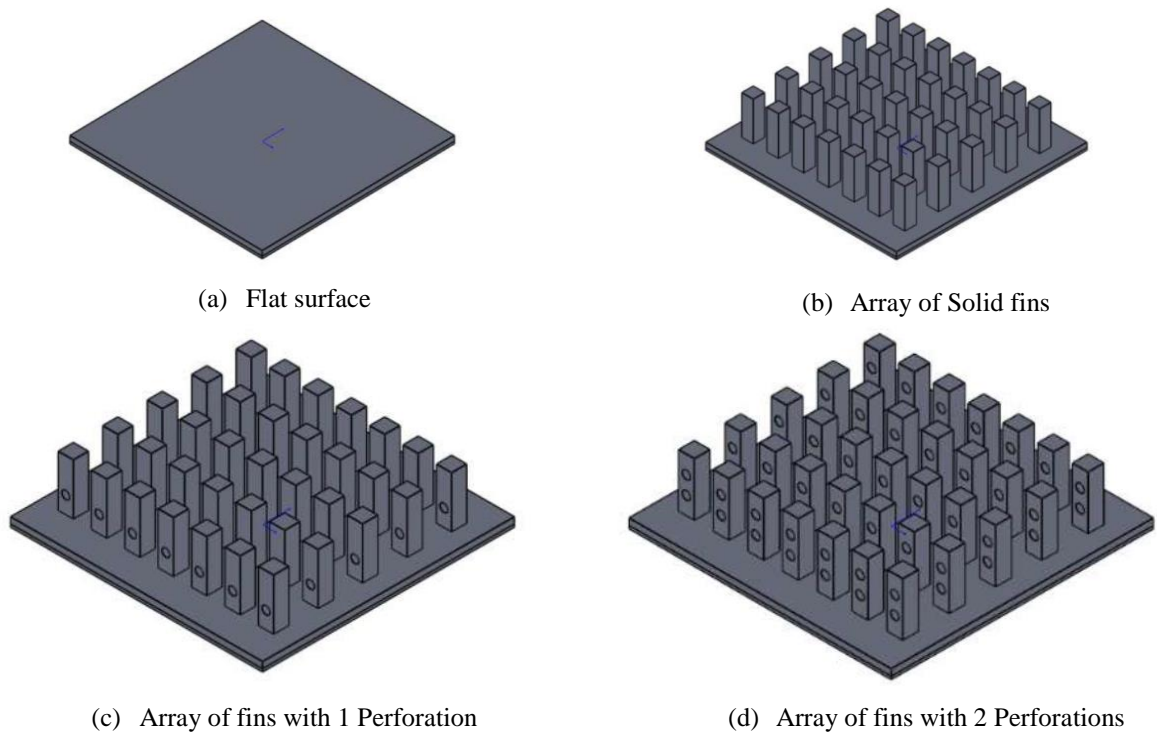
Figure1. Various configurations of solid and perforated fins
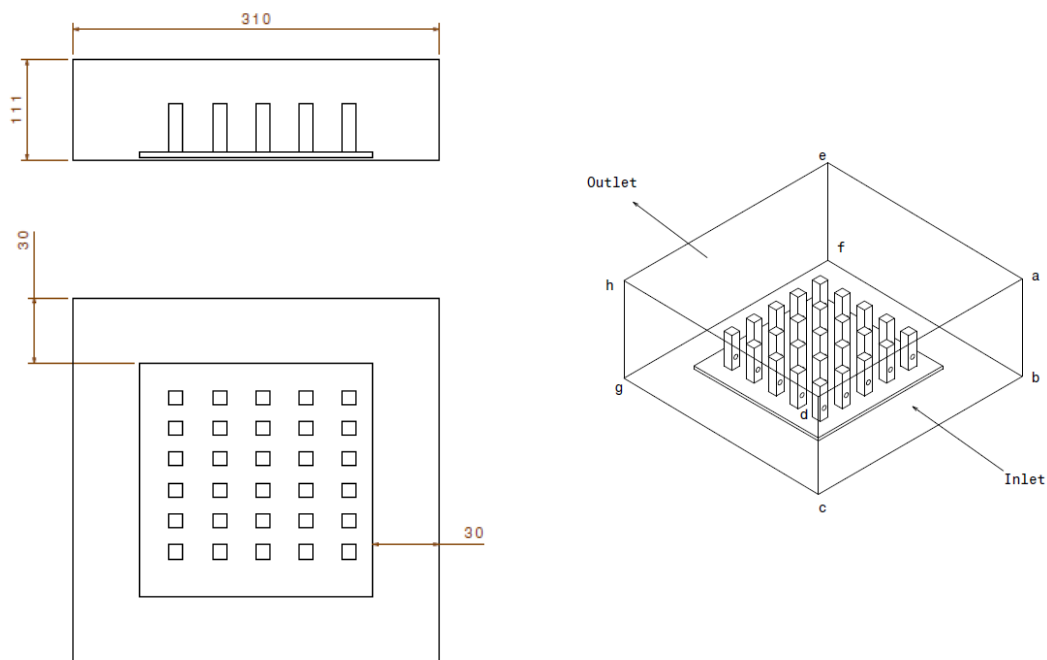
Figure 2. Computational domain

(a) Solid fins   (b) Fins with 1 perforation

(c) Fins with 2 perforations
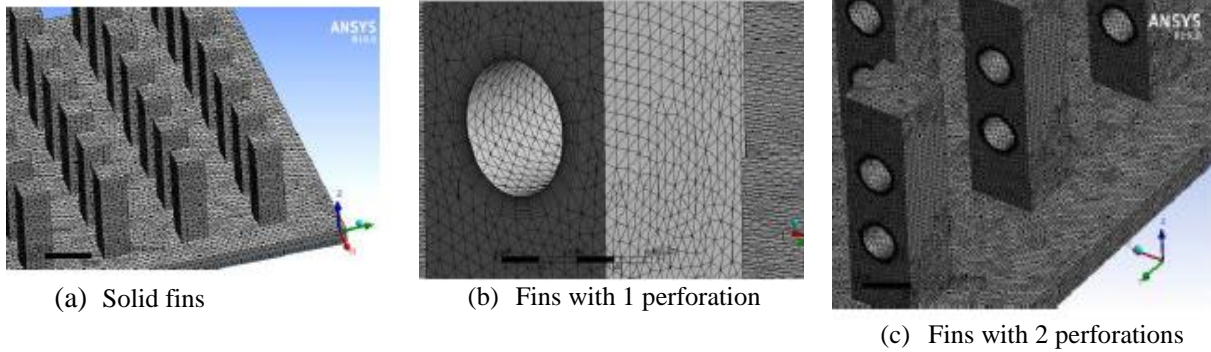
Figure 3. Typical grid generation for fins

Validation
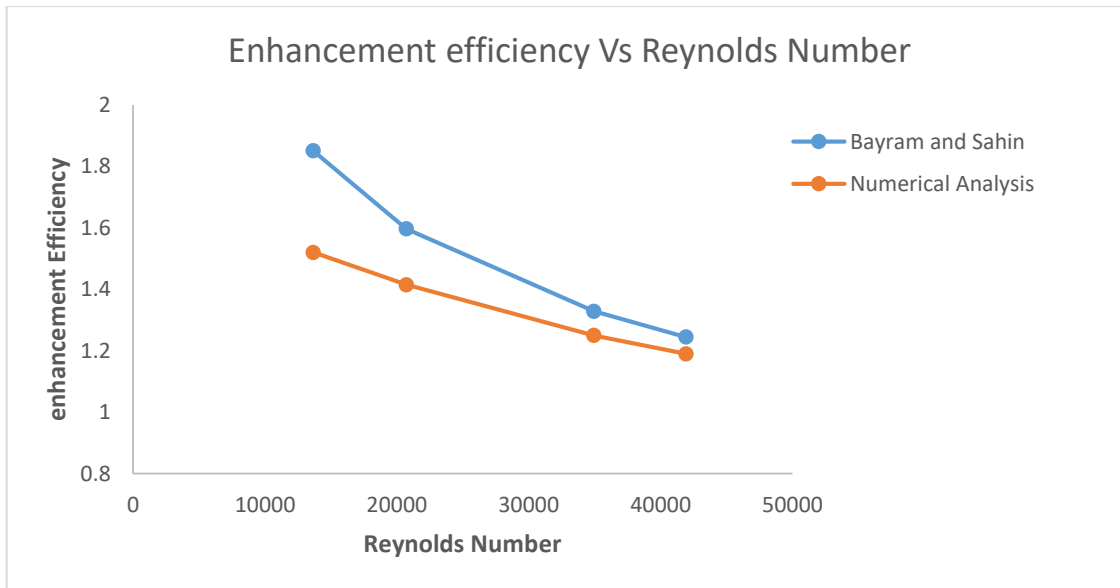
Figure 4. Comparison of numerical and experimental results

Figure 4 shows a fair agreement of numerical results with experimental results Bayram sahin and Alparslan Demir[13], at higher Reynolds number. The deviation at low Reynolds number is to be explored further by considering exactly same geometrical configuration as given in [13].

Results and discussion
Computations are carried out for flat surface, solid fin, fins with 1 perforation and 2 perforations for Reynolds number ranging from 13500 to 41000 and Prandtl number = 0.71. The temperature contours of all the configurations for Re = 13500 is shown in *Figure* 5. It is clear that the temperature of the base plate is less for fins with 2 perforations compared to solid fins since fins with perforations have larger heat transfer area in comparison to solid fin. It is also clear that by increasing the perforations, the total heat transfer rate will raise.

38

(a) Flat surface

(b) Solid fin

(c) Fins with 1 Perforation

(d) Fins with 2 perforations
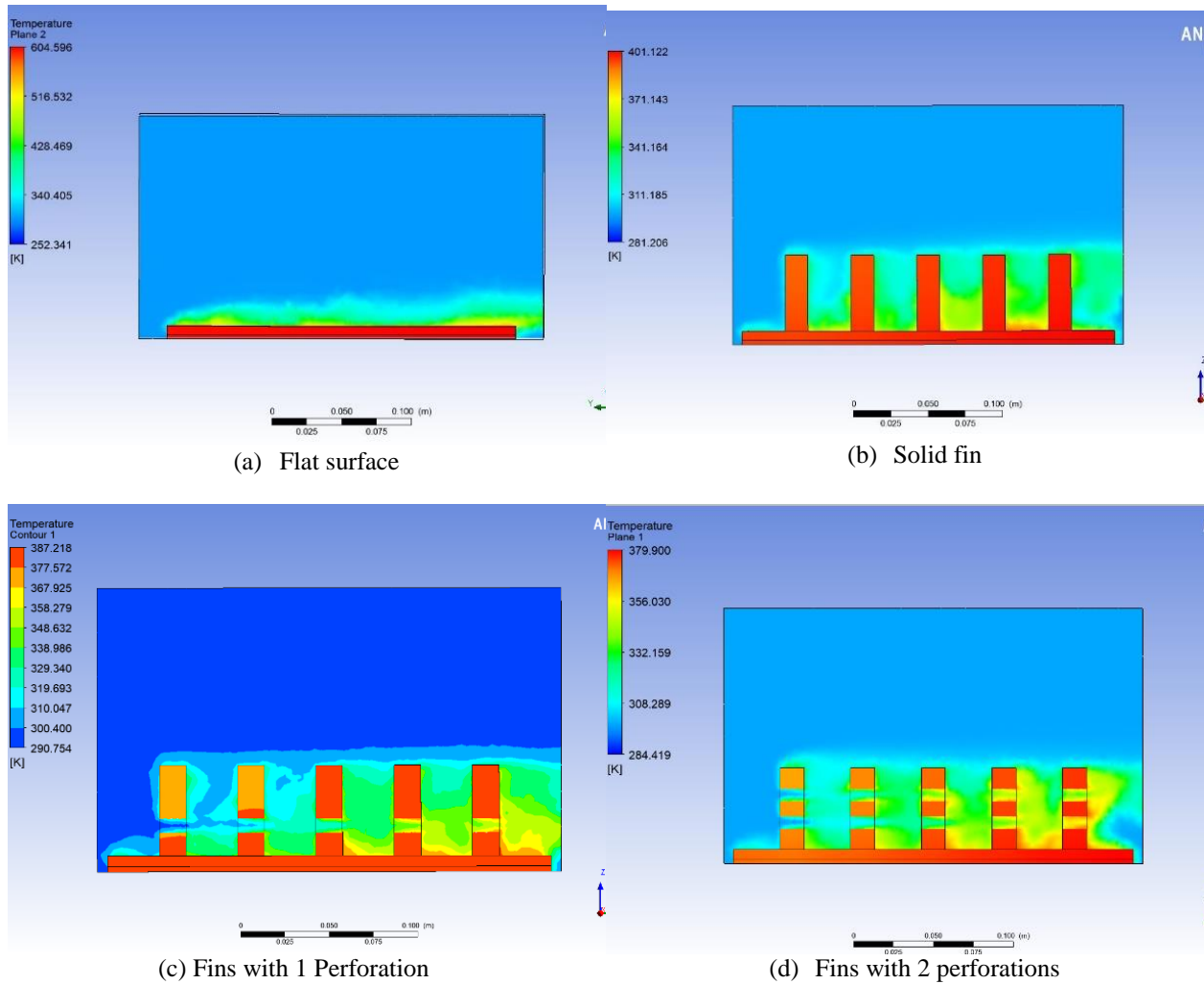
Figure 5. Contours of Temperature on the fins surface for all the configurations for Re = 13500

Conclusions

The thermal performance of flat surface, solid fins, fins with 1 and 2 perforations are investigated numerically in this paper and is seen that perforated fins have better heat transfer characteristics compared with the solid fins. This is due to the fact that the fins with perforations have higher contact surface with the fluid in comparison with the fins without perforations. Additional experimentation is required to conclude on the limiting cut out space in perforated fins in various configurations for optimum heat transfer

Acknowledgement

References

[1]. Fatima Zohra Bakhti, Mohamed Si-Ameur (2019). A comparison of mixed convective heat transfer performance of nanofluids cooled heat sink with circular perforated pin fin. *Applied Thermal Engineering*, 159, 113819

[2]. Thamir K. Ibrahim, Ahmed T. Al-Sammarraie, Manar S.M. Al-Jethelah , Wadhah H. Al-Doori, Mohammad Reza Salimpour, Hai Tao (2020). The impact of square shape perforations on the enhanced heat transfer from fins: Experimental and numerical study. *International Journal of Thermal Sciences*, 149, 106144

[3]. Liang Huang, Qingling Li, Hongyan Zhai (2018). Experimental study of heat transfer performance of a tube with different shaped pin fins. *Applied Thermal Engineering*, 129, 1325-1332

[4]. Huizhu Yang, Jian Wen, Simin Wang, Yanzhong Li (2018). Effect of fin types and Prandtl number on performance of plate-fin heat exchanger: Experimental and numerical assessment. *Applied Thermal Engineering,* 144, 726-735

[5]. Susmitha Sundar, Gihyun Song, Muhammed Zeeshan Zahir, J. S. Jaya Kumar, Se-Jin Yook. (2019). Performance investigation of radial heat sink with circular base and perforated staggered fins. *International Journal of Heat and Mass Transfer.* 143, 118526.

[6]. Cheng-Hung Huang, Po-Wei Tung (2005). Numerical and experimental studies on an optimum Fin design problem to determine the deformed wavy-shaped heat sinks. *International Journal of Thermal Sciences*, 151, 106282

[7]. M. R. Shaeri, Richard W. Bonner III (2019). Analytical heat transfer model for laterally perforated-finned heat sinks. *International Journal of Heat and Mass Transfer*, 131, 1164-1173.

[8]. Thamir K. Ibrahim, Ahmed T. Al Sammarraie, Wadhah H. Al Taha, Mohammed Reza Salimpour, Manar Al-Jethelah, Ahmed N. Abdalla, Hai Tao (2019). Experimental and numerical investigation of heat transfer augmentation in heat sinks using perforation technique. *Applied Thermal Engineering*, 160, 113974.

[9]. Ramin Karami, Babak Kamkari (2020). Experimental investigation of the effect of perforated fins on thermal performance enhancement of vertical shell and tube latent heat energy storage systems. *Energy Conversion and Management*, 210, 112679

[10]. A.M. González, M. Vaz Jr., P.S.B. Zdanski (2019). A hybrid numerical-experimental analysis of heat transfer by forced convection in plate-finned heat exchangers. *Applied Thermal Engineering*, 148, 363-370

[11]. M.R. Shaeri, M. Yaghoubi (2009). Numerical analysis of turbulent convection heat transfer from an array of perforated fins. International Journal of Heat and Fluid Flow, 30, 218-228

[12]. M.R. Shaeri, M. Yaghoubi (2009). Thermal enhancement from heat sinks by using perforated fins. *Energy Conversion and Management*, 50, 1264-1270

[13]. Bayram Sahin and Alparslan Demir (2008). Performance analysis of a heat exchanger having perforated square fins, Applied Thermal Engineering, 28, 621-632

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A Review on Applications of Acoustic Interation with Heat Transfer and Combustion Process

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Abstract: This paper exhibits the importance of acoustic oscillations on heat transfer problems and combustion processes. This study is an attempt to divulge the acoustic oscillations interaction on heat transfer situations and combustion process and will prove useful to every engineer and scientist. Oscillations are integral parts of the heat transfer and combustion processes in any system and in some cases these oscillation affect the desired results positively and in other, these may affect the result adversely. Not only the heat transfer or combustion is affected by these oscillations but these oscillations can modify any fluid flow. Oscillations can be generated automatically or induced artificially to get derived result. So, the presented study will have far reaching implication in some areas of Science and Technology.

Keywords: Acoustic Medium, Oscillations, Combustion, Heat Transfer, Heat Release Rate, Combustion Chamber

Introduction

Fluid flow with heat transfer and combustion are often unstable as in these processes a large amount of heat is being added to the surrounding medium. Heat addition causes expansion of fluid element adjacent to the combustion source or heat transfer surface. Expansion of the fluid element produces pressure wave which propagate in the surrounding medium/region. These waves after reflection from the boundary of the system interact with the combustion zone or heat transfer surfaces and makes the combustion and heat transfer process unsteady and in unsteady heat addition the fluid element produces a time dependent volume change of each fluid element which serve as a source of acoustic/ pressure disturbances. In some cases, these oscillations are artificially generated by Helmholtz oscillator or other electronic devices. These pressure oscillations could also be generated in a variety of circumstances determined by the mechanical and geometrical features of the fluid dynamical system. If acoustic disturbances are imposed upon the study state such that, acoustic displacement thickness is of magnitude equal to or greater than a characteristic study state dimension for heat and mass transfer then substantial improvement in the heat transfer and combustion efficiency can be obtained. The to and fro acoustic movements bring hotter gases into contact with heat transfer surfaces thereby increasing substantially the heat transfer rate. A similar process brings greater oxidizing air into contact with the combustion zone to increase the combustion efficiency. In a fluid flow without heat transfer surface and combustion zone, these oscillations enhance the turbulence level which is desirable for many situations.

Problem formulation

Various applications of oscillations will be identified from many research papers to conclude the importance of oscillations and to utilize them to get better result which may not be possible in the absence of oscillation.

Theoretical studies

Rayleigh [1] has given a principal in acoustic which explains the phenomenon of conversion of heat addition into acoustic energy. Several other thermo-acoustic phenomenon also explained by the same principle and provided satisfactorily result. Mathematical representation of Rayleigh hypothesis came from Putnam A. A and Dennis W. R.[2], who first proposed a formula to determine if acoustic energy in in a study heat transfer environment. The most realistic treatment of the problem was done by Chu [3], he derived an equation for the rate of change of energy of a small perturbation in viscous, heat conductive and compressive medium, and showed that the rate of change of energy of the fluid in acoustic mode is given by:

$$\iiint h_s T' / \overline{T}_{(x,y,z)} dxdydz \quad (1)$$

Where h_s (x,y,z) and T' (x,y,z) are respectively the fluctuating components of heat release rate per unit volume and temperature fluctuations at the location x,y,z and at instant time period (t) which is the mean temperature at x,y,z and

integration extends over the region, where heat is being released. He suggested in the absence of entropy fluctuations, the temperature fluctuations and the pressure fluctuations will be in phase. Therefore, in such cases equation (1.1) will become

$$\iiint \frac{r-1}{r} h_s' p' / \bar{p}_{(x,y,z)} dxdydz \quad (2)$$

Applications of oscillations/disturbance in the system will depend on the magnitude after the integration over a period of time.

$$\oint dt, \iiint h_s T' / \bar{T}_{(x,y,z)} dxdydz \quad (3)$$

$$\oint dt, \iiint \frac{r-1}{r} h_s' p' / \bar{p}_{(x,y,z)} dxdydz \quad (4)$$

If the integral exceed the energy through dissipation, acoustic energy from the system will be amplified. Mathematical model described above will differ from problem to problem depending upon the geometry. Although, the results mentioned above are very old but they are still in use to study acoustic interaction with heat and combustion.

A theoretical study [4] on theory and estimation of accosted intensity and energy density is carried by Derek C. Thomas of Brigham University in the year of 2008. Also, some of the acoustic theory [5] is available in a paper "modeling of combustion acoustic sources and their dynamics in PRECCINSTA burner test case authored by Flix Grimm, published in in international journal to spray and combustion dynamics volume-9(4) 330-348, 2017. Details of acoustic study are given in an introduction to acoustic by S.W. Rienstra and Hierschberg Eindhoven from University of Technology, published on 28 November 2019 [6]. A comprehensive study [7] on acoustics is available in Pierce A.D.

Applications of Acoustic interaction with heat transfer and combustion processes
A plenty research are available on application of acoustic interaction with heat transfer and combustion process studies. A few of them are cited below:

A study by L. K. Singh et al. has revealed that [8] performance of Rijke combustor is improved. Further, the location of heat release region is found to be critical in obtaining the heat transfer improvement. Masahiro Saito, Masahiro Hoshikawa and Masayuki Sato [9] published the work on enhancement of evaporation/combustion rate coefficient of a single fuel droplet by acoustic oscillation. In this study the flame temperature is found to be increased in acoustically oscillated droplet. Ahmet E. Karatas¸ Omer L. Gulder, [10] investigated soot suppression by acoustic oscillated combustion using acetylene diffusion flame. They found interesting result which showed that efficiency of soot suppression exceeded 90% in the region of Re> 3000. The flame temperature also increased, by the application of acoustic oscillations. Ali Seifollahzadeh and Ali Aminian [11] studied the effect of acoustic environment on the burning rate of solid propellant and found that burning rate decreases with oscillations and increases with velocity oscillation.A study of transverse to longitudinal acoustic coupling processes in annular combustion chamber is carried by J. Blimbaum, at al. This study focuses on instabilities that excite transverse acoustic modes of combustion chamber. This is a major issue in Lean pre-mixed combustion approaches [12]. A study on "combustion acoustic interaction through cross area between adjacent model gas turbine combustor" is carried by Moon Kihun et al. [13] and the study revealed that longitudinal mode combustion instability in can annular gas turbine combustion system are influenced by acoustic interactions between adjacent combustor, these interaction typically occur across an open area between a combustor transmission piece and first stage turbine nozzles. Matthew A. Cooper and Victoria T. Singleton have Carried a survey of the 2001 to 2005 quartz crystal microbalance biosensor literature [14]: applications of acoustic physics to the analysis of bimolecular interaction. According to the survey, the widespread explanation of biosensor in the analysis of molecular recognition have it origins in the mid-1990, following the release of commercial system based on Surface Plasma resonance (SPR), most recently platforms based on piezoelectric acoustic sensors (principally "bulk acoustic wave (BCW), thickness share mode (TSM) sensors or quartz crystal microbalance (QCM), have been released heat that are deriving the publication of large number of paper, analyzing binding specificities

affinities Kinetic and conformal changes associated with a molecular recognition event [15].

Guoqing Shen, Likang Ma, et al. [16] have carried out experimental studies on "Effect of ultrasonic waves on heat transfer in Nano fluid under natural convection and pool boiling"In natural convection, ultrasonic waves enhance heat transfer in alumina nanofluids with highest heat transfer efficiency reaching 128 percent which decreases with increase in heat flux. This paper also analyses experimental results from the aspect of nanoparticle dispersion on the heat transfer surface under influence of ultrasound. A study on "Multi fidelity analysis of acoustic streaming in forced convection heat transfer" is carried by Tapish Agarwal, Iman Rahbare et al. [17] with the detailed analysis of the temporal evaluation of thermal boundary layer under periodic excitation. In the presence of oscillation, the nonlinear interaction leads to the formation of secondary flows, commonly known acoustic streaming. They developed 3 tier numerical approaches, in first level fidelity, a numerical model of laminar flow with fluctuations and streaming flows are studied, in second level of fidelity, two dimensional U-RANS simulations are conducted across both laminar and turbulent flow regimes, in third level, the direct numerical simulations are conducted to simulate the application relevant to compressible flow and environment. Alessandro Franco and Carlo Bartoli, [18] developed a methodological analysis of heat enhancement due to acoustic fields. The exposed physical phenomenon underlying the alteration of convective heat transfer in a heat exchanger subjected to impose vibrations. This technique seems to have interesting features and industrial applications such as for efficiency increment, heat transfer rate control and cleanliness action. A patent for acoustically isolated heat exchanger for thermo acoustic engine by inventor Robert J Howard, explains the physics of thermoplastic engine to derive heat exchanger acoustically. Jianfeng Wang et al. [19] investigated acoustic radiator efficiency bubble, acoustic interaction in ultrasonic wave underwater welding at shallow water. In underwater welding evaluation, mode of dynamic bubble around the arc burning zone is non-stabilizing the underwater wet welding. The ultrasonic wave assisted underwater welding provides such a promising approach to control the bubble evaluation and achieve a stable bubble.

Gang Wu et al. [20] demonstrated theoretically and experimentally the mitigation of self-excited combustion oscillation using electrical heater. Theoretical model shows that the heater act like an acrostic absorber and experimental study is then performed on a Rijke tube in which implementing a heater leads to an unstable combustion system been successfully stabilized. A study on the effect of acoustic oscillations [21] on flame dynamics of homogeneous propellants in rocket motor is carried out by Tae-Seong et al. The interaction between wave and gas phase flame dynamics of double phase homogenous propellant in a rocket motor has been studied by means of a comprehensive numerical analysis. The dynamic behavior of luminous flame plays a decisive role in determining the motor stability characteristics. The interaction between self-excited oscillations [22] and fuel air mixing in dual swirl combustor has been studied by Chen, Z., Swaminathan et al. Partially premixed gas turbine model close to an industrial design is investigated using on stable and another self-excited and stable oscillations. The study explains the transition of flame shaped experiment from V to flat, when flame becomes acoustically unstable. Thomas R Boziuk et al. [23] have showed acoustic enhancement of direct contact condensation using capillary wave and Mass. TR Boziuk, MK Smith, A Glezer [24] showed that directional acrostic actuations can enhance two phase heat transfer in direct contact condensation.

Conclusion

Browsing through the different website, it is apparent that a plenty of applications are available, where acoustic interaction takes place with heat transfer and combustion. Few of them only are cited in this paper, not only in heat transfer and combustion but also in the disciplines of science and Technology. Acoustic wave can do miracle just like electromagnetic waves do in the field of computer science. It is only the matter to explore them as per the application and get the favorable results. The research which is exposed in this study is related directly or indirectly to acoustic, fluid flow problems, Rijke tube, microbiology, rocket propulsion, premixed flames, nanoparticles manufacturing and heat exchanger etc. it is attempt to infuse in the mind of readers the importance of acoustic and its application.

References

[1] L. Rayleigh, (1887). On the maintenance of vibrations by forces of double frequency, and on the propagation of waves through a medium endowed with periodic structure. *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science.* 24(147), 145–159.

[2] Putnam A.A. and Dennis W.R. (1956). Survey of organ-pipe oscillations in combustion systems. *Journal of Acoustical Society of America.* 28, 240-246

[3] C. Ma, R.G. Parker, B.B. Yellen, (2013). Optimization of an acoustic rectifier for uni-directional wave propagation in periodic mass-spring lattices. *J. Sound Vib.* 332, 4876–4894.

43

[4]   B. Scholarsarchive, D.C. Thomas, (2008). Theory and Estimation of Acoustic Intensity and Energy Density. *Physical and Mathematical Sciences; Physics and Astronomy, Brigham Young University*

[5]   F. Grimm, J. Dierke, R. Ewert, B. Noll, M. Aigner, (2017). Modelling of combustion acoustics sources and their dynamics in the PRECCINSTA burner test case. *Int. J. Spray Combust*. 9, 330–348.

[6]   S.W. Rienstra, A. Hirschberg, (1952). An Introduction to Acoustics., *Phys. Today*. 5 24.

[7]   A.D. Pierce, P.W. Smith, Acoustics (1981). An Introduction to Its Physical Principles and Applications. *Phys. Today*. 34, 56–57.

[8]   L. K. Singh C. Rajashekar S. B. Gupta T. S. Sheshadri V. K. Jain, (1990). Heat transfer performance of coal-burning Rijke combustors. *Department of Aerospace Engineering, Indian Institute of Science, International journal of energy research*, 14, 795-799

[9]   Masahiro Saito, Masahiro Hoshikawa and Masayuki Sato, (1996). Enhancement of evaporation/combustion rate coefficient of a single fuel droplet by acoustic oscillation. *Fuel*. 75(6), 669-674

[10] Ahmet E. Karatas¸ Omer L. Gulder, (2012). Soot formation in high pressure laminar diffusion flames. *Progress in Energy and Combustion Science*，38, 818-845

[11] Ali Seifollahzadeh and Ali Aminian, (2014). Simulation and Study of the Effect of Pressure Oscillations on Linear Combustion Instability in a Double Base Solid Rocket Motor. *Journal of Chemical Engineering & Process Technology,* 5(2), 1-5   ,

[12] J. Blimbaum, M. Zanchetta, T. Akin, V. Acharya, J. O'Connor, D. Noble, T. Lieuwen, (2012). Transverse to longitudinal acoustic coupling processes in annular combustion chambers. *Int. J. Spray Combust. Dyn*. 4, 275–298.

[13] Moon Kihun, Hyunwook Jegal, Changjin Yoon, Kyu Tae Kim, (2020). Cross-talk-interaction-induced combustion instabilities in a can-annular lean-premixed combustor configuration. *Combustion and Flame*，220, 178-188

[14] Y. Liu, J.J.S. Norton, R. Qazi, Z. Zou, K.R. Ammann, H. Liu, L. Yan, P.L. Tran, K.I. Jang, J.W. Lee, D. Zhang, K.A. Kilian, S.H. Jung, T. Bretl, J. Xiao, M.J. Slepian, Y. Huang, J.W. Jeong, J.A. Rogers, (2016). Epidermal mechano-acoustic sensing electronics for cardiovascular diagnostics and human-machine interfaces, *Sci. Adv*. 2

[15] Matthew A. Cooper and Victoria T. Singleton, (2007). A survey of the 2001 to 2005 quartz crystal microbalance biosensor literature: applications of acoustic physics to the analysis of biomolecular interactions. *J. Mol. Recognit*. .20, 154–184

[16] Guoqing Shen, Likang Ma, (2019). Effect of ultrasonic waves on heat transfer in Nano fluid under natural convection and pool boiling. *Journal of Heat and mass transfer*, 138, 516-523.

[17] Tapish Aggarwal, Iman Rahbare, Jorge Saavedra, (2020). Multi fidelity analysis of acoustic streaming in forced convection heat transfer. *Journal of heat transfer*. 142(2), 1-14

[18] Alessandro Franco and Carlo Bartoli (2019). Heat transfer enhancement due to a positive field a methodological analysis, acoustics. *Department of energy system territory and Constructions engineering, university of Pisa, Italy*, 281 - 294

[19] Jianfeng Wang, Qingjie Sun, Jiangkun Ma, (2019). Investigation of acoustic radiator affecting bubble-acoustic interaction in ultrasonic wave-assisted UWW at shallow water. *Journal of manufacturing processes*. 27, 563 - 577.

[20] Gang Wu, Zhengli Lu, Weichen Pan, Yiheng Guan, (2019). Experimental demonstration of mitigating self-excited combustion oscillations using an electrical heater, *Applied Energy*, 239, 331-342

[21] Tae Seong Roh, I Shih Tseng, Vigor Yang, (2012). Effects of acoustic oscillations on flame dynamics of homogeneous propellants in rocket motors. *Journal Power of propulsion and power*. 11(4), 640-654.

[22] Chen, Z., Swaminathan, S., Stöhr, M., & Meier, W. (2018). Interaction between self-excited oscillations and fuel-air mixing in a dual swirl combustor*, Department of Engineering, University of Cambridge, Proceedings of the Combustion Institute*. 1 - 20

[23] Thomas R. Boziuk, Marc K. Smith, Ari Glezer (2019). Acoustic enhancement of direct-contact condensation using capillary waves, International *Journal of heat and mass transfer*. 138, 357 to 372.

[24] TR Boziuk, MK Smith, A Glezer (2019). Enhanced Two-Phase Heat Transfer by Direct-Contact Condensation Using Directional Acoustic Actuation. *5th International Workshop on Thermal Investigations of ICs and Systems (THERMINIC).*

Short Review of Sol-gel and Chemical Coprecipitation Methods for Synthesis of Magnetic Nanoferrites

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Abstract: The extensive use of nanomaterials has made them a top field of research in present times. Various kinds of magnetic nanoferrites are being synthesized to serve numerous functions, and their specific applications demand specialized tailoring of these nanoferrites during their synthesis. It is crucial to understand the various types of synthesis methods as each of the available methods has its inherent advantages and limitations, and the quality of the synthesized nanoferrites significantly depends upon the synthesis route selected. This present study briefly reviews two of the most commonly employed synthesis techniques for the synthesis of magnetic nanoferrites. The involved general chemical reactions, their equations along with the process sequence to obtain magnetic nanoferrites through the sol-gel method and coprecipitation method have been briefly discussed.

Keywords: Nanomaterials; Magnetic Nanoferrites; Synthesis; Sol-Gel Method; Chemical Coprecipitation Method.

Introduction

Nanotechnology is an emerging field in the current age as nanomaterials find their extensive use in all areas and domains of science and technology. Nanotechnology can be explained as the study and use of a chemical substance or material that is produced and used at a microscopic scale, i.e., in the nanometer range. In other words, nanotechnology is the science and research of the very small [1]. The International Organization for Standardization (ISO), defines nanotechnology as the application of the knowledge in manipulating and controlling the matter of nanometer size [2]. The notion of nanoscience and nanotechnology was initiated during a talk by famous physicist Richard Feynman at the California Institute of Technology on December 29, 1959. He suggested and discussed the idea about how scientists can obtain specific properties from materials if they manipulated and controlled the matter at the molecular and atomic level [3]. To put in perspective how small a nanometer is, it is to know that one nanometer 10^{-9} or one billionths of a meter and that an inch contains a total of 25,400,000 nanometers [4].

Nanomaterials can occur naturally through various cosmological, meteorological, geological, physical, chemical, and biological processes [5]. Nanoparticles fall on the surface of the earth in the form of interplanetary dust and in exorbitantly large quantities per year [6]. Nanomaterials are known to be produced in the form of volcanic ash or carbon soot from large scale forest fires or can be produced as the unintentional by-products of the combustion processes [7, 8]. Such naturally occurring nanomaterials are physically and chemically heterogeneous in nature and are generally termed as termed ultrafine particles. On the contrary, engineered nanoparticles are intentionally produced and are designed with unique physical, chemical, electrical, mechanical, optical, or magnetic properties to deliver a particular purpose or function [9]. Nanomaterials have been in use since the prehistoric age, and their use in around the 4th to 9th century find mentions in historic literature [10].

Any material having a dimension in the nanoscale range (i.e., between approximately 1–100 nm) are termed as nanomaterials. Nanoparticles are often termed with their informal names, i.e., nanospheres, nanorods, nanofibers, etc. depending on the variety of shapes these particles can exist [11, 12]. The nanomaterials generally exhibit unique characteristics as compared to the bulk material [13]. These characteristics may include increased physical, chemical, optical, electrical, or magnetic properties such as mechanical strength, chemical reactivity, magnetism, or electrical conductivity [14, 15]. This enhancement in performance is generally attributed to the contribution of several properties. Nanomaterials are known to have large area/volume ratio allowing higher surface reactivity and diffusion properties. The nanomaterials also experience a significant depression in the melting point of the material as compared to the bulk material [16, 17].

One particular class of nanomaterials is called magnetic nanoferrites, and they exhibit superior magnetic properties. Magnetic ferrites are easily manipulated by the application of external magnetic fields [18]. Magnetic nanoferrites are ceramic materials doped with various additional metallic elements and are electrically nonconductive and ferromagnetic in nature [19]. Magnetic nanoferrites are generally divided into two categories depending on their magnetic coercivity. It is the measure that represents the ability of a ferromagnetic material to withstand an external magnetic field without becoming demagnetized. Magnetic nanoferrites can be categorized as soft and hard nanoferrites [20, 21]. Soft nanoferrites have low coercivity, and they tend to change their magnetization easily. Hard

nanoferrites have high magnetic coercivity, and they do not change their magnetization easily [22, 23]. Figure 1 shows the comparison between soft and hard ferromagnetic nanomaterials in terms of their magnetic coercivity [24].

The magnetic nanoferrites have been the center and focus of extensive research because of their potential use in the domains of nanomaterial-based catalysts, biomedicine, magnetic resonance imaging, magnetic particle imaging, data storage, environmental remediation, nanofluids, magnetic cooling, etc. [25, 26]. Magnetic nanoferrites, their composites, and their countless function-specialized derivatives are also finding their applications in crucial areas such as medical diagnostics, sensors, paints, cosmetics, wastewater treatment, catalysis, genetic engineering, cancer therapy, targeted drug delivery, high-frequency applications, space applications, etc. [27, 28].
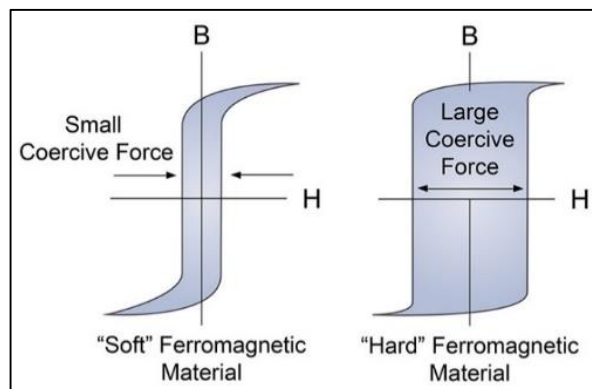
Figure 1. Magnetic Coercivity of Soft and Hard Ferrites

The boundless application areas and limitless potential of nanomaterials and magnetic nanoferrites drives interest in understanding their synthesis techniques. Nanomaterials, as well as magnetic nanoferrites, can be produced by several synthesis techniques, i.e., mechanical, chemical, pyrolysis, ion condensation, radiolysis, etc. Out of the available synthesis techniques, chemical synthesis techniques have observed exclusive focus due to the simplicity, cost-effectiveness, and yield of the process. The objective of this study is to review the two common wet chemical methods, i.e., sol-gel and chemical coprecipitation methods used for the production of magnetic nanoferrites.

Chemical Synthesis Techniques
Both dry and wet chemical methods are available and explored for the synthesis of magnetic nanoferrites [29]. The present study is focused on reviewing the wet chemical methods only. The wet chemical method includes the mixing of suitable ingredients in an appropriate solvent and creating a solution. The chemical and thermal treatment of this solution results in the production of an insoluble precipitate. The size of these precipitate is generally a factor of the reaction temperature and the quantity of the reagents [30]. The prepared insoluble precipitates, i.e., the produced magnetic nanoferrites, are obtained through separation from the solvent through conventional separation processes such as evaporation, centrifugation, sedimentation, filtration, etc. [31]. The wet chemical methods are comparatively cost-effective and offer great control over the chemical composition of the produced magnetic nanoferrites [32]. The following sections discuss the synthesis routes of interest that exist under the wet chemical method for the synthesis of magnetic nanoferrites.

Sol-Gel Method
The sol-gel method includes the process of formation of an inorganic colloidal suspension (**sol**) and gelation of the **sol** in a continuous liquid phase (**gel**) to form a three-dimensional network structure [33]. The sol-gel method has been in use since the 1800s and is a preferred synthesis technique to produce ceramics and glass materials in forms of fibers or powders [34]. In this method, metal alkoxides or metal chlorides are the preferred precursors. Hydrolysis and polycondensation reactions occur that form a colloid containing dispersed nanoparticles. The sol subsequently converts into the inorganic continuous network called as gel. Depending on the type of drying process employed, the gel gets converted into aerogel, xerogel, or cryogel. This aerogel, xerogel, or cryogel is then calcinated to obtain nanoparticles [35, 36]. The general equations that follow during the hydrolysis and polycondensation processes are represented in Equation 1 and 2 (a and b), respectively [37].

- Hydrolysis Process

$$M(OR)_x + H_2O = HOM(OR)_{x-1} + ROH \text{ (1)}$$

- Polycondensation Process

  a) Alcohol Condensation:

$$(OR)_{x-1}MOH + ROM(OR)_{x-1} = (RO)_{x-1}MOM(OR)_{x-1} + ROH \text{ (2a)}$$

  b) Water Condensation:

$$(OR)_{x-1}MOH + HOM(OR)_{x-1} = (RO)_{x-1}MOM(OR)_{x-1} + HOH \text{ (2b)}$$
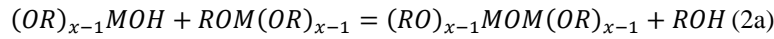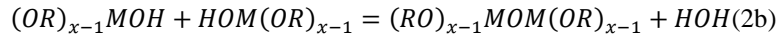
Where R represents alkyl groups such as –Ch_3, C_2H_5, etc. and M is metal, i.e., Si, Ti, Al, etc.

The sol-gel method is known to provide yield with a high surface area along with stable surfaces. Superior mixing of the precursors along with outstanding chemical homogeneity in the synthesized products, can be achieved with the sol-gel method [38]. Figure 2 depicts the flowchart of the steps involved in the sol-gel method for the production of magnetic nanoferrites.
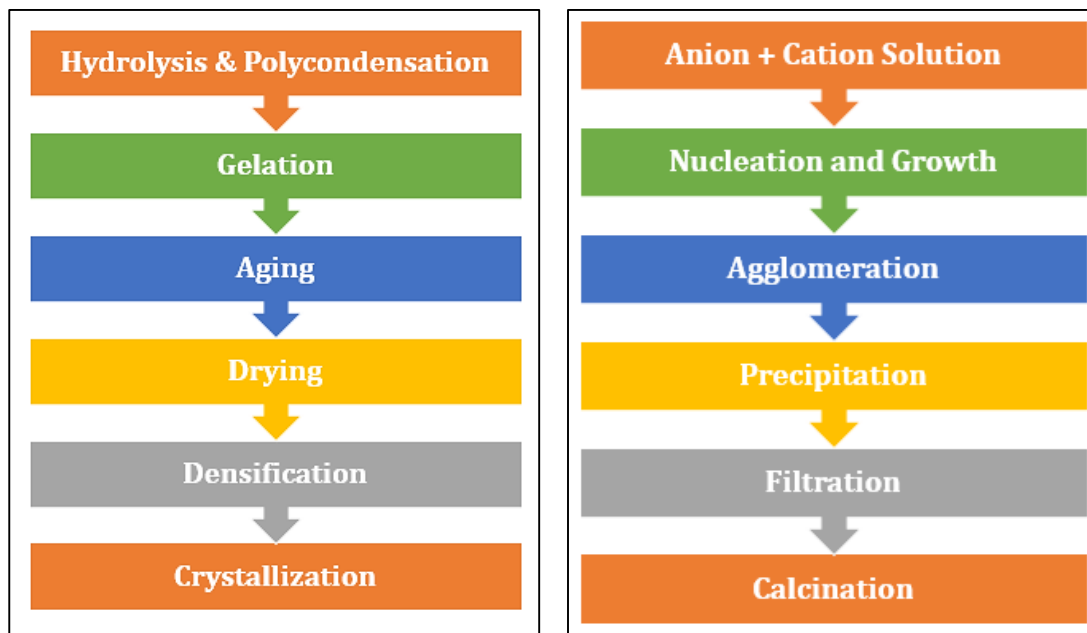
Figure 2. Steps for Sol-gel Method **Figure 3.** Steps for Chemical Coprecipitation Method

Chemical Coprecipitation Method

The chemical coprecipitation method is one of the simplest methods for the synthesis of magnetic nanoferrites. This technique delivers several advantages such as fast process, easily scalable to industrial scales, high yield, high purity of the prepared magnetic nanoferrites, low cost, and lack of using organic solvent [39, 40]. Figure 3 depicts the flowchart of the steps involved in the chemical coprecipitation method for the production of magnetic nanoferrites [41]. There are two stages involved in this method, i.e., (i) a short burst of nucleation when the concentration of the species reaches critical supersaturation, and (ii) a slow growth of the nuclei by diffusion of the solutes to the surface on the crystal. The properties of the synthesized nanoparticles are entirely dependent upon reaction parameters such as reaction temperature, pH, ionic strength, etc. [42]. It provides a comparatively eco-friendly route and does not demand treatment of high pressures and temperatures. Massart first proposed this method, and the chemical reaction that occurs is expressed by the following equation [43]:

$$M^{2+}(aq) + 2Fe^{3+}(aq) + 8HO^-(aq) = MFe_2O_4(s) + 4H_2O \text{ } (l) \text{ (1)}$$
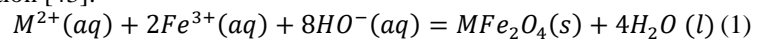
The preferred precursors for the chemical coprecipitation methods are chlorides, nitrates, sulfates, or acetates. A solvent such as distilled water, ethanol, or cyclohexane is used to dissolve the precursors and form a solution. A precipitating agent is slowly added dropwise, along with constant stirring. This process results in the precipitation of the desired compound. Distilled water is used to wash the precipitate to remove any water-soluble impurities. The

precipitate is then dried in a hot air oven, crushed lightly with mortar and pestle, and the final product is obtained. The control over the particle size, shape, magnetic properties, and crystallinity of the final product is a limitation with the chemical coprecipitation method [44, 45].

Conclusion

Magnetic nanoferrites have attracted significant interest due to their exceptional physical, chemical, electrical, and magnetic properties. Due to such augmented characteristics, magnetic nanoferrites apply to diverse fields. The authors conclude the following from the present short review about the synthesis of magnetic nanoferrites.

1. Various methods are available for the synthesis of nanoparticles, but wet chemical methods are preferred and exclusively explored by the researchers.

2. Wet chemical methods offer several advantages as compared to other synthesis techniques such as ion sputtering scattering, inert gas condensation, pulse laser ablation, sonochemical, microwave, template synthesis, spark discharge, and biological synthesis.

3. It is ascertained that the proper applications and the tendency of nanomaterials to deliver the desired purpose strongly depend on the effectiveness of the synthesis technique.

4. The simplicity and effectiveness of sol-gel and chemical coprecipitation techniques make them a favored approach for the synthesis of magnetic nanoferrites.

References

[1]. Vert, M., Doi, Y., Hellwich, K. H., Hess, M., Hodge, P., Kubisa, P., Rinaudo, M. & Schué, F. O. (2012). Terminology for biorelated polymers and applications (IUPAC Recommendations 2012). *Pure and Applied Chemistry*. 84(2), 377 410. doi:10.1351/PAC-REC-10-12-04

[2]. ISO/TS 80004-2: Nanotechnologies Vocabulary Part 2: Nano-objects. International Organization for Standardization. 2015. Retrieved 18 January 2018.

[3]. Gilbert, H. D. (1961). Miniaturization. University of Michigan, Wiley-VCH, pp. 306.

[4]. Chen, Z., Virk, A. U. R., Habib, M., Zia, T. J., Ahmed, I., Shi, C. & Nazeer, W. (2019). Irregularity Indices of Dendrimer Structures Used as Molecular Disrupter in QSAR Study. *Journal of Chemistry*. Volume 2019, Article ID 5371254. https://doi.org/10.1155/2019/5371254

[5]. Simakov, S. K. (2018). Nano- and micron-sized diamond genesis in nature: An overview. *Geoscience Frontiers*. 9(6), 1849–1858. doi:10.1016/j.gsf.2017.10.006

[6]. Plane, J. M. C. (2012). Cosmic dust in the earth's atmosphere. *Chemical Society Reviews*. 41, 6507–6518. doi:10.1039/C2CS35132

[7]. Fedotov, P. & Ermolin, M. (2018). Nanoparticles of volcanic ash as a carrier for toxic elements on the global scale. *Geophysical Research Abstracts*. Vol. 20, EGU2018-2373-1.

[8]. Sigmund, G., Jiang, C., Hofmann, T. & Chen, W. (2018). Environmental transformation of natural and engineered carbon nanoparticles and implications for the fate of organic contaminants. *Environmental Science: Nano*. 5, 2500-2518. https://doi.org/10.1039/C9EN90007A

[9]. Guo, D., Xie, G. & Luo, J. (2014). Mechanical properties of nanoparticles: basics and applications. *Journal of Physics D: Applied Physics*. 47(1), 013001. doi:10.1088/0022-3727/47/1/013001

[10]. Reiss, G. & Hutten, A. (2010). Magnetic Nanoparticles. *Handbook of Nanophysics: Nanoparticles and Quantum Dots*. CRC Press. pp. 21. ISBN 9781420075458

[11]. Kralj, S., & Makovec, D. (2015). Magnetic Assembly of Superparamagnetic Iron Oxide Nanoparticle Clusters into Nanochains and Nanobundles. *ACS Nano*. 9(10), 9700–9707. doi:10.1021/acsnano.5b02328

[12]. Sun, Y. & Xia, Y. (2002). Shape-controlled synthesis of gold and silver nanoparticles". *Science*. 298(5601), 2176–2179. doi:10.1126/science.1077229

[13]. Buzea, C., Pacheco, I. I. & Robbie, K. (2007). Nanomaterials and nanoparticles: Sources and toxicity. *Biointerphases*. 2(4), MR17–MR71. doi:10.1116/1.2815690

[14]. Hemeda, O. M., Tawfik, A., Mostafa, M., Zaki, M & Ati, M. I. A. E. (2018). Structural and Magnetic Properties of Nano Ferrite for Magnetoelectric Applications. *Journal of Physics: Conference Series*. Volume 1253, The First International Conference on Particles, Materials and Energy: Advanced Medical and Industrial Applications, 2–6 December 2018, Luxor, Egypt.

[15]. Faraz, A., Maqsood, A. & Ahmad, N. M. (2012) Structural and electrical properties of magnetic ceramics of $Co_{1-x}Cu_xFe_2O_4$ spinel nanoferrites, *Advances in Applied Ceramics*, 111(4), 228-236.

[16]. Buffat, P. & Borel, J. P. (1976). Size effect on the melting temperature of gold particles. *Physical Review A*. 13(6), 2287–2298. doi:10.1103/PhysRevA.13.2287

[17]. Gubin, S. P. (2009). Magnetic nanoparticles. Wiley-VCH. ISBN 978-3-527-40790-3.

[18]. Tadic, M., Kralj, S., Jagodic, M., Hanzel, D. & Makovec, Darko (2014). Magnetic properties of novel superparamagnetic iron oxide nanoclusters and their peculiarity under annealing treatment. *Applied Surface Science*. 322, 255–264. doi:10.1016/j.apsusc.2014.09.181

[19]. Lu, A. H., Salabas, E. L. & Schüth, F. (2007). Magnetic Nanoparticles: Synthesis, Protection, Functionalization, and Application. *Angewandte Chemie International Edition*. 46(8), 1222–1244. doi:10.1002/anie.200602866

[20]. Bossmann, S. H. & Wang, H. (2017) Magnetic Nanomaterials. Royal Society of Chemistry, Cambridge.

[21]. Thakur, P., Chahar, D., Taneja, S., Bhalla, N., & Thakur, A. (2020). A review on MnZn ferrites: Synthesis, characterization and applications. *Ceramics International, 46*, 15740 - 15763. DOI:10.1016/j.ceramint.2020.03.287

[22]. Zaka, U. Shahid, A. & Shahzad, N. (2013). Influence of Pb doping on structural, electrical and magnetic properties of Sr-hexaferrites. *Journal of Alloys and Compounds*. 555, 263–267. doi: 10.1016/j.jallcom.2012.12.061

[23]. Hosni, N. (2016). Semi-hard magnetic properties of nanoparticles of cobalt ferrite synthesized by the coprecipitation process. *Journal of Alloys and Compounds*. 694, 1295–1301. doi: 10.1016/j.jallcom.2016.09.252

[24]. https://idealmagnetsolutions.com/knowledge-base/understanding-coercivity/

[25]. Gupta, A. K. & Gupta, M. (2005). Synthesis and surface engineering of iron oxide nanoparticles for biomedical applications. *Biomaterials*. 26(18), 3995–4021. doi:10.1016/j.biomaterials.2004.10.012

[26]. Mornet, S., Vasseur, S., Grasset, F., Veverka, P., Goglio, G., Demourgues, A., Portier, J., Pollert, E. & Duguet, E. (2006). Magnetic nanoparticle design for medical applications. *Progress in Solid State Chemistry*. 34(2–4), 237–247. doi:10.1016/j.progsolidstchem.2005.11.010

[27]. Chaudhary, V., Wang, Z., Ray, A., Sridhar, I. & Ramanujan, R. V. (2017). Self pumping magnetic cooling. *Journal of Physics D: Applied Physics*. 50(3), 03LT03. Bibcode:2017JPhD...50cLT03C

[28]. Bharti, M. K., Gupta, S., Chalia, S., Garg, I., Thakur, P. & Thakur, A. (*In Press*). Potential of Magnetic Nanoferrites in Removal of Heavy Metals from Contaminated Water: Mini Review. *Journal of Superconductivity and Novel Magnetism*.

[29]. Thakur, P., Taneja, S., Sindhu, D., Lüders, U., Sharma, A., Ravelo, B. & Thakur, A. (2020). Manganese Zinc Ferrites: a Short Review on Synthesis and Characterization. *Journal of Superconductivity and Novel Magnetism.* 33, 1569–1584. https://doi.org/10.1007/s10948-020-05489-z

[30]. Hyeon, T. (2003). Chemical synthesis of magnetic nanoparticles. *Chemical Communications.* (8), 927–934. doi:10.1039/B207789B

[31]. Whitesides, G.M., Mathias, J. P. & Seto, C. T. (1991). Molecular Self-Assembly and Nanochemistry: A Chemical Strategy for the Synthesis of Nanostructures. *Science*. 254(5036), 1312–1319. DOI: 10.1126/science.1962191

[32]. Nikam, A. V., Prasad, B. L. V. & Kulkarni, A. A. (2018). Wet chemical synthesis of metal oxide nanoparticles: a review. *CrystEngComm*. 20, 5091-5107. https://doi.org/10.1039/C8CE00487K

[33]. Parashar, M., Shukla, V. K. & Singh, R. (2020). Metal oxides nanoparticles via sol–gel method: a review on synthesis, characterization and applications. *Journal of Materials Science: Materials in Electronics.* 31, 3729–3749. https://doi.org/10.1007/s10854-020-02994-8

[34]. Ramesh, S. & Das, B. B. (2012). Sol-gel synthesis, structural and characterization of Ag-Gd-Ti-O nanocomposites, *Asian Journal of Chemistry*, 24, 5543–5545.

[35]. Silva, J. B. & Mohallem, N. D. S. (2010). Nanocomposites based on nickel ferrites dispersed in sol-gel silica matrices. *Journal of Sol-Gel Science and Technology*, 55(2), 159–169. https://doi.org/10.1007/s10971-010-2228-3

[36]. Khirade, P. P. (2019). Structural, microstructural and magnetic properties of sol–gel-synthesized novel BaZrO$_3$–CoFe$_2$O$_4$ nanocomposite. *Journal of Nanostructure in Chemistry*. 9, 163–173. https://doi.org/10.1007/s40097-019-0307-8

[37]. Raut, A. V., Barkule, R., Shengule, D. & Jadhav, K. (2014). Synthesis, structural investigation and magnetic properties of Zn^{2+} substituted cobalt ferrite nanoparticles prepared by the sol–gel auto-combustion technique. *Journal of Magnetism and Magnetic Materials.* 358, 87–92. https://doi.org/10.1016/j.jmmm.2014.01.039

[38]. Toksha, B., Shirsath, S. E., Patange, S. & Jadhav, K. (2008). Structural investigations and magnetic properties of cobalt ferrite nanoparticles prepared by sol–gel auto combustion method. *Solid State Communications.* 147, 479–483. https://doi.org/10.1016/j.ssc.2008.06.040

[39]. Tabatabai, S., Iranmanesh, P., Saeednia, S. & Mehran, M. (2019). Structural, optical and magnetic properties

49

of MnxFe3-xO4 nanoferrites synthesized by a simple capping agent-free coprecipitation route. *Materials Science and Engineering B*. 245, 55-62. 10.1016/j.mseb.2019.05.009.

[40]. Iranmanesh, P., Saeednia, S., Mehran, M. & Rashidi Dafeh, S. (2016). Modified structural and magnetic properties of nanocrystalline MnFe2O4 by pH in capping agent free coprecipitation method. *Journal of Magnetism and Magnetic Materials*. 425, 31-36. 10.1016/j.jmmm.2016.10.105.

[41]. Maqsood, A. & Faraz, A. (2012). Synthesis, Structural, Electrical and Magnetic Characterization of $Mn_{0.5}Mg_{0.5-x}Ni_xFe_2O_4$ Spinel Nanoferrites. *Journal of Superconductivity and Novel Magnetism.* 25, 1025–1033 (2012). https://doi.org/10.1007/s10948-011-1343-x

[42]. Naseri, M. G., Saion, E. B., Ahangar, H. A., Shaari, A. H. & Hashim, M. (2010). Simple Synthesis and Characterization of Cobalt Ferrite Nanoparticles by a Thermal Treatment Method, *Journal of Nanomaterials*, vol. 2010, Article ID 907686, 8 pages. https://doi.org/10.1155/2010/907686

[43]. Daoush, W. M. (2017). Coprecipitation and Magnetic Properties of Magnetite Nanoparticles for Potential Biomedical Applications. *Journal of Nanomedicine Research*. 5(3), 00118. DOI: 10.15406/jnmr.2017.05.00118

[44]. Ebirahmi, M., Shahraki, R. R., Ebirahimi, S. A. S. & Masoudpanah, S. M. (2014). Magnetic Properties of Zinc Ferrite Nanoparticles Synthesized by Coprecipitation Method, *Journal of Superconductivity and Novel Magnetism.* 27(6), 1587-92. 10.1007/s10948-014-2485-4

[45]. Thirupathi, G. & Singh, R. (2012). Magnetic Properties of Zinc Ferrite Nanoparticles. *IEEE Transactions on Magnetics*, 48(11), 3630-3633. doi: 10.1109/TMAG.2012.2199475.

50

Major Boost in 3d-modeling: Solidworks & CATIA Evolution in Aerospace and Automotive Sectors

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Abstract: This research paper mainly focuses about the evolution in Aerospace & Automotive Industries. It shows that with time how the development of 3D-modeling software enhances the operations of these sectors. Basically, this paper consists a comparison between the two modern and latest 3D modeling software, i.e., Solidworks and CATIA. The authors have tried to highlight the differences along with the individual advantages that both the software provides in the two mentioned domains of Aerospace and Automotive Design. The software have been in use for quite a long time now, still a battle between these software goes on as to decide which one is better amongst others. The paper tries to provide a better understanding to the reader for these softwares by presenting different designs and solid modeled examples.

Introduction

Solidworks and CATIA, both are the computer-aided design software. They were developed by the Dassault Systems. It is a French multi-national software company that develops 3D designs and was founded by 'MARCEL DASSAULT' in 1981. [1]

CATIA was first released in 1977. It is Product Lifecycle Management software which meant it manages data during product development. This improves productivity and work flow. CATIA is very powerful 3D modeling software; it is dominating in Automotives, Aerospace and Aeronautical industry. With CATIA, one can design aircraft, car, and other complex products. This is mainly used by professional and engineers especially for large enterprises like Boeing, Dassault Aviation, Tesla, Audi, Mahindra, TATA Motors Limited.

Solidworks was first released in 1993.[2] It is parametric 3D modeling software meaning it operates on dimension values, when the dimensions are modified, the 3D model changes its shape automatically. It provides a full range of modeling, simulation, visualization, consumer products and validation tools that product designers need to develop better products and at low cost. Solidworks is very popular in product design, machinery design, and medical industry. It is also taught at mechanical and aerospace institute for educational purposes.

Contribution in the Evolution by CATIA

Earlier, before the CAD software arrived, the full-scale model or the prototype of the actual model was being created by the engineers on their own, which becomes very difficult for them, as it requires more time, more efforts and this method is way too much costly. [2] Each and every component was handmade by the engineers. The material used for making these full-scale models was usually wood. But when it comes to the final analysis or the final testing, the model sometime fails and won't give the efficient and accurate results because of the imperfection in design of the component. [3]

Figure 1 shows the various researchers and soldiers inspecting the crashed aircraft. During such times, the software were not in use and the changes or the maintenance and repair can only be done after looking on the damages parts. While in the current scenario, the presence of different modeling and analysis software help the researchers to analyze over different damaged parts sitting in the office and working on the systems. The software predicts whether the designed system will work or it will fail. If the model fails then the effort, time and money gets wasted and the whole process would have to start from the beginning. Such difficulties made the researchers or engineers to think of the better possibility to do the final analysis or testing of their model. And this gives the rise to the CAD software. This give rise to some software that deals with 3D modeling and CATIA was one of them.

CATIA gives flexibility to the engineer to create any component and then assemble those components and then run the simulation to see whether the components are working according to their position and then we do the analysis of the whole model, so the time and efforts contribution is less than the traditional way. In 2007 SpaceClaim, an innovative history-free direct-modeling 3D CAD, was released. In late 2000s, reacting to the SpaceClaim innovation, feature-based CAD developers start integrating direct modeling function in their product. In 2008 NX and SolidEdge

51

integrate a new tool called Synchronous Technology and SolidWorks proposes Instant 3D. Also CATIA V6, released in 2008, allows direct editing. In 2009 Autodesk launched its Inventor Fusion Technology. It is the age of hybrid CAD systems. [5]
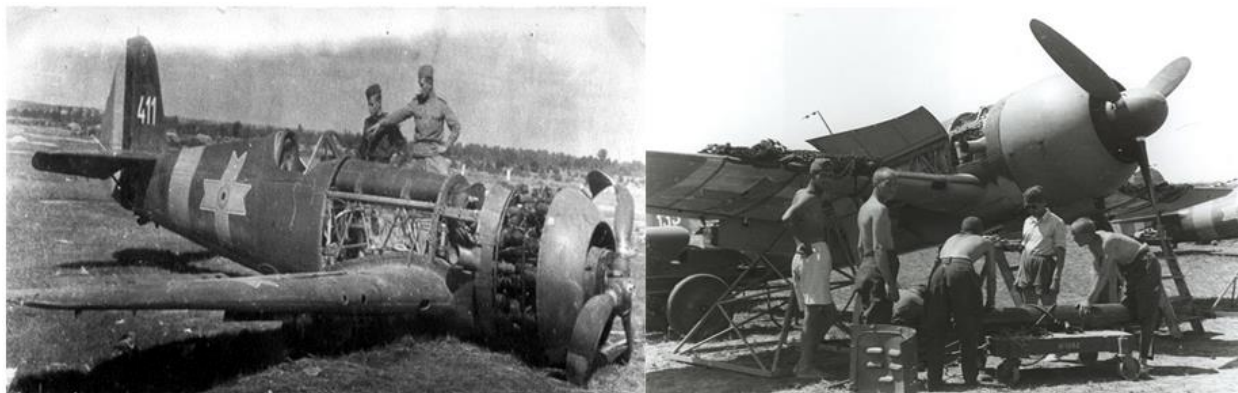
Figure 1. Researchers doing Analysis in earlier times [3-4]
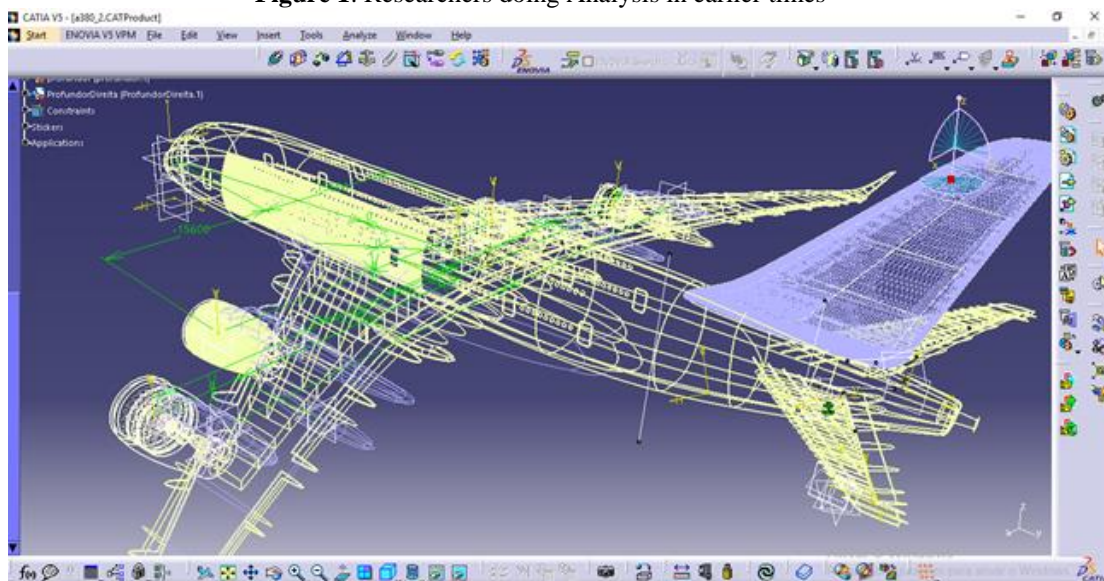
Figure 2. Modeling using CATIA [6]

Figure 2 and 3 shows the different stages of the CATIA software in which figure 2 shows the 3D modeling phase of an airbus A380 aircraft while figure 3 shows the structural analysis of the same airbus A380 aircraft using the advanced CAD modeling software CATIA. Both these figures have been adapted from the webpage of AIRBUS student projects for design and analysis. [6]

Advancement in Evolution by Solidworks
The need to create the alternative software is to reduce the complexity of operation's execution in CATIA. [7] CATIA is much more complex and has less user-friendly interface. Number of operations to create any model is much higher due to this, the time consumed of these operations is much higher, that's why, the need for such type of software existed. Solidworks is capable of creating the same model with much ease. [8-9]

Figure 4 shows an air-piston cylinder engine which was designed by the authors using Solidworks software. During the designing of the same project in both the softwares, we found certain similarities and dissimilarities as well. Solidworks came out to be easier and less complex than CATIA. Also, the modeling time was less in Solidworks than

that in CATIA. On the other hand, CATIA makes surface modeling in a far better and easier way than Solidworks. When the analysis was carried out, CATIA was found to be more useful than Solidworks although the values obtained were of the similar range but the contours obtained from the later were not descriptive.
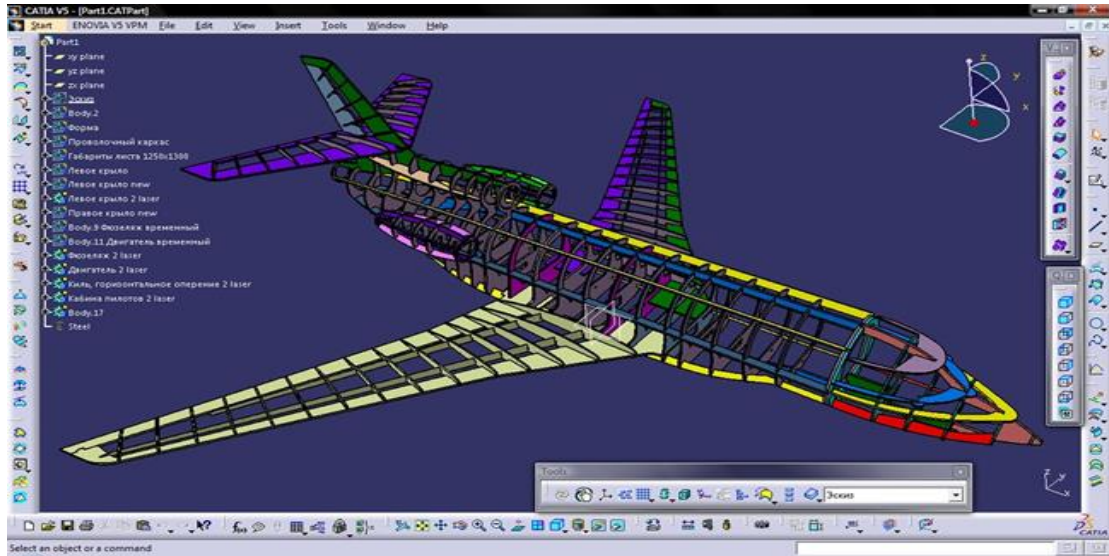
Figure 3. Analysis using CATIA [6]
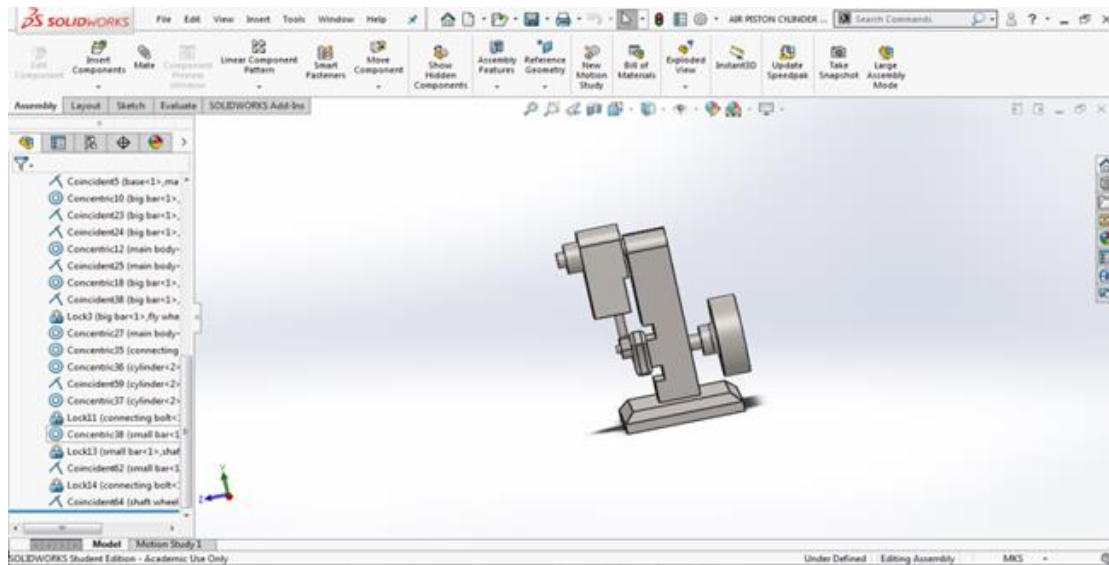
Figure 4. Air-Piston Cylinder Engine model in Solidworks

CATIA Vs Solidworks: Let the Battle Begins!!!

After completing the project using both the softwares, several observations made have been written down and presented in the Table 1 below. Although both the softwares solve the purpose of designing, modeling and analysis, still one software proves to be better in solving one purpose or the other. The observations are solely based on the project types and belong to the perception of the authors. The readers should not make opinions just by reading the texts in the paper. They are advised to try a hand on both the softwares and then make their own choices.

53

Table 1. Comparison of both the softwares based on the project work conducted

CATIA	Solidworks
It is surface modeling software.	It is solid modeling software.
Great for highly complex projects with large assemblies, such as aircraft or ships.	More suited to comparatively smaller projects, such as consumer products and machinery.
Difficult to learn for educational purpose.	Much easier to learn for educational purpose.
Recommended for analysis.	Not recommended for analysis.
Collaboration features include 2D to 3D CAD Conversion, 3D Printing, and 3D Viewing Tools.[10]	Collaboration features include only 3D Viewing Tools.[10]

Conclusion
- After analyzing all the aspects of software, CATIA is considered to be better than Solidworks, but CATIA also has limitations.
- As both CATIA and Solidworks are powerful CAD software, but for different needs.
- The choice depends on which sector the researcher is working in and on what project.

References
[1] Li, L., Zheng, Y., Yang, M., Leng, J., Cheng, Z., Xie, Y., ... & Ma, Y. (2020). A survey of feature modeling methods: Historical evolution and new development. *Robotics and Computer-Integrated Manufacturing*, *61*, 101851.
[2] Solidworks 2019 Reference Guide by David C. Planchard, CSWP & CATIA V5-6R2018 for designer, 16th Edition by Prof. Sham Tickoo Purdue
[3] Luliusbidalach (2014, Mar 4) Russian soldiers inspecting a crash landed IAR-81C. Retrieved from http://commons.wikimedia.org/wiki/File:IAR-80-4.jpg
[4] Christ (2017, Nov 9) International Tech Tree – Speculations. Retrieved from https://forum.warthunder.com/index.php?/topic/387778-international-tech-tree-speculations/
[5] Liu, J., & To, A. C. (2020). Computer-Aided Design-Based Topology Optimization System with Dynamic Feature Shape and Modeling History Evolution. *Journal of Mechanical Design*, *142*(7).
[6] Airbus (2018, May 15) Airbus A380 UNIVERSIDADE FEDERAL DE ITAJUBÁ – UNIFEI. Retrieved from https://edu.3ds.com/en/projects/airbus-a380
[7] Tornincasa, S., & Di Monaco, F. (2010, September). The future and the evolution of CAD. In *Proceedings of the 14th international research/expert conference: trends in the development of machinery and associated technology* (Vol. 1, No. 1, pp. 11-18).
[8] Barr, R. E., & Juricic, D. (1994). From drafting to modern design representation: The evolution of engineering design graphics. *Journal of Engineering Education*, *83*(3), 263-270.
[9] Chandrasegaran, S. K., Ramani, K., Sriram, R. D., Horváth, I., Bernard, A., Harik, R. F., & Gao, W. (2013). The evolution, challenges, and future of knowledge representation in product design systems. *Computer-aided design*, *45*(2), 204-228.
[10] Yadav, M., Misra, A., Malhotra, A., & Kumar, N. (2020). Design and analysis of a high-pressure turbine blade in a jet engine using advanced materials. *Materials Today: Proceedings*, *25*, 639-645.

Numerical Simulations on Aluminium Based Fibre Reinforced Hybrid Composites

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Abstract: This research paper reports the preparation, mechanical properties, structural properties and analysis of aluminium based fibre reinforced hybrid composites having different orientations. Combination of ANSYS Composite PrepPost (ACP) and Static Structural tools are used for modelling the composite sandwich and also for performing various destructive tests (tensile test, bending test and torsion test). Grid independence test was performed on six different meshes. Epoxy/E-glass fibre and aluminium-1145 alloy foil were selected and modelled individually at three different orientations i.e. 0°, 45° and (0-90°). The sandwich layer constituted of E-glass/Aluminium/E-glass, respectively. Further, a comparison of various mechanical properties and structural properties is made based on different orientations. The sample at 0° orientation gives higher strength, lower stresses and comparatively fewer deformations in the majority of tests whereas, in few tests, the samples at 0-90° and 45° orientations exhibit lower stresses and higher strength.

Keywords: ANSYS ACP; Static Structural; MFRP; Composite Orientations; Aluminium-1145 Alloy; Computational Analysis.

Introduction
Aluminium is the most abundant metal on planet Earth. Aluminium foil is a very thin sheet of aluminium extending from about 0.006 mm to 0.2 mm as stated by ISO. Aluminium foils are used for various applications such as flexible packaging, foil containers, lidding foils, household foil, heat exchanger foil, laminations for heat insulation materials, etc. being light yet strong, aluminium foil has unique dead fold characteristics which makes it ideal for wrapping and re-wrapping many different products and product shapes. When pressed into a shaped dish, the aluminium foil memorises its shape, particularly where the folds and rims occur. Because of its malleable property, it can be easily deformed without losing its barrier integrity, making it an ideal material for use in households [1]. Shape, thickness and temper can be designated to get the performance exactly as per the required applications. The mechanical properties of the composites are greatly influenced by the glass fibres. Yield stress, tensile stress and shear stress are higher for Metal & Fibre Reinforced Polymer (MFRP) compared to Fibre Reinforced Polymer (FRP) and metal laminates at equivalent loads [2]. Based on different applications, composites can be moulded at different orientations. Fibre orientation plays an important role in enhancing the strength of composites depending on the required application. As the structural properties as well as mechanical behaviour of composites changes with varying orientation, it becomes very important to analyse the strength of composite on various orientations of fibre layers for a given application [3,4].

The present research is focussed on aluminium because as per 2015 record, 1.8 million tons of aluminium packaging was produced out of which 670,000 tons (54.9%) were recycled, 50.6 per cent were landfilled and rest were combusted with energy recovery. Landfilled materials mean materials that are kept in an open field and are allowed to decompose by rusting or by other sources. Aluminium is the most widely used metal on earth providing higher strength at a low cost. Hence, those aluminium metals which are landfilled can be utilized as reinforcements when combined with different fibres like glass, Kevlar or carbon fibres and moulded into hybrid composites. Therefore, the present study aims to assess and evaluate the behaviour of aluminium composites when oriented at different angles. To achieve the same, numerical simulations on designed composite samples are performed on ANSYS workbench [5,6].

Materials and Method
For the present study, all the computational work namely geometries, models and analysis work are performed using ANSYS software. FEA or CFD package such as ANSYS can solve problems that are not amenable to an analytical approach. Geometries and models are prepared in ANSYS Composite PrepPost (ACP) tool whereas, the results are obtained through the Static Structural tool [7,8,9].

Materials and geometry

Aluminium alloy (A1145) foil of 0.2 mm thickness and epoxy E-glass fibre of 0.3 mm thickness is taken for simulations. A 2-D shell geometry is created in SpaceClaim in ANSYS ACP (Pre) with dimensions as 125 mm x 25 mm (after neglecting the 25 mm length on both ends which are used for clamping) to provide the shape of model. These dimensions are taken according to ASTM D-368 series composite specimen Standards i.e. 175 mm x 25 mm [10,11,12].

Modelling
Assignment of materials and individual ply thickness of the laminate are inserted in ACP (Pre) and a 3-D laminate model is created. The total thickness comes out to be 0.3 mm + 0.2 mm + 0.3 mm = 0.8 mm. A total of 3 samples are prepared at three different orientations with the laminate arrangements as represented in Table 1. The base ply and top ply were oriented at three different angles 0°, 45° and 90°. As mechanical properties are decided by the chemical composition and internal structure, hence, mechanical properties are calculated by ANSYS ACP (Pre) Multi-Physics modal automatically using various physics and chemistry modals as is represented in Table 2 [13,14].

Table 1. Laminate Arrangement

Base ply	Mid ply	Top ply
Epoxy E-glass	Aluminium-1145 alloy foil	Epoxy E-glass

Table 2. Ply Orientations and Mechanical Properties

Orientation			Mechanical properties		
Sample No.	Base ply	Top ply	Flexural stiffness (E1) (MPa)	Flexural stiffness (E2) (MPa)	Shear stiffness (MPa)
1	0°	0°	45407.25	11037.14	10422.93
2	45°	45°	13958.19	13958.19	14248.28
3	0°	90°	28461.54	28461.54	10422.93

Tests were conducted for both the cantilever beam and simply supported beam arrangements. A total of three tests were conducted for each prepared sample i.e. bending test, tensile test and torsion test on different orientations using six different meshes. The specification of these six meshes are given as follows:
1. Element size 0.4 mm + refined (definition 1)
2. Element size 0.6 mm + refined (definition 1)
3. Element size 0.8 mm + refined (definition 1)
4. Element size 1 mm + refined (definition 1)
5. Refined (definition 2)
6. Refined (definition 3)

From element size 0.8 mm + refined (definition 1) onwards, the results converge and hence the grid independency test is verified. The output parameters are taken based on the most common structural applications i.e. 1) Total deformation, 2) Equivalent stress, 3) Normal stress, and 4) Shear stress.

Results and Discussion

Bending test
Varying vertical loads from 1 N to 10 N are applied on top surfaces of both the cantilever and simply supported laminates. Bending test is followed by; 1) UDL on cantilever laminate, 2) UDL on simply supported laminate, 3) Remote force just before the end of cantilever laminate, and 4) Remote force in the middle of simply supported laminate. From Figure 1, it can be observed that at 0° orientation the deflection, equivalent stress and shear stress are least, whereas, normal stress is observed to be least at 90° orientation when a uniformly distributed load is applied at just before another end of cantilever laminate. At 45°, the deflection and all the stresses are highest. Also, there is an immense difference between shear stress at 45° compared to other orientations. Whereas, at 0-90° orientation the deflection, equivalent stress and shear stress falls in between 0° and 45°. This makes 0° orientation better than others. From Figure 2, it can be observed that at 0° orientation the deflection, equivalent stress and shear stress are least, whereas, normal stress is observed to be least at 90° orientation when a remote force is applied at just before another end of cantilever laminate. At 45°, the deflection and all the stresses are highest. Also, there is a great difference

56

between shear stress at 45° compared to other orientations. Whereas, at 0-90° orientation the deflection, equivalent stress and shear stress is observed in between 0° and 45°. Also, at 90° and 45° orientations, the composites are observed to be damaged much earlier than at 0° orientation. Hence 0° orientation results better than other orientations.
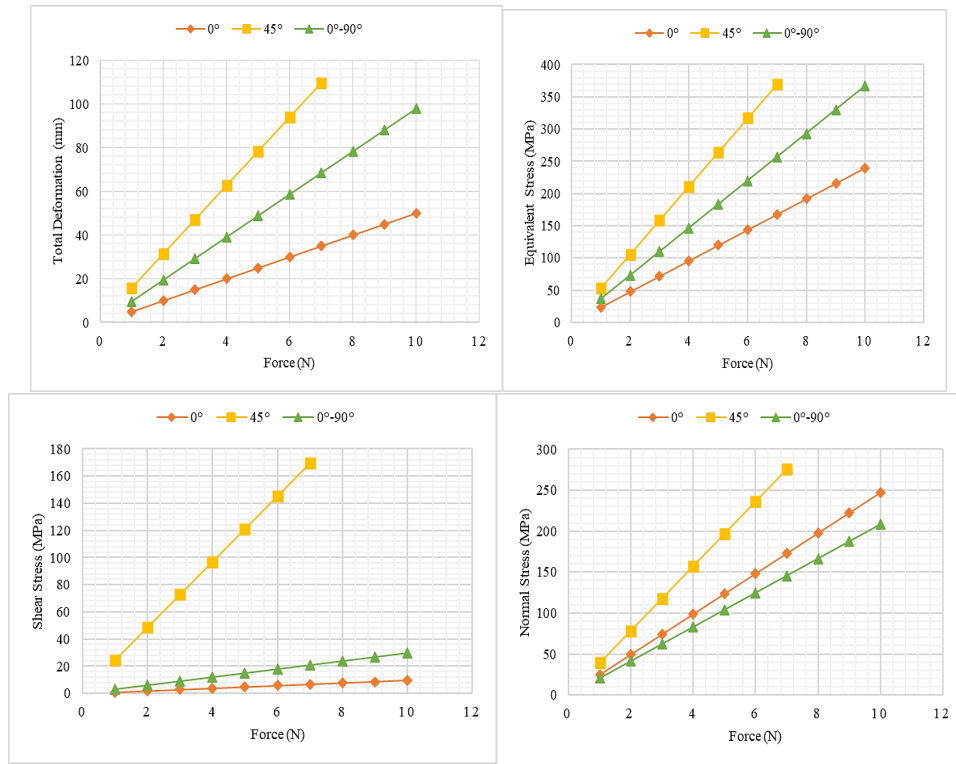
Figure 1. UDL on cantilever laminate at different orientations
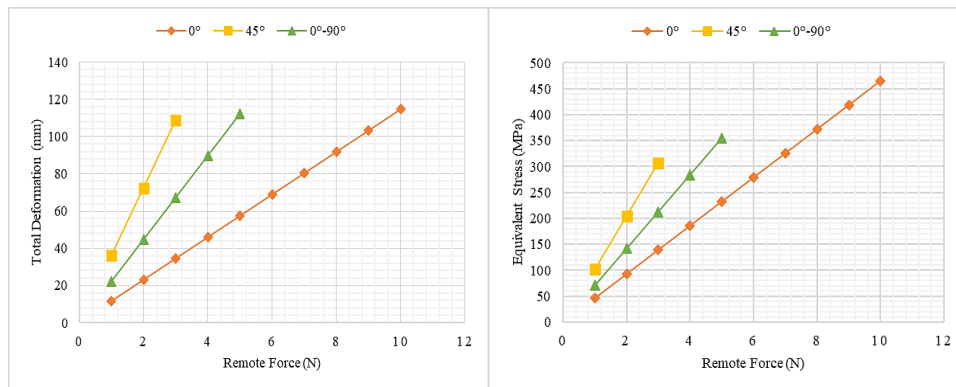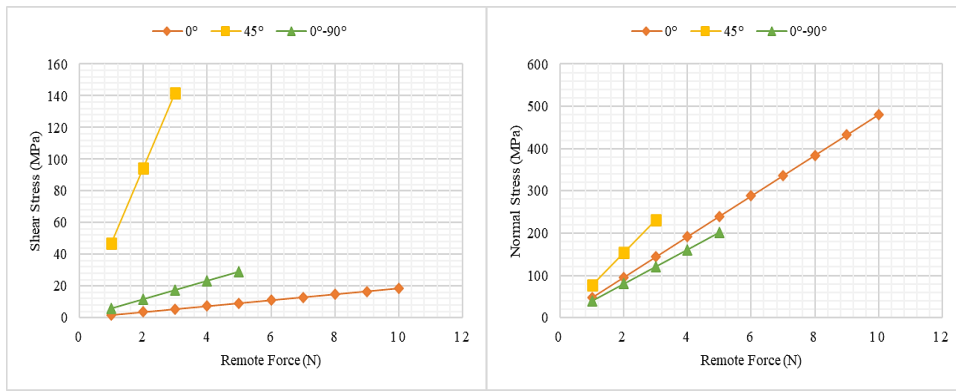
Figure 2. Remote force on cantilever laminate at different orientations
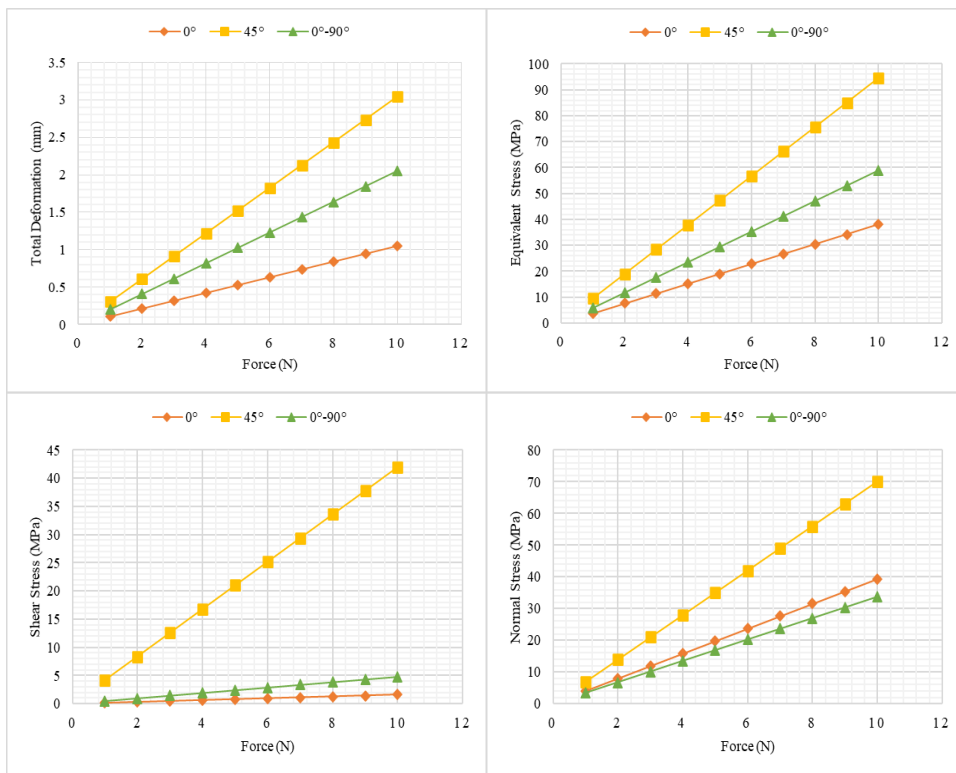
Figure 3. Remote force and UDL on simply supported laminate at different orientations

58
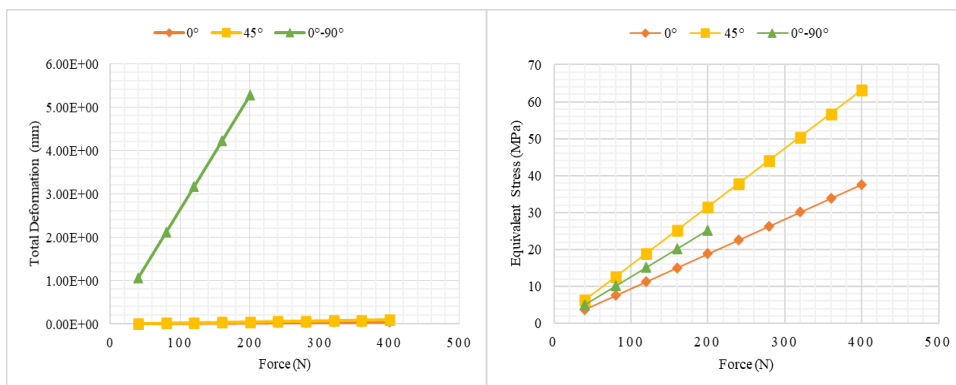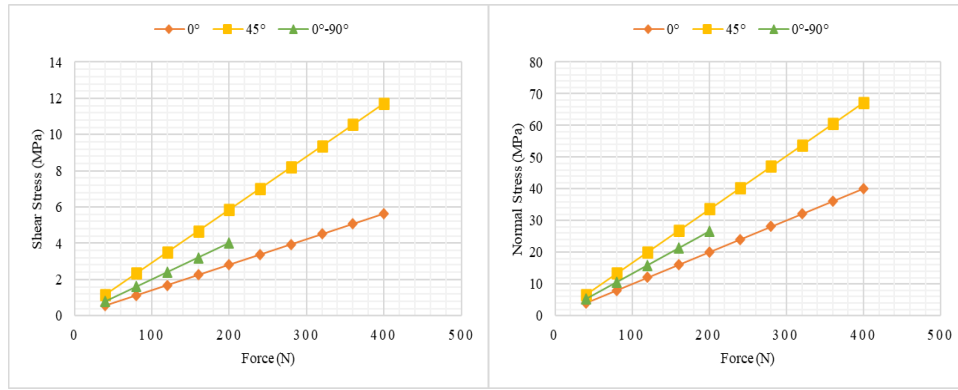
Figure 4. Tensile force on cantilever laminate at different orientations
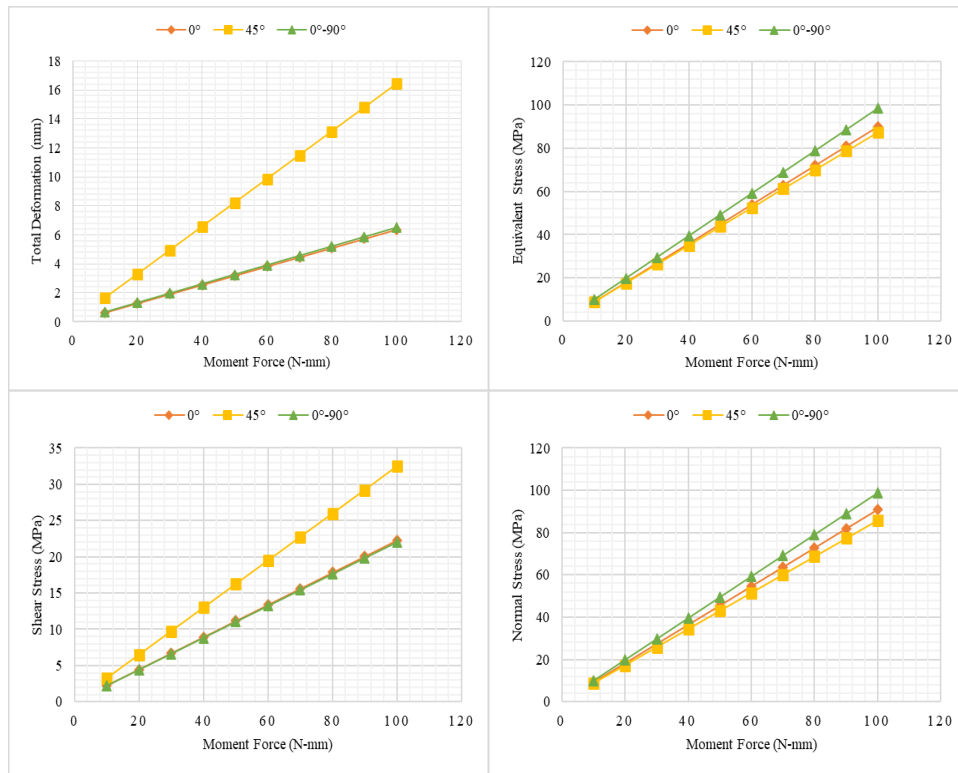
Figure 5. Tensile force on cantilever laminate at different orientations

When a remote force is applied at the centre of simply supported laminate and when a uniformly distributed load is applied on simply supported laminate, the results are observed to be equal which is shown in Figure 3. It can be observed that at 0° orientation the deflection, equivalent stress and shear stress are least, whereas, normal stress is observed to be least at 90° orientation. At 45°, the deflection and all the stresses are highest. Also, there is an immense difference between shear stress at 45° compared to other orientations. Whereas, at 0-90° orientation the deflection, equivalent stress and shear stress falls in between 0° and 45°. Again 0° orientation grades better than other orientations.

Tensile test

A varying tensile force from 40 N to 400 N with an interval of 40 N was applied on the cantilever laminate. From figure 4. it is observed that at 0° orientation the deflection, all the stresses are least when a tensile force is applied on the cantilever laminate. At 45°, the deformation is observed much lesser (almost equal to 0°) but all the stresses are highest. Also, there is a great difference between total deformation at 0-90° as compared to other orientations.

Whereas, at 0-90° orientation all the stresses are observed between 0° and 45°. Also, at 0-90° orientation, the composites are observed to be damaged much earlier than at 0° and 45° orientations. Hence, 0° orientation grades better than other orientations.

Torsion test

The varying moment force from 10 N-mm to 100 N-mm with an interval of 10 N is applied on the cantilever laminate. From Figure 5, it can be observed that at 0° orientation the deflection is least and it is almost equal to 0-90° orientation when moment force is applied at the other end of cantilever laminate. At 45°, the deflection and the shear stress are highest but equivalent stress and normal stress are the least. Also, shear stress at 0-90° is observed to be minimum and it is almost equal to 0° orientation. Whereas, at 0-90°, equivalent stress and normal stress are maximum. At 0° orientation, all the stresses are observed to fall in between 45° and 0-90°. Again, 0° orientation grades better than other orientations.

Conclusion

From all the results combined, it can be concluded that when the aluminium composite is used as cantilever application or simply supported application, then its mechanical properties at 0° orientation along the fibre direction gave better strength as compared to 45° and 90° orientations. Whereas the least strength is observed at 45°. Aluminium composites came up with higher strength at 0° as compared to other orientations when a tensile force is applied to it. However, the deformation at 90° orientation is higher and earlier than 0° and 45°. Also, typical behaviour in mechanical properties is observed when moment force is applied to it. Taking deformation and all the stresses in context, composites at 0° gives better strength.

However, for a ply which is fixed at three ends, a combination of 0° and 90° results in better strength than complete 0° or 45° orientations. Therefore, due to the changing mechanical and structural behaviour because of change in orientation, it becomes very imperative to test the fibre orientations at various angles which could be adopted according to the required application.

References

[11] Thornton, H. R. (1968). Fabrication of Metal Matrix Composite Materials, Department of Mechanical Engineering Texas A & M University-College Station, Texas; J composite materials, volume 2, no.1.

[12] Eskandari, S., Pires, F. M. A., Camanho, P. P., Cui, H., Petrinic, N., & Marques, A. T. (2019). Analysing the failure and damage of FRP composite laminates under high strain rates considering visco-plasticity. Engineering Failure Analysis, 101, 257-273.

[13] Sangamesh, K. S. & Kulkarni, S. M. (2018). Impact analysis of natural fibre and synthetic fibre-reinforced polymer composite. In AIP Conference Proceedings (Vol. 1953, No. 1, p. 130003). AIP Publishing LLC.

[14] Banakar, P., Shivananda, H. K., & Niranjan, H. B. (2012). Influence of fibre orientation and thickness on tensile properties of laminated polymer composites. *International Journal of Pure and Applied Sciences and Technology*, *9*(1), 61.

[15] Sandeep, M. B., Chaudhary, D., Inamdar, M. N., & Rahaman, M. Q. (2014). Experimental study of the effect of fibre orientation on the flexural strength of glass/epoxy composite material. *International Journal of Research in Engineering and Technology*, *3*(09).

[16] Buchnolz, F. G., Rikards, R. & Wang, H. (1997). Computation analysis of interlaminar fracture of laminated composites. International journal of fracture, 86(1-2), pp.37-57.

[17] Santiuste, C., Barbero, E. & Henar Miguelez, M. (2011). Computational analysis of temperature effect in composite bolted joints for aeronautical applications. Journal of reinforced plastics and composites, 30(1), pp.3-11.

[18] Keshavamurthy, Y. C., Sharma, D. R. S., & Kulkarni, D. R. (2012). Investigation of Tensile Properties of Fiber Reinforced Angle Ply laminated composites. *International Journal of Emerging Technology and Advanced Engineering*, *2*(4), 700-703.

[19] Xiong, W., Blackman, B., Dear, J. P., & Wang, X. (2015). The effect of composite orientation on the mechanical properties of hybrid joints strengthened by surfi-sculpt. Composite Structures, 134, 587-592.

[20] Falcó, O., Ávila, R. L., Tijs, B., & Lopes, C. S. (2018). Modelling and simulation methodology for unidirectional composite laminates in a Virtual Test Lab framework. Composite Structures, 190, 137-159.

[21] Shi, Y. & Falk, M.L. (2008). A computational analysis of the deformation mechanisms of a nanocrystal–metallic glass composite. Acta materialia, 56(5), pp.995-1000.

[22] Kaleemulla, K. M. & Siddeswarappa, B. (2009). influence of fibre orientation on the in-plane mechanical

60

properties of laminated hybrid polymer composites, Journal of reinforced plastics and composites 2010, vol. 29, no. 12/2010: 1900–15

[23] Mittelman, A. and Roman, I. (1990). Tensile properties of real unidirectional Kevlar/epoxy composites. Composites, 21(1), pp.63-69.

[24] Pawar, S. D., & Utpat, A. (2014). Analysis of composite laminate for maximum stiffness. International Journal of Recent Technology and Engineering (IJRTE) ISSN, 2277-3878.

Advanced Composite Materials: Methodology for Hybridization of Graphene and Natural Silk Reinforced Epoxy Composites

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Abstract: Composites have made deep penetrations into the wind turbines and aircraft structural applications. There is growing need for advanced composite materials in terms of light weight with high strength and high stiffness. Several ongoing researches on graphene and natural silk being used as individual reinforcements in the epoxy composites have shown significant positive results. The novel concept of hybridization of graphene and natural silk fiber as combined reinforcement materials for development of high-performance epoxy composite material is under the study. This paper discusses the suitable methodology for introducing the graphene and natural silk as a combined reinforcement medium in epoxy resin matrix. The optimum volume fraction to promote a substantial advancement in terms of the mechanical properties of the epoxy resin composites will be also discussed

Keywords: Graphene, Natural Silk, Epoxy composites, Advanced Composite Materials

Introduction

Multifunctional composites have made notable impact by providing the means to reduce the material weight which not only reduces the operational costs but also reduces the fuel consumption in aircrafts and improves the power curve in case of wind turbines. There is directed demand for applied research for advanced composite materials for wind turbine blades and aircraft wings with superior characteristics in terms of economically light weight-high strength, longer lifecycle, and higher operational performance.

Epoxy resin is used as the dominant matrix composite material vastly due to its characteristic properties – High amenability with dimensional stability, good adhesion, chemical resistance, higher temperature extreme tolerance, high strength to weight ratio, low moisture absorption along with fair mechanical properties at low cost [1-2]. However, due to its inherent brittleness, delamination, high cross-link density and low fracture toughness has limited its usage for structural component applications. Epoxy resin are compatible with all common reinforcements to enhance its impact strength and toughness.

Graphene is a single layer of carbon atoms into a 2D honeycomb lattice packing with sp2 bonds. Graphene is very light (0.77 mg per m^2),very flexible, and still has an excellent tensile strength of 130 GPa. This makes it has an excellent reinforcement material for the polymer composites. Graphene's higher specific surface area enables graphene to get disperse into the matrix without any surface modifications [3].The mechanical and chemical properties of the matrix material become superior upon addition of the graphene. This leads to the enhancement in strength and bonding between the graphene and matrix material [4]**.** Graphene fillers in the epoxy resin matrix increases the impact strength and toughness [5]. Further, graphene improves the fire retardant for epoxy resin matrix which is very vital for various industrial applications [6].

Silk is a natural protein fibre and is one of the strongest natural fibres. Silk have lower density (1.3×10^3 Kgm^{-3}), higher tensile strength (650-750 MPa), higher breaking energy (60 to 80 MJm^{-3}), good elasticity, and excellent resilience. Silk as reinforcement filler improves the tensile and bending strength of epoxy composites [7]. Further, usage of natural fibre in composites provides option for biodegradable and bio-derived products.

Several ongoing researches on graphene and natural silk being used as individual reinforcements in the epoxy composites have shown significant positive results. The work under study explores the novel concept for successful integration of resilient and tough natural silk and strong and stiff graphene together as reinforcement filler for epoxy resin composites for custom-built mechanical properties[8, 9] The work under study, based on the detailed review, expects that integration of tough natural silk and strong graphene could harmonize to fabricate advanced composite materials with enhanced properties fit for wider scope of structural applications [8, 9].

Literature Review – Understanding the Methodology for Hybridization of Graphene/Silk Epoxy Composite
In this paper, suitable process for the introduction of the graphene and natural silk as a combined reinforcement medium in epoxy resin matrix is being explored. Latest literatures were reviewed to understand the impact on the mechanical properties and agglomeration effect on of Graphene/Silk epoxy composite. Findings are presented in the below table 1.

Table 1. Summary of findings from literature review.

Matrix Medium	Reinforcement filler	Results noted /attained in the study	Critical inferences – Noted	Reference
Epoxy Resin	Graphene	• For 2% addition of Graphene, stress increased from 186 MPa to 195 MPa. (5% improvement in tensile strength) and load increased from 0.32 kN to 0.5 kN. (56% improvement in flexural strength). • From 2% to up to 8% resulted in lower tensile & flexural strength due to the non-uniform graphene dispersion and resultant voids in the matrix.	• The study reveals that the graphene dispersion in the matrix material is a critical factor and has direct characteristic impact on the composite material. • Graphene with higher surface area and of few layers of thickness (not more than 2% of volume fraction) would be the best choice for the reinforcement.	[10]
Epoxy Resin	Graphene & Carbon fibres (CF)	• Polymer epoxy composites reinforced with graphene and carbon fibres reveals better properties than that of plain epoxy test specimen- ultimate load increased by 64%.	• High surface area of reinforcement fillers enables for load distribution over a large surface resulting in better performance.	[11]
Epoxy Resin	Graphene oxide (GO) and Carbon fibres (CF)	• The bending strength and young's modulus raised up by 66% and 72% respectively • The shear strength between the laminated surface (ILSS) rose by 25% at 0.3% of GO addition, due to the interlocking and bonding.	• Matrix-filler bonding needs to be strong to have effective stress transfer. • Homogenous dispersion of the filler is essential to avoid formation of aggregates. Otherwise, this would act as a failure points.	[12]
Epoxy resin	Graphene nanoplatelet (GNP)/nano-carbon aerogel (NCA) hybrid and Carbon fibre (CF)	• The tensile strength, flexural strength, and impact strength of the GNP/NCA hybrids(1 wt%) were enhanced than the composite either with single carbon nanomaterial or pure epoxy resin. • Improvement on crack suppression was noticed due to arresting of crack growth by NCA addition and crack deflection by GNP addition.	• Synergistic effect is noticed after combined reinforcement of GNP and NCA leading to positive enhancement of mechanical properties • 1% Addition of GNP and NCA is effective in arresting Crack growth.	[13]
Epoxy Resin	Natural Silk fibres	• Carbon, glass and silk fibres providing higher impact strength • Silk fibres are noted to be providing such high impact strength as an only natural fibre reinforcements. • The impact strength of SFRP varying between 30 to 70% volume fraction • Ap silk variant had profound toughening effect at 60 vol.% and displayed tensile and flexural strength of three times and impact strength of eight times over pure epoxy resin.	• Silk is also a good reinforcement medium as it permits for higher volume fraction (30 to 70%). • Higher volume fraction of silk fibres expands the impact strength and toughness of the matrix material. • However, the toughening effects on the final silk reinforced composite were dependent on the silk species used for reinforcement.	[14]

Epoxy resin	Natural Silk fibre	• Flexural strength increased by 23%; specific flexural modulus increased by 41% in x direction and by104% in y direction. • Anisotropic mechanical properties noted due to the unbalanced weave pattern of the silk fabrics used. • SEM analysis showed extensive fibre / matrix debonding. • Drop in specific flexural strength by 25% and modulus by 20% was noted for presence of moisture @ 10% .	• Balanced weave pattern and treatment of the silk surface is critical for stronger silk/epoxy interfacial adhesion, and for improvement of mechanical properties • The moisture presence in silk fabric prior to laminate fabrication needs to be controlled.	[15]
Epoxy resin	Natural Silk & Flax fibre	• Hybridization showed increase of modulus and strength under tensile and flexural loading with progressive increase of flax fibre in total 50% fibre volume content. • Interlaminar shear strengths is enhanced due to improvement in z-direction stiffness.	• Reinforcements- Silk prevents crack propagation; flax fibres enhances the impact strength and thereby, increase the efficiency in impact energy absorption.	[16]
Different polymeric materials	Graphene oxide (GO) and Silk fibroin (SF)	• Modulus, ultimate stress, toughness of the GOSF composite are superior with outstanding mechanical properties than composite materials either reinforced with Graphene or Silk only	• Hybridization of Graphene and silk is possible for Epoxy resin • Agglomeration effect after combined reinforcement of Graphene and Silk resulted in positive enhancement of mechanical properties.	[17]
Epoxy resin	Dupion silk fibre and silicon carbide (SIC) powder	• For 6% SIC addition, resulted in max tensile strength of 41.4 MPa, flexural strength about 53 MPa and hardness value about 88 RBHN.	• In epoxy matrix medium, there is positive agglomeration of silk with other filler is noticed to be effective.	[18]

In the study by Youssef et.al, woven silk preform was noted to be better choice than random silk preform due to higher thickness variations and lower compaction leading to lower fibre content. Pressurised Vacuum assisted resin transfer moulding (VARTM) @ 30 psi allowed for uniform impregnation over silk preform resulting in lesser void formation and strong adhesion. The specific flexural strength and modulus noted to be increased by 30% and 65% over plain epoxy[19].

Conclusions

The work under the study reveals definite scope for positive hybridization effect resulting in enhanced mechanical properties like modulus, ultimate stress, and toughness of Graphene/Silk epoxy composite when compared with their individual reinforcement with epoxy composites. This is evident from the various research presented in table 1. However, still the agglomeration effect after combined reinforcement of Graphene and Silk need to be studied in detail to understand the interfacial interaction between the reinforcement fillers and epoxy resin matrix.

Following conclusions are arrived for the hybridization of the Graphene/Silk epoxy composite based on the research studies presented in the literature review:

1. Graphene with higher surface area and not more than 2% of volume fraction would provide higher results for enhancement of the mechanical properties.
2. During the hybridization, homogenous graphene dispersion in the matrix material need to be ensured to avoid formation of aggregates and failure points;
3. Since higher volume fraction of silk fibres augments the impact strength and toughness of the matrix material, volume fraction (30 to 70%) of silk reinforcement shall be considered. Moreover, toughening effects is very much dependent on the silk species and hence, A. pernyi and B. mori silk variants shall be considered. Balanced weave pattern for higher interfacial adhesion and surface treatment to address the moisture content prior to laminate fabrication shall be ensured.
4. Pressurised Vacuum assisted resin transfer moulding (VARTM) @ 30 psi shall be used and not wet-lay process.

References

1. Harke, (2006), Epoxy Resin Systems for Composites. Harke Chemical GmbH, Thailand, pp. 1-20.
2. A.B. Maureen, J.M. Cary and D.N. John, Epoxy Resin, Hexcel Corporation.
3. Yuchi Fan, Lianjun Wang and Jianlin, (2010) Preparation and Electrical properties of graphene nano sheet/Al2O3composites, *Carbon Science, 48(10),* 1743-1749.
4. T. Kuilla, S. Bhadra, D. Yao, N. H. Kim, S. Bose, and J. H. Lee, (2010) "Recent advances in graphene-based polymer composites," *Progress in Polymer Science, vol. 35,* no. 11, pp. 1350–1375.
5. Reis, J.M.L. (2012), Effect of temperature on the mechanical properties of polymer mortars. *Materials Research, 15(4)*
6. Liu S, Yan H, Fang Z, et al. (2014) Effect of graphene nanosheets on morphology, thermal stability and flame retardancy of epoxy resin. *Compos Sci Technol* ; 90: 40–47.
7. Shah, D. U., Porter, D. & Vollrath, F. (2014),Can silk become an effective reinforcing fibre? A property comparison with flax and glass reinforced composites. *Compos. Sci. Technol.* 101, 173–183
8. K N Sanjeev Kumar, Sanjeev Sharma, Abdel-Hamid I. Mourad, PB Sharma(press, 2020), A literature review for development of advanced composites materials by reinforcement of epoxy composites with graphene and natural silk, *Lecture notes in Mechanical Engineering.*
9. K N Sanjeev Kumar, Sanjeev Sharma,(2020, August). *A literature review for development of advanced composites materials by reinforcement of epoxy composites with graphene and natural silk-* Paper presented at the meeting of 2nd International Conference on Future Learning Aspects of Mechanical Engineering (FLAME - 2020), Amity university, Noida, India
10. Annamahesh A, Sunitha K Rangarajan S, (2019), Study on Mechanical Behavior of Graphene Based Polymer Composites, *International Journal of Innovative Technology and Exploring Engineering (IJITEE)* ISSN: 2278-3075, Volume-8 Issue-4.
11. Shankar A. Hallada, B, Nagaraj, et.al, (2017), Experimental investigation for graphene and carbon fibre in polymer-based matrix for structural applications, *Journal of Applied Research and Technology 15 297-302*
12. A.K. Pathak, M. Borah, A. Gupta, T.Yokozeki, S.R. Dhakate (2016), Improved mechanical properties of carbon fiber/graphene oxide-epoxy hybrid composites, *Compos Sci Technol, 135* pp. 28-38
13. Yung-Chuan Chiou, Hsin-Yin Chou, Ming-Yuan Shen (2019), Effects of adding graphene nanoplatelets and nanocarbon aerogels to epoxy resins and their carbon fiber composites, Materials and Design 178, 107869
14. Kang Yang a,b , Robert O. Ritchie b,c , Yizhuo Gu a , Su Jun Wu a,b , Juan Guan a, (2016) High volume-fraction silk fabric reinforcements can improve the key mechanical properties of epoxy resin composites, *Materials & Design,* Volume 108,
15. Youssef K. Hamidi , M. Akif Yalcinkaya , Gorkem E. Guloglu , Maya Pishvar , Mehrad Amirkhosravi and M. Cengiz Altan (2018), Silk as a Natural Reinforcement: Processing and Properties of Silk/Epoxy Composite Laminates, Materials , 11, 2135
16. Change Wu, Kang Yang, Yizhuo Gu, Jun Xu, Robert o Ritchie, Juan Guan, (2019), Mechanical properties and impact performance of silk resin epoxy composites modulated by flax fibres, Composites part A: Applied Science and Manufacturing, volume 117
17. K. Hu, M. K. Gupta, D. D. Kulkarni, V. V. Tsukruk. (2013),Ultra-Robust Graphene Oxide- Silk Fibroin Nanocomposite Membranes. *Advanced Materials*;25:2301-7.
18. Akash.S , Avinash.S , M.Ramachandra (2018), A Study on Mechanical Properties of Silk Fiber Reinforced Epoxy Resin Bio-Composite with SiC as Filler Addition , Materials Today: Proceedings 5 3219–3228
19. Youssef K. Hamidi, M. Akif Yalcinkaya, Gorkem E. Guloglu ,Maya Pishvar,Mehrad Amirkhosravi, M. Cengiz Altan (2018), 34th International Conference of the Polymer Processing Society, Taipei, Taiwan

Flow Dynamics Past a Tilted Slab

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Abstract: In the current work, flow past a slab is investigated. The slab is tilted at 45 degree to the direction of fluid flow. It is assumed that the fluid flow can be represented with the help of stream function. Study is based on the steady state conditions. The fluid flow is considered to be at low velocity. Fluid is supposed to be incompressible and non viscous. The resulting energy conservation equations are executed with the help of software named as "FLEX PDE". Streamlines and flow pattern is investigated.
Keywords: Flow pattern, Viscous, Streamlines, Slab, Tilted, Flow Dynamics

Introduction

Roshko [1954] used dimensional analysis approach for the investigation of bluff bodies. Relation was provided between two dimensionless numbers. D. Greenspan [1969] studied the fluid flow in a channel. Steady state conditions were used for the investigation. Reynolds number was varied and the results were studied in the form of steamlines. Vortex studies were also of great importance in the study. Zdravkovich (1977) expressed his studies in case of cylinders. Two cylinders were taken for study. Different arrangements were performed for the cylinders. The results were taken in the form of flow pattern and vortices. Hayashi and Sakurai (1986) expressed his results using experimental approach. The studies were performed for the wake interference. The different arrangements of plate were taken for study. The uniform flow condition was taken with value of Reynolds number as 10000. Braza et al. [1986] assumed the unsteady state conditions for the analysis. Finite volume method based studies were done which was of second order. The flow assumption was taken as laminar. The results were studied in the form of pressure and velocity variations for a cylinder. The analysis was done for the different conditions like inside, outside and in the vicinity of wake. B. H. Lakshmana Gowda [1989] did studies in case of flow in a channel. Studies were performed for the hindrance in channel flow. The hindrance was created with the help of a plate which was flat in nature. The plate was kept at the entry of the channel. Results were performed for the different positions of the plate. The flow velocity in the forward direction and reverse direction were taken as a point of study. To study the results the length of channel was given different values. Chambarel [1990] expressed his studies and results using Navier- stokes equations. The unsteady state condition was assumed for the solution of problem. A computer program was initiated to analyze the results. Solved. Circular cylinder was taken for the study and investigation. The case of two cylinders was performed. One cylinder was placed behind the other. The results are expressed in the form of flow pattern and pressure variations for different Reynolds number. Also importance was given to calculate the lift and drag coefficients. M.M. Zdravkovich [1990] examined basics of flow. It included both low velocity flow and high velocity flow. The analysis was done on cylinder having rough and smooth surface both. Breuer et al. (2000) presented the analysis of a channel. In the channel a bar of square cross section was placed. The results were carried out with different Reynolds number. The case of low velocity flow was assumed and the vortices are studied. Also the concept of blockage ratio was discussed. Alvaro Valencia [2001] focused on the flow structure which was complex in nature. Case of bars with square cross section was taken. The bars were placed side by side. With the help of conservation of mass and conservation of energy principle results were studied. Two dimensional flow conditions were selected for the study. K.M. Lam, M.Y.H. Leung [2004] investigated the flow at a value of Reynolds number is equal to 0.53×10^4. Studies were done for the inclined plate at different angles. Reults were plotted in the form of velocity profile. K. Dhiman et.al. [2006] predicted the fluid flow in case of power law fluids. The effect of Reynolds number is studied on the index of power law. The same was investigated in the steady state conditions. Also the flow conditions were studied in two dimensions. The fluid was assumed to be flow over a cylinder having square cross section. The results are plotted in the form of stream function and vortex structures. S. Bhattacharyya, Kharagpur, and D. K. Maiti [2006] studied the flow in which a cylinder was taken with a plane wall. It was positioned parallel to the plane wall. Also the maximum value of space between the two was specified. Then the results were plotted for different values of Reynolds number. B.N. Rajani [2008] studied flow of fluid both in two dimensions and three dimensions. The flow was taken as low velocity flow. Also the studies were done for the compressible flow. Finite volume method was used for the computation. Results were presented in the form of pressure distribution and friction coefficient. The complex three dimensional flow structure of the cylinder wake is also reasonably captured. M. Boubekri and M. Afrid [2008] examined the fluid flow which was viscous in case of an ellipse. Results were discussed for the stability of flow at different Reynolds number values. Solution was done using differential equations which were partial in nature. The

66

principle of conservation of mass and momentum were applied for the solution of the problem. It was found from the discussion that instability comes into picture at a value of Re = 210. B. H. Lakshmana Gowda and Myong-Gun Ju [2009] considered the case of duct flow. A plate of square cross section was placed at the inlet of duct. The distance between the two was changed and the values are noted for the reverse flow condition. Wisam K. Hussam,et.al. [2009] examined the two dimensional domain using navier- stokes equations. The study was made for a confined cylinder which was circular in cross section. Reynolds number is varied in a systematic manner. Also the blockage ratio is changed. Spectral element algorithm was used to solve the problem. Shivani T. Gajusingh [2010] placed a baffle inside a channel. The cross section of the channel was taken as square. Also the baffle taken was of rectangular cross section. Experimental study was performed. The flow conditions were assumed to be turbulent. Comparative study was performed with and without baffle in the flow. The results were performed for two values of Reynolds number. Zou Lin [2010] analyzed the concept of cross flow at a Reynolds number is equal to 200. The study was performed numerically taking four cylinders. Different arrangements were done for the cylinders. Flow pattern was investigated for different length to diameter ratio. From the results spacing ratio is observed to be an important parameter for fluid flow. S. B. Doma, I. H. El-Sirafy and A. H. El-Sharif [2010] expressed the results with the numerical solution of Navier Stokes equations. For the study steady state conditions were assumed.

Meshing
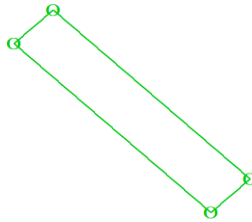
Figure 1. Slab at 45 degree
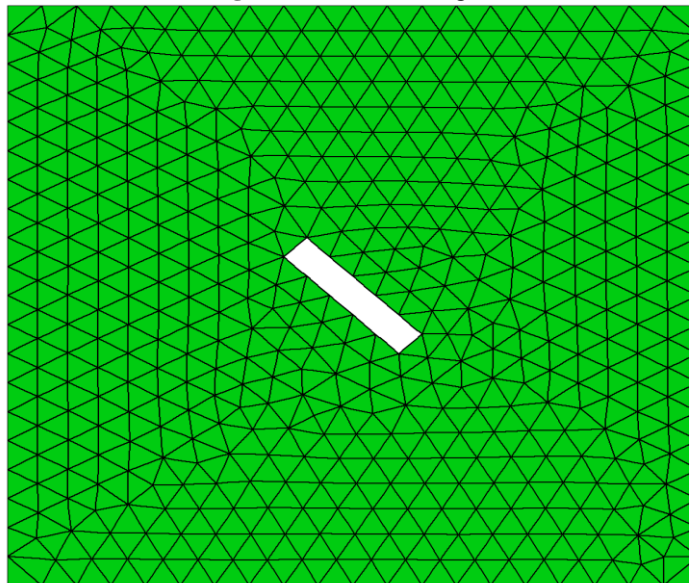
Figure 2. Meshing

Results and discussion
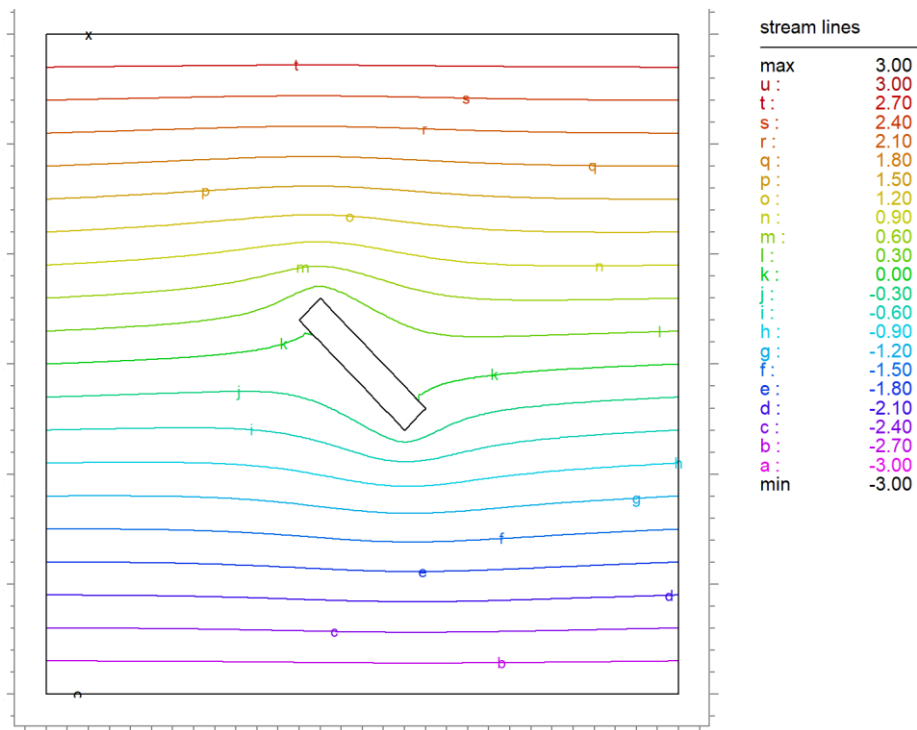
Figure 3. Variation of streamlines

The variation of streamlines is shown is shown in the figure 3. The maximum and minimum values are also shown.
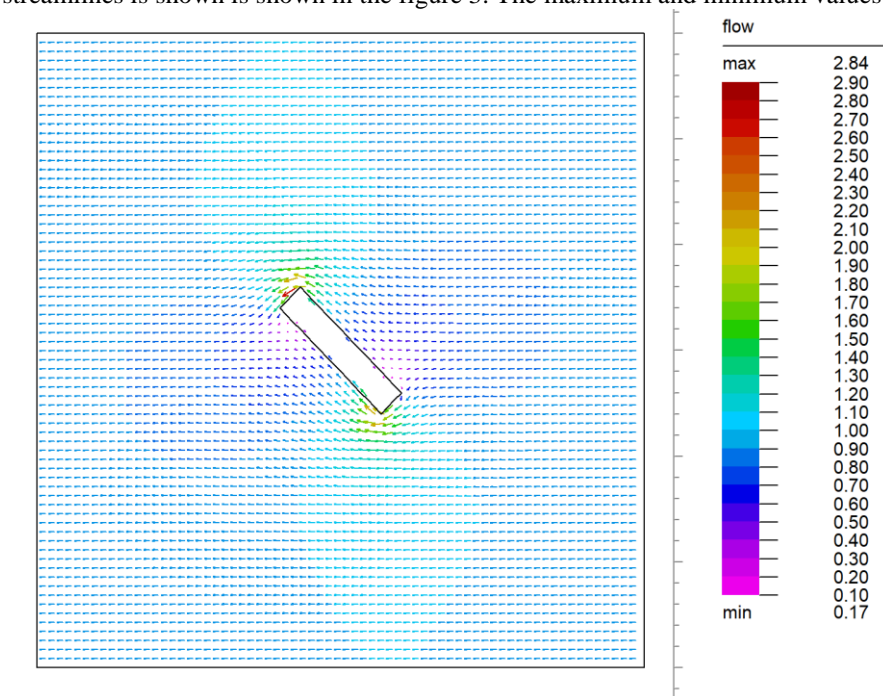
Figure 4. Flow Pattern

The flow pattern is shown is shown in the figure 4. The maximum and minimum values are also shown.

Conclusion

The variation of streamlines and flow pattern has been studied. The FLEX PDE software promotes faster processing of the flow features past an inclined slab. In the solution of partial differential equations, this is called to be pretty effective. It results in the determination of coupled PDE's quiet comfortable and less determining efforts are required.

References

[1]   B. H. lakshmana Gowda' and E. G. Tulapurkaraz (1989). "Reverse flow in a channel with an obstruction at the entry" *J. Fluid Mech.* , vol. 204, pp. 229-244.

[2]   M.M. Zdravkovich (1990). "conceptual overview of laminar and turbulent flows past smooth and rough circular cylinders" *Journal of Wind Engineering and Industrial Aerodynamics*, 33, 53-62.

[3]   J. LI,* A. Chambarel, M. Donneaud and R. Martin (1991). "Numerical study of laminar flow past one and two circular cylinders" *Computers & Fluids* Vol. 19, No. 2, pp. 155--170,.

[4]   Yinglong Zhang and Songping Zhu (1996). "Open channel flow past a bottom obstruction" *Journal of Engineering Mathematics* 30: 487--499,.

[5]   Alvaro Valencia "laminar flow past square bars arranged side by side in a plane channel".

[6]   K.M. Lam∗, M.Y.H. Leung (2005)."Asymmetric vortex shedding flow past an inclined flat plate at high incidence" *European Journal of Mechanics B/Fluids* 24, 33–48.

[7]   A. K. Singha1, A. Sarkar2 and P. K. De (2005). "Wall effect on heat transfer past a circular cylinder" - a numerical study International Conference on Mechanical Engineering 2005 (ICME2005) 28- 30 December 2005, Dhaka, Bangladesh.

[8]   A. Mueller1, J. Anthoine1 and P. Rambaud1 (2008). "Vortex shedding in a confined laminar flow past a square cylinder" 5th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008) June 30 –July 5, 2008 Venice, Italy.

[9]   B.N. Rajani A. Kandasamy Sekhar Majumdar (2009). "Numerical simulation of laminar flow past a circular cylinder" *Applied Mathematical Modelling* 33 , 1228–1247.

[10]   Chang-Hyun Sohn*, B. H. Lakshmana Gowda and Myong-Gun Ju (2009). "Reverse flow in a square duct with an obstruction at the entry" *Journal of Mechanical Science and Technology* 23, 2376~2389.

[11]   Shivani T. Gajusingh, Nasiruddin Shaikh, Kamran Siddiqui (2010). "Influence of a rectangular baffle on the downstream flow structure" *Experimental Thermal and Fluid Science* 34, 590–602.

[12]   Zou Lin Lin Yu-feng Lu Hong (2011). "Flow patterns and force characteristics of laminar flow past four cylinders in diamond arrangement" 2011, 23(1):55-64 DOI: 10.1016/S1001-6058(10)60088-1.

[13]   S. B. Doma , I. H. El-Sirafy and A. H. El-Sharif "Two-Dimensional Fluid Flow Past a Rectangular Plate with Variable Initial Velocity".

[14]   Vikram C. K., Dr. Y. T. Krishne Gowda, Dr.H.V. Ravindra (2011). "Numerical simulation of two dimensional unsteady flow past two square cylinders" ©gopalax -International *Journal of Technology and Engineering System (IJTES)*: Jan –March 2011- Vol.2.No.3.

[15]   M.A. Kabir, M.M. K. Khan and M. G. Rasul "Numerical Modelling of Reverse Flow Phenomena in a Channel with Obstruction Geometry at the Entry" wseas transactions on fluid mechanics.

[16]   D. Greenspan (1969). "Numerical Studies of Steady, Viscous, Incompressible Flow in a Channel with a Step" *Journal of Engineering Mathematics*, Vol. 3, No. 1,.

[17]   A. K. Dhiman, R. P. Chabra and V. Eswaran, (2008). "Steady Flow Across a Confined Square Cylinder: Effects of Power-Law Index and Blockage Ratio" *J. Non-Newtonian Fluid Mech.,*.

[18]   S. Bhattacharyya, Kharagpur, and D. K. Maiti, (2006). "Vortex shedding suppression for laminar flow past a square cylinder near a plane wall: a two-dimensional analysis" Acta Mechanica, 184: 15–31 (2006).

[19]   Jonhn D. Anderson, Jr. "Computational Fluid Dynamics" McGraw-Hill   International Editions.

[20]   Wisam K. Hussam, Mark C. Thompson and Gregory J. Sheard (2009). "A Quasi-   two-dimensional investigation of unsteady transition in shallow flow past a circular cylinder in a channel" Seventh International Conference on CFD in the Minerals and process Industries CSIRO, Melbourne, Australia 9-11 December 2009.

[21]   S. Kumar, C. Cantu and B. Gonzalez **"**Flow past a rotating cylinder at Low and high rotation rates "Journal of Fluids Engineering Copyright 2011 by Asme April 2011, vol. 133 / 041201-1

Synthesis of A High Entropy Alloy Using Spark Plasma Sintering and Chracterisation Using Nanoindentation

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Abstract: Engineering applications encountered today require materials with resistance to high temperatures and loads. In order to meet these demands, new classes of alloys are being developed. One such class is high entropy alloys (HEAs), which are multi component alloys with more than four constituent elements, which can find applications in high temperature strength, wear and abrasive operating environments unsuitable for traditional alloys and metals. These alloys are difficult to fabricate by traditional casting methods. Fabrication of HEAs uses chill casting or sintering. Powders are sintered at temperatures in the range of 30% to 60% of melting temperature of the lowest melting constituent element or material in the powder mixture. Experimental research has shown that this temperature gives a reasonably fast sintering rate. In this paper spark plasma sintering of powders is selected for fabrication of alloy of FeNiCrVSn. Scanning electron microscopy and nano indentation are methods used to characterise the alloy in order to get the hardness and elemental composition. Nano-indenting is a relatively new method to characterize material mechanical properties on a very small scale. Nanohardness indentation experiments are methods of characterising materials in order to derive mechanical properties of such materials without using conventional testing methods like tensile testing. In this paper, possible areas of practical industrial applications of the high entropy alloys are discussed. Nanoindentation was used to characterize material properties of the alloy.

Keywords: High entropy alloys, sintering, nanoindentation

Introduction

As society progressed from Stone Age, bronze and Iron Age to modern age, dependence on metals and alloys has increased [1]. Early uses of metals were applications such as tools artefacts and ornaments [2]. During this time, ease of fabrication and later aesthetics were most desirable properties [1] . Later technology led to invention of machinery, vehicles and other advanced equipment, which demanded materials with structural and thermal properties [3]. New applications demanded superior heat resistance, high strength and corrosion resistance [3]. This led to the development of new materials, alloys where two or more elements are smelted together to deliver best properties of both [3]. Manufacture of steels started in the18th century [4]. Advances in manufacturing, energy and transportation later in the 20th century led to the development of components for engines, turbines and nozzles for power generation plants and aerospace engines operating at temperature of over 1000^OC, under high stress and corrosion [3].   This is innovations, led to the development of alloys Monel alloy 400, titanium alloys and stainless steel that can with stand such extreme conditions [3][5] [6]. New classes of alloys are being developed as a alternatives. Alloy materials include Manganese, Vanadium, and Chromium among others. Today, powder metallurgy techniques fabricate materials incorporating metals, ceramics, carbon fibres and nitrides to further improve thermal, strength and hardness. Among these new materials are high entropy alloys. These are high strength materials, typically fabricated from powder metallurgy comprising of compacted and sintered powders of more than four elements. Experimental studies have shown that they can find use in high temperature strength, wear and abrasive applications [7]. High entropy alloys (HEAs) potential for high strength and temperature applications. This paper explains these alloys and presents the synthesis of a HEA using spark plasma sintering. After the alloy is synthesised, nano indentation hardness testing used to characterize its mechanical properties.

Literature review
High entropy alloys
High entropy alloys (HEAs), are multi-principal-elements, equi-molar, or equi-atomic ratio alloys. They are solid solutions alloys that contain at least five principal elements of near equal atomic weights [7]. They have high mixing entropy in the liquid or solid solution state [8]. The composition of each of the elemental constituents is more than 5% but less than 35% [7]. Usually elements that will form solid solutions when mixed at near-equiatomic concentrations instead of adding solutes to a single 'base' element are used [7]. The resultant solid solution has enthalpies of mixing between −22 and 7 kJ/mol and behave like an ideal solution [9]. HEAs are manufactured through powder metallurgy, chill casting or mechanical alloying [9]. An example of a high entropy alloy is e

70

CrMnFeCoNiNbGeVTi [8]. Properties of HEAs exhibit high resistance to softening at elevated temperatures and high strength, which vary with proportions of constituents [8].

Synthesis of alloys using sintering

Sintering is the powder metallurgy technique, which uses powders to fabricate parts. After the powders are mixed, they are compacted in a die and heated in a furnace to form a near net shape. Sintering occurs below its melting point to avoid liquefying so that bonding takes place by diffusion of atoms [10]. This fabrication process uses either external pressure or none but in both cases and allows powder particles to adhere to each other in a dense to compact [11]. The mixture of powders is blended and mixing in mixing devices through tumbling action to achieve homogeneity and reduce porosity and segregation during compaction and sintering [12] [13]. After mounting in a furnace, powders are sintered with a sintering temperature, which is 30%-50% of the lowest melting component [10]. This temperature, achieves a fast sintering rate while limiting excessive grain growth in crystalline materials [10] . Sintering of a single element powder is done at 2/3 to 4/5 of the solidus temperature of is phase diagram [14] [15].

Spark plasma sintering

Spark plasma sintering (SPS) utilizes direct-pulsed current along with uniaxial load under vacuum atmosphere to compact a mixture of powders into a solid component [16]. During this hot pressing process, pressure applied using graphite rods to the starting powders, which are contained in a graphite die [17]. A schematic of SPS equipment set up is shown below in Figure 1(a). This results into a net near shape sample shown in Figure 1 (b) [17].
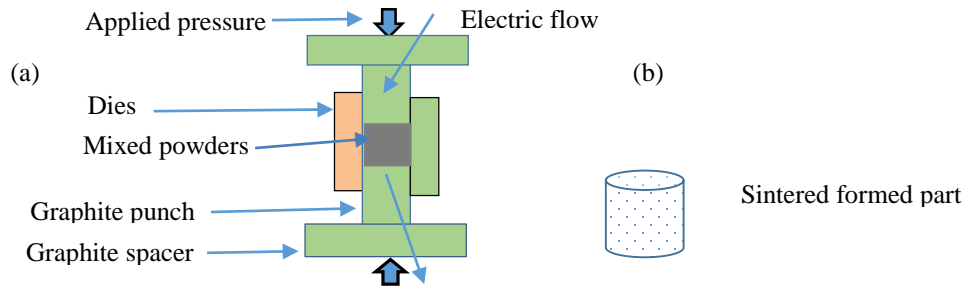
Figure 1. Diagram of the spark-plasma-sintering (SPS)

SPS is termed electric current activated; plasma activated, or electric discharge sintering [18]. The pulsed electric current enables a fast internal heating rate of up to 1000 °C min^{-1} and short holding times typically 0–10 min [7]. It shortens sintering to minutes compared conventional sintering techniques using external heating [11]. Heating rates greater than 400°C/min reduce unintended secondary reactions and growth of particles [7]. Temperature is controlled using a monochromatic optical pyrometer [19]. Application of SPS include nanomaterials, ceramics and metals matrix and composites [7].

Indentation hardness testing of materials

Several publications report on studies to determine properties of linearly elastic perfectly plastic materials using indentation experiments [20]. Oliver and Pharr carried out early research on nano indentation theory [20]. During nano indentation a probe, such as Berkovich three-sided indenter indents the material surface at nano scale level [21][22]. Properties obtained from these experiments include plastic elastic properties elastic modulus E and yield strength σ_y [23]. Spherical tip indenters to measure yield strength and work hardening rate and residual stress [24]. The experimental results depend on the material's elastic modulus, friction coefficient and hardening coefficient [23]. Developments in instrumented indentation techniques at low load levels have improved understanding the mechanics of solids at micro and nano scales encountered in small structures, in microelectronics, micro-electromechanical systems, and coatings [24]. Instrumented nano indention equipment uses atomic force microscopy [25] to locate the testing area, image indentations and their depth [26]. The probe is forced into the surface at a selected rate and applied to a selected maximum force [22]. A force-displacement curve obtained during indentation also provides indications of the sample material's mechanical and physical properties [26]. A load–depth curve is derived from the measurements a plotted to deduce the hardness and Young's Modulus of the specimen using the Oliver and Pharr method [22]. Figure 2 shows a Load-displacement curve of indentation hardness test.
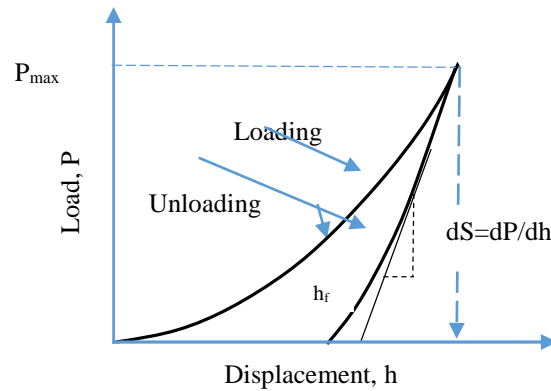
Figure 2. An indentation load–displacement data showing measured parameters

Using the Oliver and Pharr method to determine the hardness and elastic modulus [27], the contact depth h_c between the indenter and the specimen can be estimated using the equation [27]:

$$h_c = h_{max} = \varepsilon \frac{P_{max}}{S} \qquad (1)$$

Here, P_{max} is the peak load and e is a constant related to the indenter. Thus, the projected contact area A_c is established by evaluating an empirically determined indenter shape function at the contact depth [27]. The hardness (H) is calculated form the actual contact area (A_C) and maximum load, P:

$$H = \frac{P}{A_C} \qquad (2)$$

The reduced modulus (E_r), which accounts for elastic displacement in both the specimen and indenter, is [27]:

$$E_R = \frac{1}{\beta} \frac{\sqrt{\pi}}{2} \frac{S}{\sqrt{A_C}} \qquad (3)$$

where β is a constant with a value of 1.034 for a Berkovich indenter, S is contact stiffness determined by curve fitting the upper portion of the unloading curve and measuring it slope at peak load. A_C is contact area and is deduced from an empirically determined shape function [27]. The elastic modulus of the specimen (E) is calculated from the effective modulus using [27].

$$\frac{1}{E_r} = \frac{1 - v^2}{E} + \frac{1 - v_i^2}{E_I} \qquad (4)$$

where E_i is modulus of indenter, and v and v_i are Poisson's ratio for the specimen and the indenter, respectively [27]. The equations (2)–(4) were derived from a purely elastic contact solution developed by Sneddon [28] .This method is that does not need to image the residual indent for the evaluation of hardness, when measuring hardness property measurements from very small indentations [29].

Experimental procedure
Powder composition calculation
The specifications of the powders used in the spark plasma sintering fabrication was supplied from Sigma-Aldrich for the process are shown in Table 1 below.

Table 1. Composition and powder grain size for powders

Element	Particle size	purity%
Sn	<45micron	99.8
Fe	99.9	99.9
V	325 mesh	99.5
Cr	-100mesh	99.5
Ni	<150micron	99.99

The alloy of FeCrNiVSn was synthesised in the experiment and later characterized. The alloy was synthesised by spark plasma sintering. The first step involved procedure involved calculation of material required for sintering. In order to calculate the material required for sintering the procedure can be as follow: Calculation of V, the volume of fully dense body after sintering and multiply it by ρ, the density of material. Table 2 shows the charge calculation results.

$$V = \pi \frac{d^2}{4} \times \rho \tag{5}$$

Table 2. Calculation of relative density of the alloy.

Element	V	Cr	Fe	Sn	Ni	Total
% weight	20	20	20	20	20	
Element density (ρ)	6.11	7.19	7.874	7.43	8.9	
(% weight)/ρ	0.2/6.11	0.2/7.19	0.2/7.84	0.2/7.43	0.2/8.9	0.1354
Relative density = 1/0.1353		= 7.388g/cm^3				

A die of diameter 20mm by 5mm was used in sintering process
$V = \pi r^2 h$ $V = \pi \times 1^2 \times 0.5 = 1.571 cm^3$
$\rho = \frac{M}{V}$ $M = \rho V = 7,388 \times 1.571 = 11.6 g$
Adding an allowance of 4% Mass of powder M = 12.064g. The final powder weights are shown in Table 3.

Table 3. Calculation of relative density of the alloy.

Element	V	Cr	Fe	Sn	Ni
% weight	20	20	20	20	20
Mass powder (g)	2.413	2.413	2.413	2.413	2.413

Mixing and sintering of powders
The powders were weighed and mixed in a from Willy A Bachofen (WAB) AG Tubular mixer with specifications 230V, 50Hz 0.18KN for 16 hours. Mixing process takes place in a closed container to ensure that the process is controlled, hygienic and dust-free [30]. The tubular mixer used to mix and homogenise mixture. The sintering process was done in a FCT Systeme spark plasma-sintering machine. The machine specifications include H-HP D 25 hybrid heated, FAST/SPS furnace, pressing force: 250 kN, heating power FAST: 64 kW, heating power induction: 80 kW with a maximum component diameter of 100 mm [31].The sintering parameters for the experiment which include pressure, temperature, holding time , heating rate and sintering time are shown in Table 4.

Table 4. Sintering parameters for the experiment

Sintering pressure	35 bar	Heating rate	100ºC/min
Sintering temperature	1100ºC	Sintering time	45 mins
Holding time	10 mins		

Results and discussion
During preparation, the sample was cut, ground and fine machine polished for analysis for scanning electronic microscopic (SEM) analysis and hardness testing.
Scanning Electron Microscopy analysis
The synthesized Fe-Cr-V- Ni –Sn alloy was analyzed using Oxford Instruments Scanning Electron Microscope (SEM) to establish elemental composition. Figure 5 below shows SEM map of elemental distribution and elemental composition is shown in Figure 6.

(a)   (b)   (c)   (d)   (e)   (f)
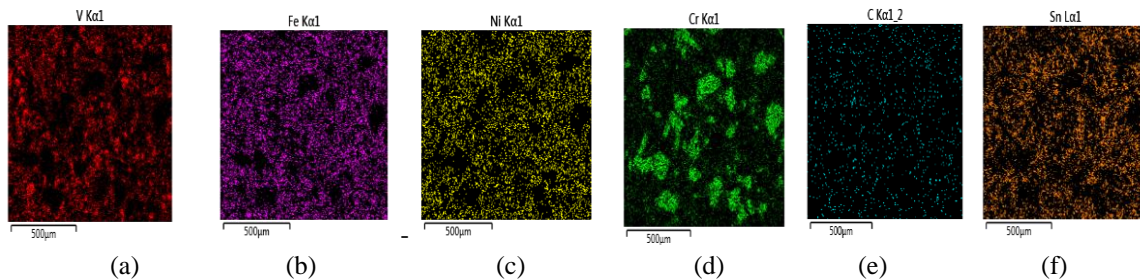
Figure 5. Micrographs from scanning electron microscopy (a) V (b) Fe (c) Ni (d) Cr (e) C (f) Sn
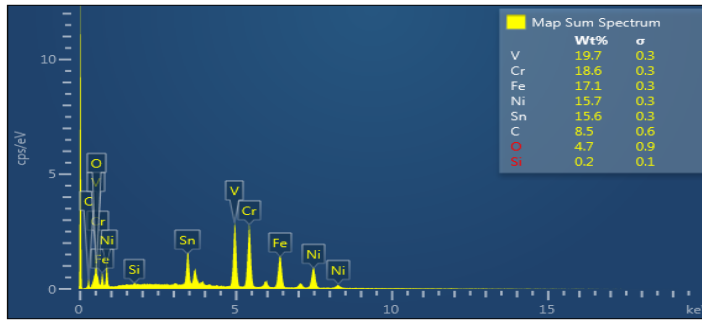
Figure 6. Elemental analysis of alloy showing elemental distribution and composition

The microstructure under scanning electron microscope various magnifications are shown below in Figure 7

     (a)   x350   (b) x4500   (d) x500   (e) x2700
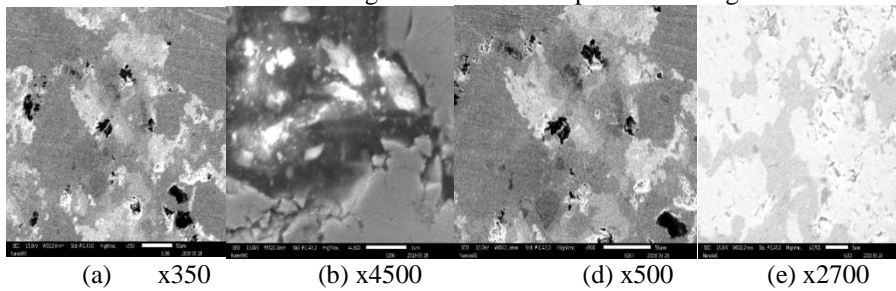
Figure 7. Distinct phases observed in the microstructure shown above in the various magnifications.

Hardness testing

Nanohardness measurements were taken on an Anton Paar Nanoindenter. Test indenter for nanohardness testing on an Anton Paar nanohardness tester was the Berkovich diamond indenter tip B-T 40 using Oliver –Pharr method. Table 5 shows the process parameters

Table 5. Process parameters for nanoindentation

Approach distance	3000 nm	Acquisition Rate	10.0 Hz,	approach speed :	40000 nm/min
Retract speed	2000 nm/min	Maximum load	50.00 MN	unloading rate :	30.00 mN/min
Pause time	50.0 s	Stiffness Threshold	150 μN/μm	A Poisson ratio of	0.21

The hardness testing method used by the instrument is. The results of the six-nano indentation experiments on the alloy are shown below in Table 5.

Table 6. Results of the six nanoindentation tests

Indentation	1	2	3	4	5	6
S	0.5273	0.3323	0.2956	0.3115	0.3661	0.4013
F_{max}	50.10	50.02	50.04	49.96	50.04	49.97
h_c	799.84	742.27	537.75	561.49	573.40	732.36
h_r	781.33	701.18	500.52	519.49	541.13	701.17
h_{max}	876.18	851.68	669.77	679.61	678.20	825.7
Epsilon	0.8	0.73	0.78	0.74	0.77	0.75
Hardness Nano Vickers	330.13	386.88	774.14	703.63	673.39	397.77
HIT MPa	3564.7	4177.4	8359	7597.7	7271.1	4295.1
E elastic modulus	134.86	88.686	113.5	114.51	133.54	110.56

From the test the average hardness is and modulus of elasticity in Vickers for the six measurements is 2491.8/6 = 415.5. The modulus of elasticity is 695.656/6 = 115.9 MPa. The alloy FeCrNiVSn showed good hardness and modulus of elasticity when compared to Aluminium 1100, Copper C93200 and Titanium Ti - 5Al - 2.5Sn which have moduli 69 MPa, -100 MPa, 110 MPa respectively [34]. Brittleness can be reduced by tempering heat treatment. However, this had high contamination with carbon as shown in the SEM map and in the elemental analysis. The carbon under high temperature to from carbides dispersed in the microstructure, which lead to very hard carbides in the structure as shown by the nanohardness values. Porosity affects mechanical properties of the alloy and surface finish [10][32]. It acts as a stress raiser leading to an increase elongation, impact and fatigue strengths as density approaches the theoretical value [33]. The wide variation of nano hardness values is attributed to the three various phases in the material. Further testing is however required for wear properties and fatigue properties encountered in engineering applications.

Conclusion
Spark plasma sintering can be an effective powder metallurgy method to fabricate high entropy alloys. Variation in alloy composition results in variable mechanical properties. Carbon contamination is a problem where graphite dies are used. Nanohardness testing is a useful tool to evaluate hardness and modulus of elasticity of a small sample where tensile tests can be impossible to carry out. It is able to relate the mechanical properties to the microstructure of the various phases.

References

[1]   A. C. Reardon, Ed., "Discovering Metals— A Historical Overview," in *Metallurgy for the Non-Metallurgist*, Material Park, OH, USA, ASM International, 2011, pp. 73-84.

[2]   R. Raymond , Out of the Fiery Furnace: The Impact of Metals on the History of Mankind, 1984, Pennsylvania: Pennsylvania State University Press, 1948.

[3]   J. S. Patel, "A century of discoveries, inventors, and new nickel alloys," *Journal of materials,* vol. 58, no. 9, p. 18–20, 2006.

[4]   W. F. Smith and J. Hashemi, Foundations of Material Science and Engineering (4th ed.), McGraw-Hill, p. 394, ISBN 0-07-295358-6, 2001.

[5]   K. H. Lo, C. H. Shek and J. K. L. Lai, "Recent developments in stainless steels," *Materials Science and Engineering R,* vol. 65, p. 39–104, 2009.

[6]   L. P. Karjalainen, T. Taulavuorl, M. Sellman and A. Kyrolainen, "Some Strengthening Methods for Austenitic Stainless Steels," *Materials Technology,* vol. 79, no. 6, pp. 404-412, 2008.

[7]   Z. Zhang, Z. Liu, J. Lu, X. Shen, C. Wang and Y. Wang , "The sintering mechanism in spark plasma sintering – Proof of the occurrence of spark discharge," *Scripta Materialia,* vol. 81, no. 15 June, pp. 56-59, 2014.

[8]   Y. Jien-Wei , C. Swe-Kai , L. Su-Jien and G. Jon-Yiew , "Nanostructured High Entropy Alloys with multiple principal elements: Novel alloy design, concepts and outcomes.,," *Advanced Engineering Materials,* vol. 6, no. 5, p. doi: 10.1002/adem.200300578, 2004..

[9]   S. Guo and C. T. Liu , "Phase stability in high entropy alloys: formation of solid-solution phase or amorphous phase," *Prog Nat Sci Mater Int.,* vol. 21, no. doi: 10.1016/S1002-0071(12)60080-X, p. 433–446, 2011.

[10]   G. Dutta and D. Bose, "Effect of Sintering Temperature on Density, Porosity and Hardness of a Powder Metallurgy Component," *International Journal of Emerging Technology and Advanced Engineering,* pp. 121-123, 2012.

[11]   IITK, "Spark plasma sintering," 30 May 2018. [Online]. Available: https://www.iitk.ac.in/biomaterialslab/Spark%20Plasma%20Sintering.pdf.

[12]   Mechscience.com, "Blending and Mixing of the Powders & Compaction | Powder Metallurgy," 18 December 2016. [Online]. Available: http://www.mechscience.com/blending-and-mixing-of-the-powders-compaction-powder-metallurgy/.

[13]   Mechscience.com, "Sintering | Isostatic Pressing | Secondary Operations of Powder Metallurgy," 20 December 2016b. [Online]. Available: http://www.mechscience.com/sintering-isostatic-pressing-secondary-operations-of-powder-metallurgy/.

[14]   ResearchGate GmbH, "How do we calculate sintering temperature ? Is there a review paper on this?,"
         2015. [Online]. Available:
         https://www.researchgate.net/post/How_do_we_calculate_sintering_temperature_Is_there_a_review_pape
         r_on_this.

[15]   R. M. German, Sintering Theory and Practice, Wiley and Sons, 1996.

[16]   X. Q. Li, Z. Cheng, K. Hu, H. J. Chen and C. Yang, "Crystallization kinetics and spark," *Vacuum,* vol.
         114, pp. 93-100, 2015.

[17]   W. Xie and S. Zhu, "Investigation of the sintering pressure and thermal conductivity anisotropy of melt-
         spun spark-plasma-sintered (Bi,Sb)2Te3 thermoelectric materials," *Journal of Materials Research,* vol. 26,
         no. 15, pp. 1791 - 1799 , 2011.

[18]   X. Li, YeY, Z. Cheng, M. Zhang and S. Qu, "The influence of sintering temperature and pressure
         onmicrostructure and mechanical properties of carbonyl iron powder materials fabricated by electric
         current activated sintering," *Vacuum 137,* pp. 137-147, 2017.

[19]   S. -H. Lee, H. -C. Oh, B. -H. An and H. -D. Kim, "Ultra-low temperature synthesis of Al4SiC4 powder
         using spark plasma sintering," *Scripta Materialia,* vol. 69, pp. 135-138, 2013.

[20]   J. Yan, A. M. Karlsson and X. Chen, "Determining plastic properties of a material with residual stress by
         using conical indentation," *International journal of solids and structures,* vol. 44, no. 11, pp. 3720-3737,
         2007.

[21]   K. F. J. Heinrich, "Electron probe microanalysis by specimen current measurement. In Castaing R,
         Deschamps P, Phillibet (eds), Proceedings 4th conference on X-ray optics and microanalysis," Paris, 1966.

[22]   J. Pharr and G. M. Oliver, *Mater. Res.,* vol. 7, p. 1564, 1992.

[23]   Y. P. Cao and J. Lu, "A new scheme for computational modeling of conical indentation in plastically
         graded materials," *Journal of Materials Research,* p. 1703–1716, 2004.

[24]   . C. A. Schuh, C. E. Pakard and A. C. Lund, " Nanoindentation and contact-mode imaging at high
         temperatures," *Journal of materials research,* vol. 21, no. 03, pp. 725-736, 2006.

[25]   Materials Evaluation and Engineering Inc, "Atomic Force Microscopy," 2014b. [Online]. Available:
         https://www.mee-inc.com/hamm/atomic-force-microscopy-afm/. [Accessed 19 February 2019].

[26]   Materials Evaluation and engineering Inc, "Nanoindentation Hardness Testing," 2014. [Online]. Available:
         https://www.mee-inc.com/hamm/nanoindentation-hardness-testing/. [Accessed 17 February 2019].

[27]   W. Wang and k. Lua, "Nanoindentation measurement of hardness and modulus anisotropy in Ni3Al single
         crystals," *Journal of Material Research,* vol. 17, no. 9, pp. 2314-2320, 2002.

[28]   I. N. Sneddon,, *Int. J. Eng. Sci.,* vol. 3, no. 47, 1965.

[29]   L. M. Qian, X. D. Xian, Q. P. Sun and X. T. Yu, "Anomalous relationship between hardness and wear
         properties of a superelastic nickel–titanium alloy," *Appl. Phys. Lett.,* vol. 84, p.
         https://doi.org/10.1063/1.1646218 , 2004.

[30]   WAB Group, "Mixing technology," 2018. [Online]. Available: https://www.wab-group.com/en/mixing-
         technology/products/. [Accessed 14 Novemeber 2018].

[31]   FCT Systeme GmbH, "FCT Systeme GmbH –High-temperature Equipment and Technology," 2018.
         [Online]. Available: http://www.tecpropro.com/media/files/2016-11-21_FCTS_general-
         presentation_short_KIR.pdf. [Accessed 15 November 2018].

[32]   P. C. Angelo, Powder Metallurgy: Science, Technology and Applications, New Delhi: Prentice-Hall of
         India, 2008.

[33]   A. K. Sinha, Powder Metallurgy, Daryagang, New Delhi: Madras House, 2003.

[34]   Amesweb, "Modulus of elasticity for metals," 2013. [Online]. Available:
         https://www.amesweb.info/Materials/Modulus-of-Elasticity-Metals.aspx. [Accessed 12 June 2019].

[35]   P. Breeze, "Chapter 5 - Advanced Gas Turbine Design," in *Gas-Turbine Generation*, New York,
         Academic Press, 2016, pp. 43-53.

[36]   R. A. Swalin, in *Thermodynamics of Solids, 2nd edn. (Eds: E. Burke, B. Chalmers, J. A. Krumhansl)*, NY,
         Wiley, 1991, p. 21.

[37]   H. S. Chen, "Glassy Metals," *Rep. Progr. Phys.,* vol. 43, pp. 353 - 432, 1980.

Track 2

Advances in Civil and Biomedical Engineering

Structural Health Monitoring of Masonry Arch Bridge with Lime Mortar Using Piezo-Electric Sensors

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Abstract: Lime is a traditional and eco-friendly building material which is used as a cementing material since ancient times. The traditional lime mortar gives more exceptional durability characteristics but slows down the hardening process. This work aims to know the hydration of lime mortar and detect the damages in the lime mortar by piezoelectric sensors. A brick-masonry arch bridge model with lime mortar was prepared in the laboratory and instrumented with piezoelectric (PZT) sensors in an arch in bricks as well as in mortar joints. Controlled damage was done in the bridge, and its monitoring was carried out using piezoelectric sensors. This work focused on structural health monitoring via electromechanical impedance (EMI) method for brick masonry arch bridge by using piezoelectric ceramic materials at high frequencies in 30-400 kHz range. This EMI technique is used to study the characteristic signatures of the structure in conductance, susceptance and RMSD forms, that gives necessary information of the behaviour of the structure, and able to analyze structural damages and deflections at various loading stages. These PZT patches are economical and show high damage sensitivity in operational as well as already existing structures.

Keywords Lime mortar, long life, hydration, damage detection, piezoelectric sensors, EMI technique, SHM, conductance, compressive strength.

Introduction

Ever since ancient times, lime has been used as a cementing material. Nowadays, cement replaced the lime to a great extent due to low compressive strength and slow hardening. However, due to some goodness in workability, more water retention, flexibility, less brittle and long life, lime is used as a reliable alternate of cement. The Ancient Egyptians and Romans used lime for various purposes. The Egyptians were the first to utilize lime mortars into their religious structures as well as in their homes. About 6,000 years ago, Egyptians utilized lime to plaster the pyramids at Giza [1]. China also utilized lime for construction purposes since about 5000 years ago.

Europe and Greece also have a history of the utilization of lime as an essential constituent of mortars. Even in India, various structures like palaces, forts, monuments, bridges were constructed with lime, and some of them are still present in good condition. Most of the structures which are made with lime mortar are older than 100 years. At the onset of the use of cement and concrete in construction, the type of structures made with lime and mortar were constructed in fewer numbers. Such type of structures is part of our heritage. Nowadays, lots of structures had become weak due to some factors such as ageing of structure, change of loading at present as compared to when the structures were constructed, natural calamities, lack of maintenance and other factors. For preserving such structures, there is a need to repair and rehabilitate the structures that require proper inspection and structural health monitoring. With increasing life of existing structure increase the cost of maintenance and repairs. However, SHM helps in reduce the unnecessary maintenance for existing structures and reduce life cycle cost in new structures during the design stage. Structural health monitoring (SHM) assess the state of structural health by the analysis, interpret data and may know the remaining life of the structure. With this, the researchers and engineers would be able to find out the causes of the weakening and performance of structure at its present condition [2].

SHM is the operation of executing a damage or failure detection and characterization approach for engineering structures. SHM techniques are categorized into Global techniques and Non-destructive Evaluation (NDE) techniques. However, for SHM, these methods are more expensive and tedious [10]. For SHM in this research, electromechanical impedance (EMI) technique utilize with the use of piezoelectric materials like PZT patches as transducers which can act as both sensors and actuator. Piezoelectric-ceramic (PZT) materials patch is bonded on a structure using high strength araldite epoxy adhesive and subjecting to an electric charge by the help of an impedance analyzer/LCR meter [3-10]. The sensitivity of this technique is high as local ultrasonic technique and can detect damage at incipient damages. At frequency range of 30–400 kHz generally, PZT patch actuates the structure and sensed the response of structural response and measures in the form of the electromechanical admittance of this patch with real and imaginary part (conductance and susceptance).

Piezoelectric sensors: The devices which use piezoelectric effect and converts strain, temperature, acceleration, the pressure to electric charge. The word 'piezo' came from a Greek word which means squeezing or pressure. The piezoelectric effect firstly discovered by Currie brothers (Jacques Currie and Pierre Currie) in 1880. The piezo impedance transducers, acting as actuators and sensors, use ultrasonic vibrations which are generally in the range of

78

30 to 400 kHz for reading the characteristic 'signature' of the structure. For the local EMI technique, a masonry arch bridge model instrumented with PI ceramic-151 Germany based piezoelectric sensors (PI ceramic technology) (Table 1) and controlled damage were done in the bridge. Its monitoring is done using piezoelectric sensors using conductance and susceptance signatures (frequency range: 20–250 kHz), was monitored from the 1st day to the 158th day using a Keysight E4980AL Inductance, capacitance, resistance (LCR) meter and Keysight VEE pro software (Figure 1).
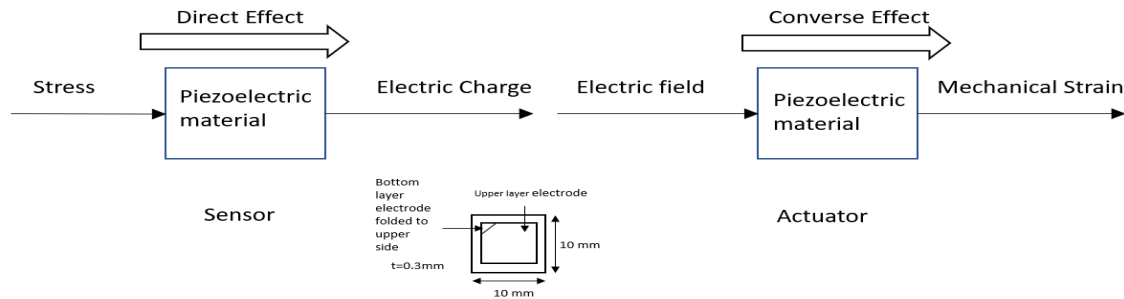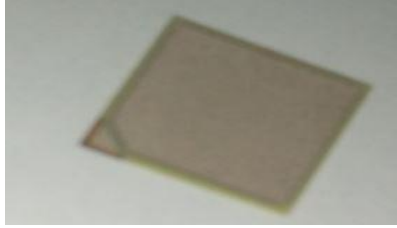
Figure 1. Sensor and actuator response behaviour during apply stress/strain
The PZT material used and its manufacturer are given in Table 1:
Table 1: PZT material with its feature, manufacturer and image.

Piezo-based sensors/actuators			
Name of the sensor	Name of manufacturer	Features	Images
PZT plate	PI Ceramic German (www.piceramic.com)	Available in 10×10×0.3 mm size, Cu Ni sputtering wrapped (both electrodes available on the same face for easy soldering)	

There are some basic terms to understand the EMI technique:
Admittance: It is the ease with which flow of current from a device, and it is opposite of impedance. Admittance also measures the dynamic effects of susceptance of material to polarization. It is in the form of measurement, and its SI unit is the siemens (symbol S).
Resistance: Resistance (R) has the only magnitude but no phase, and it is the measurement of opposite to the flow of current.
Impedance: The impedance has the same function as resistance but has both magnitude and phase. It is a composition of real and imaginary parts. The real part is resistance, and the imaginary part is reactance, that shows the impeding mechanism. SI unit is ohms.

Derivation of Admittance from Impedance:
$Z = R + j x$
Z - impedance, R - resistance, X - reactance
• Impedance is the real part (resistance), and the imaginary part is (reactance).
$Y = G + j B$
$G = R/(R^2 + X^2)$
$B = -X/(R^2 + X^2)$, $j^2 = -1$

$|Y| = \sqrt{(G^2 + B^2)} = 1/\sqrt{(R^2 + X^2)}$
$Y = 1/Z = Z^{-1} = 1/(R + j X)$,
$Y = \{1/(R^2 + X^2)\} * (R - j X)$

79

Y - admittance, G - conductance, B - susceptance

- Admittance is also a complex number as impedance which is having a real part, Conductance (G) and imaginary part, susceptance (B).

RMSD: The root-mean-square deviation (RMSD) is used to measure the difference between the new values and previous values determined during data calculation. This is the RMSD % expression where G_i^1 is the current-damage conductance value at the ith measurement location, and Gi^O is the previous-damage value [3,9].

$$RMSD (\%) = \sqrt{\frac{\sum_{i=1}^{N}(G_i^1 - G_i^0)^2}{\sum_{i=1}^{N}(G_i^0)^2}} \quad x\ 100$$

Experimental Setup

The following parameters were used for the construction of the model:

- Rise = 500 mm
- Span = 1400 mm
- Rise/span ratio = 500/1400 =0.357 (>0.29 and <0.50)
- Skewback angle = 18.9 degree
- Arch thickness = 225 mm
- Abutment size = 450*450*450 mm

Design of Shape of the arch ring: To decrease the horizontal thrust and acquire economy in the design of abutments, piers and foundations, the rise of an arch must be kept as high as possible. It must not be less than 1/3 of the span but not less than 1/5 as per arch bridge code of Indian Railway Standard. According to the northern architecture, the span/ rise varies from 2:1 to 10:1, but it generally lies in the range of 3: 1 to 6:1. The ideal value of span/rise ratio is taken as 4:1.

Materials used and its proportions

- Bricks (Traditional bricks 220×110×70)
- Lime sand Mortar
- Concoction (methi + guggal + molasses)
- Steel frame for shuttering
- Piezoelectric sensors

Lime sand Mortar

Lime sand mortar prepared by mixing lime pozzolana with sand by weight batching. Mortar mix is prepared by addition of water with water lime ratio of 0.4 into by hand mixing (Figure 2). During mixing, add some natural herbs or concoction in the form of guggal, methi and jaggery to improves, durability and some other qualities [11,15]. To determine the compressive strength of lime mortar cubes are cast which were tested at 28th and 45th day.

Figure 2. Mixing of lime mortar by tilting type hand mixture

The material used and their properties are given in Table 2.

Table 2: Material Properties [1,12-15]

Mortar mix proportions		Lime mortar cube results	
Lime Pozzolana with surkhi	1 Kg	Cube size	100*100*100mm
Sand	1.34 Kg		
Concoction	0.02 litre+	**Compressive strength in 28 days**	
Mix proportion ratio	01:01.3		
Actual Quantities in the bridge model		1st cube	Max. stress = 0.994 N/mm^2
Lime Pozzolana with surkhi	100 Kg	2nd cube	Max. stress = 0.929 N/mm^2
Sand	134Kg	3rd cube	Max. stress = 0.956 N/mm^2
Concoction (guggal, methi and jaggery)	2 Litres	**Compressive strength in 45 days:**	
Water lime ratio	0.4		
Water	40 litres	1st cube	Max. stress = 1.3 N/mm^2
Brick size	220*110*70	2nd cube	Max. stress = 1.2 N/mm^2
Mortar joint thickness	10mm	3rd cube	Max. stress = 1 N/mm^2
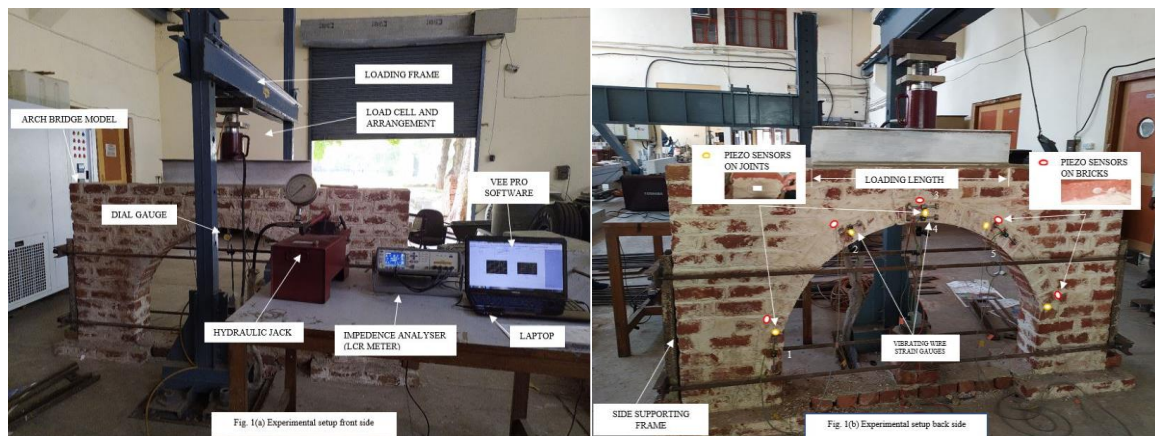
Figure 3. Investigational arrangement of masonry arch bridge with lime mortar with equipment

The investigational arrangement, as shown in Figure 3, was carried out in the laboratory. The following equipment was used in the set up:

Dial gauge: Dial gauges are measuring instruments used to measure displacements accurately.

Vibrating wire strain gauge: It functions on the principle that when a tensioned wire is plucked, then it vibrates at a frequency which is proportional to the strain in the wire.

Load cell: It works as a transducer and converts an applied force in the form of tension, compression, pressure or torque into an electrical signal that can be measured and made consistent.

Piezoelectric sensors: They are the devices which use piezoelectric effect and converts strain, temperature, acceleration, the pressure to electric charge.

Impedance analyzer: These analyzers are used to quantify and plot the composite impedance of the device which are tested over a variety of frequencies.

The side supporting frame: The behaviour of masonry arch bridges is three dimensional in real and to restrain the model we used steel side supporting frame.

Results and Discussion

The explanations for the results obtained are as per stages in all brick and joint locations (Table 3).

Table 3: Strain obtained at various stages

Stages	Load (as per UTM) (in KN)	Deflection (in mm)	Strain (in μ)				
			1	2	3	4	5
Initial	0 Load	0	1587	.....	1253	1815	1751
S-4	40	6.23	935	.....	1586	1960	2356
S-8	64	7.37	704	.....	590	2037	1378
S-10	81	8.32	1241	.....	1165	2203	1177
S-13	116	10.52	1647	.....	552	2081	1142
S-15	137	11.62	708	.....	815	2080	1605
S-16	148	12.4	780	.....	730	2070	1450
S-17	160	13.37	926	.....	790	2152	1890
S-18	172	14.02	940	.....	780	2204	1700
S-19	194	15.66	1004	.....	840	2303	1790
S-20	213	16.13	1042	.....	900	2347	1825
S-21	234	19.54	1136	.....	925	2427	1903
S-22	252	22.58	1203	.....	964	2497	1958

- Ignore the Point 2 strain gauge.

POINT 1:
- Point 1 located near the support and shows no cracks (Figure 4); hence no change in root mean square deviation (RMSD).
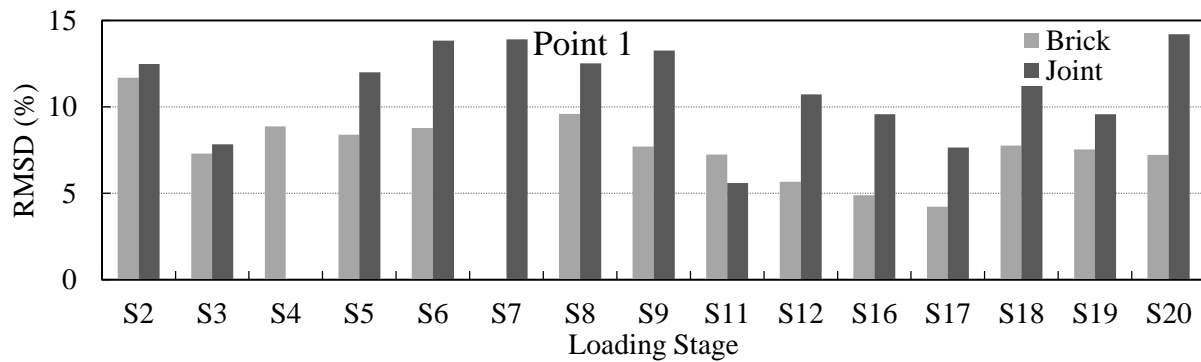
Figure 4. Results obtained in Point 1.

POINT 2:
- B-2 sensor caught the peak at S-12 stage much before the final failure, as shown in Figure 5.
- Joint J-2 also caught the failure at S-12 stage much before the final failure (at S-20 near Point 2) where it abruptly increased to a value of 13686% (not shown in the plot for clarity).
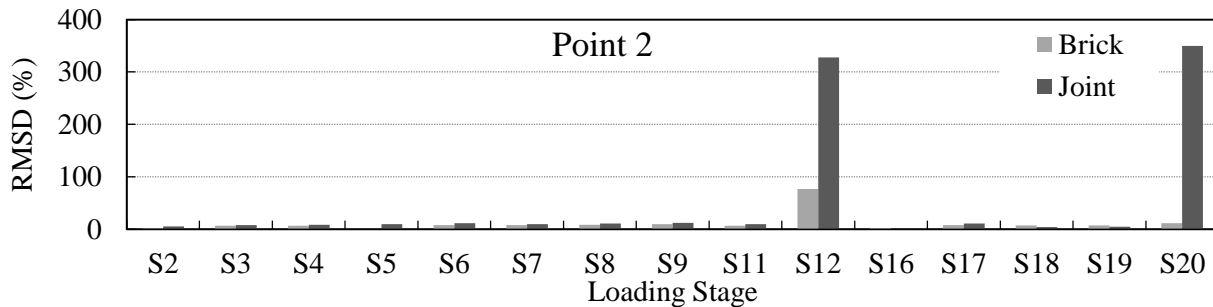
Figure 5. Results obtained in Point 2.

POINT 3:
- Point 3 located at the crown and the cracks started at S-1, S-2, S-3; therefore, RMSD increased for both joint and brick till S-3 than almost constant (Figure 6).

82

- Joint performing better in terms of consistency.
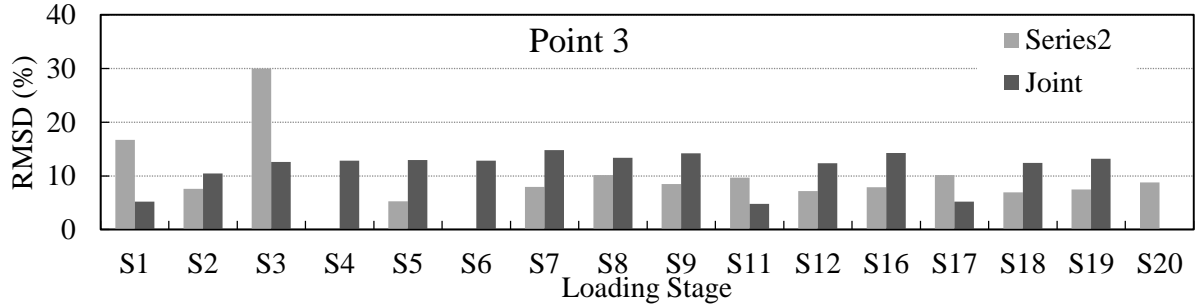
Figure 6. Results obtained in Point 3.

POINT 4:

- Brick 4 caught the damage at S-19 successfully as there was no damage or crack near point 4 before S-20 (Figure 7).
- Joint 4 was inefficient in capturing the damage at S-19.
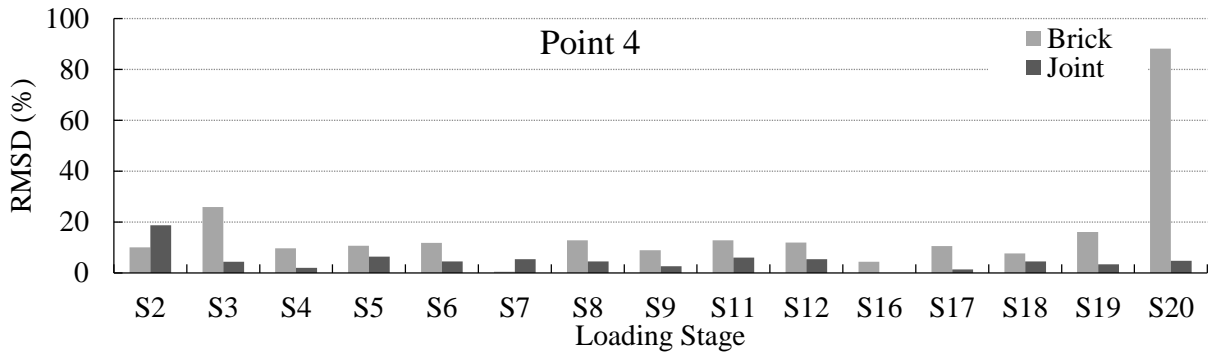
Figure 7. Results obtained in Point 4.

POINT 5:

- Similar to point 1, point 5 located near the support and shows not much damages or cracks so RMSD almost constant. (Figure 8)
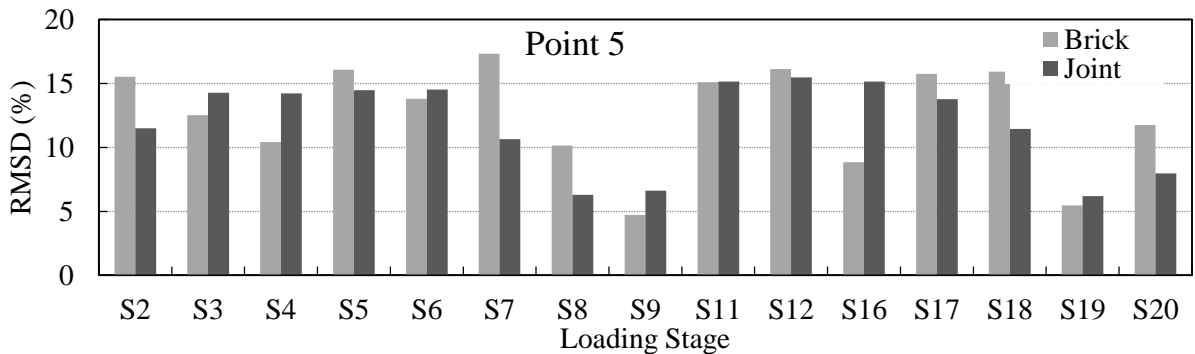
Figure 8. Results obtained in Point 5.

Figure 9. Failure of the structure
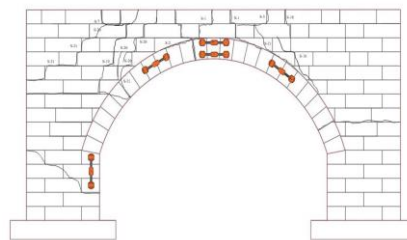
Face (a)

Figure 10. Crack mapping at every stage during the load test

Figure 9 & 10 depict the failure of the model that was developed and the cracking every stage, respectively. On collecting the experimental data and carefully examining the setup, the following results were obtained:

1. The arch action did not get activated entirely in the bridge.
2. The load was applied on the partial length 1.2m of the arch. It could have resulted in punching of the upper portion of the arch instead of activating arch action.
3. The sides of the arch bridge were restrained from providing lateral stability. The restrainment was also less till a partial height of the bridge. This is a possible reason for punching failure rather than arch failure in the bridge.
4. Before initiating the load test of the arch bridge, the cracks appeared as marked while removing the formwork on the 40th day of casting which could also have been retained for an even longer time.
5. Though cracks appeared in the arch bridge yet, it took more load than its designed strength due to long term strength properties of the lime mortar. Therefore, it establishes that the lime mortar has more long term strength as compared to other traditional building materials.

Load deflection Curve

1. Load deflection curve is generated from the load acting on the bridge model and deflections in dial gauges at every loading stage (Figure 11).
2. The curves show a linear relationship between load and deflection, in initial loading stages deflections increases as an increase in load during the initial settlement of frame and arch model.
3. After the settlement of the side supporting frame and model, the arch bridge model starts to take the load and shows less deflection than the increase in load.
4. At stage S-20 failure at point 2 and near support occurs. So, after the failure, deflection further increases with increase in load.

84
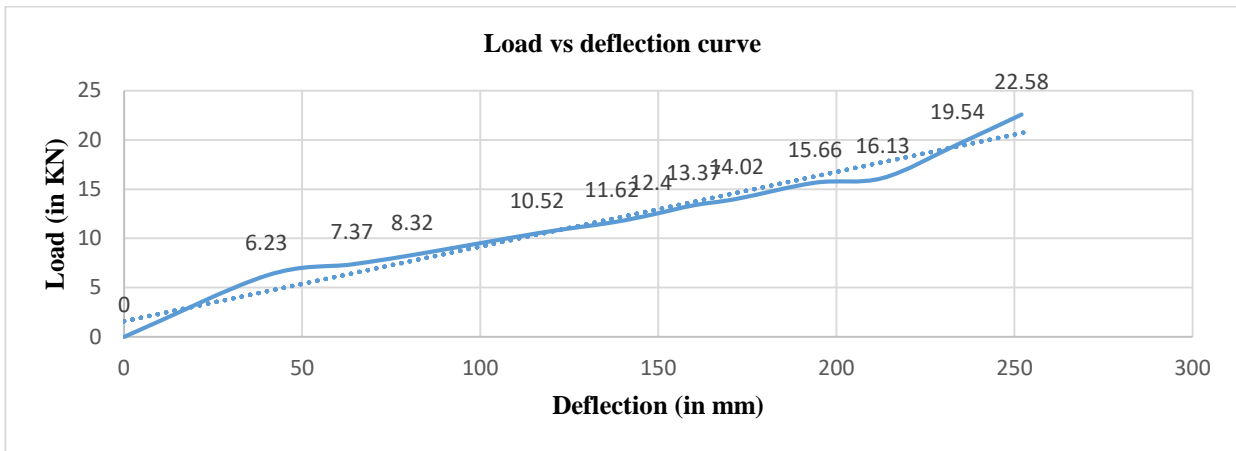
Figure 11. Load versus deflection curve

Conclusions

On obtaining the results, the following conclusions can be drawn from the present work:

1. Piezoelectric sensors successfully detected the initialization of damaged or cracks well before time in the lime mortar based masonry arch bridge.
2. Piezoelectric sensors attached on joints were more sensitive to damage in comparison to the brick piezo sensors as observed from the result of point 2, which was the most affected location by damage.
3. At location 3 also sensors on joints were more sensitive to damage in comparison to the sensors on bricks. However, both detected the damage consistently. Nevertheless, for the location, 4 sensors in brick were more sensitive to damage.
4. Point 1 and point 5 were least affected by the damage. Same was observed from the RMSD results as they remained almost constant throughout the test.

References

[1] Thirumalini, P. & Sekar, S. K. (2013), Review on Herbs used as Admixture in Lime Mortar used in Ancient Structures. *Indian Journal of Applied Research,* www.researchgate.net.

[2] Giurgiutiu, V. (2014), **Structural health monitoring with piezoelectric wafer active sensors. *Academic Press Elsavier,* <u>www.sciencedirect.com</u>.**

[3] Bhalla, S. (2004), A mechanical impedance approach for structural identification, health monitoring and non-destructive evaluation using piezo-impedance transducers, www.researchgate.net.

[4] Kaur, N. & Bhalla, S. (2016), A low-cost version of the electromechanical impedance technique for damage detection in reinforced concrete structures using multiple piezo configurations. *Advances in Structural Engineering*, ase.sagepub.com.

[5] Kaur, N. & Bhalla, S. (2017), Integration and evaluation of multiple piezo configurations for optimal health monitoring of reinforced concrete structures. *Journal of Intelligent Material Systems and Structures*, ase.sagepub.com.

[6] Kaur, N. & Bhalla, S. (2018), damage and retrofitting monitoring in reinforced concrete structures along with long-term strength and fatigue monitoring using embedded Lead Zirconate Titanate patches. *Journal of Intelligent Material Systems and Structures*, ase.sagepub.com.

[7] Negi, P. & Kaur, N. (2018), Investigations on the effectiveness of embedded PZT patches at varying orientations for monitoring concrete hydration using EMI technique. *Construction and Building Materials*, <u>www.elsevier.com.</u>

[8] Negi, P. & Kaur, N. (2019), health monitoring of reinforced concrete structures under impact using multiple piezo-based configurations. *Construction and Building Materials*, <u>www.elsevier.com.</u>

[9] Bhalla, S., Moharana, S., Talakokula, V. & Kaur, N (2017), Piezoelectric materials, applications in SHM, Wiley Athena Academic.

[10] Kaur, N. (2012), Integrated SHM and energy harvesting from thin Piezo sensor patch via axial strain actuation mode.

[11] Diamanti, N., Giannopoulos, A. and Forde, M.C. (2008), Numerical modelling and experimental verification of GPR to investigate ring separation in brick masonry arch bridges, *NDT&E International,* www.journals.elsevier.com/ndt-and-e-international.

[12] IS: 712- 1984, Indian specification for building lime, third revision, Bureau of Indian Standards, New Delhi, India.

[13] IS: 6932 (Part-1 to 10), Indian Standard Methods of tests for building limes, Bureau of Indian Standards, New Delhi, India.

[14] IS: 2250-1981, Indian standard code of practice for preparation and use of mortars, Bureau of Indian Standards, New Delhi, India.

[15] Bayraktar,O Y, Cgtoglu, G.S. and Aisha, A. E. S. (2019), Performance Research of Lime Based Mortars, *International Journal of Trend in Research and Development*, www.ijtrd.com.

Analysis of Tall Structure with Different Lateral Force Resisting System

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Abstract: Due to a lack of design to face wind loads, as the cross-section decreases the stability reduces. And these structures are more prone to earthquakes and wind. Therefore, much research is proceeding to balance out the structure from an increasingly affordable perspective. To know the best performance and economical for the lateral force-resisting system of different types of 30 story buildings are modeled in ETABS, assuming the site location as BHUJ Gujarat, India. For the different structural systems that are compared for minimum story displacement and minimum story drift, these are the qualities that characterize the human comforts for the structure. the structural system which used are conventional, shear wall, truss belt, outrigger and diagrid are used to compare the best performance of the structure

Keywords: Conventional, Shear-wall, Truss-belt, Outrigger, Diagrid, Response spectrum, ETABS.

Introduction
The community among the urban areas is expanding each day, accordingly, the rate concerning cost is increasing then vegetation is diminishing, because of humbled vegetation illness is expanded, in that circumstance, new improvement strategies are rehearsing according to failure whole the issues of precious building development. As required of high rise development is increasing, such will increase the improvement concerning economics, aesthetics, technology, then other things. Mainly the financial system is the governing element [1]. At the factor then the great shape begins growing higher, started out confronting numerous troubles as fabric selection, wind and earthquake governing, and other things. To tack care this problem appropriate lookup is directing in imitation of finding a recent solution, to stable, the current structural systems are started out working towards kind of a shear wall, truss belt, outrigger, and diagrid. It is important to know how these structures behave during wind and earthquake.

Literature Review

Numerous speculations have been proposed to explain how the structure behaves under lateral force. Although the literature review covers a wide variety of theories, this will review will focus on some major aspects on how the different type of structure will act under the influence of lateral force and other things like the importance of the structural system in tall structures how the building will act with and without lateral stability systems and how they influence the economy and the future trends.

- Raju et al. (2019). Worked on how the shear wall in a building increases performance. He has given complete details on how the shear wall plays an important role in the seismic zone and how to place the shear wall economically in the building.
- Bhavsar et al. (2019). worked on how the story displacement is reduced due to the shear wall, how the shape of the shear wall will affect the building performance both in X and Y direction, and the increase in the percentage of the shear wall how it will influence the stiffness of the building.
- Kala et al. (2017). worked on how the outrigger and truss belt system influence on lateral behavior of the structure and the optimum location of the outrigger and truss belt system under the wind load is 0.25-0.33 times the height of the building for the wind loads.
- Khanorkar et al. (2016). worked on the various techniques and methods used to investigate the uses of truss belts and outriggers in tall structures. He differentiated the deflection criteria and bending moment criteria.
- Tavakoli et al. (2019). worked on the analysis of the outrigger and truss belt system and how the soil structure interaction effects on the best location of the truss belt and outrigger system also analysis is done for inelastic analysis for both with a fixed base and with soil-structure interaction.
- Ganatra et al. (2017). worked on 50 story outrigger system for varying depth. For 50 story building decrease in depth of outrigger in building to 2/3 rd,1/3 rd. and 1/2 reduces the lateral displacement up to 3%-4% and 5%-6%. and also worked not only on how to control lateral displacement but also on how to control inter-story drift.
- Shah et al. (2016). Has analyzed a work on the behavior of outriggers in tall buildings, from the work it is known that by using the virtual outrigger it reduces the load on the structure and structurer made economical, and by seeing the comparison from the virtual outrigger to conventional outrigger with truss belt, a combination of

outrigger and truss belt perform better.
- Jani et al. (2012). Had worked on analysis and design of diagrid structures for 36 floors, he concluded that the most of the lateral load is observed by diagrid structures, while other loads are taken up by both internal columns and diagrids, and by providing diagrid structures how we can maximize the interior space.
- Moona, (2011). worked on diagrid structural performance and constructability issues for complex shape structures, by the unique compositional characteristics of diagrid for good structural efficiency.
- Nawale et al. (2017) have analyzed both conventional and diagrid structures it is known that in the material point of view the diagrid structure uses less material without compromising the stability of the structure and due to the presence of the diagonals, and how the inner column is not affected by lateral loads so they only take gravity loads.
- Somvanshi et al. (2019). Has worked on comparison on orthogonal and diagrid structure concluded that the diagrid structures have a lesser time period when compared to orthogonal and the cost is the same for both the structural system.
- Lee et al. (2014). Analyzed a wok on high strength steel tube for diagrid structure using triz by conducting non-linear pushover analysis from the results, a convex-shaped is being an improvement for the new structural details of the existing diagrid in tall buildings, he also has given the idea on applications of diagrids in the structure in the field of architecture and civil engineering.
- Moon (2011). Worked on the design of the diagrid structural system he has concluded that the varying angle of diagrid configuration can produce a different result for tall structures under lateral loads and it can be known that the importance of the diagrid structural system in high rise building.
- Manikandan (2016). Has worked on the skyscraper design and behavior of steel structures form construction point of view, he has reviewed that the while construction of tall structures proper design and proper planning is needed and what are the precaution needs to be taken for the steel structures and connections.
- Kachchhi et al. (2019), has done work on comparative analysis on diagrid with another structural system, form the study it is concluded that the diagrid performs better than other structural system and also discussed how it affects the increase in base shear in diagrid structural system.
- Lee et al. (2010). Has analyzed a diagrid for the tall building based on the optimized diagrid angle and to understand the global diagrid mechanism by using the topological technique.

Methodology

This section will give the framework of research techniques that are followed in this examination, it gives the data on how the information is gathered to play out the investigation, in this model shear wall, truss belt, outrigger, diagrid, and viscous damper are considered, these auxiliary frameworks are displayed in ETABS to fulfill the aim and objectives. Much research has been done to know the performance of diagrid and other structural systems but here we will be discussing how all the structures will behave and by choosing the best performance while comparing them to each other by drift, displacement, time period, and consumption of steel.

Fundamental Assumptions for Analysis
- The material of the structure is continuous and elastic.
- The relation between stress and strain is linear.
- The deformation of the building is caused due to the applied loads are small and do not change the original design diagram.
- The superposition principle is applicable.

Assumptions for Modelling
- Analysis components are lined up with the highest points of steel bars in floors in this way overlooking the little counterbalances in the focus line between light emissions profundity.
- The horizontal offset of edge beams is usually small enough to be ignored.
- All columns are typically modeled as being co-linear along their centerline.
- Small offsets of columns from grids are typically ignored in design.
- To ensure that all the lateral loading is carried by the braced or moment frame, it is typical to assume that all they are columns not in braced bays or moment frames are pinned at each floor level, so they do not attract lateral loads.

Models

1.Conventional System

In the conventional structural system, all the frame members are of special moment resisting frame with no additional lateral force resisting system is considered, considering the conventional system as a reference for comparing to other lateral force resisting system to find out the objectives mentioned. *Fig .1.*
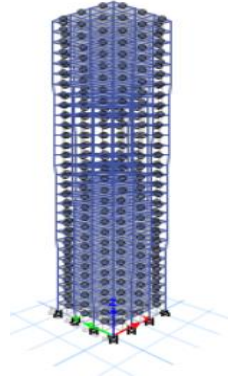
Figure 1. Conventional System

2. Shear Wall Structural System

Shear wall act as a panel for horizontal loads, in the model shear wall, is assigned at all corners of the building from top to base of the structure. *Fig 2*
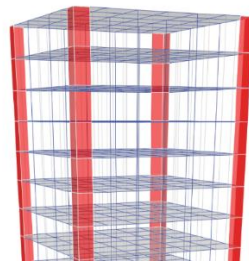
Figure 2. Shear Wall System

3.Truss Belt And Outrigger System

Truss belt (*Fig 3 & Fig 5)* and outrigger *(Fig 4)* which is provided around the building are tied to the core structure, where the truss belt is provided at the top base and middle of the structure and outrigger is provided at the economical height of the structure to obtain best results.
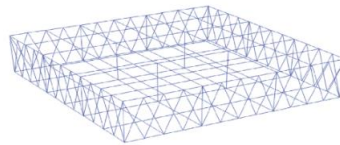
Figure 3. Truss Belt System
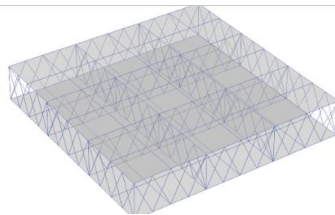
Figure 4. Outrigger Structural System
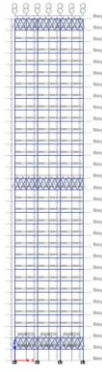
Figure 5. Truss Belt System Elevation View.

4.Diagrid Structural System

For the Diagrid structural system, the diagrids are provided at the exterior to resist lateral loads and the interior column to take up gravity loads, the optimum angle is considered as a 60-75 degree from previous studies. To obtain the best results.
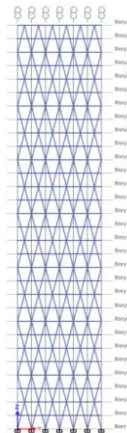
Figure 6. Diagrid Structural System
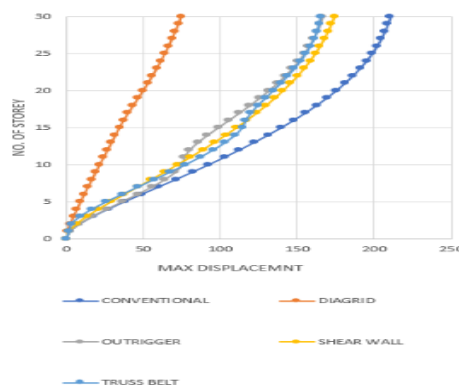
Figure 7. Maximum Displacement
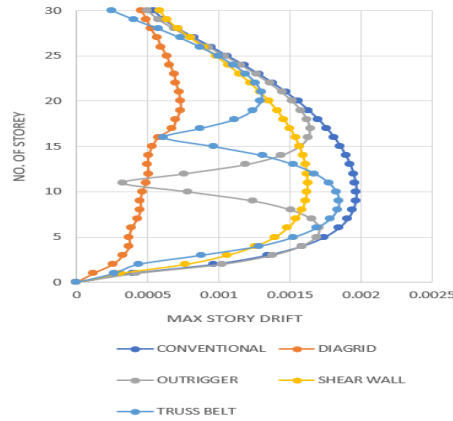
Figure 8. Maximum Drift
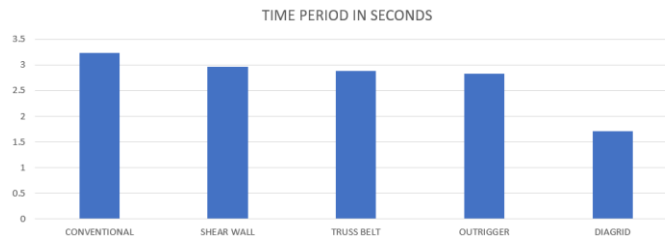
Figure 9. The time period in seconds.

Results and Discussion

1. Conventional system: As found in the figure the traditional framework gives the most extreme displacement *(Fig 10),* drift *(Fig 11),* and time period *(Fig 12).* Because the conventional system does not have any lateral force-resisting system. The results of the conventional model are similar to the reviewed paper (Kachchhi.M).

2. Shear wall: as the shear walls are provided in all corners it reduces the maximum displacement *(Fig 10),* drifts *(Fig 11),* and time period *(Fig 12)* compared to the conventional structural system, and it uses less steel compared to all the structural systems in terms of drift and displacement, and the graph of the shear wall gives the smooth curve from the bottom to top showing the same graph as the conventional system but showing minimum values.

3. Truss belt and outrigger: When this structural system compared to the shear wall and conventional, it shows minimum displacement *(Fig 10),* the graph indicates the curve increases progressively to the top floor, drift (Fig 1*1),* the graph shows the minimum value in the center because of the provided truss belt system in the middle. and time period *(Fig 12)* but steel consumption of these structures slightly increases due to the addition of truss inside the structure. Both the system behaves the same but outrigger gives less minimum value.

4. Diagrid structural system: when compared to other structural system diagrid gives minimum displacement *(Fig 10),* the curve represents an inclined line by an increase in values because of the diagrids are provided at the periphery of the structure, drift *(Fig 11),* for the drift curve it shows minimum then all other structural system and it has a lesser time period *(Fig 12)* because of the stiffness of the structure due to diagrids, that are provided from bottom story to top story, but the quantity of steel consumption slightly increases then the shear wall. Because total vertical loads are taken by inside columns due to this reason the interior column size increases then other models and maximum lateral loads are taken by diagrid which is provided on the exterior side so the steel sections increase at the bottom increases when compared to the top floor.

When compared to conventional to other structural system considering Displacement, the Shear Wall gives 17% of the best result, Truss Belt gives 21% result, Outrigger gives 21% result, diagrid gives 64% result, when considering Drift, the Shear Wall gives 17 % of the best result, Truss Belt gives 7.1 % result, Outrigger gives 60% result, diagrid gives 76% result,

91

Conclusion

- Comparing the shear wall system, truss belt system, outrigger system, and diagrid structure system, Diagrid performs better in terms of displacement, drift, and time period.

- When compared to conventional to other structural system considering Displacement, the Shear Wall gives 17% of the best result, Truss Belt gives 21% result, Outrigger gives 21% result, diagrid gives 64% result,

- when considering Drift, the Shear Wall gives 17 % of the best result, Truss Belt gives 7.1 % result, Outrigger gives 60% result, diagrid gives 76% result,

References

1. Ali. Mir M & kyoung Sun Moon,2007. Structural developments in tall buildings: current trends and feature prospects. Architectural science review, vol 50.3, p 205-223.
2. Alam,2017. Innovative Structural Concept & Solution for Mega Tall Buildings Applied to One Kilometer Skyscraper, Open Access Library Inc.Vol 4,e3459.
3. Bhavsar, Rathva, S.B, D.P, 2019. Optimization of G+7 Storeyed Rcc Building with Different Positioning of Shear wall. International journal of advanced engineering and research development 6, Special Issue 01.
4. Chandrasekar,Karthikeyan.K,Thangakathiravan.T,G.A.,P.R.,2015. Planning and Structural Analysis of Trophy Shape Skyscraper, vol 0, Issue 03.
5. CTBUH Council on Tall Buildings and Urban Habitat (2016), https://www.ctbuh.org/resource/height.
6. Ganatra.V.P,Jhummarwala.R.A, Dr. Parikh.K.B.,2017. Study on Behaviour of Outrigger System on High Rise Structure by Varying Outrigger Depth,.International Journal for Research in Applied Science & Engineering Technology, Vol 5, issue 9.
7. Kachchhi.M. J, S.V.M, V.B.P,2019. Comparative study of Diagrid structure with other structural systems for tall buildings. Global journal of engineering science and researches. ISSN 2348-8034.
8. Kala,Mangulkar.M, Jain. I, 2017. The use of outrigger and belt truss systems for high rise buildings. International Journal of Civil Engineering and Technology, vol 8, issue 7.
9. Khanorkar.A.A, Mr. S. V. Denge ,2016. Belt Truss as Lateral Load Resisting StructuralSystem for Tall Building: A review.Global Research and Development Journal for Engineering, vol 2, Issue 10.
10. Lee, U.S, and Shin,2010. Optimized Topology Extraction of Steel-Framed DiaGrid Structure for Tall Buildings. International Journal of Steel Structures, Vol 10, No 2,157-164.
11. Modelling and analysis, Steel construction info, https://www.steelconstruction.info/Modelling_and_analysis.
12. Milana, Olmati.P, K. G, F. B,2015. Ultimate Capacity of Diagrid System for Tall Buildings in Nominal Configuration and Damaged State. RPeriodica Polytechnica Civil Engineering .59(3),pp.381-391.
13. Moon (2016), Diagrid System for Structural design of complex-Shaped Tall Building.The Twelfth East Asia-Pacific Conference on Structural Engineering and Construction. Vol 5, No 4, 243-250.
14. Nanduri.R.K., Suresh.B, Hussain.I., 2013. Optimum Position of Outrigger System for High-Rise Reinforced Concrete Buildings Under Wind and Earthquake Loadings. American Journal of Engineering Research, vol 02, Issue 08.pp-76-89.
15. Parekh,Dhandha.K.J,2016. Study on position of outrigger system in tall structure. Journal of Emerging Technologies and Innovative Research, vol 03, Issue 05.
16. Raju, Readdy.S.R, 2019. Dynamic analysis of regular and irregular high-rise buildings under the influence of shear walls by using ETABS. Journal of applied science and computations, vol 6 issue 2.440-448.
17. Szolomicki.J, Szolomicki.G.H, 2017.Application of the diagrid system in modern high rise buildings. International Journal of Advances in Science Engineering and Technology,volume-5, issue-3.
18. Shah, Gore .N.G.,2016. Review on Behavior of Outrigger System in High Rise Building. International Research Journal of Engineering and Technology, vol 03, Issue 06.
19. Somvanshi,T.R, Kolase,P.K, V. R. R,2019. Comparative analysis and design of diagrid structure and orthogonal structure. International Journal of Engineering Development and Research.vol 7, issue 3.
20. Skyscraper Center, (2016). http://www.skyscrapercenter.com/building/capital-gate-tower/3172.
21. Tavakoli,Kamgar.R, R .R,2019. Seismic performance of outrigger–belt truss system considering soil-structure interaction, international journal of advanced structural engineering. (https://doi.org/10.1007/s40091-019-0215-7).

Advancements in the Field of Neurotechnology

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Abstract: Advancements in the field of artificial intelligence, the Internet of things, robotics, nanotechnology, and genetic engineering have all contributed to the enhancement of medical technology. Neurotechnology is one of the most fascinating yet controversial branch of medical technology. The field promises a lot and may even hold the clue for the next industrial revolution. This paper aims to give an introduction and an overview of the interdisciplinary field of neurotechnology. The paper discusses the two most essential areas of neurotech – neurorecording and neurostimulation, and their application in the treatment of genetic and degenerative neurological diseases. Since a lot of research is going on in this field, there was a need to review the current state of the art. This paper provides a brief yet comprehensive study of the available technologies. The future prospectus and related ethical issues of the area are also discussed.

Keywords: Neurotechnology, Brain implants, Neuroprosthetics, Neurostimulation, Brain-computer Interface, Neuroimaging.

Introduction

Neurotechnology can be defined as any method or tool that helps us visualize and understand the brain, various aspects of consciousness, thought, and other cognitive functions. It also includes technologies that are designed to enhance [1] and repair brain function. Science fiction has always popularized neuroscience, but recent advancement has brought many of those imaginative technologies under the realm of science.

Neurotechnology has more than 100 years of history, although rapid development began only after the development of imaging technologies. In 1875, R Caton published the first detail of the oscillatory activities of the brain [2]. The year 1985 marked a new era of magnetic stimulation research as A. Barker et al. demonstrated the ability of a non-invasive alternating magnetic field to cause muscle contraction by affecting the central nervous system [3]. The number of studies in this area has been steadily increasing over the past 10 years. This trend can be seen by plotting the number of scientific papers (figure 1) published in peer-reviewed scholarly journals [4].
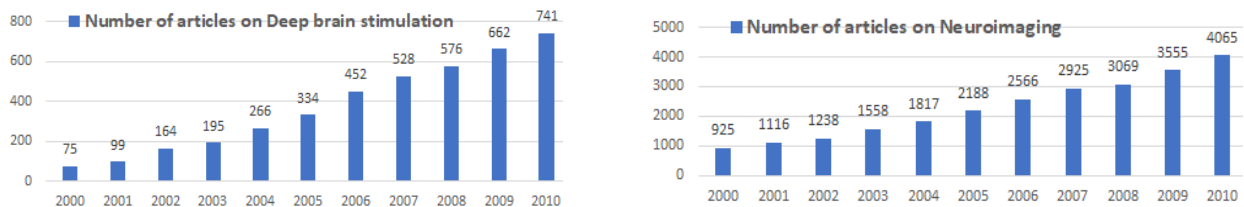
Figure 1. Number of studies done by year in the field of neurotechnology. Reprinted from Neurotechnology Premises, Potential, and Problems, by James Giordano, 2012.

The question of why we need neurotechnology and if it's worth promoting cannot be answered in a single statement. Many questions arise whenever any new technology emerges, especially something that can change not only the world but also ourselves and what we define as humans. Apart from improving the individual health and quality of life, how does it impact society when societal norms, freedom of decision, and legal aspects of behaviour are concerned? Answers to such queries need an understanding of technical fundamentals of pros and cons, opportunities, and threats of the current state-of-the-art of the field.

This paper gives an insight into the field of neurotechnology and introduces its major components enabling the reader to make an informed opinion about this new class of medical technologies. The paper also speculates about the potential applications, and discuss the issues that may come with a neuro-technologically powered future. Of the quickly expanding scope of this field, this paper discusses the most fundamental components – Neurorecording and Neurostimulation.

Neurorecording

Various invasive and non-invasive methods for observing brain activities are available. Modalities like electroencephalography (EEG), functional magnetic resonance imaging (fMRI), magnetoencephalography (MEG) and functional near-infrared spectroscopy (fNIRS) are non-invasive. EEG has precise temporal resolution [5], is relatively inexpensive and portable but its spatial resolution is low and it picks up a lot of electrophysiological noise, eye movements, neck muscles, etc. fNIRS measures the oxygen levels of blood in the brain, which is delayed by a few seconds, but it has better spatial accuracy [6], and it is much more robust to electrical noise than EEG. Hence integrated EEG-NIRS acquisition hardware [7] can be promising in getting neurotechnology outside the lab and detecting clear signals in the noise of daily chores. fMRI has a high spatial resolution. It has been used to show that patients with disorders of consciousness do understand and respond to instructions [8-10]. But it has a low temporal resolution, is expensive, and includes big equipment. Also, the subject needs to be in the scanner while recording. Hence, it isn't suitable for daily-life human augmentation applications [11]. MEG measures the magnetic fields of electric currents in the brain [12]. It requires a magnetically-shielded lab, which is bulky and expensive. It is usually combined with MRI to get what is called magnetic source imaging (MSI).

   Invasive methods involve inserting the electrodes into the brain through surgery. So, although they are unaffected by the disturbances caused by the skull or the scalp, they are more risky, expensive, and have associated ethical issues. Electrocorticography (ECoG) [13] is similar to EEG but the electrodes are placed onto the cortex. ECoG can record activities from only a small area of the cortex. Although EEG is reliable it provides low bandwidth. Microelectrode arrays that are inserted into the cortex can provide higher bandwidths. Since each electrode records the activity of a single or a few neurons, the signals are very detailed and hardly affected by noise. Due to the presence of multiple pads on the surface and an elongated shape, these electrodes allow precise and highly dense multi-recordings. Ceramic-based microelectrodes are strong and prevent cross-talk between recording sites [14]. The technology has been used to interpret the subject's intention of moving the arms from the electric activities of motor and parietal cortices [15–17]. So far, studies have been done mostly on humans with motor disabilities due to the associated risks and ethical issues [18,19]. These invasive techniques cover limited regions of the brain, though high-density probes are being developed [20,21]. Optical cellular imaging technology promises a lot in this regard. The influx of calcium ions due to the action potential can be measured optically in neurons expressing genetically encoded calcium indicators (GECI) [22,23]. Through a glass window on the skull, millions of neurons were recorded in mice [24]. Viral delivery methods can also be used for the genetic construct to induce the expression in non-transgenic beings, like the ones used for gene therapy in humans [25].

Figure 2. Comparison of various modalities for recording and stimulating brain activity based on temporal resolution, spatial resolution, invasiveness (circle vs. square), and portability(color). Reprinted from Neurotechnologies for Human Cognitive Augmentation: Current State of the Art and Future Prospects, by Cinel C, Valeriani D and Poli R, 2019.
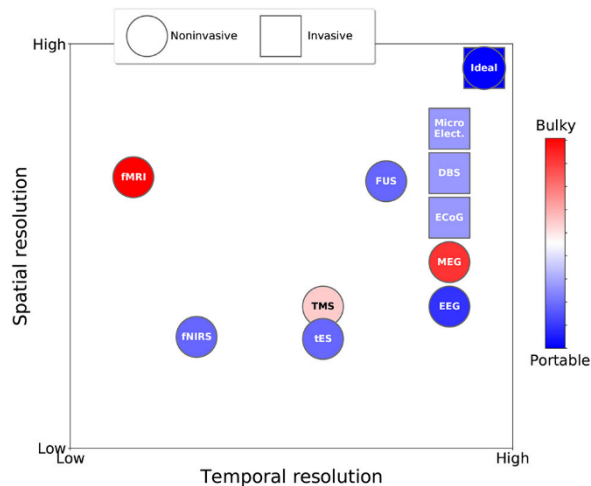
Neurostimulation

Non-invasive methods for influencing neural activity include transcranial magnetic stimulation (TMS), transcranial electrical stimulation (tES), and focused ultrasound (FUS). In TMS, strong currents flowing in a coil are used to produce a magnetic field which further induces electric currents in the cortex [26]. The coil is placed on the scalp, which doesn't allow the electromagnetic waves to be focused precisely resulting in low spatial resolution. Moreover, stimulation of deeper structures also results in the simultaneous stimulation of shallower ones [27]. TMS is bulky and not appropriate for day to day applications. In tES, direct (tDCS) or alternating (tACS) [28] current is infused through electrodes fixed to the scalp. A small amplitude of 2 mA is used for not more than 30 minutes. There are concerns about its non-invasiveness [29], the effects of prolonged use [30], and the inconsistency in outcome across different subjects [31]. FUS is quite new and still under experimentation. It focuses low-intensity ultrasound waves onto a brain region to produce excitation or inhibition of the neurons [32]. This technique does not affect the untargeted regions

traversed by the waves while converging onto the desired area. The spatial and temporal resolutions are also high. Figure 2 compares the different neurorecording and neurostimulation techniques discussed.

Invasive neurostimulation includes deep brain stimulation (DBS). Herein, a stimulation electrode is implanted into deeper parts of the brain (basal ganglia usually), which deliver electrical currents to modify the neuronal activity in the targeted area. It is generally performed on both sides of the brain. It involves a Neurostimulator, a battery-powered pacemaker to create electric pulses. It is placed under the skin of the chest and is connected to the electrodes through a wire running under the skin. Likewise, implanted microelectrode arrays are also used for neurostimulation. They have been used to transfer information acquired from the brain of one rat to that of another [33,34] and to improve memory [35]. Many applications of DBS have FDA approval, like its use to treat Parkinson's, cochlear implants for hearing loss [36], and a visual prosthesis that can restore some vision [37]. In Parkinson's, DBS can reduce patients' reliance on drugs for symptom relief, lowering drug side effects by 44% [38]. DBS also has an FDA Humanitarian Device Exemption to treat the obsessive-compulsive disorder. The method is also promising in conditions, such as treatment-resistant depression and dementia [39].

Neurostimulation has tremendous potential in both medicine and cognitive science. Initiatives like SPARC and BRAIN [40] are developing methods to automatically detect and prevent epileptic seizures. Researchers have developed unprecedented biodegradable and bioresorbable electronic medicine. They are wireless devices that speed-up nerve regeneration and can improve the healing of damaged nerves [41]. To treat paralysis, the Battelle NeuroLife Neural Bypass Technology skips the damaged region of the nervous system, allowing the brain to communicate directly with the muscles [42]. This can allow paralyzed patients to regain natural control of their muscles, eliminating the requirement of any prosthesis. Neurostimulation techniques are also being applied to restore and even improve vision. The primary visual cortex is the most studied region of the brain. It contains a 2D map of the visual field. Its stimulation elicits the perception of small dots of light (known as phosphenes) at the corresponding location on this map [43]. In a study [44], intracortical multiple electrodes were used to stimulate a pattern of neurons in the visual cortex. Hence, pixel by pixel primitive visual percepts were built. Stimulation in the higher visual cortex evokes much distinct percepts, such as the shape of faces [45,46], depth, and motion [47,48]. Stimulating higher brain areas can directly influence a subject's emotions and behavior. In a few studies, the behavior of animals- sex, appetite, and thirst, could be controlled by stimulating the hypothalamus and nearby areas [49,50]. Complex cognitive tasks like memory and attention can also be manipulated. Penfield showed that by stimulating the temporal lobes of a patient, vivid recollections of memories could be evoked [51]. Sensory brain areas are the most advisable stimulation targets to evoke percepts without contravening the subject's autonomy. But in BCI (Brain-Computer Interface) applications where influencing the behavior is desired, like in eating disorders [52] or addictions, then stimulating the applicable higher-order brain areas is viable. A versatile approach is to affect behavior indirectly by stimulating circuits that process punishments and rewards. Researchers could reinforce the desired behavior of animals by stimulating dopamine neurons in the ventral tegmental region [53,54] and curb undesired behavior by triggering neurons that mediate repugnance. Using such approaches to humans requires thorough consideration as they may interfere with one's freedom of choice. In the future, neuroprosthetics can aim to simultaneously stimulate multiple brain regions to elicit much vivid and detailed sensations. Primary percepts evoked in lower regions can be complemented with semantic features evoked in the higher regions.

A much recent method is the use of optogenetics for stimulation. The neurons are genetically modified to express light receptors in their membranes [55]. Light of specific wavelengths can be used to either excite or inhibit these neurons, which can be simply controlled externally by switching the light source on or off. This new technique can also be suggested for targeted inhibition in case of epileptic seizures. Since it involves genetic manipulation- efficiently carried out by engineered viruses, much additional research, and methodological verification is required before it can be safely administered on humans. A wearable single-photon microscope [56] makes the technology less bulky and appropriate for clinical use. These optical methods have huge potential for therapeutic applications.

A closed-loop interaction of brain recording and stimulation systems is the subject of recent works. The combined application of brain reading and brainwriting, for which stimulation depends on synchronously monitored brain activity, together with artificial intelligence will make for a much robust and adaptive system. The feedback can be used to control the electrical stimulator to stimulate only when the intervention is required. This can increase battery life while reducing the risks of potentially harmful effects.

Conclusion

Cognitive decline and disorders are well established as a normal part of aging. By 2050, 2 billion people will be over the age of 60. Hence, advancement in neurotechnology is crucial in improving the lives of many. For now, much of the field is restricted to medical contexts. But as we gain significant confidence in the technologies, they may be used as a general optional procedure for cognitive and lifestyle enhancements. Today, smart devices together with the

internet already provide a cognitive boost. But a bottleneck is faced in the bandwidth of human-machine interactions: it takes time to type text or understand information on the screen. The primary goal of BCI is to establish a direct connection between the computer and the brain, hence increasing the speed of information transfer by many folds. This can take us from movement to mind-controlled machines. Machines that are an extension of ourselves may become machines integrated into ourselves, increasing our productivity by many folds. The first milestone on our roadmap towards cognitive enhancement includes a detailed understanding of the complex neural code, for which, neurorecording techniques will play a lead role.

A much more abstract concept is the application of neurotechnology in forming a tertiary layer of artificial intelligence (AI) over human intelligence enabling us to cope up with the exponentially rising capabilities of AI. It may even pave the way to better understand consciousness and even manipulate it. Will our brains and the consciousness slowly adapt to include a BCI? What if we can interface the thought processes of many individuals together, over the internet?

As with every emerging technology, there are ethical, legal, and social concerns. The issues of autonomy, privacy, and the possibility of hacking or spamming are some of the most disputed topics. The risks of brain surgeries do not yet outweigh the benefits of enhanced cognition for healthy humans. This paper aims to present an optimistic view of the technology. With all the proposed value comes a strong need for discussion and guidelines, and this is the right time for it.

References

1. Cinel, C., Valeriani, D., & Poli, R. (2019). Neurotechnologies for human cognitive augmentation: current state of the art and future prospects. *Frontiers in human neuroscience*, *13*, 13.
2. Caton, R. (1875). The electric currents of the brain. *Br Med J*, *2*, 278.
3. Barker, A. T., Jalinous, R., & Freeston, I. L. (1985). Non-invasive magnetic stimulation of human motor cortex. *The Lancet*, *325*(8437), 1106-1107.
4. James Giordano (Ed.). (2012). Neurotechnology Premises, Potential, and Problems. Boca Raton, FL: *CRC Press.*
5. Niedermeyer, E., & da Silva, F. L. (Eds.). (2005). *Electroencephalography: basic principles, clinical applications, and related fields*. Lippincott Williams & Wilkins.
6. Ferrari, M., & Quaresima, V. (2012). A brief review on the history of human functional near-infrared spectroscopy (fNIRS) development and fields of application. *Neuroimage*, *63*(2), 921-935.
7. von Lühmann, A., & Müller, K. R. (2017, July). Why build an integrated EEG-NIRS? About the advantages of hybrid bio-acquisition hardware. In *2017 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)* (pp. 4475-4478). IEEE.
8. Owen, A. M., Coleman, M. R., Boly, M., Davis, M. H., Laureys, S., & Pickard, J. D. (2006). Detecting awareness in the vegetative state. *science*, *313*(5792), 1402-1402.
9. Owen, A. M., & Coleman, M. R. (2008). Functional neuroimaging of the vegetative state. *Nature Reviews Neuroscience*, *9*(3), 235-243.
10. Monti, M. M., Vanhaudenhuyse, A., Coleman, M. R., Boly, M., Pickard, J. D., Tshibanda, L., ... & Laureys, S. (2010). Willful modulation of brain activity in disorders of consciousness. *New England Journal of Medicine*, *362*(7), 579-589.
11. van Erp, J. B. F., Lotte, F., and Tangermann,M. (2012). Brain-computer interfaces:beyond medical applications. *Computer -IEEE Computer Society*. 45, 4 (2012) 26-34.
12. Hämäläinen, M., Hari, R., Ilmoniemi, R. J., Knuutila, J., and Lounasmaa, O. V. (1993). Magnetoencephalography theory, instrumentation, and applications to noninvasive studies of the working human brain. *Rev. Mod. Phys.* 65, 413–497.doi: 10.1103/RevModPhys.65.413
13. Wyler, A. R. (1987). Electrocorticography. In *Presurgical evaluation of epileptics* (pp. 183-191). Springer, Berlin, Heidelberg.
14. Hampson, R. E., Coates, T. D., Gerhardt, G. A., & Deadwyler, S. A. (2003, September). Ceramic-based microelectrode neuronal recordings in the rat and monkey. In *Proceedings of the 25th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (IEEE Cat. No. 03CH37439)* (Vol. 4, pp. 3700-3703). IEEE.
15. Velliste, M., Perel, S., Spalding, M. C., Whitford, A. S., & Schwartz, A. B. (2008). Cortical control of a prosthetic arm for self-feeding. *Nature*, *453*(7198), 1098-1101.
16. Schaffelhofer, S., Agudelo-Toro, A., & Scherberger, H. (2015). Decoding a wide range of hand configurations from macaque motor, premotor, and parietal cortices. *Journal of Neuroscience*, *35*(3), 1068-1081.
17. Musallam, S., Corneil, B. D., Greger, B., Scherberger, H., & Andersen, R. A. (2004). Cognitive control signals for neural prosthetics. *Science*, *305*(5681), 258-262.

18. Brumberg, J. S., Nieto-Castanon, A., Kennedy, P. R., & Guenther, F. H. (2010). Brain–computer interfaces for speech communication. *Speech communication*, *52*(4), 367-379.
19. Kennedy, P. R., Kirby, M. T., Moore, M. M., King, B., & Mallory, A. (2004). Computer control using human intracortical local field potentials. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, *12*(3), 339-344.
20. Qiao, S., Brown, K. A., Orsborn, A. L., Ferrentino, B., & Pesaran, B. (2016, August). Development of semi-chronic microdrive system for large-scale circuit mapping in macaque mesolimbic and basal ganglia systems. In *2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)* (pp. 5825-5828). IEEE.
21. Jun, J. J., Steinmetz, N. A., Siegle, J. H., Denman, D. J., Bauza, M., Barbarits, B., ... & Barbic, M. (2017). Fully integrated silicon probes for high-density recording of neural activity. *Nature*, *551*(7679), 232-236.
22. Chen, T. W., Wardill, T. J., Sun, Y., Pulver, S. R., Renninger, S. L., Baohan, A., ... & Looger, L. L. (2013). Ultrasensitive fluorescent proteins for imaging neuronal activity. *Nature*, *499*(7458), 295-300.
23. Sofroniew, N. J., Flickinger, D., King, J., & Svoboda, K. (2016). A large field of view two-photon mesoscope with subcellular resolution for in vivo imaging. *Elife*, *5*, e14472.
24. Kim, T. H., Zhang, Y., Lecoq, J., Jung, J. C., Li, J., Zeng, H., ... & Schnitzer, M. J. (2016). Long-term optical access to an estimated one million neurons in the live mouse cortex. *Cell reports*, *17*(12), 3385-3394.
25. Dunbar, C. E., High, K. A., Joung, J. K., Kohn, D. B., Ozawa, K., & Sadelain, M. (2018). Gene therapy comes of age. Science 359, eaan4672.
26. Walsh, V., & Cowey, A. (2000). Transcranial magnetic stimulation and cognitive neuroscience. *Nature Reviews Neuroscience*, *1*(1), 73-80.
27. Epstein, C. M. (2014). Promise and perspective in transcranial magnetic stimulation. *Clinical neurophysiology: official journal of the International Federation of Clinical Neurophysiology*, *125*(6), 1077.
28. Moreno-Duarte, I., Gebodh, N., Schestatsky, P., Guleyupoglu, B., Reato, D., Bikson, M., & Fregni, F. (2014). Transcranial electrical stimulation: transcranial direct current stimulation (tDCS), transcranial alternating current stimulation (tACS), transcranial pulsed current stimulation (tPCS), and transcranial random noise stimulation (tRNS). In *The stimulated brain* (pp. 35-59). Academic Press.
29. Davis, N. J., & Koningsbruggen, M. V. (2013). "Non-invasive" brain stimulation is not non-invasive. *Frontiers in systems neuroscience*, *7*, 76.
30. Wurzman, R., Hamilton, R. H., Pascual-Leone, A., & Fox, M. D. (2016). An open letter concerning do-it-yourself users of transcranial direct current stimulation. *Annals of neurology*, *80*(1), 1.
31. Krause, B., & Cohen Kadosh, R. (2014). Not all brains are created equal: the relevance of individual differences in responsiveness to transcranial electrical stimulation. *Frontiers in systems neuroscience*, *8*, 25.
32. Bystritsky, A., Korb, A. S., Douglas, P. K., Cohen, M. S., Melega, W. P., Mulgaonkar, A. P., ... & Yoo, S. S. (2011). A review of low-intensity focused ultrasound pulsation. *Brain stimulation*, *4*(3), 125-136.
33. Deadwyler, S. A., Hampson, R. E., Sweat, A., Song, D., Chan, R. H., Opris, I., ... & Berger, T. W. (2013). Donor/recipient enhancement of memory in rat hippocampus. *Frontiers in systems neuroscience*, *7*, 120.
34. Pais-Vieira, M., Lebedev, M., Kunicki, C., Wang, J., & Nicolelis, M. A. L. (2013). A brain-to-brain interface for real-time sharing of sensorimotor information. Sci Rep.
35. Hampson, R. E., Song, D., Robinson, B. S., Fetterhoff, D., Dakos, A. S., Roeder, B. M., ... & Laxton, A. W. (2018). Developing a hippocampal neural prosthetic to facilitate human memory encoding and recall. *Journal of neural engineering*, *15*(3), 036014.
36. Goodman, C. (1988). Food and Drug Administration Center for Devices and Radiological Health. In *Medical Technology Assessment Directory: A Pilot Reference To Organizations, Assessments, and Information Resources*. National Academies Press (US).
37. Rachitskaya, A. V., & Yuan, A. (2016). Argus II retinal prosthesis system: An update. *Ophthalmic genetics*, *37*(3), 260-266.
38. Medtronic, D. B. S. (2015). Therapy for Parkinson's Disease and Essential Tremor Clinical Summary.
39. Hariz, M., Blomstedt, P., & Zrinzo, L. (2013). Future of brain stimulation: new targets, new indications, new technology. *Movement Disorders*, *28*(13), 1784-1792.
40. Insel, T. R., Landis, S. C., & Collins, F. S. (2013). The NIH brain initiative. *Science*, *340*(6133), 687-688.
41. Koo, J., MacEwan, M. R., Kang, S. K., Won, S. M., Stephen, M., Gamble, P., ... & Birenbaum, N. (2018). Wireless bioresorbable electronic system enables sustained nonpharmacological neuroregenerative therapy. *Nature medicine*, *24*(12), 1830-1836.
42. Sharma, G., Annetta, N., Friedenberg, D. A., & Bockbrader, M. (2017). Advances in BCI: a neural bypass technology to reconnect the brain to the body. In *Brain-Computer Interface Research* (pp. 9-20). Springer,

Cham.

43. Schmidt, E. M., Bak, M. J., Hambrecht, F. T., Kufta, C. V., O'rourke, D. K., & Vallabhanath, P. (1996). Feasibility of a visual prosthesis for the blind based on intracortical micro stimulation of the visual cortex. *Brain*, *119*(2), 507-522.

44. Histed, M. H., Bonin, V., & Reid, R. C. (2009). Direct activation of sparse, distributed populations of cortical neurons by electrical microstimulation. *Neuron*, *63*(4), 508-522.

45. Moeller, S., Crapse, T., Chang, L., & Tsao, D. Y. (2017). The effect of face patch microstimulation on perception of faces and objects. *Nature neuroscience*, *20*(5), 743-752.

46. Schalk, G., Kapeller, C., Guger, C., Ogawa, H., Hiroshima, S., Lafer-Sousa, R., ... & Kanwisher, N. (2017). Facephenes and rainbows: Causal evidence for functional and anatomical specificity of face and color processing in the human brain. *Proceedings of the National Academy of Sciences*, *114*(46), 12285-12290.

47. Salzman, C. D., Britten, K. H., & Newsome, W. T. (1990). Cortical microstimulation influences perceptual judgements of motion direction. *Nature*, *346*(6280), 174-177.

48. DeAngelis, G. C., Cumming, B. G., & Newsome, W. T. (1998). Cortical area MT and the perception of stereoscopic depth. *Nature*, *394*(6694), 677-680.

49. Brown, J. L., Hunsperger, R. W., & Rosvold, H. E. (1969). Defence, attack, and flight elicited by electrical stimulation of the hypothalamus of the cat. *Experimental Brain Research*, *8*(2), 113-129.

50. Caggiula, A. R., & Hoebel, B. G. (1966). " Copulation-reward site" in the posterior hypothalamus. *Science*, *153*(3741), 1284-1285.

51. Penfield, W. (1959). The interpretive cortex: The stream of consciousness in the human brain can be electrically reactivated. *Science*, *129*(3365), 1719-1725.

52. Lipsman, N., Lam, E., Volpini, M., Sutandar, K., Twose, R., Giacobbe, P., ... & Lozano, A. M. (2017). Deep brain stimulation of the subcallosal cingulate for treatment-refractory anorexia nervosa: 1 year follow-up of an open-label trial. *The Lancet Psychiatry*, *4*(4), 285-294.

53. Tsai, H. C., Zhang, F., Adamantidis, A., Stuber, G. D., Bonci, A., De Lecea, L., & Deisseroth, K. (2009). Phasic firing in dopaminergic neurons is sufficient for behavioral conditioning. *Science*, *324*(5930), 1080-1084.

54. Lammel, S., Lim, B. K., Ran, C., Huang, K. W., Betley, M. J., Tye, K. M., ... & Malenka, R. C. (2012). Input-specific control of reward and aversion in the ventral tegmental area. *Nature*, *491*(7423), 212-217.

55. Pashaie, R., Anikeeva, P., Lee, J. H., Prakash, R., Yizhar, O., Prigge, M., ... & Williams, J. (2013). Optogenetic brain interfaces. *IEEE reviews in biomedical engineering*, *7*, 3-30.

56. Ghosh, K. K., Burns, L. D., Cocker, E. D., Nimmerjahn, A., Ziv, Y., El Gamal, A., & Schnitzer, M. J. (2011). Miniaturized integration of a fluorescence microscope. *Nature methods*, *8*(10), 871.

Recent Trends in Brain Imaging for Clinical Purposes

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Abstract: The rapid growth in search of the brain imaging approach had led to many queries for the neuro world to resolve all antithetical queries into the human brain. Studies generally found many incomplete problems in brain functionality related to emotion, cognition, language, memory, various other externally induced stimuli, and the resting stage in the brain. Analysis of brain imaging help to determine the functional and anatomical basis for neurological disorders and, respective brain functioning, as well as to find out further investigation feedback of these disorders for the cure of brain. Neuroimaging is a highly resourceful field, and no one plays a demanding role in initiating a relevant approach to get knowledge about this and to evaluate evidence for precise assumptions. Neuroimaging having so many provocations that give numerous amounts of data, including the vast possible thing to from every individual and present many-dimensional view to grab data. Given the evidence for many neuro-imaging data available now, show data are taken from analysis of the current approach targeting these intentions and give data in research for a future aspect to counter all types of neuro-imaging conflict.

Keywords: Neuroimaging, Neurological disorders, fMRI, EEG, BOLD imaging.

Introduction

In the past few years, neuroimaging had a rapid growth for the study of the human brain. Various non-invasive techniques were used for brain imaging and extract various other functions such as emotion and memory [1]. Taking into the response received by these imaging techniques various assistance and treatments are given according to the patient's need. Different imaging techniques like Magnetic Image Resonance (MRI), Diffusion Tensor Imaging (DTI), positron Emission Tomography (PET), Electroencephalography (EEG), Magneto Encephalography (MEG), show the different properties of the brain and other functionality [2].

In this paper, different techniques were reviewed to access the functionality of the brain but major focus is given on widely and commonly used technique for brain functionality they are fMRI (for studying brain common functional anatomy as well as the effect of stroke and guide for brain treatment) And Electroencephalography (evaluation of electrical activity in the brain).

Different Imaging Techniques

CT Scan

Computerized tomography shows brain structure using X-rays in two-dimensional low resolution in comparison with various other approaches. In recent years the quality and speed of image formation have been improved and 3D image can be formed. CT Scan may reveal various features of the brain but somehow lack in its structural imaging formation. [3]

Positron Emission Tomography (PET)

This technique forms the 3D image of the brain structure as well as its functionality. PET is a nuclear drug imaging approach in which the subject is given a small dosage of nuclear material into the bloodstream through an injection. The radioactive material produces gamma-rays, similar to electromagnetic radiation similar to X-rays, but with higher energy. The injected material is carried across the whole body. A band of detectors is placed exterior to head for detection of gamma rays emitted indirectly by the nuclear material, in each part which is to be studied. But this is not much r

Diffusion Tensor Imaging (DTI)

It is a sort of diffusion MRI used to observe brain functionality whenever they occur. Restricted dispersal of water is measured for the examined brain tissue and is often used for the study of white matter. Water flow is decided by the direction of neural axon bundle [5]

Magnetoencephalography (MEG)

It is an imaging approach for the analysis of magnetic fields produced by electrical action in the brain with the help of precise devices known as SQUIDs. This assessment is used in both research and clinical works. Its usage is for assisting surgeons in localizing a pathogen, neurofeedback. [6]

fMRI

99

fMRI works by the analysis between the blood movement and the oxygen activity in the brain. As the neurological action is linked with the increase in the metabolic activity in that particular area of the brain, considering a memory task, there is a net gain in localized oxygen utilization, to fulfil this requirement much more oxygen-rich blood is sent to the brain. At this moment, BOLD imaging is used for detecting the change in the magnetic sensitivity between the oxygenated haemoglobin as well as deoxygenated haemoglobin. Haemoglobin shows diamagnetic attributes when oxygenated and shows paramagnetic attributes when deoxygenated. This difference is observed depending upon the oxygenation levels of the blood. This technique is an indirect measurement of the neural activity but also it has been found that there is a strong relation of the BOLD signal with the neural activity. BOLD signals are stronger and can be acquired in less time than the perfusion signals, thus BOLD signals are much more known. [7]

A major difference can be seen between the capillaries of the brain during rest and during the activity, as shown in Fig. **1.** Red balls represent RBC that are fully oxygenated and blue balls represent RBC that are fully deoxygenated, respectively. The signal entering the blood vessels is suppressed in the venous region of the capillary because of the paramagnetic response of the HB imitating as an internal variation agent. Similarly, in the active region, elevated blood flow causes the Hb to be moved out and restored by HbO2, generating a boost in BOLD signal. [8]
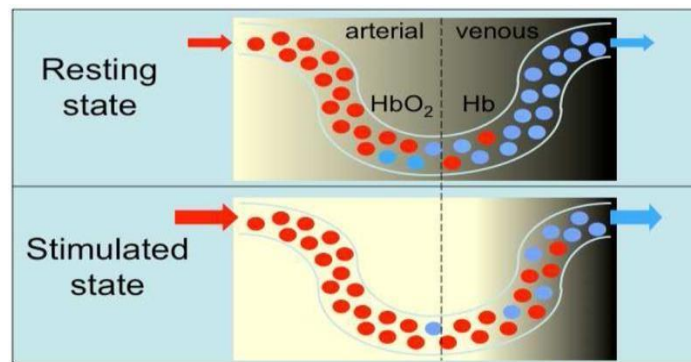
Figure 1. Representation of Hemoglobin in blood vessels and its magnetic behavior. [8]

1.2 Electroencephalography (EEG)
It is used for the analysis of the electrical activity going on in the brain, by sticking electrodes on the different skull location, 64-256 electrodes are used nowadays in the neuroscience research. Two different types of brain activity are recorded by the EEG. Spontaneous EEG casts neuronal feedback that occurs unjustified without any behavioral change. While the Event-Related potentials are related with some thoughts or any stimulus generated. the amplitude of these ERP is very low thus signal processing techniques are required for its study. The amplitude generated ranges below millivolts to a few millivolts in comparison to tens of nanometres of spontaneous EEG. [2]

 The subjective events may be as long as, of a second or a few minutes. Performing multiple trials of memory tasks and memory recognition can provide different values of power and coherence. Carrying out a few tests, the power and integrity of EEG can be customized for tests. The preliminary circumstances are made such that the grinding is comparatively small. The proper care is to be taken for the application of the electrodes on the head such that no noise is detected during the signal processing, to overcome this situation gel is used to reduce noise in the signal. [9]

2.1 COMPARISON OF fMRI and EEG
Both the techniques have their strengths as well as weakness depending upon the property taken into comparison. Firstly, talking about EEG, it has a high level of terrestrial resolution at the level of nanoseconds, also its direct measurement to neural feedback. It also has several drawbacks like, it is only sensitive to post-synaptic potentials that are enraged in the surface layers of the cortex. Secondly, it is almost impossible to recreate an exclusive intracranial current source handling for a given EEG signal. [10]

fMRI has immense spatial resolution and wide-area description of the whole brain. BOLD fMRI has a spatial resolution of 3-6 nanometres, this resolution fMRI can reach about 1-millimeter spatial resolution at the amount of whole-brain coverage. Talking about limitations, the extensive drawbacks of fMRI is its terrestrial resolution because the BOLD response is a bit low. These signals are an indirect analysis of neural activity. [10]
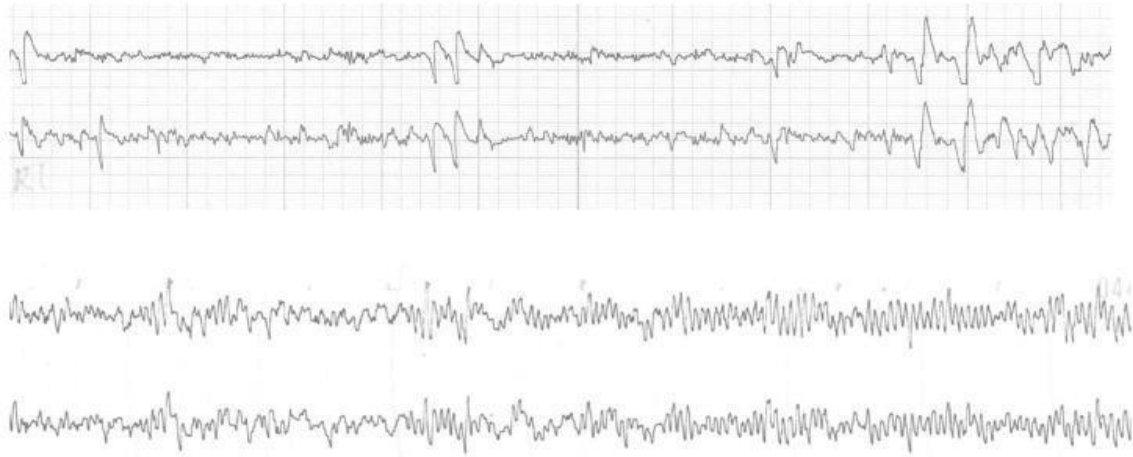
Figure 2. Adult (above) and 8-month-old infant (below) EEG tracings of left and right medial frontal skull locations. Major difference in frequency and amplitude can be observed [9]

CONCLUSION

The brain is a complicated organ to be studied anatomically as well as physiologically. But medical science is progressing in the field of Brain imaging, CT Scan, PET, DTI, these techniques are not much reliable for the study of the proper functionality of the brain. So, fMRI and EEG are the most common and at max used techniques for brain imaging. There is an evolution of simultaneous high-power EEG and high field fMRI reporting approach, new data recovery protocols, better data pre-processing approach, and exceptional study models to enhance the sensitivity in recognizing the BOLD responses.

References

1. Wager, T. D., & Smith, E. E. (2003). Neuroimaging studies of working memory. Cognitive, Affective, & Behavioral Neuroscience, 3(4), 255-274.
2. Gui, X. U. E., Chuansheng, C. H. E. N., Zhong-Lin, L. U., & Qi, D. O. N. G. (2010). Brain imaging techniques and their applications in decision-making research. Xin li xue bao. Acta psychologica Sinica, 42(1), 120.
3. Wright, A. (2010). Brain scanning techniques (CT, MRI, fMRI, PET, SPECT, DTI, DOT). Cerebra: Positively Different, 1-14.
4. Metser, U., Tau, N., & Singnurkar, A. (2019). Molecular Imaging with Positron Emission Tomography. Medical Imaging for Health Professionals: Technologies and Clinical Applications, 437-483.
5. Yuh, E. L., Cooper, S. R., Mukherjee, P., Yue, J. K., Lingsma, H. F., Gordon, W. A., ... & Maas, A. I. (2014). Diffusion tensor imaging for outcome prediction in mild traumatic brain injury: a TRACK-TBI study. Journal of neurotrauma, 31(17), 1457-1477.
6. Paetau, R., & Mohamed, I. S. (2013). Magnetoencephalography (MEG) and other neurophysiological investigations. In Handbook of Clinical Neurology (Vol. 111, pp. 461-465). Elsevier.
7. Laumann, T. O., Snyder, A. Z., Mitra, A., Gordon, E. M., Gratton, C., Adeyemo, B., ... & McCarthy, J. E. (2017). On the stability of BOLD fMRI correlations. Cerebral cortex, 27(10), 4719-4732.
8. Uludag, K., & Havlicek, M. (2018). Hemodynamic modeling of laminar resolution fMRI. Proceedings of ISMRM, Paris, France.
9. Cao, Z., Lin, C. T., Chuang, C. H., Lai, K. L., Yang, A. C., Fuh, J. L., & Wang, S. J. (2016). Resting-state EEG power and coherence vary between migraine phases. The journal of headache and pain, 17(1), 102.
Moosmann, M., Eichele, T., Nordby, H., Hugdahl, K., & Calhoun, V. D. (2008). Joint independent component analysis for simultaneous EEG–fMRI: principle and simulation. International Journal of Psychophysiology, 67(3), 212-221.

Internet Of Things (IoT) Based Health Monitoring System

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Abstract: Many applications are providing daily in the IoT sector, but healthcare applications are the most indispensable part of our life. In this period, so many people are using IoT to connect smart appliances for an improved health care system for providing smart and valuable health-related services to the people. Sensors can be implanted directly to the body, to monitor 24 hrs. of their health and detect the issues. By using this information data of Body Temperature, pulse, and many more, we can evaluate the patients. Information is collecting in such a way that can be analyzed, cluster, and processed to finding early prognostic for diseases. The clarifying formula is suggesting to the physician for the betterment of patient and better conclusion. This paper discussed challenges faced by this device in the implementation of IoT device compactly and effectively in this smart era.

Keywords: Internet of Things (IoT), Health Monitoring, sensor.

Introduction

The increase in population and size of cities, crowded workplace and changing stressful lifestyle leads to demands of healthcare advancement for the human race. Each day increasing in medical resources and services in cosmopolitan are high; still, the distribution needs isn't complete the target. Tremendous pressure towards the management causes the development of technologies of the rapid problems with suitable solutions.

Between the people increasing the rate of a medically related problem, result wireless healthcare becomes part of our life. In a few decades, the demand is increasing day by day of wearable sensor and health-related device which also help in finding that if someone is affected by any problem, then they can quickly know about their complication. In research also find that the implantation of this device causes in collecting data and processing it which help in mentoring patient's health 24hrs.

IoT boosted in achieving the advancement services in the healthcare field [2]. It provides an economical, easy-to-use device to the patient, which also assists the physician by records. The sensors recorded the data signal, analyzing and advised them on physical parameters of the body after they send the data by networking to physicians and patients via the Internet or Bluetooth devices and stored in the cloud also for future use. It requires current data for comparing the health record [1].with obtained data.

Summarize the records of data available in the cloud and by using a decision support system, analyzing that data for prediction of diseases. When the person suffering from any disorder and travelled somewhere without doctor concern, then the person using this wireless networking for prediction of the abnormality. The device using this machine learning algorithm for prediction of the disease and from systemic data of the medical database help to suggesting any medicine related to the problem. The early diagnosis of treatment also performed.

The developing technology supported the health monitoring system for the prediction of disease. It also helps in reducing the additional expense in this field and given additional accuracy support to raise the prediction process. In this paper, we are suggesting the economic view and technological service model in the IoT field and challenged faced in implementing IoT in the world for the medical-related field.

Methods and Methodology

In this decade, they developed diverse IoT systems for health monitoring systems. Zhang [6] designed an appropriate IoT system for medical devices, which was having multiple communication levels. A method was proposed by Zhang [7] for the well-being of information-concentrated health applications.

Few IoT technologies and Peer-to-Peer (P2P) are merged in a medical-related system called smart box to patient routine check [8] executed for the betterment of results. Web Real-Time Communication (WebRTC) was given by B

Johnsson [9], which focuses mostly on securing the transmission part of data to multiple concurrent streams effective manner.

An android application [10] established to record the data as DBP - Diastolic Blood Pressure, SBP-Systolic Blood Pressure, and Heart Rate. Although this application made it simple to transfer the recorded data using any mobile devices and after that, the stored shown an abnormality, and the message is sent to the people.

IoT based application introduced and that one is real time application help in flow environment. As the range extend in which monitored the person in observation faced difficulty, then stored data will help the local server for communication later on. Monitoring the heart functioning is performed by intel board having IoT medical programmes which are designed for electrocardiogram (ECG) signal examination and based on that algorithm.

Today's era, the patient's flexibility is increasing due to IoT based devices. In Portable Medical Devices constantly, where we have seen some security-related problems and few complications were there in devices. For Predicting diseases the lightweight IoT devices, using their current databases, which make them more advanced. In some predictions database storage not useful for researching those databases in the cloud. The framework represent regarding health information[11] was presented, which assists the security-related issues and the cloud exchange issues.

An approach for IoT based devices for communication between IoT based living system [12] was proposed for the problem facing in the techno world. An appliance is introduced related to medical-aid was originated for the blind people to assist them in ultrasonic range spotter to detect the users' problems and connected directly with the blind people through Bluetooth handset. The navigation system is there to help blind people with higher precision and help to inform users via vibrio tactile feedback in the hand gloves. While we labelled previous works, there is a limitation of database connectivity between the unrelated cloud environment, which is monitoring the data in continuous time intervals and analyzed data later. Considering this drawback, in this paper, we introduced a cloud-based Internet of Things system that can be implemented in different health monitoring systems

This system contains four-protocol layers such as the network layer, physical layer, application layer and middleware layer. First, the network layer, which mange of transferred signals from sensors to the Cloudlets whereas the Middleware layer does the work of collecting the data into the cloud and make accessible for people who are needed. The physical layer is mange the devices embedded with transmitters and sensors. Ultimately, the application layer, diagnosis and problem-solving process are performed.

Data collection and Transmission:

Now, Patients with the essential wearable sensors efficient of test Electromyography (EMG), Temperature, Electrocardiography (ECG) glucose level, muscle activity, and sweating. Use these portable devices, diseases such as fever, obesity, diabetes, and neuromuscular abnormality. Nowadays, sensors given accurate measures easily with advance technologies.

We embed some compact sensor and transmitter in the patient body and collecting the data of essential parameter to transmit to serves. Sensor gave a big part in finding problems so the sensor must be easily useable and small for easy operation. We operate the sensor on small better so that can be effortless with any troubling the patient. Small hardware is responsible for pre-processing the data. The component assists data transmission for the patient to their location with higher accuracy and security. The sensor easily operated through the Internet via phone and means of communication. For low transmission power, short-range radio is their name Zigbee or Bluetooth is used.

System Architecture

In today's system Wireless Sensor Networks (WSN) arranged in sensible node to find the distance between the health centre and transmission, also collected some information regarding the patient details to avoid and complications [13]. While we consider on low energy consumption, threshold levels should be low to easily counter the emergencies. At that moment, power off for the other sensor to save battery life

While they limit energy utilization, the rise in need of low power agrees for communication. When compared with IEEE 802.15.4, Zigbee is a low power Wireless Personal Area Network (LR-WPAN), which controls even between 10m. Zigbee is embedded in web networking with enlarging battery life and dependability.

An alternative wireless communication selected in Bluetooth low energy (BLE) which is responsible for short-distance communication with low power exhaustion. It suits for a specific demand of applications such as home entertainment, portable devices and also game. The component is introduced name BLE using for sleep of patient so long term so that the energy computation during sleep condition is immensely low as compared to the awake condition [14]. Additionally, the Low Power Wireless Personal Area Networks (6LoWPAN) is used to save the energy for further processes [15].

Cloudlet Processing:

These days, smartphones are given with a great deal and more improved feature so it having both WiFi and LTE. Similar smartphones can serve as consolidators in this system. We will transfer data collected by the consolidator to the cloud to storage. Those data, if-kept, it will be considered friendly to access on request by the analytics or for physicians. A small processing unit called cloudlet responsible for both collecting and analysing locally whereas the local resources don't complete the demands. It also helps in processing the time-critical task for patient data. While it stores data in cloudlet, it permits all-time access for data processing for better diagnostic features.

Cloudlet Computing is suggesting the better solution for the health-related applications through PAN as offline data is also accessible. The Cloudlet and centre are permitted for communication through the WiFi interface to reduce the data fetching for critical tasks. Finally, the data in the cloudlet saved in well-founded storage and assigned entry of data

It has been important to remain the patient's electronic medical documentation secure while storing in the cloud. To block unofficial entry, we should reserve suitable privacy conserving measures when we transmitted offline data to the cloud. Hence, the framework is introduced to secure the cloud-related storage[16], and still, it is a provocation.
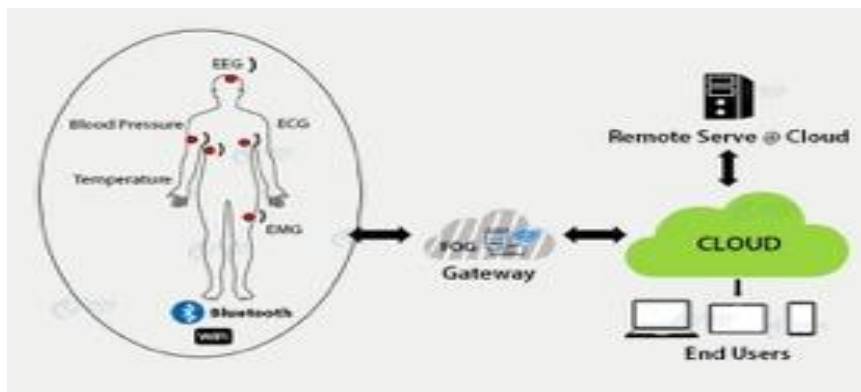
Figure1. Cloudlet Networking [17]

Result with Analytics

During the time of medical datasets, quantity is numerous. The formula assists the clinical data and sensor parameters. Alongside look over for such a long period, precision in the healthcare is enhance.

Transmitter data are processed in-depth section for analyzing the disease. Some arrangement is there for handling extra diversified as well as continuously altering in data, advancement in machine learning help in this field.

There are mainly three difficulties we are facing in analyzing the process of IoT in the medical field. First, numerous medical devices and equipment were introducing these days. And then, facing drawbacks in updating all the devices and sensors in period time. It will make a massive consequence in managing the database blueprint and devices at all this time.

Secondly, whenever the condition of the patient differs, the data is collected is different as collected by the physician. Thus, extra time is not needed in this changing. Categorization and retrogression techniques can be useful to arrange the data by using machine learning algorithms, yet once more, it is a load for specialist.

Finally, we take input information from unique sources. The sensory data will produce diversified modalities. This diversified remains a disputed with the machine learning since it handles equivalent data. Graphical models make a framework with input data with remarkable customization

Conclusion

In this review, we say the importance of IoT based project in this wireless healthcare monitoring system. The sensors with IoT make Hugh effect on patient life, the even-though patient is far away from the physician, but this helps them make them relax. Besides, challenging facing in data collecting and prediction of diseases are considered in higher rates, although some minor error is they're only the importance of implanting IoT in healthcare sector give next level result. The prediction of diseases by analyzing them is underlined. The sensory data get in-home and workplace also, which makes it comfortable for the patients and physicians also for medical records. This thing give advancement in the medical field.

References

1. Sanders D. A Model for Measuring Industry-Wide Adoption and Capability of Healthcare Analytics and DataWarehousing in the USA. ElectronicHealthcare. Vol.11 No.2 2012.
2. Dave Evans. April 2011. The Internet of Things:How the Next Evolution of the Internet Is Changing Everything, Cisco.
3. Hongyang Zhang; JunqiGuo; Xiaobo Xie; RongfangBie; Yunchuan Sun, "Environmental Effect Removal Based Structural Health Monitoring in the Internet of Things", 2013
4. Dennis Cox, Emil Jovanov, and Aleksandar Milenkovic, "Time synchronization for ZigBee networks" System Theory, 2005. in SSST '05. Proceedings of the Thirty-Seventh Southeastern Symposium on 20-22 March 2005 pp. 135-138
5. S. Babu, M. Chandini, P. Lavanya, K. Ganapathy and V. Vaidehi, "Cloud-enabled remote health monitoring system", Int. Conf. on Recent Trends in Inform. Tech. (ICRTIT), pp. 702-707, July 2013.
6. S. Boyd-Wickizer, H. Chen, R. Chen, Y. Mao, F. Kaashoek, R. Morris, A. Pesterev, L. Stein, M. Wu, Y. Dai, Y.
   Zhang, and Z. Zhang. Corey: an operating system for many cores. In OSDI, 2008
7. Health Information Technology for Economic and Clinical Health (HITECH) Act, title XIII of division A and title IV of division B of the American Recovery and Reinvestment Act of 2009 (ARRA), Pub. L. No. 111-5 (Feb. 17, 2009).
8. Bradshaw, J., Breedy, M., Groth, P., Hill, G., Jeffers, R., Mitrovich, T., and Suri, N. An Overview of the NOMADS Mobile Agent System. 2nd International Symposium on Agent Systems and Applications, ASA/MA2000, Zurich, Switzerland, September 2000.
9. C. Perkins, M. Westerlund, and J. Ott, " Web Real-Time Communication (WebRTC): Media Transport and Use of RTP, " draft-ietf-rtcweb-rtp-usage-05, Oct. 2012
10. (10)A. Jian, G. Xiao-lin, Y. Jian-wei, Z. Wen-dong and J. Jin-hua, "Research on a Mobile-aware Service Model in the Internet of Things", KSII Transaction on Internet and Information Systems, vol. 7, no. 5, (2013), pp. 1146-1165
11. (11)K. Minami, H. Nakajima, and T. Toyoshima, "Real-time discrimination of ventricular tachyarrhythmia with Fourier-transform neural network," IEEE Trans. Biomed. Eng., vol. 46, pp. 179–185, Feb. 1999
12. (12)S. Amendola, R. Lodato, S. Manzari, C. Occhiuzzi, G. Marrocco, « RFID Technology for IoT-based Personal Healthcare in SmartSpaces », IEEE Internet of Things Journal, Vol.1, N.2, pp. , 144.152, April 2014
13. (13)L. Ran, S. Helal and S. Moore, (2004, March). Drishti: an integrated indoor/outdoor blind navigation system and service. In Pervasive Computing and Communications, 2004. PerCom 2004. Proceedings of the Second IEEE Annual Conference on (pp. 23-30). IEEE.
14. (14)Blasch, B. B., & Stuckey, K. A. (1995). Ac-cessibility and mobility of persons who are visually impaired: A historical anal-yses. Journal of Visual Impairment & Blindness, 89(5), 417-422.
15. (15)A. H. Delaney and Y. Bresler, "A fast and accurate iterative reconstruction algorithm for parallel-beam tomography", IEEE Trans. Image Process., vol. 5, no. 5, pp. 740-753, May 1996
16. (16)ZigBee Alliance, "ZigBee smart energy version 2.0 technical requirements." [Online]. Available: zigbee.org/ imwp/idms/popups/popdownload.asp?contentID=17552
17. (17)Dataflair Team "IoT Project Ideas that you Should Start Working Right Now" data-flair.training blogs IoT project ideas,2020

GUI Based Classifier for Predicting Heart Disease

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Abstract: The objective of this study is to develop an automated system to predict heart disease using machine learning techniques. In this study 14 attributes were used: Age, sex, type of chest pain, resting bp, serum cholesterol, blood sugar during fasting, resting ECG result, maximum heart rate achieved, exercise - angina, exercise - ST depression, ST-segment slope - peak exercise, major vessels count, defect type and heart disease diagnosis. Different machine learning algorithms like logistic regression, support vector classifier, decision tree, and the k-nearest neighbor were evaluated. Among these, the logistic regression model outperforms with 90.1% accuracy. Further, a graphical user interface (GUI) was developed for making the system user friendly. This system can improve the quality of medical care and reduce the high medical cost.

Keywords: Machine learning algorithms, Logistic regression, Heart disease, GUI, Confusion matrix

Introduction
Heart disease refers to the conditions that damage the heart. Among all fatal disease, it is one of the primary causes of death every year. According to WHO, heart disease causes an estimated 31% of all death each year [1]. Medical decisions are generally based on the doctor's insight and experience rather than on the hidden knowledge available in the historical clinical dataset; this leads to errors, unwanted biases, and high medical costs thus affect the patient's service quality, delay in treatment and increases the chances of mortality. Heart disease prediction system emerged out as a way to aid in heart disease diagnosis using different medical parameters. The objective of this paper is to evaluate different machine learning models and to come up with the GUI of the heart disease prediction system.

Methodology

1. Data Collection and Preprocessing
The heart disease data were collected from the UCI machine learning repository [2]. Among all the heart disease database available, Cleveland database was used because of the presence of lesser missing values and outliers. The dataset contains 303 samples out of which 164 samples were of patients having no heart disease, and 139 samples were of patients having heart disease. The database contains 76 attributes out of which only 14 were used (the last attribute is for target variable), and that are mentioned in Table 1.

These 13 clinical parameters collectively drive the target variable by classifying them into patients with and without heart disease. Since both categorical and numerical values were available in the dataset, so all these categorical variables were converted into numerical value during preprocessing and many dummy variables were created in the process. The dataset was then separated into 70% training and 30% testing data. The numpy and pandas library in python was used for preprocessing the data.
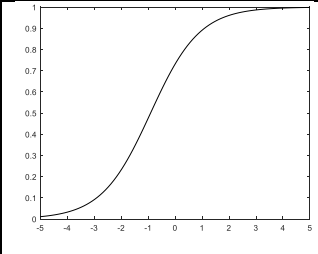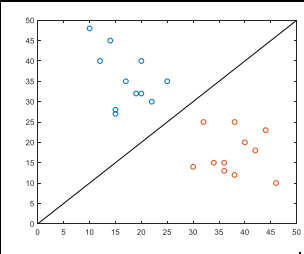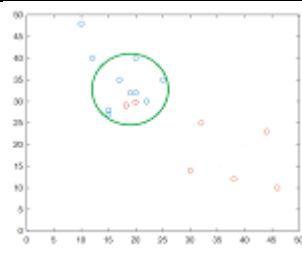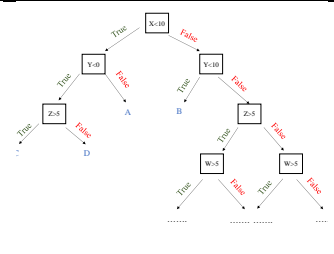
2. Machine Learning Models
The data was trained and evaluated on machine learning algorithms like logistic regression, support vector classifier, decision tree, and the k-nearest neighbor. These algorithms helped in the classification of data into the one having heart disease and the other with no heart disease. These algorithms were trained and evaluated using the scikit-learn library in python. Logistic regression is a supervised learning algorithm that helps in predictive analysis. It is used to predict the probability of the categorical variable. It is also called as a sigmoid function. The support vector classifier is the supervised machine learning classification algorithm. It is the representation of different classes in multidimensional space that are separated by a hyperplane. Some of the import concepts of hyperplane are support vectors, hyperplane, and margin. Support vectors are those data points that are very close to the hyperplane. The hyperplane is the plane that separates different classes. Margin is the perpendicular distance between the support vectors and the separating line. K-nearest neighbor is the machine learning algorithm that can perform both regression and classification. In this study, it was made to perform a classification problem. This algorithm stores all available cases that are, data points and performs classification based on a similarity measure, for example, distance function

[3]. The decision tree classification model classifies the classes by building a decision tree. In this algorithm, the node corresponds to a test on an attribute, its descending branches specifies to one of the possible values for that attribute and the leaves represent class labels. The samples of the dataset are classified following the top-down approach that is from the root, down to a leaf of the decision tree along the path according to the test outcome [4]. The formula and plot for these classification models are mentioned in table 2 [5].

Table 1. Clinical Parameters

S.No.	Clinical Parameters	Description
1	age	Age (years)
2	sex	1 for male and 0 for female
3	cp	Type of chest pain 1 for typical angina, 2 for atypical angina, 3 for non-anginal pain and 4 for asymptomatic
4	trestbps	Resting bp (mm Hg) on admission to the hospital
5	chol	serum cholestoral (mg/dl)
6	fbs	Blood sugar during fasting. 1 if greater than 120 mg/dl else 0
7	restecg	Resting ECG value. 0 for normal, 1 for ST-T abnormality , 2 for definite or probable left ventricular hypertrophy (Estes' criteria)
8	thalach	Heart rate (max)
9	exang	Exercise - angina 1 for yes and 0 for no
10	oldpeak	Exercise - ST depression (relative to rest)
11	slope	The slope of ST-segment - peak exercise 1 for upsloping, 2 for flat and 3 for downsloping
12	ca	Major vessels count from 0 to 3 (colored by fluoroscopy)
13	thal	Defect type 3 for normal, 6 for fixed defect and 7 for reversible defect
14	num	Heart disease diagnosis (target variable) 0 for the absence of heart disease and 1 for the presence of heart disease

Table 2. Formula and Plot of different ml models

Models	Logistic Regression	Support vector classifier	K-Nearest Neighbors	Decision Tree
Formula	$y = \dfrac{e^{(b_0 + b_1 x)}}{1 + e^{(b_0 + b_1 x)}}$ $y = predicted\ output,$ $x = input,$ $b_0 = bias\ or\ intercept,$ $b_1 = coefficient\ for$ $the\ single\ input\ x$	$l(y) = \max\big(0, 1 + \max w_y x - w_t x\big)$ $l = loss\ function$ $(hinge),$ $w = parameters,$ $t = target\ variabl,$ $x = Input\ variable$	$d = \sqrt{\sum_{i=1}^{k}(X_i - Y_i)^2}$ $d = euclidean\ distance,$ X and Y= data points	$e = \sum_{i=1}^{c} -p_i * log_2 (p_i)$ $Gini = 1 - \sum_{i=1}^{c}(p_i{}^2)$ $e = entropy,$ $c = no.\ of\ classes$
Plot				

3. Performance Analysis

The parameters like confusion metric and accuracy were used to evaluate the model performance. A confusion matrix was created to predict patients with heart disease. It contains four attributes that are mentioned in table 3 [6].

Table 3. Confusion Matrix

Output	Patient with heart disease	Patient with no heart disease
Patient with heart disease	TP (Samples predicted as true and they were actually true)	FN (Samples predicted as false and they were actually true)
Patient with no heart disease	FP (Samples predicted as true and they were actually false)	TN (Samples predicted as false and they were actually false)

The formula for accuracy is mentioned in Table 4.

Table 4. Performace Measure

Measure	Accuracy
Formula	(TP+TN)/(TP+FP+TN+FN)

4. GUI Design

A graphical user interface was designed to make the system user friendly. A python GUI is created using flask. Flask is a python web application framework that can scale up to complex applications [7]. The GUI includes the input medical data section and the prediction display section. The GUI of the heart prediction system is shown in Figure 1. The proposed system architecture is shown in Figure 2**.**
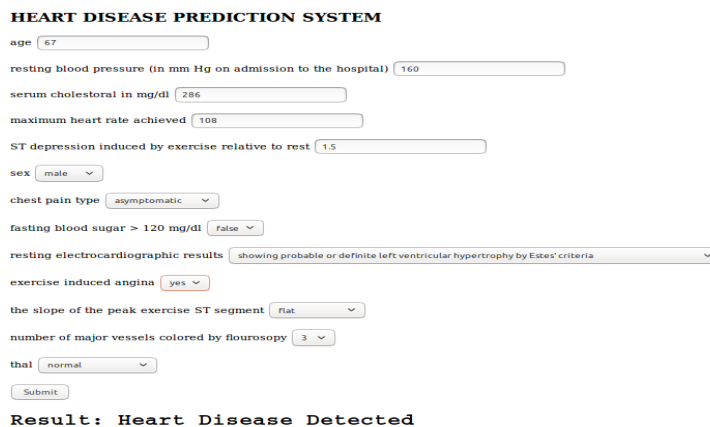
Figure 1. GUI of the Heart Disease Prediction System
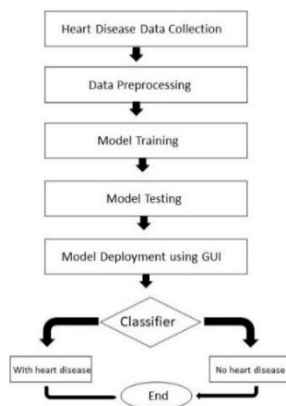
Figure 2. System Architecture

108

Results and discussion

Among the four classification techniques evaluated logistic regression outperformed and was able to classify individuals with and without heart disease with the accuracy of 90.1%. The confusion matrix for all classification models used is shown in table 5.

Table 5. Confusion matrix of the ML models

Models	Logistic Regression	Decision Tree	K Nearest Neighbor	Support Vector Classifier
Confusion Matrix	[[42, 2], [7, 40]]	[[35, 9], [15, 32]]	[[30,14],[20, 27]]	[[44, 0],[46, 1]]

The accuracy of the models are compared in figure 2.
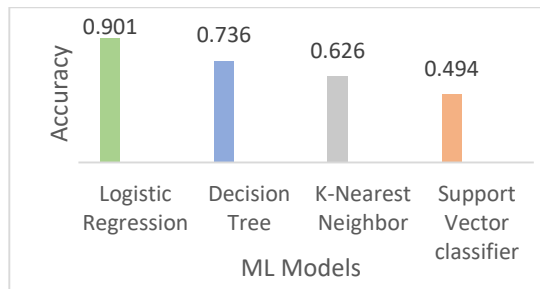
Figure 2. Accuracy of different models

In this study, our goal was to evaluate different classification models and to define the most effective one. So it was observed that logistic regression shows more accurate results which means that it can predict the actual result with more probability than in other algorithms used. The decision tree and K-NN shows average performance while the support vector classifier shows the least performance. Every model has the capacity to outperform others depending upon the dataset. The prediction accuracy of 88.29% for logistic regression on the heart disease dataset was also found to be the highest among all other classification models in the previous research reported by Swain et al. [8]. The GUI further makes the system user friendly, accessible, and scalable.

Conclusion

The logistic regression model proves better results. The proposed system can assist the medical professionals and domain experts to plan for early diagnosis of the disease for the cardio-patients. This tool can even help reduce the excessive medical cost. The system is GUI-based, scalable, and user-friendly.

References

[1] Shanthi, M., Pekka, P., & Bo, N. (2011). Global Atlas on cardiovascular disease prevention and control. *World Health Organization*, 3-18.

[2] Detrano. UCI Machine Learning Repository [https://archive.ics.uci.edu/ml/datasets/Heart+Disease]. Long Beach, Cleveland Clinic Foundation: V.A. Medical Center.

[3] Ray, S. (2019, February). A quick review of machine learning algorithms. In *2019 International conference on machine learning, big data, cloud and parallel computing (COMITCon)* (pp. 35-39). IEEE.

[4] Zhong, Y. (2016, August). The analysis of cases based on decision tree. In *2016 7th IEEE international conference on software engineering and service science (ICSESS)* (pp. 142-147). IEEE.

[5] Thakar, P. The math behind Machine Learning Algorithms. *Towards Data Science*. Retrieved from https://towardsdatascience.com/the-math-behind-machine-learning-algorithms-9c5e4c87fff

[6] Fatourechi, M., Ward, R. K., Mason, S. G., Huggins, J., Schlögl, A., & Birch, G. E. (2008, December). Comparison of evaluation metrics in classification applications with imbalanced datasets. In *2008 Seventh International Conference on Machine Learning and Applications* (pp. 777-782). IEEE.

[7] Singh, P., Singh, S., & Pandi-Jain, G. S. (2018). Effective heart disease prediction system using data mining techniques. *International journal of nanomedicine*, *13*(T-NANO 2014 Abstracts), 121.

[8] Swain, D., Ballal, P., Dolase, V., Dash, B., & Santhappan, J. (2020). An Efficient Heart Disease Prediction System Using Machine Learning. In *Machine Learning and Information Processing* (pp. 39-50). Springer, Singapore.

Effect of Geotextile on CBR Value of Soil Subgrade in Panchgaon Area in Gurugram, Haryana

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Abstract: With the advancement of industrial and modern technology, many materials are developed to overcome the challenging problems in the construction industry. The development of these materials is seen through the dimensions of safety, durability, economy, production, sustainability and others. The quality of the roads, highways, expressways the essential corners of the nation's development index. In India, most of the roads are designed as flexible pavements which have a foundation of soil subgrade that is quite varying with the geographical and topographical locations. Sometimes weak, swelling, soft, compressible soils are met in the road alignment, which needs to be stabilized by using a particular additive. In this study, the soil sample used is collected from different spots of Panchgoan area of Gurugram Haryana that is technically identified by doing necessary soil tests like gradation analysis, index properties (Atterberg limits), compaction and shear strength tests & the new additive material used is non-woven geotextiles. Since California bearing ratio (CBR) is regarded as the primary parameter for the design of flexible pavements in India as per IS-codes and IRC guidelines. Therefore, non-woven geotextiles are positioned as a single horizontal layer at a depth of 0.5H from the base plate of the mould, and California Bearing Ratio (CBR) tests were conducted to estimate the strength of the subgrade soil. It was observed that the CBR values of soil were increased by about 35% under un-soaking conditions with the optimum thickness of the geotextile layer is 8mm. At the same time, the CBR value was 25% under soaked conditions with the optimum value of geotextile layer as 6mm resulting in a decrease in the thickness of the pavement by about 13% and 7% under two soaking conditions respectively.

Keywords: Soil stabilization, CBR value, Pavement design, IITPAVE, Flexible pavement, Model comparison.

Introduction
Flexible pavement is a multilayered system comprising of top surface coarse of dense bituminous macadam (DBM), semi-dense bituminous macadam and a seal coat. The top course is the main component of the flexible pavement although having very low bending strength but having the properties of leakage protection, providing good riding and frictional surface. The next course is the base course which is mainly 45-22.5mm aggregate rage material also called grade-III in highway engineering terminology underlying the similar aggregate layer of the quite larger size called grade-II or sub-base coarse and acts as a load transferring medium. The next or the bottom course is the soil subgrade which is the final traffic load absorbing component. The soil subgrade should be more stable and more reliable with the desired required engineering properties. The repeated traffic loads induce the cracks in the top bitumen layer and the inelastic strain in the soil subgrade, and through these cracks, rainwater ingress into the subgrade or the water table rises or floods occur which results in the compaction and consolidation of the soil. The subgrade layer is accountable for transferring the load from the above layers to the ground. Flexible pavements are planned in such a way that the load that reaches the subgrade does not go beyond the designed safe bearing capacity of the subgrade soil. Consequently, the thickness of the layers above the subgrade is determined w.r.t CBR value and is varying with the strength of soil affecting the overall cost of a pavement to be constructed. Fatigue cracking, thermal cracking and rutting are the major types of flexible pavement failures.

Geotextiles, geomembranes, geogrids, soil reinforcement, and chemical thermal and mechanical methods of ground improvement are mostly used in road construction, especially to improve soil fabric and structure. Geotextile makes fragile soil more beneficial for use and then easy to make infrastructure under challenging places also. It improves compaction, consolidation, shear strength, consistency & stability and other geotechnical properties.

Around 30% decrease was detected in pavement rutting when geotextile was used at the top of the sub-grade. The decrease was assessed using a pavement testing device known as the one-third scale Model Mobile Load Simulator. The device stimulates the cyclic traffic loading on a scaled model of flexible pavement. Road designers should consider the use of geotextiles to enhance the California Bearing Ratio under different conditions of soakage, reduce thickness of layers and increase structural stability of pavements while designing roads for flexible pavements. Use of geotextiles have also shown considerable effect on the compaction characteristics like optimum moisture content and dry density of the soil subgrade. According to California Bearing Ratio (CBR) Test, it was observed that when the two soil samples were reinforced with non-woven geotextiles, there was an increase in their CBR values in unsoaked condition (15%

and 21%) than when compared with their CBR values (4% and 7%) without reinforcement which indicate that the soil samples reinforced with non-woven geotextiles are suitable for subgrade as set by the Federal Ministry of Works General Specification (1997) criteria for subgrade soils. The depth at which the non-woven geotextiles is placed dictates its effectiveness as reinforcement as it performs best at depth H/4 from the base surface as this gives the best increase in strength of the soil samples which will therefore aid in reducing the cost of the pavement thicknesses. The CBR test was carried out 11 months and 18 months after construction. The test results revealed a 67–73% enhancement in the road because of the use of Jute– high-density polyethene (HDPE) blended geotextiles as compared to the results revealed by not using the geotextiles for some part of the road. Such type of geotextiles is generally used for rural roads. In an experimental investigation, there were nine test sections used. Each section was 15 m (50 ft) long and the sections were constructed to observe the impacts of geogrid and geotextile stabilization. After 8 months of operation, the instrument survivability ranged from 6% for the strain gauges mounted on the geotextile to 100% for the soil moisture blocks. The mainstream instrument failures happened either during the construction process or the first few weeks of maneuver. The data acquisition system was activated by the traffic that is passing over the piezoelectric sensors and functions remotely by the integration of geotextile, and nine instrumented flexible pavements (as stated above) test sections. These were built in a rural secondary road in southwest Virginia [1-11].

The aim/objectives of the present study are to determine the design thickness of different layers in a flexible pavement using non-woven geotextile in the subgrade material for Amity-Panchgaon connecting road by an important engineering parameter called CBR and to analyze the flexible pavement with the help of IITPAVE using non-woven geotextile.

Experimental Methodology

In the present work, detailed testing on virgin soil testing was performed, in addition to its traffic data collected and analyzed the properties and parameters obtained were used as input in IITPAVE Software [9].

Soil

The virgin soil samples were collected from three different spots of Panchgoan area and seen as silty-clayey loam with the following basic geotechnical properties:

Table 1: Soil identification and classification

Gradation/sieve analysis	Index properties	Strength properties
Sand=20-30%	Natural water content=20-28%	OMC=17.22%
Silt=45-55%	Liquid limit=39-50%	MDD=1.82g/cc
Clay=15-25%	Plastic limit=27-31%	Undrained cohesion=0.1-0.15kg/cm2
	Plasticity index=11-15%	The angle of internal friction=12-14 Degrees
	Swelling potential=Med.to High	CBR (unsoaked)=9-11%, CBR (soaked)=6-8%

From the Table 1, essential soil testing the native soil will be classified as per IS classification as sandy, clayey silt,

CI-MI

Geotextiles

Non-woven type of Geotextiles used for the study was taken from a local market in Gurugram Haryana placed as a a special thin layer of 2mm to 10mmthickness at the height of 50% of the mould height.

Software used

The software used for the study is IITPAVE. Scheme R-56 of MoRTH has modified FPAVE software and have made IITPAVE. It is a multilayer analysis programme correctly used for analysis programme specially utilized for analysis and design of pavement based on the codal provision of IRC: 37 – 2012 [9-10]. Flexible pavements are exhibited as elastic multiple layered structures. At the critical locations, stresses and strain are calculated using a linear layered elastic model.

Results and Discussion

The CBR value is determined as per IS: 2720 (Part 16) 1979. The specimen was positioned in the mould in four number of layers. The soil sample was allowed for soaking and swelling for at least 72 hours. Water absorption was detected, which was restricted by placing a load/surcharge at the top of the sample. The sample is placed in the loading frame load is applied at a strain rate of 1.25mm/min. At particular penetration values of 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0,

111

4.0, 7.5 12.0 mm the load values are observed on the proving ring ,the load for 2.5 mm or 5 mm penetration are very important and are recorded very accurately. The tested samples are shown below in Figure 1.

Figure 1. Tested CBR samples with and without geotextile layer

$$CBR(\%) = \frac{\text{Load (Pressure)sustained by the specimen at 2.5 or 5mm penetration}}{\text{Load (Pressure)sustained by the standard aggregates at the corresponding penetration level}} \qquad (1)$$

From the CBR tests, we obtain followings results, as shown in Table 2:

Table 2. Test observations of CBR value

Thickness of Geotextile layer	CBR (unsoaked) value (%)	CBR (soaked) value-4 days (%)
0.00mm	9.22	6.23
2.00mm	9.64	7.78
4.00mm	10.41	8.54
6.00mm	11.24	9.38
8.00mm	12.50	7.92
10.00mm	11.98	7.45

Pavement thickness
Manual calculations determine the thickness of the pavement by using IRC 37 (CBR as an input parameter) and is compared with the optimized value of thickness different pavement layers and maximum tensile and vertical strain values from the software IITPAVE (taking elastic modulus, poisons ratio, single wheel load in newtons, tyre pressure, wheelset, number of layers and CBR in percentage as the input parameters). Refer to Figure 2 and Table 3.

The flexible pavement consists of various sub-layers as Granular Sub-base (GSB), Base Course (WMM), Dense Bituminous Macadam (DBM), Bituminous Concrete (BC) etc. thickness of which is given separately by IITPAVE Software and which mainly shows an appreciable effect on the GSB and BC layer. For all the cases, the maximum tensile strain and the maximum vertical strain given by software were found less than an allowable value of strain calculated as per IRC-37 (Figure 2 & 3).

Conclusions and Future scope
For extended durability of all civil engineering projects like flexible pavements, the base/subgrade was treated with non-woven geotextile to improve the CBR values. The obtained thickness was then optimized using IIT PAVE to

112

make the pavement economical and reduce the construction time and cost. Soil stabilization increases the strength of soil by increasing the CBR value of the soil, which decreases the required thickness of the pavement. In the present study, the optimum value of additive geotextile was found to be 8% under unsoaking conditions for which the CBR value had enhanced from 9.22% to 12.5%. The corresponding pavement thickness had reduced from 440mm to 380mm.

On the other hand, the optimum value of the additive geotextile was found to be 6% under four days soaking conditions for which the CBR value had enhanced from 6.33% to 9.38%. The corresponding pavement thickness had reduced from 496mm to 459mm. This study can be extended to the vast field ranging from highway engineering to traffic planning by using the same geotextile in different forms like random mixing, varying contents and stratified arrangements in all vertical, horizontal and oblique directions.

Table 3. IITPAVE Software observations of pavement thickness

Thickness of Geotextile layer	CBR (unsoaked) value (%)	CBR (soaked) value-4 days (%)	Pavement thickness(mm)	
			Vs. Unsoaked	**Vs. Soaked**
0.00mm	9.22	6.23	440	496
2.00mm	9.64	7.78	426	485
4.00mm	10.41	8.54	412	471
6.00mm	11.24	9.38	402	459
8.00mm	12.50	7.92	380	465
10.00mm	11.98	7.45	410	471
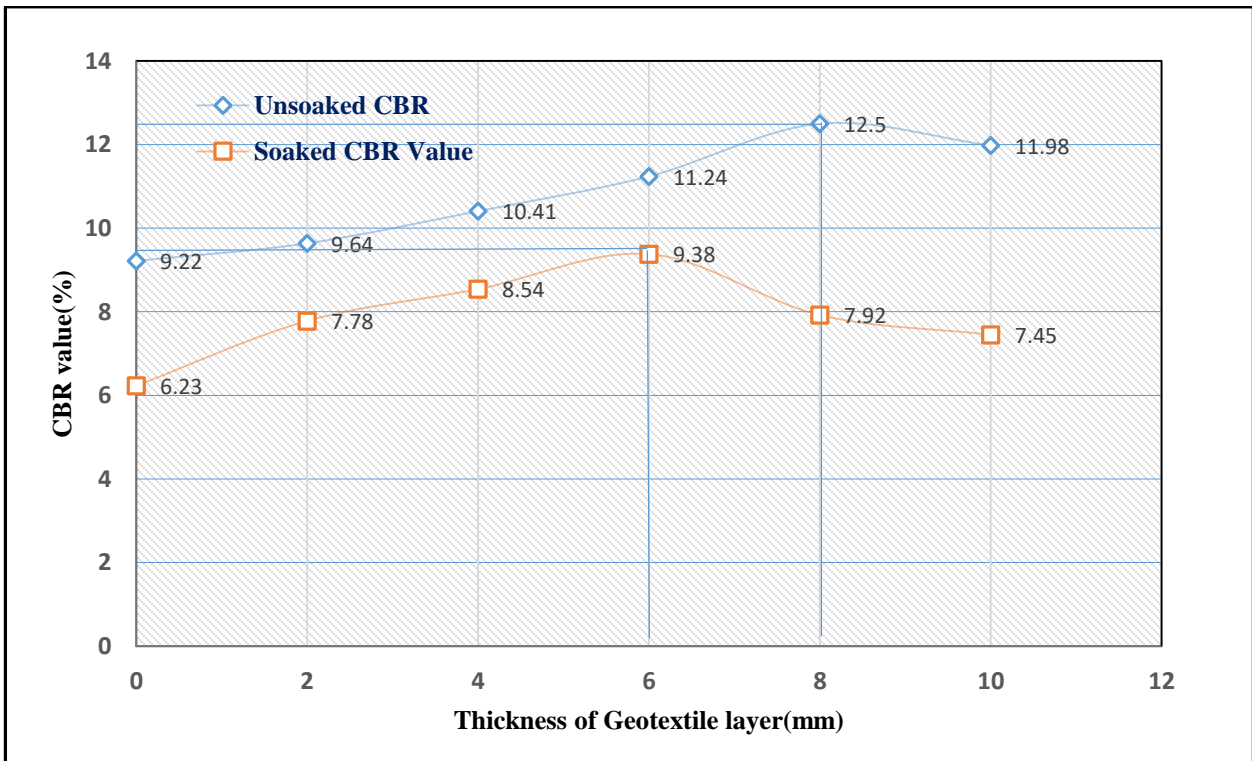
Figure 2. Tested CBR samples with and without Geotextile layer
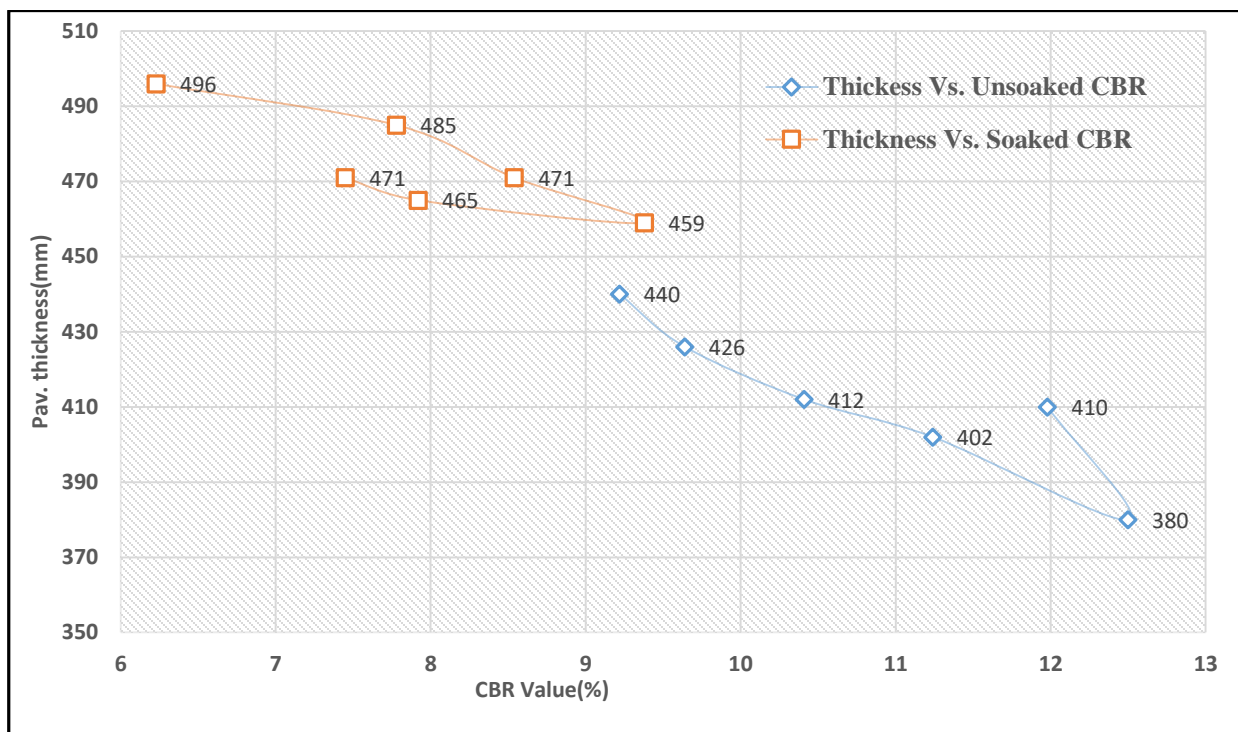
Figure 3. Pavement thickness (mm) Vs. CBR (%) with Geotextile Layer.

References

[1] Thomas, L., Imad, L., Bruce, A., Salman A. (1996). Construction and Instrumentation of Geosynthetically Stabilized Secondary Road Test Sections. *Journal of the Transportation Research Board*, 15(34), 50-57.

[2] Basu, G., Roy, A.N., Bhattacharyya, S.K., Ghosh, S.K. (2009). Construction of unpaved rural road using jute–synthetic blended woven geotextile – A case study. *Geotextiles and Geomembranes*, 27(2009), 506-512.

[3] Adebayo, A.O., & Adigun, A.O. (2018). Engineering Properties of Flexible Pavement and Subgrade Soil along Papalanto – Sagamu Road, Sagamu Local Government Area Ogun State. *Nigerian Association of Engineering Geology and the Environment (NAEGE),* 1(1), 197-206.

[4] Austin, D.N., & Coleman, D.M. (1993). A Field Evaluation of Geosynthetic Reinforced Haul Roads over Soft Foundation Soils. *Proceedings of Geosynthetic Conference, Vancouver, BC, Canada*, 9(14), 65-80.

[5] Barksdale, R. D., Brown, S. F., & Francis, C. (1989). Potential Benefits of Geosynthetics in Flexible Pavement Systems. *National Cooperative Highway Research Journal Washington, DC*, 3(9), 256-263.

[6] Bell, L., McCullough, L.M., & Snaith, M.S. (1982). An Experimental Investigation of Base Protection Using Geotextiles. *Proceedings of the Second International Conference on Geotextiles*, 2(7), 435-440.

[7] Christopher, B. R., & Holtz, K.D. (2001). Geotextiles for Subgrade Stabilization in Permanent Roads and Highways. *Proceedings of Geosynthetics*, 2(91), 846-854.

[8] Dhule, S.B., Valunjkar, S., Sarkate, S. D., & Korrane, S. (2011). Improvement of Flexible Pavement with Use of Geogrid. *Electronic Journal of Geotechnical Engineering*, 16(9), 269-279.

[9] Harish, G.R. (2017). Analysis of Flexible Pavements using IIT Pave. *Imperial Journal of Interdisciplinary*, 3(6), 815-818.

[10] Ogundare, D.A., Familusi, A.O., Osunkunle, A.B., & Olusami, J.O. (2018). Utilization Of Geotextile For Soil Stabilization. *American Journal of Engineering Research*, 7(8), 224-231.

[11] Adebara, S.A., Ogundare, D.A., Familusi, A.O., & Adewumi, B.E. (2018). Stabilization Of Subgrade Using Geosynthetics (Case Study- Geotextile) Under Soaked Condition. *ANNALS of Faculty Engineering Hunedoara – International Journal of Engineering*, 16(4), 157-162.

[12] IRC 37. (2018). Guidelines for the design of flexible pavements.

[13] IS 2720. (1983). Methods of test for soil.

Estimation of Air Pollution from Vehicular Emissions: A Case Study in MG Road, Gurugram City

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Abstract: This paper focused to find out the amount of exhaust emission (CO, HC+NOx, CO_2, and PM) from vehicular emission. The intersection of MG road between MG road metro station and IFFCO Chowk metro station as a major road with high pedestrian and high density of vehicles in the Gurugram city. This intersection carries a traffic volume of 27,697 vehicles per hour. The vehicle composition of MG road in the study area is 40.99% Car, 14.25% three-wheelers, 42.14% two-wheelers, 1.72% bus, 0.25% heavy commercial vehicles, and 0.64% light commercial vehicles. And it shows that 98.11% of vehicle composition belongs to Car, two-wheel, and 3-wheel. The amount of pollutants observed from the vehicle exhaust is carbon dioxide (CO_2); 3605.35 kg/km per hour, carbon monoxide CO; 21.785 kg/km per hour, (HC+NOx); 17.813 kg/km per hour and PM is 0.858 kg/km per hour.

Keywords: Air pollutants, traffic volume, emission inventory, and emission factor.

Introduction

Air pollution is one of the biggest problems in big cities, getting worse over time [1, 2 and 7]. The production of greenhouse gases from the transportation sector plays an important role in air quality management in developing cities [2, 3, 5 and 6]. Traditionally, industries are considered pollutants due to their high energy intensity and obsolete pollution control equipment, but the production of greenhouse gases from the transportation sector is increasingly the biggest contributor to the health effects of air pollution [4 and 5]. According to the US Environmental Protection Agency (USEPA), 53 to 73 percent of air pollution comes from the mobile source, and vehicles are the main branch of the mobile source that emits exhaust gases. According to (India State-Level Disease Burden Initiative Air Pollution Collaborators- 2017), air pollution was responsible for 1.24 million deaths in India and 4.2 million worldwide. The effects of harmful gases from transportation on human health (for drivers, pedestrians, and those who work on the road or live near highway) are significantly detrimental, and these people are struggling with their lives. In this study, the focus is on finding harmful gases (CO_2), (NOx) and Particulate Matter (PM) in the MG road (study area) caused by vehicles [4, 6 and 7].

The main objectives of this studies are to determine the Carbon dioxide (CO_2), Hydrocarbons (HC), Nitrogen oxide (NOx) and Particulate matter (PM) in the study area by (India specific road transport emission factor and Emission Factors for Indian in use vehicles) as emission factor (EF) in Gururgram city.

Methodology

Study area

Gurgaon is a city located in the northern Indian state of Haryana. It is situated near the Delhi-Haryana border, about 30 kilometers (19 mi) southwest of the national capital New Delhi and 268 km (167 mi) south of Chandigarh, the state capital. It is one of the major satellite cities of Delhi and is part of the National Capital Region of India [2 and 7]. Gurgaon has become a leading financial and banking center in India after Mumbai and Chennai. Gurgaon is categorized as very high on the Human Development Index, with an HDI of 0.889 (2017), which is also the highest in India. In 2016, the state of Haryana had a vehicle population that amounted to approximately 8.63 million with growth rate approximately 10 % per year.

In March 2019, Gurgaon was named the most polluted city in the world, according to data released by IQ Air Visual and Greenpeace. Transportation plays a major role in air pollution in Gurgaon so this air pollution can effect on the population which lives on-road and off-road.

To find out the amount of exhaust emission (CO, NOx, CO_2, and PM) from vehicles that effect on human life in a particular area I selected an intersection of MG road between MG road metro station and IFFCO Chowk metro station as a major road with a high pedestrian and high rate of vehicles Figure 1. The city has an adequate road network but lack of public transportation systems, promotes the use of private vehicles and leads to traffic congestion, parking

115

problems and thereby increases air pollution.

Figure 1. Study area

Traffic density survey

Portable video camera is mounted at suitable height for capturing the traffic volume in peak hour period and data collected from the each four leg of intersection. I recorded in tow shift morning (7:00 am- 11:00 am) and evening (4:00 pm – 8:00 pm) for finding the peak hours. After counting I find out the peak hours traffic in the study area Mehrauli- Gurugram (MG) road which is (9:00 – 10:00) AM on Friday and Monday. And then count manually all type of vehicles in each link.

Link-1 is MG road, the main road with a high rash of traffic which carries 11,126 vehicles per hour with 42.32% car, 33.79 % three-wheelers and 22.64% two-wheelers, the composition of the bus, heavy commercial vehicles and light commercial vehicle are 1.07%, 0.07% and 0.11% respectively.

Link-2 is the Mehroli Gurgaon Service road which connects the two main roads (Gurugram-Delhi Expy with Mehrauli Gurgaon road). This road carries 2809 vehicles per hour with the composition of 51.8% car, 20.54% three-wheeler, 26.88% two-wheelers, and less than 1% bus, LCV, and HCV which is very low than link-1. But when it jointed with MG road they make congestion in the area. The result of data from these two link is shows in below table.

Link-3 is the MF Husain Marg road from IFFCO Chowk toward MG road with its under pass road. This road carries 3846 vehicles per hour with the following composition: 43.29% Car, 23% three-wheeler, 31% two-wheelers and 2.65% bus at the peak hours.

Link-4 : is Mehrauli-Gurgaon (MG) road which it has also under pass with high traffic volume around 10,000 vehicles per hour in the peak time. The traffic composition of this road is 41% Car, 14.25% three-wheelers, 42.14% two-wheelers, 1.72% bus and less than 1% HCV and LCV.

This intersection carries a traffic volume of 27,697 vehicles per hour. The vehicle composition of MG road in the study area are 40.99% Car, 14.25% three-wheelers, 42.14% two-wheelers, 1.72% bus, 0.25% heavy commercial vehicles and 0.64% light commercial vehicles which shown in Table3.4. According to these data which collected from the study area this intersection consist of 98.11% of vehicle composition which belongs to Car, two-wheel and 3-wheel.

Results and discussion

Summary of Emission factor (EF) for different types of vehicles as per Automotive Research Association of India (ARAI) and India Specific Road Transport Emission Factors-2015 is shown Table 1 which is used in this method. According to the result for the link-1 the total carbon monoxide (CO) is 8.772 kg/kmh for hydrocarbon plus nitrogen oxides is 7.038 kg/km.h and particular matter PM is 0.359 kg per km per hour and total CO_2 is 1421.31 kg/km per hour as shows in Table 2. In link-2 the total emission form exhaust and non-exhaust which emits from all types of traffic are Carbon monoxide (CO) 2.243 kg/km per hour, Hydrocarbon plus nitrogen oxide (HC+NOx) is 1.561 kg/km per hour and for PM is 0.087 kg/km per hours while for Carbon dioxide is 383.019 kg/km per hour. In Table 3, link-3 total carbon monoxide (CO) is 3.260 kg/kmh, (HC+NOx) is 2.775 kg/kmh, particle matters (PM) is 0.143kg/kmh, and carbon-dioxide (CO_2) is 526.270 kg/kmh. In Table 4, link-4 according to the result total carbon-monoxide is 7.509 kg/kmh, (HC+NOx) is 6.437 kg/kmh, particle matters (PM) is 0.268 kg/kmh and Carbon-dioxide (CO_2) is 1264.75 kg/km per hours.

Table1. Emission Factors

Types of vehicle	Co (gr/km)	HC+Nox gr/km	PM (gr/km)	CO_2 (Kg/km)
Car	0.84	0.21	0.02	0.183475
Three- wheeler	1.065	1.1	0.09	0.117793
Two wheeler	0.435	0.645	0	0.042975
Bus	3.92	6.69	0.3	0.7375
HCV	3.92	6.69	0.3	0.7375
LCV	0.06	0.36	0.02	0.4499

Table.2 Result for link-1

Result- link-1				
Type	No. Veh/h	CO (g/km.h)	HC+NOX (g/km.h)	PM (g/km.h)	CO2(kg/km.h)
Car	4709	3955.56	988.89	94.18	863.984
Three- wheeler	2519	2682.735	2770.9	226.71	296.721
Two wheeler	3759	1635.165	2424.555	0	161.543
Bus	119	466.48	796.11	35.7	87.763
HCV	8	31.36	53.52	2.4	5.900
LCV	12	0.72	4.32	0.24	5.399
Total emission		8,772.02	7,038.30	359.23	1,421.31

Table 2. Result for link-2

Result- link-2				
Type	No. Veh/h	CO (g/km.h)	HC+NOX (g/km.h)	PM (g/km.h)	CO2 (kg/km.h)
Car	1455	1222.2	305.55	29.1	266.956
3- wheeler	577	614.505	634.7	51.93	67.967
2- wheeler	755	328.425	486.975	0	32.446
Bus	20	78.4	133.8	6	14.750
HCV	0	0	0	0	0.000
LCV	2	0.12	0.72	0.04	0.900
Total emission		2243.65	1561.745	87.07	383.019

Table 3. Result for link-3

Result- link-3				
Types of Veh	No. Veh/h	CO (g/km.h)	HC+NOX (g/km.h)	PM (g/km.h)	CO2(kg/kmh)
Car	1665	1398.60	349.65	33.30	305.486
3-wheeler	885	942.53	973.50	79.65	104.247
2-wheeler	1194	519.39	770.13	0.00	51.312
Bus	102	399.84	682.38	30.60	75.225
HCV	0	0.00	0.00	0.00	0.000
LCV	0	0.00	0.00	0.00	0.000
Total emission		3260.36	2775.66	143.55	536.270

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Table 4. Result for link-4

Result of link-4					
Type	No. Veh/h	CO (g/km.h)	HC+NOX (g/km.h)	PM (g/km.h)	CO2(kg/km.h)
Car	4065	3414.60	853.65	81.30	745.826
3-wheeler	1413	1504.85	1554.30	127.17	166.442
2-wheeler	4179	1817.87	2695.46	0.00	179.593
Bus	171	670.32	1143.99	51.30	126.113
HCV	25	98.00	167.25	7.50	18.438
LCV	63	3.78	22.68	1.26	28.344
Total emission		7509.41	6437.33	268.53	1264.754

Conclusion

This study reveals that air pollution at traffic intersections in MG road is critical and the problem has been reached threatening dimensions. The city has an adequate road network but lack of good public transportation systems, promotes the use of private vehicles and leads to traffic congestion, parking problems and thereby increases air pollution. Even with the introduction of advanced emissions control technology, motor vehicles remain the dominant sources of urban air pollution. Addressing this problem requires a better understanding of the source and cause of emissions and an effective means of addressing in-use emissions. The uncontrolled growth of the vehicle fleet following the improvement to the road system represents the worst outcome, in terms of urban air quality. There is a great requirement for accurate inspection and maintenance (IM) programs in the city. The methodology adopted may be useful in similar situations in India and elsewhere.

References

[1] Palancar E. G. and Tosell, M. (2001). An inexpensive method to estimate CO and NOx emissions from mobile sources. *A. Environment*, Vol.35, 6213–6218.

[2] Kathuria, V. (2002). Vehicular pollution control in Delhi. *Trans. Research*. D7, 373–387.

Gurjara B.R., Aardennea J. A., J. and Mohanb. (2004). Emission estimates and trends (1990–2000) for megacity Delhi and implications. *Atm. Environment*. Vol.38, 5663–568.

[3] Mrinal. K, Ghosea. R. and Banerje. (2004). Assessment of the impacts of vehicular emissions on urban air quality and its management in Indian context: the case of Kolkata (Calcutta). *Env. Science & Policy*. Vol.7. 345–351.

[4] Guo, X.R., Cheng, S.Y., Chen, D.S., Zhou, Y. and Wang, H.Y. (2010). Estimation of economic costs of particulate air pollution from road transport in China. *J. Atmos. Environment*. Vol. 44, 3369-3377.

[5] Yan, F., Winijkul, E., Jung, S., Tami C. Bond, David G. Streets. (2011). Global emission projections of particulate matter (PM): I. Exhaust emissions from on-road vehicles. *Atmos. Environment*. Vol. 45. 4830-4844.

[6] Ya Wu, Li Zhang. (2017). Can the development of electric vehicles reduce the emission of air pollutants and greenhouse gases in developing countries? *Transn. Research*. Vol. D 51, 129–145.

[7] Jaiprakash, and Habib, G. (2018). On-road assessment of light duty vehicles in Delhi city: Emission factors of CO_2 CO_2 and NO_X. *Atmos. Environmental*. Vol. 174,132-139.

Water Resource Management at Microshed Water Level Using GIS Tool

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Abstract: For sustainable development, water is very important .It is highly necessary to manage water resources at micro and macro watershed level for achieving sustainability. To understand drainage basin characteristics, Morphometric analysis plays a vital role. Many of the studies proven that, Geographical Information System (GIS) is an efficient tool for morphometric analysis of a drainage basin. Here, authors made an attempt to study morphometric parameters of two watershed of bidadi area, Karnataka, India. Drainage density was found to be 1.88 km^{-1} and 1.72 km^{-1} for Byramangala and Nelligudde watershed. Topographical circulatory ratio was 0.50 and elongation ratio was 0.69. From the study it is found that, GIS is a competent tool for morphometric analysis and can be effective for planning and managing the watershed.

Keywords: curve number, GIS, Runoff, Morphometric, watershed.

Introduction

Mathematical analysis and its measurement of earth surface configuration over space and time will be found using morphometric analysis. This help to understand the drainage of the basin and it is an important characteristic of the basin. Ground water potential assessment is very important for hydrological investigation. Hydrological characteristics are associated with physical characteristics of the basin such as length, area, slop etc. Since most of the basin are ungauged, estimation of runoff in complex one. Water resource management based on watershed is highly necessary to conserve the water resources [2]. Rainfall-runoff is complex, non-linear process affected by many physical factors [3]. Watershed prioritization to estimate the sediment yield using GIS and RS technique [4]. RS and GIS technique for prioritization of agricultural watershed [5]. Used Antecedent moisture condition for runoff computation in SCS-CN model [6]. Water availability can be evaluated using rainfall-runoff approach. Rainfall-runoff was estimated for a watershed using SCS-CN method [8]. Rainfall-runoff process for ungauged watershed is an important aspect of surface water hydrology [9]. GIS method to estimate the runoff form river [1]. GIS Interface for runoff estimation from watershed[7]. This detailed study helps to understand the drainage basin characteristics. The present study highlights the advantage of GIS techniques in describing the morphometric characteristics of Nelligudde and Byramangala watershed basin.

Methodology

Methodology adopted in this study is shown in the Figure 1.

Result and discussion

The minimum runoff for Nelligudde Sub-watershed and Byramangala Sub- watershed was estimated to be 58.54mm and 11.62mm respectively in the year 2002 and 2006 respectively. The maximum runoff for Nelligudde Sub-watershed and Byramangala Sub-watershed was estimated to be 442.52mm and 458.88mm in the year 2004, and 1998 respectively. The total runoff estimated in each watershed for 12 years were 3003.18mm and 2618.82mm respectively. Rainfall and runoff relationship between Nelligudde and Byramangala sub-watershed were shown in the figure 2 and figure 3 respectively. Assigned curve numbers for both the watersheds were presented in the Table 1.

Conclusion

Here, GIS based morphometric analysis was done using SCS-CN method and found to be economical. Drainage density for Byramangala and Nelligudde watershed was found to be 1.72 km^{-1} and 1.88 km^{-1}. The minimum runoff for Nelligudde Sub-watershed and Byramangala Sub- watershed was estimated to be 58.54mm and 11.62mm respectively in the year 2002 and 2004.The maximum runoff for Nelligudde Sub-watershed and Byramangala Sub- watershed was estimated to be 442.52mm, and 458.88mm in the year 2004

119

and 1998 respectively. The total runoff estimated in each watershed for 12 years were 3003.18mm, and 2618.82mm respectively.

Figure 1. Methodology

Table 1: Assigned curve numbered for watershed.

Watershed	Area (km²)	Curve number I	Curve number II	Curve number III
Byramangala	360.27	63.5	78.5	88.9
Nelligudde	65.75	63.7	78.9	89.3
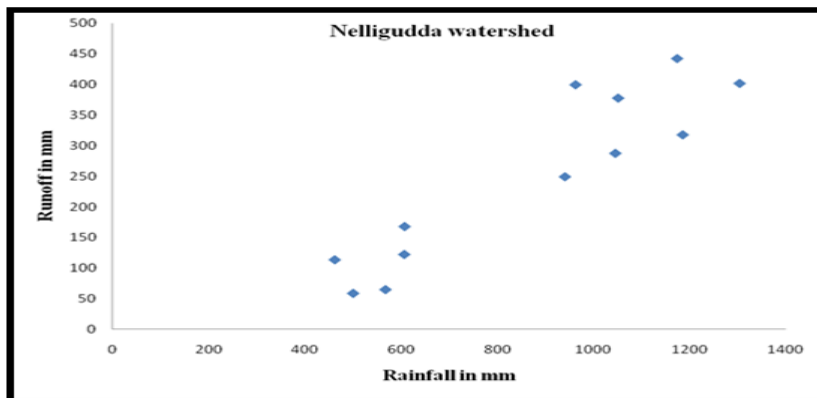
Figure 2. Rainfall and runoff relationship of Nelligudde Watershed
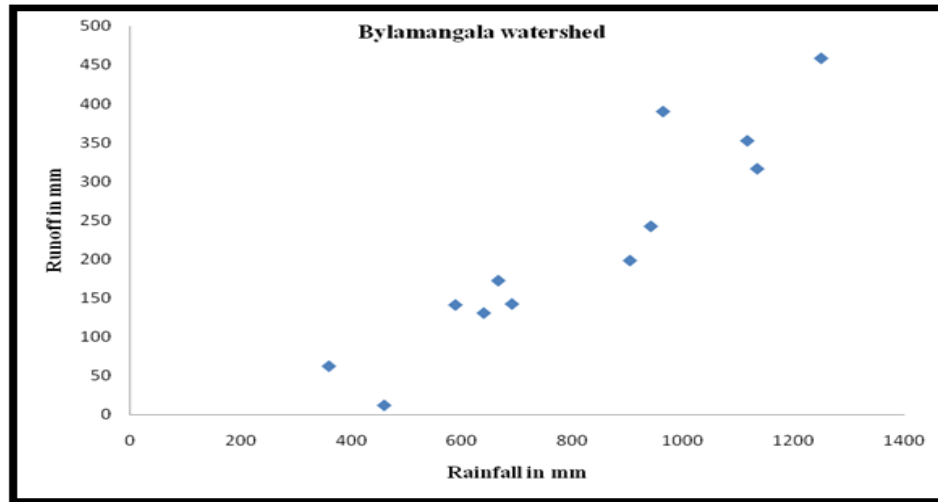
Figure 3.Rainfall and runoff relationship of Byramangala watershed

References
[1]Abhijit, M. Zende1., Nagarajan R., Atal K.R. (2014). Analysis of surface runoff from Yerala River Basin using SCSCN and GIS. International Journal of Geomatics and Geosciences, 4(3).
[2]Amutha, R., & Porchelvan, P. (2009). Estimation of surface runoff in Malattar sub-watershed using SCS-CN method. J Soc Remote Sens, 37(2):291–304
[3]Fan, F., Deng, Y., Hu X., Weng, Q., Change, E., Systems, E., &Haute, T.(2013). Estimating composite curve number using an improved SCS-CN method with remotely sensed variables in. Remote Sens. 5(3):1425–1438.
[4]Jain, M K., & Das D. (2010). Estimation of sediment yield and areas of soil erosion and deposition for watershed prioritization using GIS and remote sensing. Water Resour Manage. 24(10):2091–2112.
[5]Makwana, J., Mukesh, K., & Tiwari. (2016). Prioritization of agricultural sub-watersheds in semi arid middle region of Gujarat using remote sensing and GIS. Environ Earth Sci. 75(2):1–12.
[6]Mishra, S K., Jain, M K., & Singh VP (2004). Evaluation of the SCS–CN-based model incorporating, antecedent moisture. Water Resour Manag 18:567–589, 2004.
[7]Patil, J. P., Sarangi, A., Singh, O. P., Singh, A. K. and Ahmad, T.(2008). Development of a GIS Interface for Estimation of Runoff from Watersheds, Water Resources Management, 22-9, 1221-1239.
[8]Satheeshkumar, S., Venkateswaran, S. & Kannan, R.(2017). Rainfall–runoff estimation using SCS–CN and GIS approach in the Pappiredipatti watershed of the Vaniyar sub basin, South India. *Model. Earth Syst. Environ.* 3, 24
[9]Saravanan, S., Manjul, R.(2015). Geomorphology based semi-distributed approach for modeling rainfall-runoff modeling using GIS. Aquat Proc 4:908–916

Seepage Analysis and Dynamic Analysis of Earthen dam in Impervious Foundation by Using Geostudio Software

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Abstract Seepage analysis is necessary to find out the stability of structure or seepage itself.The seep/w model is developed to illuminate 2-dimensional circumstances with various soil layers. For finite component computations, the seep/w model is separated by elements. The rise of the water level at every element is determined. In quake/w programming displaying in the assessment of dynamic stability examination of the dam. In the deformation based techniques, an assessment of change in deformation during an earthquake is made and afterward contrasted with what is viewed as permanent deformation. Numerical investigation using Geostudio programs is extensively used to model a change of seepage flow circumstances in the earthen dam. Due to lack of suitable silt soil, sometimes the dams are designed as a zoned core that is composed of three vertical zones including central impermeable core and two permeable shells on either side of the core. The results show how this earthquake causes a change in pore water extra pressure, phreatic line, accelerations, displacement in a wide area of the foundation and core of the dam.

Keywords: Earthen Dam, Dynamic, Response, Earthquake, Finite Element Method

Introduction

Earthen dams have been constructed since past times to control the water level and to lower or channel the lake for emergency purposes or normal maintenance. Daghigh (1993) studied the behavior of the Alavian earthen dam in Iran by applying the EL-Centro technique with an acceleration of 0.35g in the software DIANA when subjected to an earthquake. He was concluded that the damping had an intense effect on the actual value of the simulation of the dam, the lesser the damping ratio, the larger the simulation value. Khire (2000) discussed the concept of saturated and unsaturated model properties and the influence of the water balance to consider the variables thickness model of the fine-grain surface and coarser surface. Gui and chiu (2006) examined the dynamic analysis of Renyitan earthen dam in Taiwan by using the program FLAC 2D. The results show that during earthquake excess pore water pressure would be generated mainly near the upstream region, which was also concluded by Ming and Li (2004) who analysed the failure of the San Fernando dam. Fattah et al (2014) described a case study of an Al-Adhaim dam which is located in Iraq using the program seep/w. Seged and Haile (2010) described a case study of a Tendaho earth-fill dam located in Ethiopia when subjected to the earthquake with peak ground acceleration of 0.3g through the program quake/w. Nomiri and Khosrojerdi (2015) described a case study of an Azad earth-fill dam located in Iran on the river of "Cham Ghooreh" through the program seep/w. The results show that during earthquake excess deformation would be generated but the weight of water provides resistance against the sway of structure. Raja and Maheshwari (2016) discussed the concept of static in the 2D finite element numerical model to consider the behaviour of the nonlinear model of an earthen dam on the impervious foundation. Khassaf and Madhloom (2017) studied the behaviour of a Khassa Chai Dam located in Iran when subjected to medium permeability of core. They noted that the exit gradient and seepage decrease by 23% when the thickness of the core increases. Doaa and Molla (2018) discussed the concept of vertical sheet pile in a 2D finite element numerical model to consider the impact of adding a vertical sheet pile in the center of an earthen dam on an impervious foundation.

Finite Modelling of the dam

The 2D FEM simulation of all boundary conditions has appeared in Figure 2. The section meshing is done utilizing a triangular and quadrilateral mesh of 5 m element size mesh. An entire number of 521 nodes and 469 elements have been utilized for the simulation of the dam. The base of the dam is demonstrated fix in both x and y-direction

Output of computer simulation

The output to be obtained by examination in software are as pursues:

1. Development of total flow net by following flow lines and equipotential lines for two types of the dam.
2. 2d Visualization of dam or estimation of permanent deformation during an earthquake is made and then compared to what is regarded as acceptable deformation.
3. Profile of the phreatic line for different conditions.

4. Estimation of seepage transition through the dam profile and impact of maximum acceleration during an earthquake.
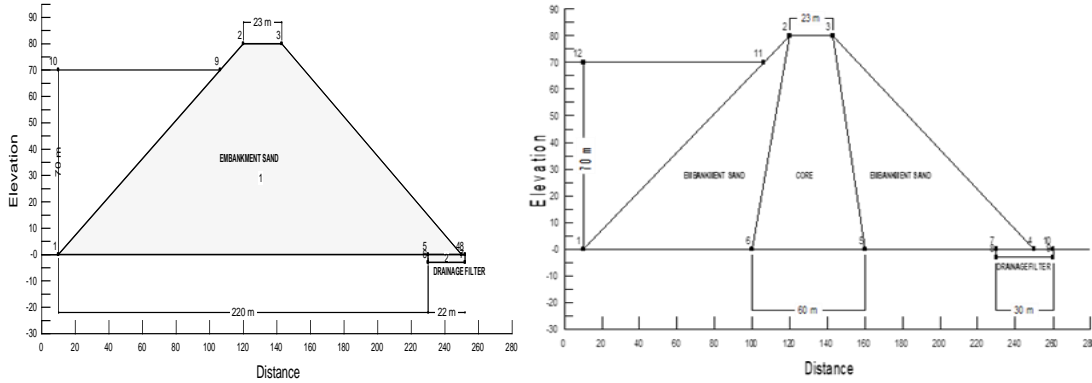
Figure. 1. cross-sectional lay-out details of a homogeneous and zoned dam

Table 1. Material property in Seep/w. (khire,2000)

USCS Classification	SP	CL	GP
Hydraulic Conductivity (K$_s$)	2.9 × 10^{-3}	1.0 × 10^{-9}	1
Saturated Water Content (θ_s)	0.40	0.38	0.30
Residual water Content(θ_r)	0.01	0.22	0.01

Steady-state analysis in seep/w

The governing equation in 2D flow.

$$\frac{\partial^2 h}{\partial x^2} + \frac{\partial^2 h}{\partial y^2} = 0$$

Where,

H = the total head

x, y = direction of flow

Volumetric water content of the soil

Soil water storage and water content function

$\theta_w = nS$

θw = the volumetric water content.

n = the porosity of the soil.

S = the degree of saturation.

Equivalent Linear Model

The Equivalent Linear model is fundamentally the same as the linear elastic model. To identify this conduct in a numerical model, a genuine nonlinear investigation is required where excess pore pressures are determined and the soil properties are changed during the shaking.

Table 2. Material property in Quake/W

Location in the dam →	Embankment Sand	Core	Drain
TotalUnit Weight $r[KN/m^3]$	19.7	20.8	19.5
Poisson's Ratio v [-]	0.3	0.4	0.3
Angle	36	76	90

123

A seismic pseudo-static

$$F_h = a_h W/g = k_h W$$

$$F_v = a_v W/g = k_v W$$

$$S_{resistance} = c' + (N - \mu - F_h \sin \alpha) \tan \phi'$$

where

ah = horizontal pseudo-static acceleration,

av = vertical pseudo-static acceleration,

g = gravitational acceleration constant,

kh = horizontal seismic coefficient,

kv = vertical seismic coefficient.

Results and discussion
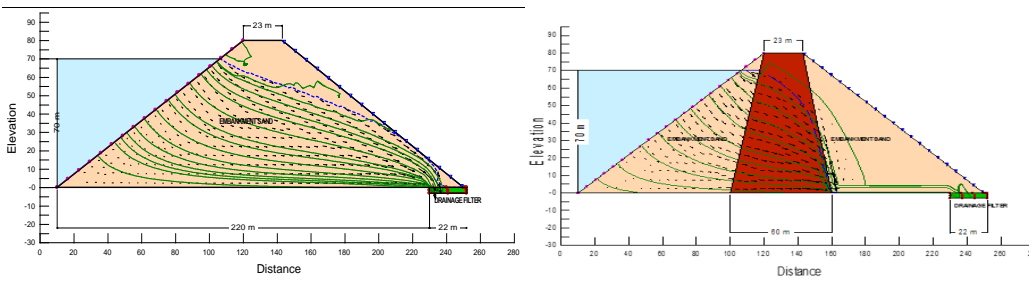
Figure 2. Flowlines and phreatic line through the homogeneous dam

Table 3. summarizes the total seepage rate into the homogeneous earthen dam is (–)9.18363e-05, and in the zoned earthen dam is (–)1.47979e-10m3/sec.

Dam	Negative Water flow rate (Seepage occurs)
Homogeneous dam	(–)9.18363e-05
Zoned dam	(–)1.47979e-10

Dynamic result in quake/w

1. Result of Maximum Effective Stress

As the graphic fig. 5.5 or fig. 5.6, outcome presents, maximum limit of effective stress is noted in the homogeneous and zoned dam is 605.16 Kpa or 623.26 Kpa would occur in the distance of 180.55 m or 194.51 m. Effective stress is recorded by minimizing pore water pressure from total stress.
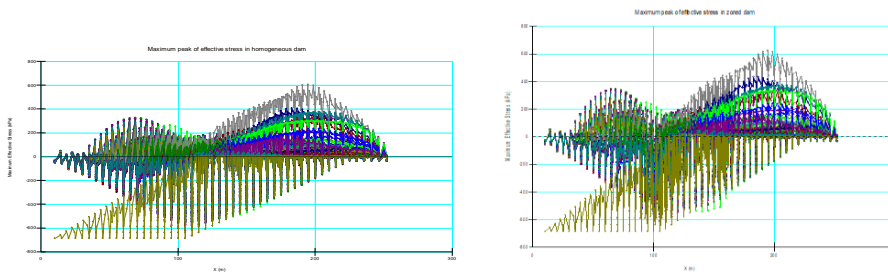
Figure 3. Maximum peak of effective stress in a homogeneous and Zoned dam
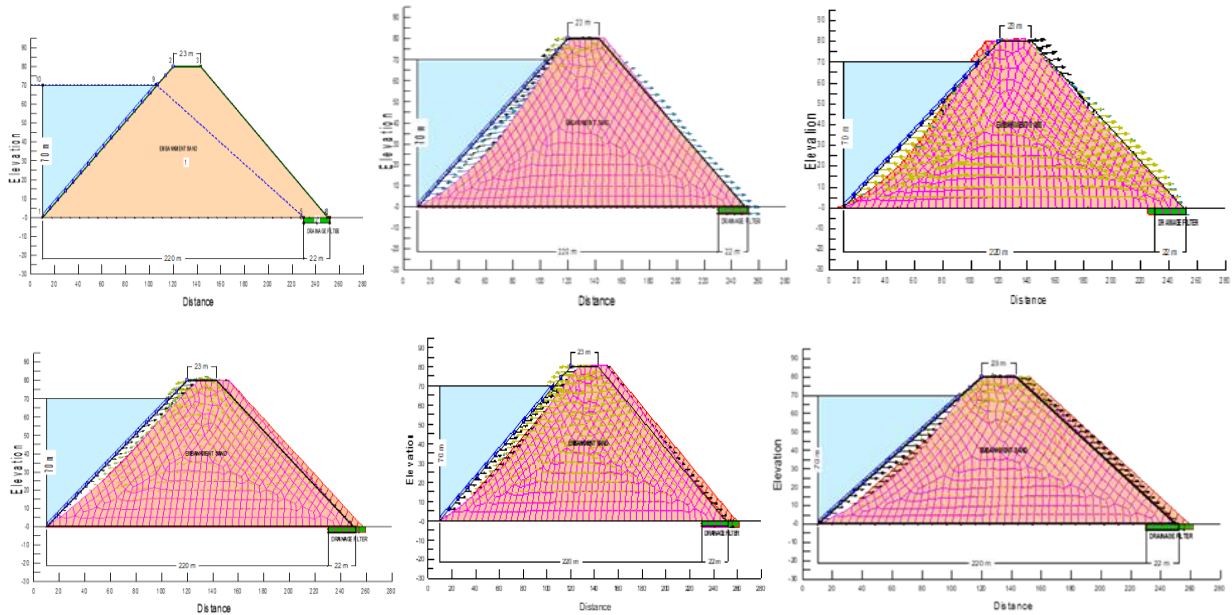
Figure 4. Displacement at 0, 20,40,60,80,100 seconds in a homogeneous dam
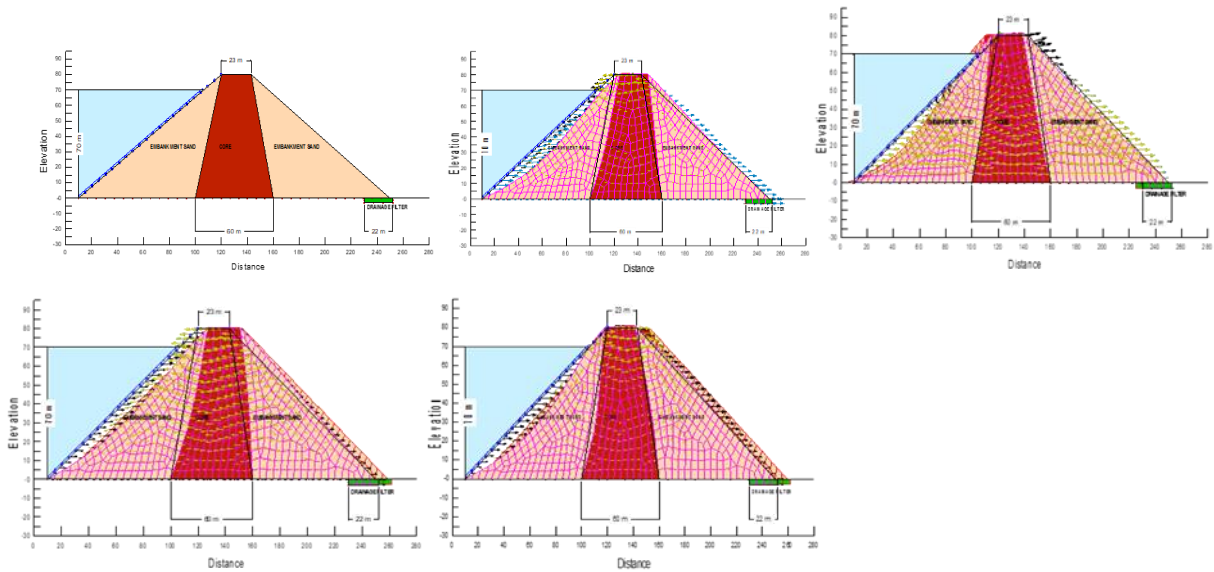
Figure 5. Displacement at 0,20,60,80 and 100 seconds in a zoned dam

Table 4. summarizes the maximum values of the displacement in X direction increased by 2.76% in the case of the homogeneous dam compared to the zoned dam, but in Y direction increased by 26.6% in the case of the zoned dam compared to the homogeneous dam.

Location of maximum X-displacement and Y-displacement
The accompanying graph shows the x-direction movement of a homogeneous dam and zoned dam in dynamic analysis. From fig.6, the maximum X-displacement of the homogeneous dam and zoned dam is 414.85 cm or 425.53 cm with a distance of 143 m and 133 m would occur at the time of 24 seconds. From fig.6, maximum X-displacement occurs in the zoned dam clay core of 425.53 cm with a distance of 143m in the x-direction. From fig. 36 or 37, maximum Y-displacement of the homogeneous dam and zoned dam is 78.62 cm or 75.47 cm would occur with a distance of 54.78 m and 51.73 m.

125

Table 4. Maximum values of the displacement in X & Y direction.

Time ⟶ Maximum-X, Y Displacement	20 seconds	40 seconds	60 seconds	80 seconds	100 seconds	Total Displacement
X-Displacement in Homogeneous Dam (cm)	65.45	43.65	163.14	93.19	67.25	432.68
X-Displacment in Zoned Dam (cm)	69.29	43.56	151.72	92.07	64.39	421.03
Y-Displacment in Homogeneous Dam (cm)	5.03	9.85	15.58	4.97	13.7	49.13
Y-Displacment in Zoned Dam (cm)	8.81	11.59	17.19	8.17	15.99	61.75

2.
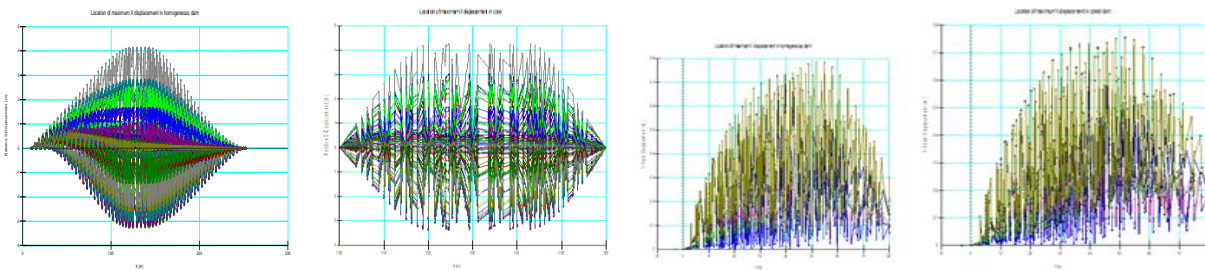
Fig. 6: Location of maximum X-displacement in a homogeneous and zoned dam

3. Acceleration result in the homogeneous dam and zoned dam

The maximum X-acceleration recorded for the graph at the time of 26 seconds was 0.56g. From fig. 7, the location of the maximum acceleration of the homogeneous dam and zoned dam is with a distance of 143 m and 133.8 m in the X-direction. Concerning both graphs, the maximum acceleration occurs in the clay core with a distance of 133.8 m in the x-direction of the zoned dam.
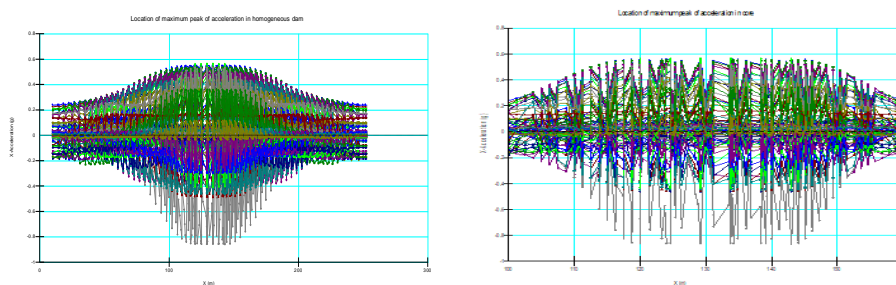
Figure 7. Location of the maximum peak of acceleration in a homogeneous and zoned dam

Conclusion

1. As per the figures acquired from the reaction of the structure in the duration of an earthquake by increase time duration, it has been seen that the peak acceleration and peak displacement have been seen in the middle of the earthen dams. According to the theory of resonance. As it tends to be comprehended from the displacement of earthen dams, the maximum recorded in zoned earthen structures and this is because of the core.

2. The horizontal and vertical displacement, maximum during the time interval of 40-60 seconds, which shows that the soil loses its strength during this period.

1. The incidence of clay core essential affects reducing the amount of seepage and exit gradient, the amount of seepage and the exit gradient. The core is extremely important in the dam to drop down the phreatic surface and reduce the seepage and pressure head within the dam.
2. The variety of hydraulic conductivity of medium dense materials considerable effects on the steady-state seepage. Flow rate reduces if medium dense materials are utilized as embankment material.

References

[1] GeoStudio (2004). Tutorial Manual, GEO-SLOPE International Ltd, www.geo-slope.com.
[2] Gui, M., and Chiu, H., (2006). "Response Ofrenti-Tan Dam During 921- JIJI Earthquake", 4th International Conference on Earthquake Engineering of Taipei, Taiwan.
[3] Daghigh, Y., (1993). "Numerical Simulation of Dynamic Behaviour of an Earth dam During Seismic Loading", Ph.D. Thesis, Delft University of Technology, Netherland.
[4] Fattah MY.; Al-Labban SNY.; Salman FA 2014. Seepage analysis of a zoned earth dam by finite elements. Int J Civil Eng Technol (IJCIET).
[5] Gazetas, G.; Psarropoulos.; P.N.; Anastasopoulos, I.; and Gerolymos, N. 2004. Seismic behavior of flexible retaining systems subjected to short-duration moderately strong excitation. Soil. Dyn. Earthquake Eng., pp. 537 – 550.
[6] Santosh Kumar Garg. 1976. Irrigation Engineering and Hydraulic Structures 21st revised edition, Khanna Publishers, New Delhi.
[8] Punmia B. C. (2001). Soil Mechanics & Foundation, Laxmi Publication Private Limited, New Delhi.
[9] Imran Arshad.; M.M. Baber September. 2014. Finite Element Analysis of Seepage through an Earthen Dam by using Geo-Slope (SEEP/W) software, International Journal of Research (IJR), Vol-1, Issue-8, ISSN: 2348-6848.
[10] Ming, H.Y.; Li X.S. 2003. Fully Coupled Analysis of Failure and Remediation of Lower San Fernando Dam." Journal of the Geotechnical and Geoenvironmental Engineering, ASCE, 129(.4), pp: 336-349.
[11] Doaa A.; El Molla T. 2019. Seepage through homogeneous earth dams provided with a vertical sheet pile and formed on the impervious foundation. Ain Shams Eng J 10(3), pp. 529–539
[12] IS: 1893-2002 Part-1. Criteria for Earthquake Resistance Design of Structures. Bureau of Indian Standard, New Delhi.
[13] EQ (2011-18). Seismic Slope Stability Studies of Nara Dam, Kandi Area, Hoshiarpur, Punjab. Earthquake Engineering Department, IIT Roorkee, Roorkee.
[14] IS 8826-1978. Guidelines for Design of Large Earth and Rock-Fill Dams. Bureau of Indian Standard, New Delhi.
[15] IITK-GSDMA. 2007. Guidelines for Seismic Design of Earth Dams and Embankments.
[16]http://www.soilvision.com/subdomains/soildatabase.com/databases.shtml
[17] DeAlba, P.; Chan, C.K.; Seed, H.B. 1975. Determination of Soil Liquefaction Characteristics By Large-Scale Laboratory Tests, Report EERC 75-14, Earthquake Engineering Research Center, University of California, Berkeley.
[18] John Krahn, 2004. Stability Modeling with SLOPE/W. An Engineering Methodology. first edition, Canada.
[19] Terzhagi, K. 1950. Mechanism of landslides. In: Paige, S. (Ed.), Application of Geology to Engineering Practice (Berkey Volume). Geological Society of America, New York, NY, pp.83-123.
[20] Kokusho, T. 2003. The current state of research on flow failure considering void redistribution in liquefied deposits, Soil Dynamics and Earthquake Engineering, Vol. 23, pp. 585-603.
[21] Novak, P.; Moffat, A.I.B.; Nalluri, C.; and Narayanan, R. 2007. Hydraulic Structures, 4thed., Taylor & Francis, London.
[22] John Krahn, 2004. Stability Modeling with SLOPE/W. An Engineering Methodology. First Edition, Canada.
[23] Gui M W.; Wu H H. 2003. Seismic analysis of the Renyi dam in Taiwan. Proc 12th Asian Regional Conf. on Soil Mechanics and Geotechnical Engineering, Singapore, pp: 287-290.
[24] GEO-SLOPE International Ltd. (2007). Seepage Modeling with SEEP/W. User's guide.
[25] Chandradhara, G. P. 2008. Seismic Performance study of earth embankments, Ph.D. thesis submitted to Kuvempu University, Karnataka, India.
[26] Khassaf SI, Madhloom AM. 2017. Effect of impervious core on seepage through zoned earth dam (case study: Khassa Chai dam). Int J Sci Eng Res 8(2):1053–1064.

Nanoparticles for Cancer Detection and its Future Implications

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Abstract: Cancer has become a deadly disease in today's modern industrialized world, with no surety of cure for life. Although, various methods for the detection of cancer exist, most of which rely on standard methods, but major advancements in this field are yet to come for improving the long-term survival of cancer suffering patients. So, here the authors have put a focus on the discussion of the upcoming technological advancements related to the use of nano-mechanical bioparticles in the field of cancer diagnosis and treatment. In today's world, the use of nanotechnology in detecting cancer cells and drug monitoring is at a peak. Many scientists and researchers all over the world are using various kin of nanotechnology tools for developing different procedures and facilities which can help in easy detection of cancer at an earlier stage and hence improve the longevity of cancer patients. With the help of this review, the authors provide an overview of the existing nano-particle tools and an overview of the upcoming bio-sensing technologies, along with their future perspectives in this field.

Keywords: CSCs, Nano-particles, Nano-sensors, Nano-medicine, Carbon Nanotubes, Cancer drug-therapy

Introduction: Initial studies to define the cancer-causing cells or tumor cells or CSCs show that these cells grow and divide at an abnormal rate are poorly differentiated and have proliferation and self-renewal capabilities. This abnormality is seen as a transfer of normal cells to benign tumors to malignant tumors. It is also seen that tumors are not only formed by the proliferation of cells but are also caused due to transfer of tumor on transplantation in experimental recipient models. The first experiment for studying cancer was done by injecting cancer CD133(+)/CD34(+) cells in an immunocompromised mouse which led to the generation of tumor xenografts which were identical to the original tumor [32]. This experiment was then conducted to find various kinds of solid tumors, generated in many different locations example brain, lung, liver, pancreatic cancers. The use of this genetically engineered mice model for the detection of stem cell overages has provided direct evidence in support of this hypothesis. Moreover, the criticism about the use of stem cells for cancer detection was also resolved by this technique. Back in 2000, two scientists quoted these cells as 'Next generation cells', and listed some essential alterations in cell biology that characterized malignancy. These characteristics were called hallmarks of cancer as per the scientists stating six biological capabilities acquired during the development of tumor cells [8][9]. These capabilities, as stated by Hanahan D. and Weinberg, R were growth suppressors, replicative immortality, inducing angiogenesis, resisting cell death, and activating invasion and metastasis. This proposed theory of Hanahan and Weinberg thus provided us with a proper framework for understanding the diversity of neoplastic diseases. Moreover, by their theory, it was understood that as normal cells evolve steadily to a neoplastic state, they acquire these hallmark biological capabilities. And further, the multistep process of development of human tumors could be rationalized based on the need of developing cancer cells to acquire the traits that enable them to become tumor cells and ultimately malignant. This report also showed the major role of CSCs in both tumor development and disease recovery. This highly important role of CSCs in cancer detection led to an increase in the demand for more and more clinical studies related to CSCs and to have a better knowledge of the characteristics and response of CSCs to different therapeutic regimes. Present techniques to manage CSCs related cancer relapse use techniques such as targeting CSCs specific surface markers, diminishing the tumor environment, and decreasing regulation of CSCs self-renewal. Because of these important roles of CSCs, they are seen as an attractive target for the development of various anti-cancer therapeutic techniques. Also, during the past several areas, the application of nanotechnology in the field of cancer treatment is oriented on this study only and are even found to be highly useful. Some of the nano techniques that are currently in developing phases are for example CNTs (an excellent nanosensor for cancer detection and also a nanomedicine carrier), which the authors have discussed later in the text. These newly developing technologies are majorly focused on developing the tools and techniques with a future directive of enhancement of anti-CSCs activities and improvements in the immunotherapy of CSCs.

Cancer Cells and Various Therapeutic Approaches: The studies related to cancer cells or stem cells started several years ago, showing the development of tumor-forming cells from stem cells. Most of these studies showed that tumors consisted of cells having stem cell properties, known as cancer stem cells (CSCs). From this data, we concluded that

CSCs are an important factor for all kinds of cancer. And, thus it is necessary to study the characteristics of these stem cells to develop anti-cancer therapeutic approaches. So, the scientists started developing techniques with the help of their knowledge of CSCs and nanoparticles, correlating both the topics for developing techniques targeting CSCs. The basic approach for developing CSCs related therapeutic techniques starts with studying the biological properties of CSCs, including the self-renewal and differentiation properties. Then, based on a study of these properties, CSCs targeted therapeutic strategies were summarized along with the targeted cell surface markers, differentiation therapy, signaling pathway, and drug resistance for CSCs. Furthermore, from the studies of the past few years, it is found that the use of these CSCs related therapies has shown improvement when combined with the existing conventional chemotherapy and radiotherapy methods. Also, CSCs could be easily eradicated, gradually resulting in inhibited tumor growth and metastasis. Thus, this technique is found to be an effective and promising therapeutic strategy for cancer, to date.

Table 1. This table depicts different kinds of Cancer stem cells (CSCs) and their specific markers found to date. These markers or biomarkers are also called as cell-surface markers and are used for identification and eradication of CSCs.

CANCER STEM CELLS	CSC's MARKERS FOUND
Teratocarcinoma	SSEA3, SSEA4, SSEA1, TRA-1-60, TRA-1-81,
Breast	SSEA3, TRA-1-81, CD133 (AC133), SSEA4, Cripto-1 (TDGF1), PODXL-1 (Podocalyxin-like protein 1), TRA-1-60, ABCG2, CD24, CD10 (Neprilysin), CXCR1, 2, CD55 (DAF), CD29 (Integrin β1), CD44 variants
Prostate	TRA-1-60, CD133 (AC133)
Renal	SSEA1, CD105 (Endoglin)
Lung	SSEA1, Cripto-1 (TDGF1), PODXL-1 (Podocalyxin-like protein 1), ABCG2, Notch2, CD56 (NCAM), CD166 (ALCAM), Notch3
Colon	CD133 (AC133), CD326 (EpCAM), Cripto-1 (TDGF1), CD29 (Integrin β1), CD44 variants,
Glioma	CD133 (AC133), CD49f (Integrin α6),
Ovary	CD133 (AC133), CD117 (c-KIT), DLL4 (Delta-like ligand 4), CD44 variants,
Liver,	CD133 (AC133), CD90 (Thy-1), CD326 (EpCAM), CD13 (Alanine aminopeptidase), CD44 variants,
Brain	CD90 (Thy-1), ABCG2, CXCR4,

Nanotechnology- Fundamental Concept and Its Use in Cell Biology: Nanotechnology is a relatively new branch of science that has found a wide range of applications in the past few years, especially in the field of biomedical. One of the key biomedical applications of this technology is in the field of cancer, which is proved to be highly effective. The property of nano-particles to image biological processes on the cellular level is used to study CSCs and further summarize various anticancer CSCs related therapies.

Targeted Nanoparticles- The concept of nanotechnology is surfaced around targeting the nanoparticles. In recent years, this targeting concept has become a very significant focus in biological research, thereby showing a large amount of effectiveness in biological applications. In particular, the use of NPs in the field of biomedical has resulted in the development of several enhanced techniques that are way more effective and beneficial than the earlier existing

techniques. As a result, there has been a significant interest in the development of various NP designs and therefore a boost is also seen in development in this particular field.

Nano Sensors and Their Biomedical Application in Cancer Treatment: In a few recent years, we were able to develop methods by which nanoparticle can be used as a tool for detecting cancer in very early stages and very precisely, quantum dots are small crystals of semiconductor and on excitation, these particles emit fluorescence and show more precise results than organic dye, carbon dots also serves the same function but are much more biocompatible. nano-gold particles are also used for cancer detection, they show a change in their behavior when they come in contact with the high-temperature surrounding like growing tumor cells.

Nanomedicine – An Effective Tool Against Cancer: As already discussed, this emerging field of Nanotechnology is slowly and gradually leaving a huge impact on biomedical applications, so let us now discuss some of its highly beneficial and useful applications in the field of cancer. The biocompatible and biodegradable nanoparticles or molecules find their importance majorly in delivering a wide range of therapeutic molecules. The list of these therapeutic molecules includes several different types of proteins, different kinds of drugs, nucleic acids, and several antibodies. By limiting the unfavorable biological conditions and enhancing the profiles of the drug molecules, these nanocarriers offer their benefits. Similarly, other kinds of nanocarriers which are stimuli-responsive are developed with the capacity to respond to various external stimuli like pH, light, and temperature, thereby helping in providing control over the release of drugs to the targeted cells only. The extremely small nanoscale size of these carriers is the reason that provides them the capability of getting accumulated in the tumor regions. Further, their enhanced permeability and retention effect also adds up to this. There have also been sufficient advancements in describing various small molecules and proteins using nanoparticles to ensure targeting of cancer stem cells(CSCs), through various kinds of therapeutic techniques by using the above-discussed resistance mechanism.

Table 2. Different anticancer medicine with their nanoparticles and type of cancer defined.

MEDICINE	NANOPARTICLE	TARGET CANCER
Doxorubicin	Liposome NP	ovarian cancer, and multiple myeloma, etc.
Vincristine sulfate	Liposome NP	Acute lymphoblastic leukemia
Irinotecan	Liposome NP	Metastatic pancreatic cancer
Paclitaxel	Liposome NP, Polymeric micelle, Albumin NP	Pancreatic cancer, liver metastases, and HER2-negative breast cancer
Cisplatin	Liposome NP	Non-small-cell lung cancer
Multi Cancer-associated antigens	Liposome NP	Ovarian, breast, and prostate cancers
siRNA against PLK1	Lipid NP	Advanced hepatocellular carcinoma
TNF	Colloid gold NP	Late-stage cancers

Some Advantages of Nanoparticles Over the Conventional Therapies are discussed below:

Bioavailability of CSCs Specific Drugs: Bioavailability is defined as the extent of the active effect that a drug can give, and nanoparticles stay pretty ahead in this race by offering high capacity capabilities for chemotherapeutic drug molecules. The large porosity of the vasculature of the lymphatic drainage system offers a passive accumulation of nanoparticles and the drug molecules attached to it. Alternatively, nanoparticles are also found useful in enhancing the drug delivery to these tumor sites by connecting the nanoparticles with a high-affinity molecule against the specific receptor. Most studies have reported that conventional therapeutic agents have limited access to the CSCs due to their

microenvironment and distant location away from the vasculature. This problem or glitch is overcome by nanoparticles.

Nanoparticles and CSCs Drug Resistance: So far, several studies have reported that the use of chemotherapeutic agents, which are conjugated to nanoparticles are not recognized as a solid substrate by transporters and can therefore stay at the target site for longer periods. Additional advantages to this are provided through cell-penetrating peptides that increase the accumulation of drugs at the cellular level. Thus, we can easily conclude that specifically designed nanoparticles are found to be extremely useful in enhancing intracellular accumulation.

Carbon Nanotubes in Cancer Diagnosis and Therapy: CNT is made up of a single graphene sheet rolled up in a tube-like structure, it has many physical and electrical properties that make it an excellent nanomaterial for becoming a biosensor and for carrying medicinal nanoparticle.

Structure and Properties of CNT: CNTs are made up of graphene which is a single layer of graphite having hexagonal rings of carbon joined together, the nanotube has sp2 bonding which makes it the strongest and most flexible molecular material, the tube has an inner diameter ranging from 1nm-3nm and outer diameter from 2nm-100nm, the length comparative to diameter is much higher. It is divided into 2 types i.e. Single-walled CNT and Multi-walled CNT, as the name suggests, SWCNT is made up of a single graphene sheet in cylindrical form while MWCNT is made up of multiple Graphene sheets rolled concentrically. It has a very high current carrying capacity and it can take maximum strain up to 10% which is much higher than other materials. Other chemical groups can be attached to the outer surface of the tube (functionalization) this property makes it convenient to use it as a biosensor.
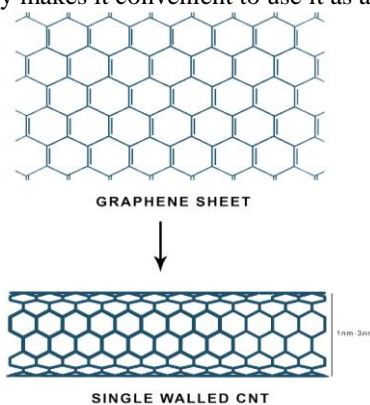
Figure1. Structure of CNT

CNT as nano sensors and nanomedicine: Properties of CNTs can be altered through functionalization and various chemical groups can be attached to make it more biocompatible and soluble in water, one of these techniques are attaching an ssDNA probe on the surface of the nanotube this probe when comes in contact with target ssDNA it reacts and form a structure altering various electrical properties of the molecule this process is called Hybridization. This property can be used for cancer detection as well because tumors have Cancer stem cells and some specific markers are present on them known as CSC markers. CNT can also be filled with the different nanoparticles containing anticancer drugs e.g. dioxin and can be used for targeting specific CSCs and destroying tumors.

Future Directives and Conclusion: Nanotechnology and Nano-particles are the most effective kind of newly-developed technology in the field of biological sciences especially in terms of advancements of biological applications. As mentioned above, nanotechnology-enabled creation of devices with a unique approach to drug delivery systems, which is extremely effective for developing anti-cancer therapeutic devices. Moreover, the interest in biological applications for NPs is very recent and evolving, thus a reason for the development of more and more innovative technologies and advancements in the existing ones is growing day by day. Also, from the current developments, we can easily depict that the nanomedicines discovered so far are very promising. But, how various biological units process and assemble remain unknown. Leaving a wide range of possibilities for advancement in this field and a boost to the probabilities of their use in clinics. In this virtue, some important directions are discussed below, giving you a glimpse of the most advanced technology in the field.

Some specific improvements that will boost the therapeutic- techniques in the field of cancer and detection of CSCs are:

131

Advance Nanocarriers for the Anti-cancer Cell activities: A tumor consists of two major anatomical regions the outer layer known as the outer perivascular region which has proper vascularization system and interior hypoxic regions with poor vascularization system, both the regions have an abundant amount of CSCs present on them and can be easily transported to other regions of the body especially from the perivascular region of the tumor. with the latest research going on new and advanced nanocarriers are under development with capabilities of penetrating inside these cancer tumors filled with anti CSCs targeting and destroying these CSCs.
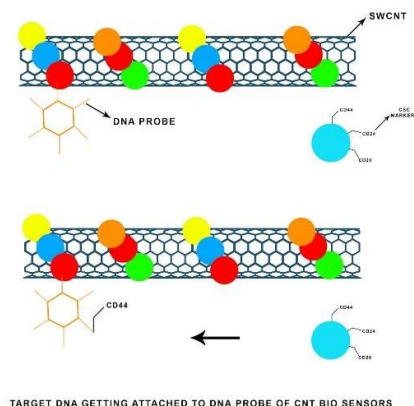
Figure 2. CNT as a nano-biosensor

Improvements in the Immunotherapy of CSCs:
Different types of cells present in our body such as T cells, natural killer cells, tissue-associated fibroblast, etc. directly affect cancer stem cells and affect the growth of the tumor, with the latest advancement in the identification of tumor cells we can use Immunotherapy (using natural immune cells) to target cancer, with more precision coming in the detection of CSCs and tumor in early stages can help to give a combine response including Immunotherapy and anti-CSCs to cure cancer at very initial stages.

Acknowledgments

References
[1] Boisseau P, Loubaton B (2011). "Nanomedicine, nanotechnology in medicine". Competes Rendus Physique. 12 (7):620636. Bibcode:2011CRPhy..12..620B. DOI:10.1016/j.crhy.2011.06.001.
[2] Coffey R (August 2010). "20 Things You Didn't Know About Nanotechnology". Discover. 31 (6): 96.
[3] Deepak Rohila, Yang Yao, Xuexiao Jin. "Chapter 4 Cancer Stem Cells (CSCs) and Their Application in Cancer Immunotherapy", Springer Science and Business Media LLC, 2018
[4] Dreaden, Erik C; Austin, Lauren A; Mackey, Megan A; El-Sayed, Mostafa A (2016-12-06). "Size matters: gold nanoparticles in targeted cancer drug delivery". Therapeutic Delivery. 3 (4): 457–478. DOI:10.4155/tde.12.21
[5] Duarte, S., Momier, D., Baque, P., Casanova, V., Loubat, A., Samson, M., et al. (2013). Preventive cancer stem cell-based vaccination reduces liver metastasis development in a rat colon carcinoma syngeneic model. Stem Cells 31, 423–432. DOI: 10.1002/stem.1292
[6] Du, J.-Z., Du, X.-J., Mao, C.-Q., and Wang, J. (2011). Tailor-made dual pH-sensitive polymer–doxorubicin nanoparticles for efficient anticancer drug delivery. J. Am. Chem. Soc. 133, 17560–17563. DOI: 10.1021/ja207150n
[7] Freitas RA (1999). Nanomedicine: Basic Capabilities. 1. Austin, TX: Landes Bioscience. ISBN 978-1-57059-645-2. Archived from the original on 14 August 2015. Retrieved 24 April 2007.
[8] Freitas RA (March 2005). "What is nanomedicine?" (PDF). Nanomedicine. 1 (1): 2–9. DOI:10.1016/j.nano.2004.11.003
[9] https://www.frontiersin.org/(Internet Source)
[10] http://www.freepatentsonline.com/ (Internet Source)
[11] Hanahan, D.; Weinberg, R. A. (2011). "Hallmarks of Cancer: The Next Generation". Cell. 144 (5): 646–674. DOI:10.1016/j.cell.2011.02.013. PMID 21376230.

[12] Hassellöv, Martin; Readman, James W.; Ranville, James F.; Tiede, Karen (July 2008). "Nanoparticle analysis and characterization methodologies in environmental risk assessment of engineered nanoparticles". Ecotoxicology. 17 (5): 344–361. DOI:10.1007/s10646-008-0225-x

[13] Heppner GH, Miller BE (1983). "Tumor heterogeneity: biological implications and therapeutic consequences". Cancer Metastasis Reviews. 2 (1): 5–23. DOI:10.1007/BF00046903

[14] Integr Biol (Camb). Author manuscript; available in PMC 2015 Jan 1. Published in final edited form as Integr Biol (Camb). 2014 Jan; 6(1): 9–26. DOI: 10.1039/c3ib40165k

[15] Jessica Méndez, Moraima Morales Cruz, Yamixa Delgado, Cindy M. Figueroa et al. "Delivery of Chemically Glycosylated Cytochrome C Immobilized in Mesoporous Silica Nanoparticles Induces Apoptosis in HeLa Cancer Cells", Molecular Pharmaceutics, 2013

[16] Kreso A, Dick JE (2014), "Evolution of the cancer stem cell model", Cell Stem Cell, 14 (3): 275–91, DOI:10.1016/j.stem.2014.02.006

[17] Liu, C., Zhao, G., Liu, J., Ma, N., Chivukula, P., Perelman, L., et al. (2009). J Novel biodegradable lipid nano complex for siRNA delivery significantly improving the chemosensitivity of human colon cancer stem cells to paclitaxel. Control. Release 140, 277–283. DOI: 10.1016/j.jconrel.2009.08.013

[18] link.springer.com (Internet Source)

[19] Li, Z., Bao, S., Wu, Q., Wang, H., Eyler, C., Sathornsumetee, S., et al. (2009). Hypoxia-inducible factors regulate tumorigenic capacity of glioma stem cells. Cancer Cell. 15, 501–513. DOI: 10.1016/j.ccr.2009.03.018

[20] Market report on emerging nanotechnology now available. Market Report. US National Science Foundation. 25 February 2014. Retrieved 7 June 2016.

[21] Mukherjee, Siddhartha (2010-10-29). "The Cancer Sleeper Cell". New York Times. Retrieved 15 July 2014.

[22] Nanomedicine Overview. Nanomedicine, US National Institutes of Health. 1/08/ 2016. Retrieved 8/04/2017

[23] "Nano Biomedicine", Springer Science and Business Media LLC, 2020

[24] Ping Gong and Rastislav Levicky; DNA surface hybridization regimes; PNAS April 8, 2008, 105 (14) 5301-5306; https://doi.org/10.1073/pnas.0709416105

[25] Piotr Grodzinski and Dorothy Farrell. Future Opportunities in Cancer Nanotechnology—NCI Strategic Workshop Report DOI: 10.1158/0008-5472.CAN-132787 Published March 2014

[26] "Proceedings of the International Conference on Modern Research in Aerospace Engineering", Springer Science and Business Media LLC, 2018

[27] publicist.unicatt.it (Internet Source)

[28] Qingxin Mu and Bing Yan. Nanoparticles in Cancer Therapy-Novel Concepts, Mechanisms, and Applications By Published on 22 January 2019 Front. Pharmacol. DOI: 10.3389/fphar.2018.01552

[29] Ranganathan R, Madanmohan S, Kesavan A, Baskar G, Krishnamoorthy YR, Santosham R, Ponraju D, Rayala SK, Venkatraman G (2012). "Nanomedicine: towards the development of patient-friendly drug-delivery systems for oncological applications". International Journal of Nanomedicine. 7: 1043–60. DOI:10.2147/IJN.S25182

[30] Salvati, Elisa, Francesco Stellacci, and Silke Krol. "Nanosensors for early cancer detection and therapeutic drug monitoring", Nanomedicine, 2015.

[31] Sung, KM; Mosley, DW; Peelle, BR; Zhang, S; Jacobson, JM (2004). "Synthesis of monofunctionalized gold nanoparticles by for solid-phase reactions". Journal of the American Chemical Society. 126 (16): 5064–5. DOI:10.1021/ja049578p

[32] Sara M. Nolte; Inside a cancer stem cell researcher's toolbox: CSC markers & flow cytometry; Dec 8, 201

[33] Suzuki, KG; Fujiwara, TK; Edidin, M; Kusumi, A (2007). "Dynamic recruitment of phospholipase Cat transiently immobilized GPI-anchored receptor clusters induces IP3 Ca2+ signaling: single-molecule tracking study 2". The Journal of Cell Biology. 177 (4): 73142. DOI:10.1083/jcb.200609175.

[34] The Advances of Carbon Nanotubes in Cancer Diagnostics and Therapeutics Volume 2017 |Article ID 3418932 | 13 pages | https://doi.org/10.1155/2017/3418932

[35] Vimal K. Singh1, Abhishek Saini 1, and Ramesh Chandra2. The Implications and Future Perspectives of Nanomedicine for Cancer Stem Cell Targeted Therapies Front. Mol. Biosci., 21 July 2017 | https://doi.org/10.3389/fmolb.2017.00052

[36] Wagn er V, Dullaart A, Bock AK, Zweck A (October 2006). "The emerging nanomedicine landscape". Nature Biotechnology. 24 (10): 1211–7. DOI:10.1038/nbt1006-1211. PMID 17033654

[37] Won-Tae Kim and Chun Jeih Ryu Cancer stem cell surface markers on normal stem cells2017 Jun; 50(6): 285–298. Published online 2017 Jun 30. DOI: 10.5483/BMBRep.2017.50.6.039

[38] World Cancer Report 2014. World Health Organization. 2014. p. 22. ISBN 978-92-832-0429-9. Archived from the original on 12 July 2017.

Landslide Susceptibility of Rock Cut Slope Hrishikesh NH-58 (India) using Arc GIS

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 Abstract: Geographic Information Systems (GIS) gives an incredible help in overseeing and investigating spatial information. GIS has been applied effectively to numerous fields of science and technology to assort, collate and compare various parameters and get pertinent results. One of such fields is the field of catastrophe identification and mitigation. GIS becomes more appropriate in particular when used with Remote sensing (RS) data and information and have been utilized all through the world for delineating hazard zones. Remote Sensing in combination with GIS, extracting information give real-time modelling of events and prevailing situations. The ability to efficiently examine different hazard zones and related factors spread over large region and areas with difficult to reach physically can be identified easily and to take mitigation measures for any catastrophic event and disaster. In the present analysis of the study area various thematic maps prepared from GIS software using IDW (inverse distance weight) method which shows that this area is highly susceptible to landslide these thematic maps can be used in preliminary evaluation in demarcation of landslide prone areas.

Keywords: Geographical Information Systems; Landslide susceptibility, IDW method (inverse distance weight); landslide.

Introduction

Landslides are defined as movement of slope material such as rock debris and earth whether downward and outward under the influence of gravity [1].On the other hand it can also be defined as when mass movement become sudden and fast termed as Landslides. Whereas mass movement refers to degraded rock, rock debris and resultant soil on slope move constantly downward until the influence of gravity known as Mass movement. Redistribution of Soil and Sediments served by Landslides by a sudden collapse or a sluggish surge of mud, rubble, earth failure, slope failure etc. Landslide most commonly occur in geodynamic sensitive belts i.e. area and zones where earthquake is common and affected by other neotectonic activities [2].

The most important factors which are responsible to start the mass movement are*:*
(a). Long and heavy rainfall
(b). Cutting and deep digging of slopes for building, road, canal construction and mining without convenient disposal of debris
(c). Earthquake shock and tremors

Major forces working on slopes as per various studies are:
  (a). Shear strength of the materials that act on the slip planes. (b). Weight of the slope material, i.e. rocks, man-made structures, soils, and vegetation acting downwards. Water is the major cause of mass movement and serves as an agent of rock weathering that produces self-cohesive and yielding materials. It impacts rock shear energy and reduces further. Landslide cause immense loss to human and animal life apart from infrastructure and economy with its different variance. By CRED-Munich RE scheme of classification (2019) landslides are mainly classified in two types:
  1- Geophysical/Geological disaster: In this case the material mass movement is dry. 2- Hydrological disaster: In this the mass movement material is wet.
In India landslide effects 12.6 percent of our nation area (as per GSI) is prone to landslide which accounts for 0.42 million km^2 area. All 22 states and 5 union territories are affected from hilly states Jammu Kashmir, Himachal Pradesh, Uttrakhand to Kerala and Tamil Nadu.
One of the world's biggest geohazards is Landslides, which account for nearly 9 per cent of the global natural disaster[3];[4].In the emergency events database(EMDAT,2016), which shows landslide causes 16,500 deaths and af fects 4.5 million people worldwide with propertydamage of USD 3.5 million (OFDA / CRED 2016)[5],the landslide statics per continent are summarized from 2007 to 2014.Uttrakhand saw exceedingly profuse precipitation with monstrous torrent due to cloudburst because of the combination of Westerlies with the Indian Monsoonal system

[6] that provoked huge blaze outlines and subsequently catastrophic landslide .The investigation being led here along National Highway-58 and it has outstanding significance because of the tourism industry and religious journey exercises and goes about as a corridor for financial improvement of the area and serves as the lifeline. For re-establishing environment with feasible financial turn of events, geotechnical evaluation is essential. A few roadways are under danger of an assortment of failure of slopes. From quite a few years, mass movements of debris and rocks are   posing   challenges   to   smooth   traffic movement.Different geotechnical analysts conducted work to evaluate the slope stability of cut slopes along in Utta rakhand [7],[8],[9]. Which includes study on the basis of standard empirical methods and finite element analysis such qualitative and thorough studies found that there are some areas along the highway (NH-58) that need a complete evaluation.

Seismic vulnerability and its ongoing progressive tectonism are the key segments for predicting the characteristics of the rock mass all such unfavorable exercises have consistently diminished the rock mass's inborn quality attributes and an adverse event can cause major landslides in the region. It is evident from various seismic activity in recent, the whole Himalayan mountain chain is inalienably delicate. It is more noteworthy greater Himalaya faces much successive seismicity when contrasted with the Lesser Himalaya. The Lesser Himalayan arrangement has extensively undergone deformation. In the region of lesser Himalaya (Garhwal-Kumaon region) litho-tectonic slide was assessed [10] and concluded that anthropogenic activities and strong pace of development especially excavation leading towards a dangerous condition developed in the area due to dynamic forces, and particularly in case of NH-58 Hrishikesh Badrinath highway is alarming.

On basis of weight assignment relative significance of landslide causative variables is controlled by a few LHZ strategies in an unexpected way [11], in any study from a combination remote sensing data and GIS for landslide hazard and risk assessment susceptibility thematic map generation with the help of parameters responsible for triggering landslide [12], each parameter has its significance to probable of landslide activity [13] and case studies [14],[15],[16],[17],[18],[19],[20] and GIS based hazard zonation [21]. As already reported in the previous studies [22, 23, 24], all work on susceptibility assessments must be focused on a reliable set of previous records and history of events to serve as the foundation and facilitate the whole operation.

Study Area
The field of study falls in the state of Uttarakhand Consisting of hilly terrain with steep and uneven topography consisting of 13 districts in Garwhal and Kumaon. Also the state has huge glacier, i.e. two major rivers. Ganga and Yamuna originate from this broad cover of the Glacier. The Area identified in this study includes rocks exposed in Rishikesh along NH-58, Rishikesh-Devprayag Road. The rocks are Krol Limestones of Mahi Formation of Neo Proterozoic Age, exposed in Lesser Himalayas, in between $30°8' – 30°9'$ Lats. and $78°19' – 78°21'$ Longs. lying in Survey of India Topographic Map 53 J / 8.

Methodology

Data acquisition
The data used in this analysis contains information that is transmitted spatially along with other ancillary data. The f ollowing systematic approach involves several steps to acquire the necessary data from the sourcesof concern, proce ssing and analyzing it, generating thematic maps and conducting field visits to the present research.

The available published and unpublished literature, technical reports, special volumes and research papers published in various national and international journals, relevant to this review, is compiled and extensively reviewed.

The SRTM DEM data for the uttarakhand region's 90 m spatial resolution was freely downloaded from the http:/ear thexplorer.usgs.gov website to produce the various components such as height, slope and aspect.

Data Used

A list of data required and used for analysis is given below:

1- Survey of India (SOI) topographical maps no.53J/8 on **1:50,000** scale.
2- SRTM DEM 90m resolution data.
3- Satellite imagery of high resolution freely available on *google earth*.

Software Used

1- SRTM DEM data processing is performed using ArcGIS10.0
2- The various GIS software used for the study is, ArcGIS 10.0.

135

3-   Microsoft office module from MS-Office 2007 software program used
4-   ArcGIS 10.0, have been used for georefrencing maps and making of various thematic maps.

Result and Discussion

Aspect map
Aspect is the slope's direction, and measured as smooth, N, NE, E, SE, S, etc *(Fig.1)*. The dimension of a slope can also lead to slope failure and was used by some in the study of landslide susceptibility. It recognizes the down slope direction of the maximum rate of change in value from each cell to all of its neighbors. One could think of it as slope direction. The raster values for the output will be the compass's aspect direction.

Slope Map
It is measured as an angle in degrees or in percentage. Slope defines a unit of terrain as its steepness or gradient. Slope is a resolution function, and slope is determined by using spatial resolution. In terrain analysis slope, aspect and surface curvature are all obtained from neighborhood operations using elevation values of all neighboring cells. Slope *(Fig.2)* is prepared by SRTM DEM data in Arc GIS software. Slope is mostly classified into six classes as Plain, Gentle, Moderate, fairly inclined, Inclined, very inclined. In the study area maximum area is fall under fairly inclined and inclined region whereas area in northern region is fall in very inclined region.

Contour Map
Contour map generally shows the elevation above sea level and surface feature of land by means of contour lines. Contour map *(Fig.3)* was extracted from SRTM DEM data using Arc GIS software with interval of 50 meters.

DEM
DEM is another important conditioning factor because it is affected by various geomorphic and geologic processes *(Fig.4)* [14]; [15]. Landslides are generally more prone to occur at high altitude [16]. In the study area altitude ranges from 392 to 713 m above mean sea level.

Relief
Relief maps show contours, based on form and height, of landscapes and ground. Detailed variants of topographic maps are relief maps *(Fig.5)*. To construct two-dimensional models, the topographic maps use contour lines to link areas of the same elevation. The focus on the three-dimensional elevation of topography is what makes relief maps distinct from other maps; shading is often used between contours for better representation of terrain, known as shaded relief *(Fig.6)*.

The general estimation of the for landslide susceptibility zone is a results from the combination of the vulnerability factors of the individual elements. In particular, the Map has been first re-classed; then the information layers have been consolidated utilizing Arc GIS (Raster Calculator Tool – Spatial Analyst). In the instability map, the major part of the region is described by a moderate degree of instability. The most prone region is having the height greater than 300m portrayed by steep slopes; the investigation has given data on the susceptibility of the territory to slope instability and can be utilized for the stability assessment and anthropogenic activities, the construction of new structure and for the catastrophe management. The most susceptible class was above 627-713 m (**Fig.4)** which has a high elevation in the study area.

Conclusion
In present study of the study area various thematic maps prepared from GIS software using IDW(inverse distance weight) method including viz; DEM shows that most of the low lying areas are lying at the boundary side and high lying areas are lying as we move inward from the boundary, slope map of area under investigation shows that maximum area is under fairly inclined to inclined region which shows that this area is highly susceptible to landslide and northern part of the study area is very inclined which is mostly prone to landslide, Aspect map generally shows the direction of slope or the downslope direction. In the study area maximum direction of slope found in North-West and South direction. Relief map of the study area also shows that area is under high risk zone of landslide. These thematic maps can be used in preliminary assessment in demarcation of landslide prone areas. It is suggested Toe ditch and wall, Pattern bolting, Systematic shotcreting, Dental concrete, Re-excavation, Deep drainage, Gravity Wall, Anchored retaining wall with buttresses can be used as remedial measure.
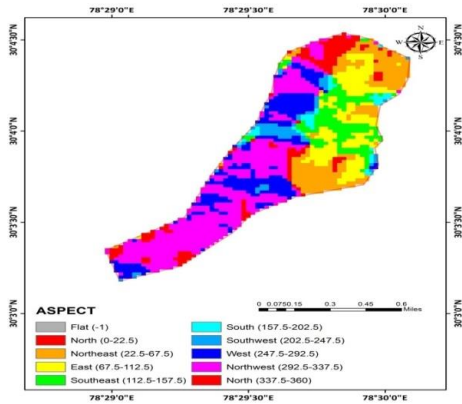
Figure 1. Aspect Map of the slope.
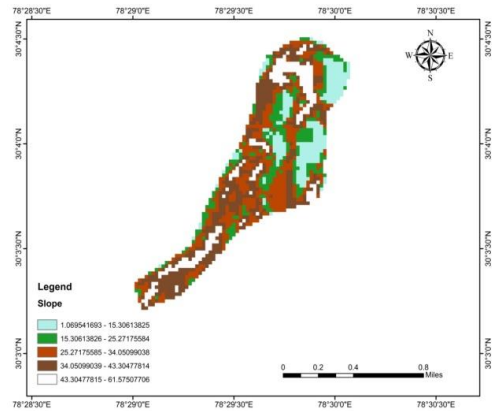
Figure 2. Slope Map of the slope.
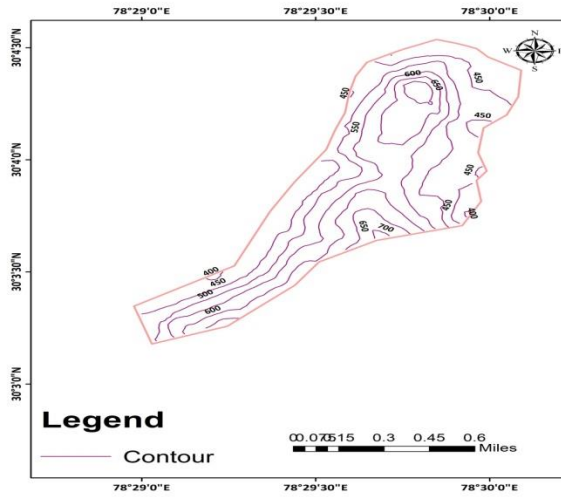
Figure 3. Contour Map of the slope.
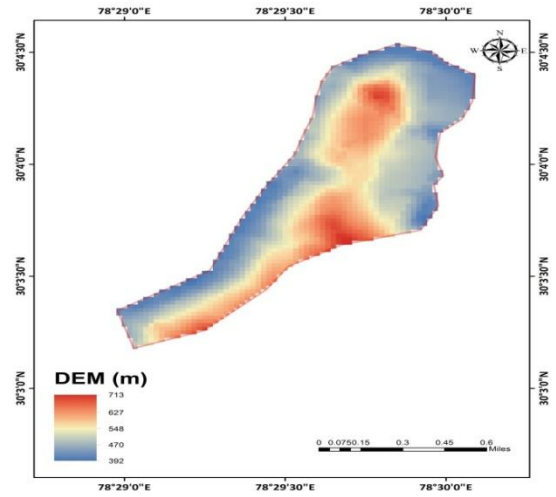
Figure 4. Digital elevation model of the slope.
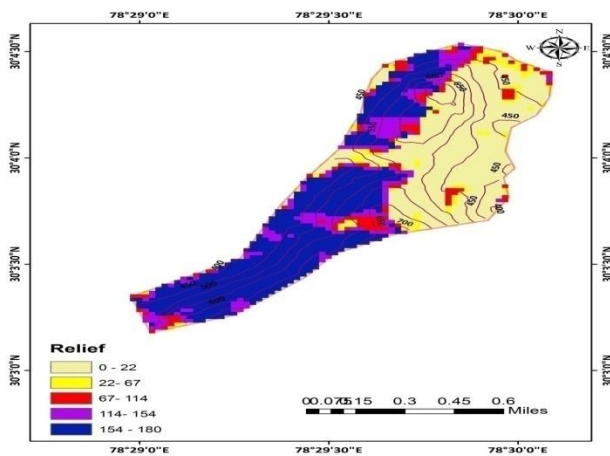
Figure 5. Relief Map of the slope.
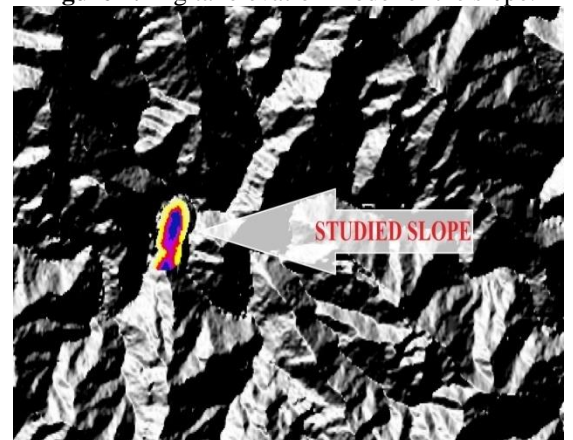
Figure 6. Hill shade of the region and studied slope

137

Conflict of interest: On behalf of all authors, there is no conflict of interest.

References
[1]. National Disaster Management Guidelines. Management of Landslides and Snow Avalanches, (2009). Pp 1 – 144. A publication of the National Disaster Management Authority, Government of India.
[2]. Bolt, B.A., (1975). Landslide Hazard, Geological Hazard, Springer Verlog, New York, 150
[3]. Chae, B. G., Park, H. J., Catani, F., Simoni, A., and Berti, M. (2017). Landslide Prediction, monitoring, and early warning: A concise review of state-of-the-art, J. Geosci., 21, 1033–1070.
[4]. Christos, Chalkias. , Maria, Ferentinou .,Christos Polykretis (2014) GIS-Based Landslide Susceptibility Mapping on the Peloponnese Peninsula, Greece Geosciences, 4, 176-190;
[5]. Ahangama, Kankanamge., Rasika ,Nishamanie Ranasinghe. , Ranmalee, Bandara. , Udeni,Gnanapriya., Anuruddha, Puswewala ., and Thilantha, Lakmal Dammalage.(2019).Efficacy of using radar-derived factors in landslide susceptibility analysis, case study of Koslanda, Sri Lanka. Nat. Hazards Earth Syst. Sci., 19, 1881–1893
[6]. Nair,A S.,Singh,SK . (2013) Understanding the cause of disaster of june,a scientific review.In:Proceedings of 2nd disaster and vulnerability conference ,Trivandrum India 2014 p.57-64.
[7]. Siddique, T., Alam, MM., Mondal ,MEA., Vishal V. (2015). Slope mass rating and kinematic analysis of slopes along National Highway-58, near Jonk, Rishikesh, India. Journal of Rock Mechanics and Geotechnical Engineering, 7(5):600e6.
[8]. Pain, k, A., Kanungo, DP. Sarkar, S.(2014). Rock slope stability assessment using finite element based modelling - examples from the Indian Himalayas. Geomechanics and Geoengineering,9(3):215-30
[9]. Sarkar S, Pandit., K, Shamra M, Pippal(2018). A. Risk assessment and stability analysis of a recent landslide at Vishnuprayag on the RishikesheBadrinath highway, Uttarakhand, India. Current Science ,114(7):1527-33.
[10]. Mithal, RS. (1988).Lithotectonics landslides and hazards in part of Garhwal-Kumaon Himalayas.in:proceeding second international conference on case histories in geotechnical engineering, RollaMissouri .
 [11]. Pardeshi ,Sudhakar D, Sumant E Autade and Suchitra S Pardeshi(2013) .Landslide hazard assessment: recent trends and techniques. SpringerPlus 2:523.
[12]. Dibs, Hayder. Ahmed ,Al-Janabi., Gomes ,Chandima. (2018). Easy To Use Remote Sensing and GIS Analysis for Landslide Risk Assessment. Journal of University of Babylon, Engineering Sciences, Vol.(26), No.(1): 2018.
[13]. Saied, Pirasteh. & Jonathan Li (2017).Landslides investigations from geoinformatics perspective: quality, challenges, and recommendations, Geomatics, Natural Hazards and Risk, 8:2, 448-465, DOI,10.1080/19475705.2016.1238850
[14]. M.L.,Gritzner.,Marcus., W.A., Aspinall, R., Custer, S.G. (2001). Assessing landslide potential using GIS, soil wetness modelling and topographic attributes, Payette River, Idaho. Geomorphology, 37, 149–165
[15]. Dai, F.C., Lee, C.F (2002). Landslide characteristics and slope instability modeling using GIS, Lantau Island, Hong Kong. Geomorphology, 42, 213–228
[16]. Ercanoglu, M.,& Gokceoglu, C.(2004). Use of fuzzy relations to produce landslide susceptibility map of a landslide prone area (West Black Sea Region, Turkey). Eng. Geol., 75, 229–250.
 [17]. H.,Shahabi. , B.B. Ahmad , and S., Khezri (2012). Landslide Susceptibility Mapping Using Image Satellite and GIS Technology, International Journal of Engineering Research & Technology (IJERT) Vol. 1 Issue - ISSN: 2278-0181-2012
 [18]. Tripathi, Mahesh Kumar., Govil,Himanshu., P.K,Champati ray. , Das I.C. (2018).Landslide hazard zonation mapping of Chamoli landslides in Remote sensing and GIS environment, The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLII-5.
[19]. F, El Bchari., B. Theilen-Willige. , H, A, Malek.(2019).Landslide hazard zonation assessment using GIS analysis at the coastal area of Safi (Morocco) Proceedings of the International Cartographic Association, 29th International Cartographic Conference (ICC 2019), 15–20 July 2019, Tokyo, Japan
[20]. Van Westen, C.J., Ghosh, S., Jaiswal, P., Martha, T.R., Kuriakose, S.L. (2011). From landslide inventories to landslide risk assessment; an attempt to support methodological development in India. In Proceedings of the Second World Landslide Forum, Rome, Italy.
[21]. Van ,Westen,, C.J., Rengers, N., Terlien, M.T.J., Soeters, R. (1997): Prediction of the occurrence of slope instability phenomenal through GIS-based hazard zonation. Geol. Rundsch, 86, 404–414.

 [22]. Ahmed, B. (2015).Landslide susceptibility mapping using multi-criteria evaluation techniques in Chittagong Metropolitan Area, Bangladesh. Landslides, 12, 1077–1095.

[23]. Van Westen, C.J., Castellanos, E., Kuriakose, S.L. (2008).Spatial data for landslide susceptibility, hazard, and vulnerability assessment: An overview. Eng. Geol. 2008, 102, 112–131.
[24]. Abella, E.A.C., van Westen., C.J. (2008).Qualitative landslide susceptibility assessment by multicriteria analysis. A case study from San Antonio del Sur, Guantanamo, Cuba. Geomorphology, 94, 453–466.

Effect of Rice Husk Ash on The Strength and Thickness of Pavement Quality Concrete (PQC) Layer Using M40 Grade of Concrete

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Abstract: The interest to Construction of rigid pavement is increasing, due to its high strength, better serviceability, overall economy in the long run and durability. The drive nowadays is to create or design thinner of better quality of concrete pavement all the above mentioned factors are related to the strength characteristics of concrete, in rigid pavement has been used high strength concrete, the high strength concrete is the concrete, which compressive strength is more than 40Mpa. In this study the purpose is developing pavement quality concrete mixtures incorporating rice husk ash as replacing with cement by weight. The aim is to design the thickness of slab of PQC with rice husk ash concrete and compare it with M40 grade. It is found that the compressive strength of rice husk ash is 17.14% increased with replacing of rice husk ash at the rate of 15% replacement.

Keywords: PQC, Concrete M40, Rice Husk Ash.

Introduction

The pavements of Highway are the top layers structure, which are placed above the natural soil (subgrade). The function or workability of pavement structure is distribution of the applied load from wheel to the subgrade. The pavement shall have the qualification of providing better riding, adequate skid resistance, light reflection should be desirable and also low pollution of noise.[1]. If we study road network all over the world, India is such a kind of country which name is includes in the list of those country, which has the biggest road network. The value of road network is around 5.9 million Km ,and from this value 15% is rigid pavement structure By passing time, India Government (Ministry of Road Transportation and Highway) interest to build rigid pavement[1] .The attachment of construction rigid pavement decision taken later on considering factors such as , service life , the condition of weather , cost of maintenance , resource of natural material locations of rainfall . for the area of waterlogged and for the place which have weak subgrade or subgrade with low CBR value , in addition of the factors mentioned very highlighted point is fuel consumption of vehicles that ply on them. As per estimation in research paper , the consumption of fuel of commercial vehicle is 14 -15% less with respect to the flexible pavement or bituminous road and 3.2% less in traveler vehicles and 4.5% less in tractor- trailer[2], so the India Government spent and investigate large amount for rigid pavement projects such as PradhanMantri , Delhi to Agra projects etc. for connection the population and rural in last few years.

Rice husk ash

The outer cover of rice is called rice husk it is an agricultural produces and obtained after milling process. In all over the world around 500 million tons of rice paddy is produced and 20 percent of this amount is husk lots of study and experiments were executed for explaining the characteristic of concrete by adding RHA to achieve the optimum. The tests have been done for mix of RHA with concrete due to evaluate the splitting tensile, compressive strength, workability, water absorption and flexural strength. If the tests of compressive strength of normal concrete and mixed concrete with RHA compared the results show the blended concrete compressive strength increased and permeability of water so, these two factors are very important factors that RHA is a waste material in countries there are growing rice. Usage of these materials for concrete is not just consumption of a waste material , but it reduce the amount of cement use at construction structure due to more strength it have, therefore RHA used instead of cement without the sacrificing of durability and strength .

Results and discussion

- While adding 15% of Rice Husk Ash in concrete by replacing weight of cement it increases 17.14% the compressive strength of concrete and it gives maximum strength.
- If the amount of Rice husk Ash is added more than 15% it decreases the compressive strength of concrete and vice versa, if the amount of Rice Husk Ash is used leaser than the aforementioned amount it also decrease the compressive strength of concrete.
- The percentage of Rice Husk Ash is relates to the presence of silica in the Rice Husk Ash and the amount of silica is direct to the shape of furnace and temperature at the time of process.

140

1- Result of mix design without mineral admixture of rice husk

Table 1.The rice husk ash chemical composition (Habeeb et al.-2010)

Ingredients	Percentage (%)		
	Khani et al.(2009)	Habeeb et al.(2010)	Give et al.(2010)
Alumina [Al2O3]	0.04	0.46	0.68
Sodium Oxide[Na2O3]	0.07	0.12	0.12
Iron Oxide[Fe2O3]	0.22	0.67	0.93
Magnesium Oxide[MgO]	0.42	0.44	0.35
Calcium Oxide[CaO]	0.91	0.67	1.30
Potassium Oxide[K2O]	1.58	2.91	2.37
Silica [SiO2]	89.61	88.32	87.86
LOI loss on ignition	**5.91**	**5.81**	

Table 2. The ratio of all calculated materials

Material	For one cube per kg	General relation by ratio
Cement	1.68	1
Fine aggregate	1.93	1.144
Coarse aggregate	3.99	2.369
Water	0.59	0.35

2- Result of mix design with mineral admixture of rice husk ash

Table 3. The ratio of all calculated materials with mineral admixture

Material	For one cube per kg	General relation by ratio
Cement	1.231	1
Fine aggregate	2.16	1.756
Coarse aggregate	4.471	3.63
Water	0.431	0.35
Superplastisizer	0.03374	

Table 2. The results of compressive strength obtained from lab and compare it with limits recommended by IS 456

Minimum compressive strength N/mm2 at 7 days for M40	Identified properties compressive strength for 28 days(N/mm2), M40	The result of compressive strength of the study for 7 days Mpa	The result of compressive strength of the study for 28 days Mpa
27	40	30.05	40.03

Conclusion

From the results of this study, the conclusion of flexural strength, compressive strength and the thickness of pavement quality concrete slab are concluding bellow.

- The compressive strength test of rice husk ash concrete by replacing of 15% rice husk ash by weight of cement has shown better result.

- Rice husk ash at 5% replacing with cement does not have significant effect on compressive strength of concrete.

The important issue is the thickness of pavement quality concrete so, in this study the resulthad showed using of 15% rice husk ash replacing of cement have noticeable results for reducing the thickness of pavement quality concrete , the design of rigid pavement by IRC 58 method has been conducted and the output identified that, if use M40 grade of concrete the thickness is safe at 28 cm on the other hand , if use rice husk ash concrete the thickness of concrete slab reduce 5.17% it means the thickness for the same requirement is 26.55cm and it is completely save.

Table 5.The results of compressive strength obtained from lab and compare it with limits recommended by IS 456

Minimum compressive strength N/mm2 at 7 days for M40	Identified properties compressive strength for 28 days(N/mm2), M40	The result of compressive strength of the study for 7 days Mpa with additives of RHA	The result of compressive strength of the study for 28 days Mpa with additives of RHA
27	40	34.21	46.89
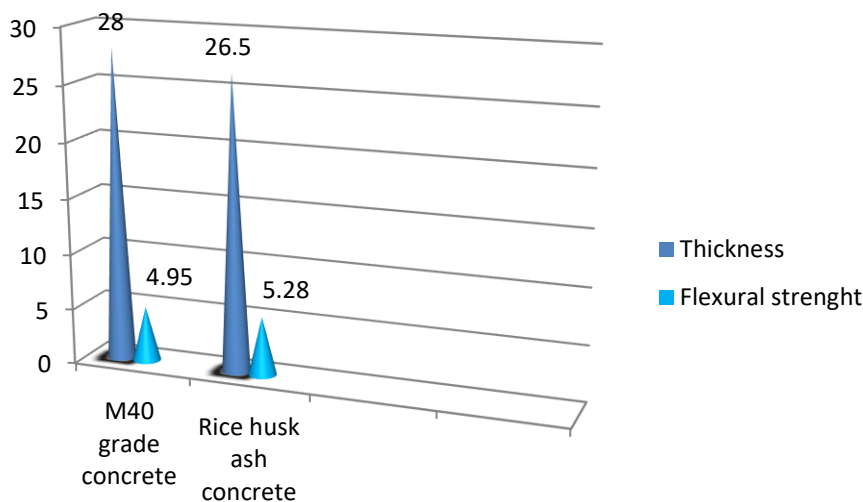
Figure 1. Comparison in Thickness and Flexural Strength between M40 Grade and Rice Husk Ash Concrete

References
[1],S.K.Khana,C.E.G.Justo., &Author,A.Veeraragavan.(2015). Highway Engineering, edition.10,pp.390-391,2015 (book)
[2]Bienvenu.,& Jiao,(2013). Comparison of fuel consumption on rigid versus flexible pavements along1-95 in florida6FIU.Civil and Environmental Engineering, 1(4), 1-9.
[3]PS,Rajput. (2020) .Rigid and Flexible Pavement Designs in Construction. IJRTE,1(3), 1-14
 [4]Mydin,M.,&S.Soleimanzade (2012) Effect of polypropylene fiber content on flexural strength of lightweightnfoamed concrete at ambient and elevated temperatures ISSN Pelagia. Reseach Library,2(13),2837-2846.
[5]S.Jain,&Y.P.Josil, (2013) Design of Rigid and Flexible Pavements by Various Methods & Their Cost Analysis of Each Method. IJERA Eng. Research application2(3), .119-123, .
[6]Pavan&Narasimhan,. (2014).Interfacial shear study on a composite rigid pavement,
 RGATE,1(2),.1-9,.
[7] S.U. Khan, M.F. Nuruddin,&T.Ayub(2014) Effects of Different Mineral Admixtures on the Properties of Fresh Concrete,.HindawiScintific.world Journal 2(2),.11-19.
[8]R.Kummar ,&S.Andavan(2015). Effect of Various Mineral Admixtures in the
Properties of Concrete, ISSN Eng. Environmental Technology3(2),.469-473.

[9] S. Singh,&S.N.Sachdeva,(2015). Thickness Requirement of a Rigid Pavement with varying Conditions of Subgrade, Sub-Base and Shoulders, IOSR Eng. Management, 1(2),52-57.

[10] S. I. Sarsam, (2016).Influence of Nano Materials Addition as Partial Replacement of Cement in the Properties of Concrete Pavement, JNN Eng. Science,2(2),1-5.

[11] P. Easwaryi,& J. P. Sweetlin, (2016),Comparative Analysis of Pavement Quality Concrete and Dry Lean Concrete Multi-layered Rigid Pavement Slabs," IJIR Trans. Imperical, 1(2),664.

[12]Kummar, (2016),Properties of pavement quality concrete and dry lean concrete with copper slag as fine aggregate, IJPE Trans. National information, 1(14),746-751.

[13]kummar, (2016),A comparative study on dry lean concrete manufactured with OPC vis-a-vis PPC to be used for the construction of concrete roads, Gate Eng. Pavement, 1(2),34-42.

[14] M. A Jibrael ,&F. Peter,(2016), Strength and Behavior of Concrete Contains Waste Plastic, JEE. J EcosysEcogragh, 1(6),34-49.

[15]A. Mire,& R.C. Singh,(2017), Study of Different Admixtures and their Effects on Concrete, IJRASET. Engineering, 1(2),1-5.

[16] T.U. Mohammed,& F. Shahriar,(2017) ,Influence of Chemical Admixtures on Fresh and Hardened Properties of Prolonged Mixed Concrete, AMS Eng. Hindawi, 1(5),1-12.

[17] C. Karakurt,& A. T. Arslan,(2017), PROPERTIES OF CONCRETE PAVEMENTS PRODUCED WITH DIFFERENT TYPE OF FIBERS, JOTCSB. Engineering, 1(3),17-24.

[18] J. Lad , Prof. A. R. Darji,&Dr K. B. Parikh,(2017), Strength and Durability Study of Concrete by Using Rice Husk Ash and Coconut Fiber, IJRASET, 1(5),45-98.

[19] N. Kummar, M. Rohith,& S.R. Sagar,(2018) ,Properties of Pavement Quality Concrete for Partial Replacement of Natural Coarse Aggregates with Coconut Shell Aggregates, IJOAER Eng, 1(13),146-149.

[22] Ministry of Road Transportation& Highway "Specification for road and bridge work", 2013 Fifth Revision.

[23] IRC 58 2011, "Guidelines for the design of pavement quality concrete,".

[24] IS 456-2000, "Mix design for low slump test concrete,".

Computational Study of SHG and LE-O Susceptibility Coefficients of GaAs Crystal

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Abstract: A modelling, involving two coupled anharmonic oscillators (electronic and ionic), is applied to the zinc-blende-type cubic crystal of GaAs belongs to III-V group compounds, to calculate its Second Harmonic Generation (SHG) and Linear Electro-Optic (LE-O) susceptibilities. Here, for the selected spectral region 1250 nm – 390 nm, the contribution of the imaginary part of the involved complex linear ionic susceptibility to the resultant SHG and LE-O susceptibilities, is taken into account and so absolute value of $\chi_i^{(1)}(\omega)$ i.e. $|\chi_i^{(1)}(\omega)|$, is used in place of $\chi_i^{(1)}(\omega)$ in the computation of SHG and LE-O coefficients. All of the four constants (nonlinear strength factors) appearing in the model are determined from experimental data of SHG susceptibility in the selected region of 1076 nm -535 nm. Then using these constants, the SHG and LE-O susceptibility coefficients are computed as a function of frequency to illustrate the dispersion in the region of 1250 nm –390 nm.

Keywords: Nonlinear Susceptibility, Second Harmonic Generation, LE-O Susceptibility Coefficient.

Introduction

The determination of the magnitude of the nonlinear susceptibility represents a significant area of both experimental and theoretical research in nonlinear optics. Garrett [1] used a model with two coupled anharmonic oscillators (electronic & ionic) to predict the non-linear susceptibilities for a simple diatomic, cubic material. With the limitation of 1-D (1-dimensional), the model should give a reasonable description of the behaviour of zinc-blende-type materials that are both diatomic and cubic. GaAs is one of the III-V group compounds having a zinc-blende-type structure. Previously several models are proposed and used by different workers for the computation of second-order optical properties of III-V group compounds for the different regions of radiation. Some of such models are bond-charge model [2]-[4], charge-transfer model [5]. Jha, S.S. and Bloembergen, N. [6]; Tang, C.L. [7] and Flytzanis, C. et al.[8], also, have calculated the second-order optical susceptibility coefficients such as Second Harmonic Generation (SHG) and Linear Electro-Optic (LE-O) coefficient, for III-V group compounds to which GaAs belongs. None of the authors [5]-[8], classically, had obtained a dispersion relation for the estimation of second-order optical susceptibilities, involving a simultaneous contribution from linear electronic and linear ionic susceptibilities for GaAs along with other III-V group semiconducting compounds. In present work, the author applied a model to the GaAs crystal to compute its nonlinear optical properties (SHG and LE-O susceptibility coefficients, here) in the selected spectral region of 1250 nm – 390 nm. For this, first, the four Nonlinear Strength Factors (NSF) appearing in our modelling, are computed with the help of existing available experimental data [9]. And then, as per the purpose of author's present work, by using such calculated parameters, the author computed the required LE-O and SHG coefficients as a function of the frequency, to illustrate the dispersion in the near infra-red (NIR) region of 1250 nm- 390 nm.

Theoretical Aspect

Garrett has taken one-dimensional lattice and writes the equations of motion in terms of configuration co-ordinates q_e and q_i for electronic and ionic oscillation respectively as, $\qquad \ddot{q}_e + \omega_e^2 q_e = \frac{e_e}{m_e} E \,(1)$

$\ddot{q}_i + \omega_i^2 q_i = \frac{e_i}{\mu} E. (2)$ Here, m_e is the electronic mass, μ is the reduced ionic mass, e_e and e_i is the charges of the order of one electronic charge and defined in terms of cation, anion core and anion shell charges. ω_e is the resonant frequency associated with the dominant ultraviolet inter-band electronic transition responsible for the dispersion in the visible region and ω_i is the resonant frequency associated with transverse optical (TO) phonon frequency in the infrared region. q_e is called electronic configuration co-ordinate associated with ω_e and q_i is ionic configuration co-ordinate associated with ω_i. The polarization, $P = N[e_e q_e + e_i q_i]$ and the linear susceptibility is, $\chi^{(1)} = \frac{N}{E\epsilon_0}[e_e q_e + e_i q_i] = \frac{N}{E\epsilon_0} e_e q_e + \frac{N}{E\epsilon_0} e_i q_i = \chi_e^{(1)} + \chi_i^{(1)}$. Where $\chi_e^{(1)}$ and $\chi_i^{(1)}$ is electronic and ionic susceptibility respectively. As, $q_e = \frac{e_e E}{m_e D_e(\omega)}$, one gets, $\chi_e^{(1)} = \frac{Ne^2}{\epsilon_0 m_e D_e(\omega)}$, where, $D_e(\omega) = \omega_e^2 - $

ω^2. On taking the ionic damping effect on the harmonic oscillatory motion of the ion, into account, an extra damping term is appeared in the equation of motion (2) as, $\ddot{q}_\iota + \tau\dot{q}_\iota + \omega_i^2 q_i = \frac{e_i}{\mu}$ E. It gives, $q_i = \frac{e_i}{\mu(-\omega^2 - i\tau\omega + \omega_i^2)}$ E. And

$$\chi_i^{(1)}(\omega) = \frac{Ne_i^2}{\epsilon_0 \mu D_i(\omega)}. \quad (3) \qquad \text{Where } D_e(\omega) = \omega_i^2 - i\tau\omega - \omega^2.$$ Here, the author has added a phenomenological damping rate τ in the ionic response only. Cochran [10] has introduced the quadratic terms as nonlinear terms in potential as he was interested in centrosymmetric crystals. The noncentrosymmetric 1-D model necessarily possesses a unique polar axis, will be pyroelectric. So, Garrett [1] has added a cubic instead of the quadratic term to potential.

So, the potential is $\qquad U = \frac{m_e q_e^2 \omega_e^2}{2} + \frac{\mu q_i^2 \omega_i^2}{2} + Aq_i^3 + Bq_i^2 q_e + Cq_i q_e^2 + Dq_e^3 - E(e_e q_e + e_i q_i).$ (4)

Where, A, B, C, and D are constants referred to as nonlinear strength factors (NSF).

So, $\qquad\qquad\qquad \ddot{q}_e = -\omega_e^2 q_e + \left(\frac{e_e}{m_e}\right)E - \left(\frac{3D}{m_e}\right)q_e^2 - \left(\frac{2C}{m_e}\right)q_e q_i - \left(\frac{B}{m_e}\right)q_i^2.$ (5)

$\ddot{q}_\iota = -\omega_i^2 q_i - \tau\dot{q}_\iota + \left(\frac{e_i}{\mu}\right)E - \left(\frac{C}{\mu}\right)q_e^2 - \left(\frac{2B}{\mu}\right)q_e q_i - \left(\frac{3A}{\mu}\right)q_i^2.$ (6)

An applied electric field $\underline{E}$ is assumed to be a superposition of two fields as,

$\underline{E} = \frac{1}{2}\left[\underline{E_1}e^{-j\omega_1 t} + C.C. + \underline{E_2}e^{-j\omega_2 t} + C.C.\right]$ (7)

Here, $\underline{q_e}$ and $\underline{q_i}$ will respond to the applied electric field having components at ω_1 and ω_2 due to linear and at $\omega_1 \pm \omega_2$, $2\omega_1, 2\omega_2$ due to nonlinear behaviour.

Thus, $\qquad q_e = q_e^{(1)} + q_e^{(2)}(0)|_{\omega_1,\omega_1} + q_e^{(2)}(0)|_{\omega_2,\omega_2} + \frac{1}{2}\big[q_e^{(2)}(\omega_1 - \omega_2)e^{-j(\omega_1-\omega_2)t} + q_e^{(2)}(2\omega_1)e^{-j(2\omega_1)t} +$

$q_e^{(2)}(\omega_1 + \omega_2)e^{-j(\omega_1+\omega_2)t} + q_e^{(2)}(2\omega_2)e^{-j(2\omega_2)t} + C.C.)\big]$ (8)

$q_e^{(1)} = \frac{1}{2}\big[q_e^{(1)}(\omega_1)e^{-j\omega_1 t} + C.C. + q_e^{(1)}(\omega_2)e^{-j\omega_2 t} + C.C.\big]$ (9)

$q_i^{(1)} = \frac{1}{2}\big[q_i^{(1)}(\omega_1)e^{-j\omega_1 t} + C.C. + q_i^{(1)}(\omega_2)e^{-j\omega_2 t} + C.C.\big]$ (10)

Using the expressions of $\underline{q_e}$, $\underline{q_i}$, and $\underline{E}$ into (5) and (6), $q_e^{(2)}$ and $q_i^{(2)}$ can be solved in terms of $\underline{E_1}$, $\underline{E_2}$, $\underline{q_e^{(1)}}$ and $\underline{q_i^{(1)}}$.

Second-order polarization at ω_{ij}, $\underline{P}(\omega_{ij}, \omega_i, \omega_j) = \frac{1}{2}\big[\underline{P^{(2)}}(\omega_{ij}, \omega_i, \omega_j)e^{-j\omega_{ij}t} + C.C.\big]$.

Or, $\underline{P}(\omega_{ij}, \omega i, \omega_j) = \frac{1}{2}\big[\chi^2(\omega_{ij}, \omega_i, \omega_j)\underline{E_i}\,\underline{E_j}\,e^{-j\omega_{ij}t} + C.C\big].$ (11)

A detailed tedious calculation results in the general expression for the first-order nonlinear susceptibility,

$\chi^{(2)}(\omega_i \pm \omega_j, \omega_i, \omega_j)|i = 1, j = 2| = -\frac{\epsilon_0^2}{2}\Big\{\left(\frac{3D}{N_e^2 e_e^3}\right)\big[\chi_e^{(1)}(\omega_1).\chi_e^{(1)}(\omega_2).\chi_e^{(1)}(\omega_1 \pm \omega_2)\big] +$

$\left(\frac{C}{N_e N_i e_e^2 e_i}\right)\big[\chi_e^{(1)}(\omega_1).\chi_i^{(1)}(\omega_2).\chi_e^{(1)}(\omega_1 \pm \omega_2) + \chi_i^{(1)}(\omega_1).\chi_e^{(1)}(\omega_2).\chi_e^{(1)}(\omega_1 \pm \omega_2)\big] +$

$\left(\frac{C}{N_e^2 e_e^2 e_i}\right)\big[\chi_e^{(1)}(\omega_1).\chi_e^{(1)}(\omega_2).\chi_i^{(1)}(\omega_1 \pm \omega_2)\big] + \left(\frac{B}{N_e N_i e_i^2 e_e}\right)\big[\chi_e^{(1)}(\omega_1).\chi_i^{(1)}(\omega_2).\chi_i^{(1)}(\omega_1 \pm \omega_2) +$

$\chi_i^{(1)}(\omega_1).\chi_e^{(1)}(\omega_2).\chi_i^{(1)}(\omega_1 \pm \omega_2)\big] + \left(\frac{B}{N_i^2 e_i^2 e_e}\right)\big[\chi_i^{(1)}(\omega_1).\chi_i^{(1)}(\omega_2).\chi_e^{(1)}(\omega_1 \pm \omega_2)\big] +$

$\left(\frac{3A}{N_i^2 e_i^3}\right)\big[\chi_i^{(1)}(\omega_1).\chi_i^{(1)}(\omega_2).\chi_i^{(1)}(\omega_1 \pm \omega_2)\big]\Big\}$ (12)

Present Modelling

The author made a realistic approach and modified Garrett's anharmonic model [1] and took the contribution of the imaginary part of the complex linear ionic susceptibility $\chi_i^{(1)}(\omega)$, into account along with its real part and so absolute value of $\chi_i^{(1)}(\omega)$ i.e. $|\chi_i^{(1)}(\omega)|$ is used in place of $\chi_i^{(1)}(\omega)$ in the computation of SHG and LE-O coefficients for the GaAs crystal, for the selected spectral range of photon energy (1.000 eV-3.200eV).

SHG Susceptibility Coefficient: For sum-frequency mode $\omega_1 + \omega_2 = \omega + \omega = 2\omega$, (17) gives the expression for SHG, $\quad \chi^{(2)}(2\omega, \omega, \omega) = -\frac{\epsilon_0^2}{2}\Big\{\left(\frac{3D}{N_e^2 e_e^3}\right)\big[\chi_e^{(1)}(\omega).\chi_e^{(1)}(\omega).\chi_e^{(1)}(2\omega)\big] + \left(\frac{2C}{N_e N_i e_e^2 e_i}\right)\big[\chi_e^{(1)}(\omega).|\chi_i^{(1)}(\omega)|.\chi_e^{(1)}(2\omega)\big] +$

$\left(\frac{C}{N_e^2 e_e^2 e_i}\right)\big[\chi_e^{(1)}(\omega).\chi_e^{(1)}(\omega).|\chi_i^{(1)}(2\omega)|\big] + \left(\frac{2B}{N_e N_i e_i^2 e_e}\right)\big[\chi_e^{(1)}(\omega).|\chi_i^{(1)}(\omega)|.|\chi_i^{(1)}(2\omega)|\big] +$

$\left(\frac{B}{N_i^2 e_i^2 e_e}\right)\big[|\chi_i^{(1)}(\omega)|.|\chi_i^{(1)}(\omega)|.\chi_e^{(1)}(2\omega)\big] + \left(\frac{3A}{N_i^2 e_i^3}\right)\big[|\chi_i^{(1)}(\omega)|.|\chi_i^{(1)}(\omega)|.|\chi_i^{(1)}(2\omega)|\big]\Big\}$ (13)

LE-O Susceptibility Coefficient: For $\omega_1 = 0$, $\omega_2 = \omega$, (17) gives the LE-O coefft., $\chi^{(2)}(0 + \omega, 0, \omega) = -\frac{\epsilon_0^2}{2}\Big\{\left(\frac{3D}{N_e^2 e_e^3}\right)\big[\chi_e^{(1)}(0).\chi_e^{(1)}(\omega).\chi_e^{(1)}(\omega)\big] + \left(\frac{C}{N_e N_i e_e^2 e_i}\right)\big[\chi_e^{(1)}(0).|\chi_i^{(1)}(\omega)|.\chi_e^{(1)}(\omega) + \chi_e^{(1)}(\omega).|\chi_i^{(1)}(0)|.\chi_e^{(1)}(\omega)\big] +$

145

$\left(\frac{C}{N_e^2 e_e^2 e_i}\right)\left[\chi_e^{(1)}(0).\chi_e^{(1)}(\omega).|\chi_i^{(1)}(\omega)|\right] + \left(\frac{B}{N_e N_i e_i^2 e_e}\right)\left[\chi_e^{(1)}(0).|\chi_i^{(1)}(\omega)|.|\chi_i^{(1)}(\omega)| + \chi_e^{(1)}(\omega).|\chi_i^{(1)}(0)|.|\chi_i^{(1)}(\omega)|\right] +$

$\left(\frac{B}{N_i^2 e_i^2 e_e}\right)\left[|\chi_i^{(1)}(0)|.|\chi_i^{(1)}(\omega)|.\chi_e^{(1)}(\omega)\right] + \left(\frac{3A}{N_i^2 e_i^3}\right)\left[|\chi_i^{(1)}(0)|.|\chi_i^{(1)}(\omega)|.|\chi_i^{(1)}(\omega)|\right]\Big\}$. (14) Where Linear electronic

susceptibility, $\chi_e^{(1)}(\omega) = \frac{N_e e_e^2}{m_e \epsilon_0 (\omega_e^2 - \omega^2)}, \leftarrow\leftarrow Real$ Linear ionic susceptibility, $\chi_i^{(1)}(\omega) = \frac{N_i e_i^2}{\mu \epsilon_0 (\omega_i^2 - \omega^2 - i\tau\omega)}, \leftarrow\leftarrow$

$Complex.$ And $|\chi_i^{(1)}(\omega)| = Absolute\ value\ of\ \chi_i^{(1)}(\omega) = \left\{\left[Re\chi_i^{(1)}(\omega)\right]^2 + \left[Im\chi_i^{(1)}(\omega)\right]^2\right\}^{1/2}$. Where

$Re\chi_i^{(1)}(\omega) = $ Real part of $\chi_i^{(1)}(\omega)$ *and* $Im\chi_i^{(1)}(\omega) = $ Imag. part of $\chi_i^{(1)}(\omega)$.

Applications and Numerical Computations
The input parameters are listed in *Table 1a.* and the SHG experimental data are given in *Table1b*.
*Nonlinear Strength Factors (NSF)***:** Using the input parameters (*Table 1a.*) and the experimental data[9] (*Table 1b.*), in (18), A, B, C, and D are calculated for the further applications (*Table 2.*).

Table 1a. Input Parameters [11] for the Calculation of Nonlinear Strength Factors A, B, C, and D.

Parameter	Sym.	Value	Unit
1. Electronic Oscillator Density	N_e	2.230000E*+28	m^{-3}
2. Electronic Charge**	e_e	-1.600000E-19	C
3. Electronic Mass**	m_e	9.109999E-31	kg
4. Elect. Resonant Frequency	ω_e	8.510000E+15	rad/s
5. Ionic Oscillator Density	N_i	2.230000E*+28	m^{-3}
6. Reduced Mass of Electronic & Ionic Oscillator ***	μ	6.000000E-26	kg
7. TO Phonon Freq.	ω_i	5.070000E+13	rad/s
8. Ionic Charge	e_i	1.600000E-19	C
9. Damping Rate	τ	5.070000E+11	rad/s
10. Permittivity of Free Space **	ϵ_0	8.854000E-12	C^2/N.m^2

E* $\pm$ n = x 10$^{\pm n}$,**Standarddata,***Calculated data.

Table 1b. Input Data (Experimental) [9] for GaAs.

S.N.	hν (eV)•	ν (xE15rad/s)••	Normlizd SHG
1.	1.152	1.7515	(5.83±0.79)E+2
2.	1.604	2.4378	(9.95±0.34)E+2
3.	1.789	2.7194	(4.91±0.40)E+2
4.	2.325	3.5343	(8.14±1.09)E+2

•Photon Energy, ••Photon frequency

Table 2: Calculated Nonlinear Strength Factors (NSF) A, B, C, and D for GaAs.

S.N.	N S F	Value (kg/ms^2)
1.	A	-1.37910307E+25
2.	B	3.47906081E+21
3.	C	-3.26093467E+17
4.	D	1.10257724E+13

*SHG and LE-O Coefficients***:** So calculated A, B, C, and D (*Table 2.*), are applied in (13) and (14) to compute SHG and LE-O susceptibility coefficients respectively, at several different frequencies in the selected spectral region of 1.000 eV – 3.200 eV. The normalization of SHG results is done with $\chi_{KDP}^{36} = 0.39$ pm/v (at 1064 nm) [12]. Here, the author did the computations in double precision to record the changes in the results of the dependent function.

Results and Discussion
Following the present model, the graphical representation of the computed results of normalized SHG and LE-O coefficients (absolute values) is plotted as a function of photon energy, in *Figure 1.* and *Figure 2.*, respectively. GaAs shows large absolute values of SHG susceptibility for the range 1.283 eV– 1.600 eV that belongs to the NIR region (*Figure 1.*). The first two dips result from the sum of +ive and –ive values of the cross terms involved in the concerned expression.
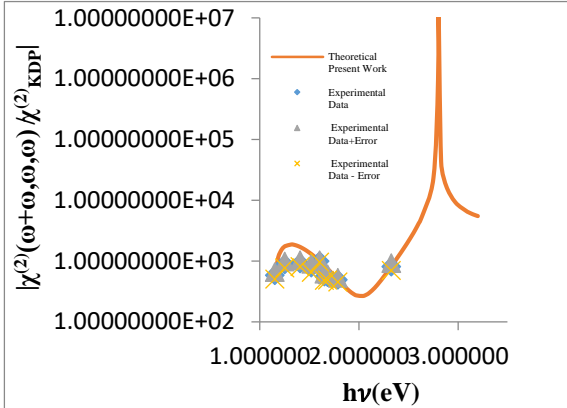
Figure 1. Normalized SHG Susceptibility Coefficient (Absolute value) $[|\chi^{(2)}(\omega+\omega,\omega,\omega)/\chi^{(2)}_{KDP}|]$ shows its variation with Photon Energy (hν) of radiation hitting the selected crystal of GaAs . Normalization is done with $\chi^{(2)}_{KDP}{}^{36}$=0.39 pm/V(at 1064nm)*.*
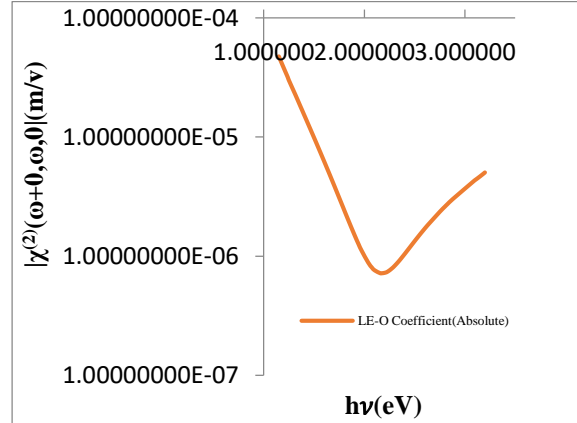
Figure 2. Linear Electro-Optic (LE-O) Susceptibility Coefficient (Absolute value) $[|\chi^{(2)}(0+\omega,0,\omega)|(m/V)]$ shows its variation with photon energy (hν) of radiation hitting the crystal of GaAs*.*

Absolute SHG susceptibility goes to infinite at $\omega_e/2$ = 3.8224E+15 rad/s ($\approx$ 2.514957 eV) which is caused by the doubling of the applied field(fundamental) frequency (SHG process) equal to $\omega_e/2$, at which the electronic oscillators get in their resonance-mode and causing the maximum (infinite) absolute value of the SHG susceptibility. Near $\omega_e/2$, GaAs shows quite large SHG susceptibility but it falls exponentially in the region near to $\omega_e/2$. For 2.822 eV – 3.200 eV, GaAs crystal shows the very small variation in the dispersion and hence refers almost constant SHG response concerning this special band of frequencies. Thus it is found that for these regions, GaAs can be more useful to fabricate the SHG based NLO devices than other NLO materials. GaAs shows large absolute values of LE-O coefficient in the region 1.250 eV – 1.645 eV of the NIR region(*Figure 2*.).

Conclusion

As results, obtained in the present work, are in a good agreement with the experimental [9] ones, the modelling applied here, can be justified for the considered region of radiation. And hence it can be concluded that the theoretical consideration of the contribution from the imaginary part (along with real part) of the linear ionic susceptibility to the resultant SHG coefficients, is very closely true experimentally. So the linear absorption corresponding to $Im\chi_i^{(1)}(\omega)$ susceptibility is highly acceptable in the spectral region selected here. , the LE-O coefficient estimated in the present work shows large absolute value in the NIR region, that indicates the potential application of GaAs crystal in the fabrication of nonlinear electro-optic devices such as Electro-Optic Modulators.

References

[1]Garrett, C.G. (1968). *IEEE J. of Quantum Electronics,*4,70.

[2]Lavine, B. F. (1969). *Phys. Letters,* 25, 440.

[3] Lavine, B. F. (1969). *Phys. Letters,* 22, 787.

[4] Miller, R. C., Nordland, W. A., Abrahams, S. C., Bernstein, J. L. and Schwab, C. (in press). *Phys. Rev.*

[5] Tang, C. L. and Flytzanis, C.(1971). *Phys. Rev.B*, 4,2520.

[6] Jha, S. S. and Bloembergen, N. (1968) *IEEE J. Quantum Electronics,* 4, 670.

[7] Tang, C. L. (1973). *IEEE J. Quantum Electronics,* 9,755.

[8] Flytzanis, C.and Ducuing, J.(1969). *Phys.Rev.,*178, 1218.

[9] Chang, R. K., Ducuing, J. and Bloembergen, N. (1965). *Phys. Rev. Lett.,* 15, 415.

[10] Cochran, W. (1960). *Advances in Phys*. 9, 387.

[11] Singh, C. P. (2003). *Optical nonlinearities in III-V group compounds.* PhD thesis, Department of Physics, Ch. Charan Singh University, Meerut, U.P., India.

[12] Roberts, D.A.(1992).*IEEE J.Quantum Electron.,*28, 2057.

Determination of Blackspot on National Highway-154, Himachal Pradesh, India

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Abstract: Road transport has become an important part of each individual. National highways play a significant role in development of country by meeting travel needs of individuals and product. Several growing countries like India have a heavy road accident issue. Road accident will cause property harm, minor injury or casualty.The NH-154 (Pathankot-Mandi) has seen an increase in range of accidents from past few years. "The location in a road wherever most range of road accidents happens is termed Black spots". This paper deals with the determination of such black spots on a stretch in NH-154 i.e.Kuthman to Malan in Kangra by using the Accident Severity Index (ASI) methodology. Some remedies have additionally been projected to cut back the quantity of accidents on the known black spot areas.

Keywords: National Highway, Road accidents, Black spot, Accident severity index.

Introduction

Roads are a vital mode of transport in India. India includes a network of over 5,897,671 Kilometres of road. This is the second largest-road network in the world after USA. The share of National Highways (NH) and State Highways (SH) within the total road network is just 6% however they witness 52% of the total road traffic. A lot of accidents on Highways is attributed to higher vehicle speeds and excessive volume of traffic on these roads. India accounts for 10% of deaths from road crashes all over the globe. According to Global status report on road safety 2018, highlights that the annual road traffic deaths has reached 1.35 million in the world. It is calculated that low and middle financial gain countries have a highest burden and road traffic death rates. [1]

"The location in a road wherever the traffic accidents typically occur is termed a black spot". The identification of location, analysis and treatment of road accident black spots are widely regarded one among the foremost effective approach to road accident prevention. [2]

In Himachal Pradesh in last year 3110 road accidents occur within which 1208 person died. The death rate rose by 0.4% over the previous year. The foremost causes of road accidents are road condition, over rushing and also drink & drive etc. This study aims to spot accidental black spots on a section (Kuthman-Malan) of NH-154 by using Accident Severity Index (ASI) and through this study basic causes of accidents were observed and appropriate remedial measures were additionally provided for a selected spots.

Scope and Objectives
The objectives of the study can be given specifically as the following:

- To collect accident data of NH-154 (Kuthman to Malan) from concerned police stations of last three years (2017, 2018 & 2019).
- To identify the hotspots using Average Severity Index method.
- To identify various factors contributing these black spots and to provide suggestion for the improvement of each black spot.

Study Area
Kuthman to Malan is a stretch of the road on Pathankot-Mandi in the state of Himachal Pradesh was chosen for the current study. The entire stretch is a two way National Highway. Some of the features of this highway stretch are

- The entire stretch is a two way National Highway.
- The road surface is asphalt bitumen.
- No divider at this stretch.

Site Investigations: A visit of the site is done to gain information about cross sectional elements such as pavement surface type, Road length, Kerbs, shoulders, median. [2] It helps to know about the condition of existing road and gives the idea of black spot locations in the highway.

Methodology
The following methodology has been adopted for obtaining the objectives of the study.

Data Collection
In this study data was collected in two sections i.e Primary data and secondary data.

Primary Data
● Detail of road inventory.
● Signage inventory.

Road inventory consist of name of road, type of the road (flexible or rigid), Length of road, carriageway width.

1. Name of the road- Pathankot to Mandi (NH-154)
2. Type of road- The road is flexible pavement type i.e Bitumen road.
3. Length of road- 279.0 Km.
4. Carriage width- 7.0 to 7.5 (Two lane)

Signage Inventory: Traffic signs are necessity of highway because they guide, warn and inform the drivers for safe and efficient movement on the roads. Well maintained signs help the driver to make good decision and reduce the chances of road accident. In signage inventory we study about the different signs used, condition of sign board and proper position where it is required. [2]

Secondary Data
In this data collection the accident data on Kuthman to Malan road were collected from the NagrotaBagwan, Gaggal, Kangra police stations.The accident data was collected for a period of three years i.e 2017 to 2019.It consist of exact place of accident, number of accidents, person injured, person died, month wise number of Accidents. The nature of accidents in last three years is shown in Table 1

Table 1. Nature of Accidents

Nature	Number of accidents
Fatal	45
Serious	142
Minor	56

Analysis of Data
In this section, collected data like primary and secondary data are analysed. Firstly the analysis of secondary data is done using Accident Severity Index (ASI) for identifying accidental black spots and then primary data is analysed.

Analysis of Secondary data
The main objective for analysing the secondary data is to determine the accidental black spots on NH-154. The accident data collected of three years is analysed by using Accident Severity Index method (ASI).The black spots were treated according to the severity of the location. The concept of this method is that the weight age of fatal or serious accidents is given a greater weight age than property damage or minor accident. For estimation of ASI, the fatal accidents are assigned a weightage 6 , A serious injury is assigned a weightage 3 and 1 is assigned to minor injury accident. [3]

The following equation has been used :

149

ASI = $(N_f * W_f) + (N_s * W_s) + (N_m * W_m)$ (1)

Where, N_f = Number of fatal accidents at the location in the last 3 years

W_f = Weight age assigned to fatal accidents

N_s = Number of serious accidents at the location in the last 3 years

W_s = Weight age assigned to serious accidents

N_m = Number of minor accidents at the location in the last 3 years

W_m = Weight age assigned to minor accidents

Table 2. Accident Details

Chainage	Number of fatal injuries	Number of Serious injury	Number of Minor injury	ASI
74+350	3	4	3	33
74+450	0	3	1	10
75+100	1	3	2	17
75+500	1	3	1	16
75+700	0	3	1	10
76+100	1	1	1	10
76+300	1	3	0	17
76+400	1	3	2	15
76+800	0	1	1	4
77+600	1	3	2	17
78+100	0	3	2	11
79+100	1	2	1	13
79+550	2	6	3	33
81+050	1	3	2	17
81+600	1	2	1	13
82+400	3	6	2	38
82+900	1	3	1	16
83+800	0	3	2	11
84+850	1	4	2	20
85+00	1	3	2	17
86+00	2	4	2	26
87+400	2	4	2	26
87+800	1	3	1	16
88+700	2	6	3	33
89+100	1	4	0	18
89+800	1	3	1	16
90+300	0	2	0	6
91+100	0	3	0	9
91+400	5	9	3	60
92+100	1	3	2	17
92+700	0	2	1	7
93+00	0	3	0	9
93+200	1	4	2	20
93+700	0	3	0	9
93+900	1	3	1	16
95+00	4	7	2	47
95+400	0	3	1	10
96+050	0	4	0	12
96+150	2	5	1	28
96+700	1	3	2	17
96+900	1	3	0	15

The locations having Accident severity index (ASI) value higher than   threshold value are called as hazardous spots or black spots. [4]

Threshold value = Average severity + 1.2 (Standard deviation)   (2)

From Table 2,Average Severity = 18.707

Standard deviation = 11.353

Therefore, Threshold value = 32.330

Analysis of Primary Data

- Road Inventory survey: Road inventory survey was done on the identified black spots to know about the roadway geometric parameters like width of roadway, width of carriage way, median, shoulder , Type of surface, width of footpath etc. [2]

    It is observed that he entire stretch carriage way width varies from 6m to 8m. The existing highway does not satisfy the standards of National Highway. Median is not provided as it is a two way highway. It is also identified during the road inventory survey of the stretch that footpath is absent.

- Signage Inventory: Traffic signs are important elements of the road because they Guide, Warn and inform the driver about the road condition so that they can efficiently move on road with safety. In this inventory survey it was identified that no traffic lights were present in complete study area even at the junction. Sign boards were also not present at the junction. Road markings also absent.

Result and Discussion

Based on the analysis of accident data using Accident Severity Index method (ASI), six black spots on the selected stretch of National Highway is determined as shown in **Table 3**.

Table 3. Spots and locations which are treated as black spots and their ASI values

Spot/Chainage	Location	ASI
74+350	Shanidevmandir (Kuthman)	33
79+550	Matour-Dharamshala road	33
82+400	Kangra Bypass road	38
88+700	Baroh road	33
91+400	Peer baba (NagrotaBagwan)	60
95+00	Hatwas bus Stop	47

- **Peer baba (NagrotaBagwan)**

It is identified as most vulnerable stretch on NH-154 (Kuthman-Malan) in district Kangra. There are following deficiency in this identified stretch.

- Centre line and both road side markings are absent.
- Shoulder is not present.
- Road side parking of vehicles.
- Presence of trees at the curve.
- Lack of speed limit sign board.

Suggestion:

- Proper speed limit sign board should be provided as per IRC 67-2012. [5].
- Road markings should be done. It was noticed that most of the vehicle in this curve overlap to opposite lane due to the presence of sharp curve and no centre line.
- White markings should be done on old trees on curve so that it warns the driver's in night.

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Figure 1. Peer Baba NagrotaBagwan Black spotFigure 2. Hatwas Bus stopBlack spot

- **Hatwas bus stop**
- The following deficiencies of this stretch are:
- Presence of sharp curve.
- Absence of left turn sign board.
- Absence of shoulders.

Suggestion:
- Left turn sign board should be provided.
- Shops just touching one side of the highway should be removed. It should be done to provide a space for shoulder on highway and also to provide a good sight distance to driver.

- **Kangra bypass junction (kachhiari)**
  Existing Deficiencies of black spot are:
- Road side marking is absent.
- Uneven Gradient provided.
- Road sign board not provided.
- Shoulder of Highway is Unpaved.

Suggestions:
- The vehicle entering national highway from bypass faces problem due to the sharp upward gradient.
- Speed limit board should be provided at the highway.
- Shoulder of the highway should be paved . It will help the driver to suddenly divert vehicle to the shoulder in the case of emergency.

- **Baroh Road**
  Deficiencies in this black spot are:
- This stretch has a sufficient lane width and the condition of road is also good but shoulders are not provided on both sides.
- Sign boards not provided.
- Signal not provided.
- Speed breaker not provided.

Figure 3. Kangra bypass road blackspot   **Figure 4**. Baroh Roadblackspot

Suggestions:
- The National highway at this spot is straight. So speed breakers should be provided on the highway to reduce the chances of collision of vehicle with the vehicle entering from SH to NH.
- Speed limit sign board should be provided.
- Proper zebra crossing should be provided.
- No buses should stand at the junction. Bus stop should be provided because a lot of people use this junction.

Conclusions
- The identification and analysis of accident black spot is done to identify the stretches where accidents occur more. It helps to study the reason behind occurrence of accidents. This present study deals with finding the most vulnerable accident locations on NH-154 (Kuthman-Malan) in District kangra, Himachal Pradesh.
- The Accident Severity index method (ASI) was used to find the hotspots. There are six locations which were identified as the black spot. Some suggestions were given to improve the transportation system.
- Some of the deficiencies like No sign boards, No markings, non-availability of footpath and zebra crossing, No traffic signals, unauthorized parking were common in identified black spots.
- It was also found out that nature of accidents is mainly serious injury which is 58% of all cases, whereas minor injury is 23% of all cases. The road fatalities are high at 19%.

References
[1] Global status report on road safety (2018), World Health Organisation retrieved March, 2020 from http://who.int/voilence_injury_prevention//road_safety_status/2018

[2] Verma, S., &Khan, J. (2018). Identification and Improvement of Accident Black Spots on N.H. 86 District Sagar, Madhya Pradesh. International Research Journal of Engineering and Technology, Volume-5, ISSN: 2395-0056

[3] Fayaz, M.M., Mrudula, S.P., George, S.J., Yoyak, S.P., & Roy, S.S. Black spot identification using Accident Severity Index. Technical Research Organisation India. Volume-5, ISSN: 2394-0697

[4] Sharma, Chopra (2017). Accident studies and road safety audit of four lane Jammu to Udhampur section retrieved from http://hdl.handle.net/10266/4576

[5] IRC;67-2012; "Code of practice for road signs", Indian Road Congress, New Delhi, India.

[6] IRC;35-2015; "Code of practice for road markings", Indian Road Congress, New Delhi, India.

[7] Khanna, S.K., Justo, C.E.G., Veeraragavan, A. (2014). Handbook of Highway Engineering, Nek chand Publications.

153

Track 3

Advances in Computing Sciences

Star Information Flow Monitor Approach for Cyber Physical System

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Abstract: A cyber physical system is a collection of various mechanical components which are controlled and managed by computer systems and algorithms. This is a simple and efficient approach of cyber physical system when it comes to single cyber-physical interaction. On the other hand it can be potentially insecure and time consuming process in cyber systems. An IFM (Information Flow Monitor) is an application to backtrack queries and find the culprit in an error that has occurred in the cyber system. However, while backtracking and flow monitoring is not always guaranteed in terms of secure and efficient transaction. In some cases the sender may deny the authority of the data so the information flow monitors may fail to provide a trustful and authentic source of data. The proposed architecture increases the server – packet interaction which leads to a linear trend while capturing malicious packets. This paper formulates an approach to overcome the problem of authenticity and security together with proposed star topology in cyber physical system using IFM.

Keywords: Cyber physical systems (CPS), Information flow monitor (IFM), Star topology, Distributed CPS, Security

1. Introduction

Cyber physical system or CPS is a group or collection of computing devices like a computer interacting with other physical components in a system to produce a desired outcome. Cyber-Physical Systems (CPS) comprises interacting digital, analog, physical, and human components engineered for function through integrated physics and logic. These systems will provide the foundation of our critical infrastructure, form the basis of emerging and future smart services, and improve our quality of life in many areas. Cyber-physical systems will bring advances in personalized health care, emergency response, traffic flow management [1]. One of the solutions to Cyber Physical System is information flow monitoring system of IFM [2]. This situation might appear to be simple and efficient when it comes to single cyber-physical interaction, but in a distributed system this can be potentially insecure and time consuming [3]. An IFM (Information Flow Monitor) is a great application to backtrack queries and find the culprit in an error that has occurred in the system. However, while backtracking and flow monitoring a secure and speed efficient transaction is not always guaranteed. Also, in some case the sender or any information may deny the authority of the data, in such case the information flow monitor may fail to provide a trustful and regulate authenticity of the source of data. Information flow monitor System is an existing technique which monitors the flow of data in a Cyber Physical System [4, 5]. The Authors has summarized the challenges and the proposed solutions for securing CPS from a Physics-based perspective. [10, 11]

In other words, IFM-CPS monitors the flow of data from one node to another node as in the above figure 1, it illustrates the current working of IFM-CPS. Though this technique is adequate for conventional situations, there is still need of a system essential for various set of circumstances.
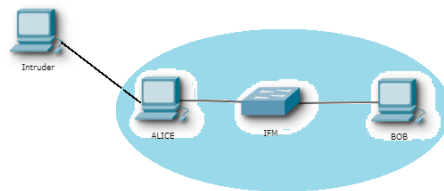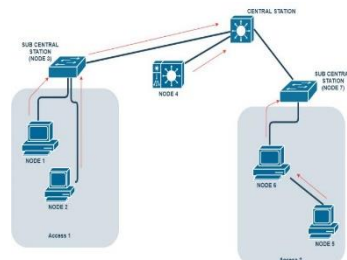
Fig. 2. Information Flow Monitors in Cyber Physical Systems

Fig. 3. Alice claiming the false source of data i.e. Hindrance

2.Hindrance of Existing System

Let's "Alice" be a sender and "Bob" a receiver. Now Alice sends data to Bob, the data sent to Bob in normal circumstances would be the genuine data or instruction for Bob, but in a case if Alice tries to send malicious data to the system, the same process would be followed and the data will be passed to the next node. Further, when the Information Flow Monitor realizes this malicious behavior, Alice will simply deny the fact that he sent the wrong

155

data. Alice may state that the data was sent to Bob by some other node and Alice is not responsible for the same. A false situation like this may be showed by Alice [2]. In this situation, the system may continue to proceed with the regular flow in-spite of such a malicious activity by Alice as in given figure 2.

3.Related Work

Implementing strategies for a continuously changing environment sort of a CPS may tend to face various challenges. CPS may contain physical components which may be unknown at the time of deployment. In this context of cyber physical systems, finding the source of error is a challenging task [3], [6]. In the same context, there are issues regarding the location and ownership of data storages, responsibilities for coordination and execution of computations and the general trust issue of distributed system. For decentralized, trustless and transparent applications, IoT, Data Science analytics and blockchain technology is a solution which handles the challenges easily [7], [8]. Malwares (software which will grant unauthorized access to any system and gather sensitive information) are one among the potential threat to the CPS and Distributed CPS according to the authors mentioned in [9]. Malware can damage, corrupt or cause potential harm to CPS's. It can steal sensitive data or may induce anomalous behavior of physical systems [10].

4.Proposed Solution to the Existing System

To overcome the problem of existing system, there is a need of a Central Information Flow Monitor or Central Verification System (CVS), that verifies where the data is coming from and going to. This system will ensure the data flow and origin of data. This is the reason where all communication handled between nodes of different parties should store dependency information with the help of the Information Flow Monitor. However, the node has an immediate advantage when storing data since the data are then stored safely with consensus and own memory can be released. By saving data in a collective transaction costs can further be reduced. The Central IFM will ensure the data flow in between all the nodes as well as the node interacting each other in that private network or a global network like Internet. This change in the topology of the system proves to be very effective for enhancing the generic Information Flow Monitors.
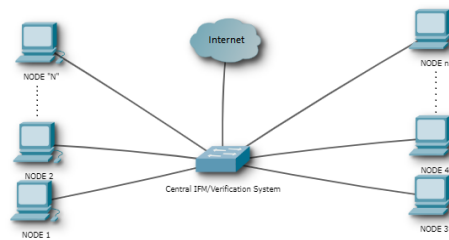
Figure 4. Proposed Star connected IFM cyber physical systems

The possible solutions are like, "Node 1" send corrupted data to "Node n", to verify the origin of the data Node n can simply raise a query to the Central IFM which can substantiate the origin of data back to "Node 1" though the logs or via backtracking. This system will ensure to find the origin of the corrupt data in the cyber physical system. Consider the following two cases. In one of the cases, the sender node sends a routine package or data to the next node. In the other case the node sends a malicious package to the next node (Figure 3). Initially "NODE 1" sends a data packet for "NODE 3". For this "NODE 1" sends the data to the SUB-Station. The Sub- Station in this case checks for the content description in the packet sent by "NODE 1" as in figure 4.
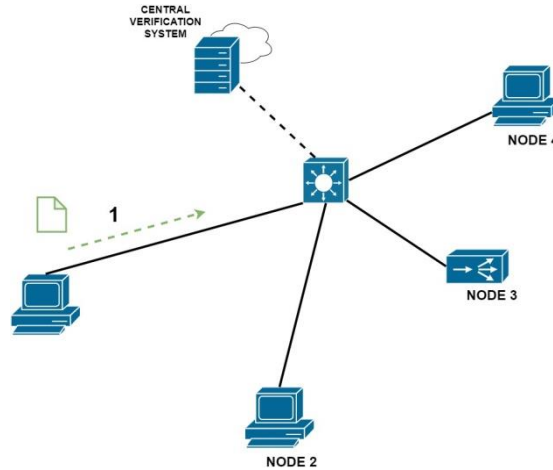
Figure 5. Step 1 A packet is sent for delivery at Node 3

This packet contains the sender and the receiver address which is verified by the Sub-Station. In order to verify the authenticity of the source of the packet, the Sub-Station sends the information to the Central Verification System, which in turn matches the contents from its database and then acknowledges the Sub-Station. On receiving a positive acknowledgement, the Sub-Station forwards the packet to the desired destination. The figure 5 and 6 states the success Stage for the system where the packet reaches to its destination.
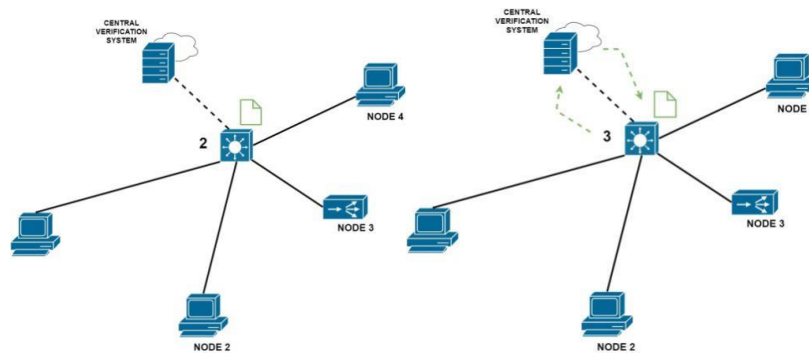
Figure 6. Step 2 and 3 Ideal Case where correct packet is sent to the server and verified
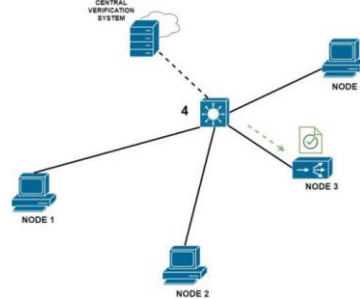
Figure 7. Step 4 Packet reaches the destination

In other case, "NODE 1" sends a malicious packet to the Sub-Station stating that the data is forwarded to it from some other Node (figure 7). Here, this packet is forwarded to the Sub-Station normally. But in this case when the Sub-Station requests verification from Central Verification System, the Sub-Station gets a negative acknowledgement with failed identity.
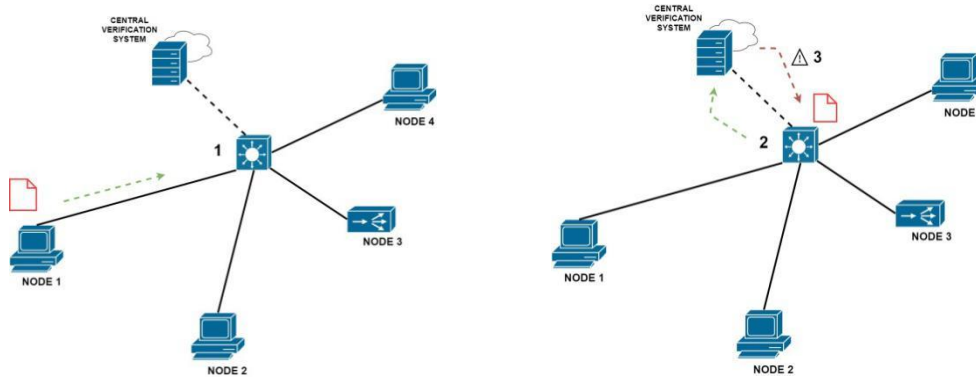
Figure 8. Step 1 and 2 Corrupted packet sent for delivery and failed verification

The Sub-Station in this case understands that this is a malicious packet and thus does not forward this packet to the destination as depicted in figure 8.
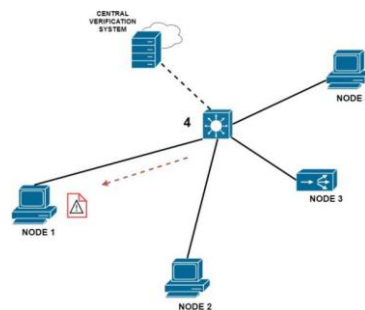
Figure 9. Step 1 and 2 Corrupt data is sent back to the sender

5.Results and Discussions

Although it is a proposed idea for the hindrance problem, so the solutions be in the form of security features by implementation on cyber physical systems. One can minimize the invasion of malicious packets or data into the system. At the same time, the fundamental properties of Confidentiality, Availability, Integrity and Security can be achieved in months or over period. In a distributed cyber physical system with n numbers of connected nodes the following outcomes are likely to occur. This proposed solution does not allow any malicious packet into the system, thus the delivery rate may decrease if there are many malicious packets trying to enter into the system. Simultaneously, security of the entire distributed system will increase in a linear progressive way with irrespective of malicious items which are trying to enter in the cyber physical system. As the IFM or the central sub-station needs the information of the data flow in the system, initially the confidentiality of the system is high but with increase in number of nodes connected over a distributed network, it reduces with respect to number of nodes.
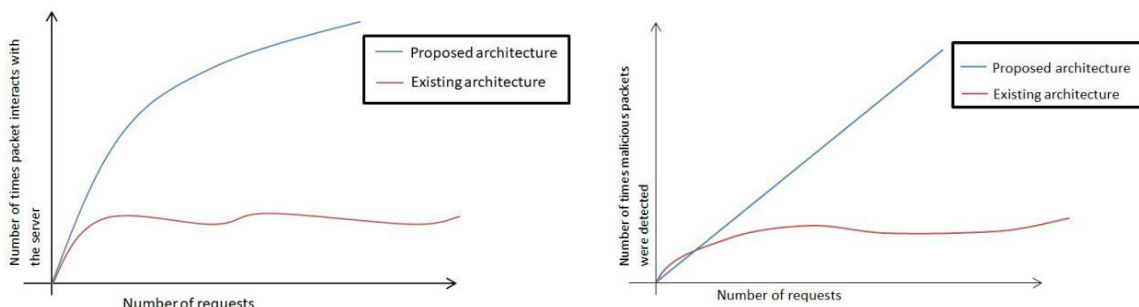
Figure 9 (a) & (b). No. of requests vs. interacted packets detection

The following graphs figure 9 (a) and (b) represent the number of times every packet interacts with the server with respect to the requested packets. Using this architecture for cyber physical systems, the server interaction increases with increase in number of packet request. This increases the server load, but considering the star topology connection over distributed architecture, with the presence of multiple servers, the server overload can be avoided.

At the same time we see that because of direct server – packet interaction, a linear trend is observed, that is – any packet whether malicious or not will have to undergo a server screening where the chances of skipping or missing out the infected packet is close to zero. The major point of concern with increase in number of packet request is the increase in the probability of finding malicious packet by the sender. The proposed Star Information Flow Monitor architecture can have hardware as well as software implementations. The architecture can also be simulated on any packet simulation software like Network Simulator 2, Cisco Packet Tracer, and others to name a few.

6. Conclusion

From the above discussions authors, researchers may explore the change in topology which brings great changes in the glow pattern of the cyber physical system. In this paper the limitations and drawbacks of the generic Information Flow Monitors for Cyber Physical Systems and formulation of such cyber system has been presented. The proposed star topology solution together with IFM will enhance the drawbacks of the existing CPS in such case where the sender sends a malicious packet in the system and then denies the fact. The solution suggests the use of a Star connection in the general cyber physical system topology which leads to better error handling during runtime of the system. For further work the proposed architecture of star IFM together with CPS can be implemented for the improvement in network performance parameters such as throughput, delivery ratio, cpu utilization, network lifetime, energy conservation ratio.

References

[1].Online Available: NIST Website Cyber Physical Systems, www.nist.gov/el/cyber-physical-systems.

[2].Gries, S., Meyer, O., Wessling, F., Hesenius, M., & Gruhn, V. (2018). CPS with the information flow monitor, IEEE International Conference on Software Architecture Companion, IEEE, ICSA-C.2018.00014

[3].Gries, S., Hesenius, M. & Gruhn. V. (2017). Tracing cascading data corruption in CPS with the information flow monitor, Frontiers in Artificial Intelligence and Applications, vol. 297, pp. 399–408.

[4].Gruhn., V., Gries, S., Hesenius., M, Ollesch. J, Rehman. S, Schwenzfeier. N., Wahl, C. & Wessling, F. (2017). Engineering cyber-physical systems," in New Trends in Intelligent Software Methodologies, Tools and Techniques - Proceedings of the 16th International Conference, SoMeT 17, Kitakyushu City, Japan, September 26-28, pp. 3–18.

[5].Gries, S. Hesenius, M. & Gruhn, V. (2017). . Tracking Information Flow in Cyber-Physical Systems. pp. 2589–2590.

[6]. Swan. M, Blockchain: Blueprint for a New Economy. (2015). online available: silo.pub/blockchain-blueprint-for-a-new-economy.html

[7]. A, M, Antonopoulos., Mastering Bitcoin: Unlocking Digital Crypto Currencies, 1st ed. O'Reilly Media, Inc., 2014.

[8]. B, Min. and V, Varadharajan., "Design and analysis of a new feature distributed malware," in 2014 IEEE 13th International Conference on Trust, Security and Privacy in Computing and Communications, Sept 2014, pp. 457–464.

[9]. Min, B. & Varadharajan, V. (2015). Design and evaluation of feature distributed malware attacks against the internet of things (IOT). 20th International Conference on Engineer,

[10] Guo, Y. Hu, X. Hu, B. (2018). Mobile cyber physical Systems: Current challenges and future networking applications. IEEE Access, 6 (2018), pp. 12360-12368.

[11] Ahmed, M., C., and Zhou, J., (2020). Challenges and Opportunities in CPS Security: A Physics-based Perspective", arXiv:2004.03178, https://arxiv.org/abs/2004.03178

Applications of Internet of Things (IoT) in Smart Healthcare

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Abstract: Coronavirus disease (COVID-19) is a newly discovered infection which has been infected a large number of human being and animals in the world. According to the report of World Health Organization (WHO), more than 4 lakh death cases has been reported by the hospitals and in a very less time it has been spread out globally. Due to wide range of application domain of IoT, it can play a major role in healthcare system. Different sensors and other IoT enabled devices are used to sense the useful information related to health sector and share the information on the network for decision making. In this paper, the role of IoT in smart health care system has been discussed to minimize the impact of Covid-19. The useful real time data related to the health of patient can be tracked by incorporating the IoT in smart healthcare systems. To prevent and control COVID-19, different applications of IoT provides best solutions.
Keywords - Covid-19, IoT, Sensors, Smart health care, WHO, Global disease.

Introduction

Pandemic condition is due to Covid-19 disease caused by one kind of disease Corona. According to the World Health Organization, around 200 countries plus witnesses this situation of the pandemic. The virus belongs to a major virus family that can cause disease in animals or humans and even to death in some situations. In people, many coronaviruses that cause respiratory infections from normal cold to more serious diseases to include respiratory syndrome in the near east (MERS) and severe acute respiratory syndrome (SARS). The most recently discovered Coronavirus causes Coronavirus disease (COVID-19). It was named as the world's true 2019-nCoV(nCoV) organization of health 12 January 2020 [1]. Till the date, a vaccination date for COVID is not available. More than 50 countries take the clinic for the vaccine trial. If every patient gets infected Covid-19 is under observation/hospital admission, the body temperature, the heart rate, the amount of oxygen, blood is constantly tracked. These are just a handful of the relevant parameters that are observed.

The speed of this disease within the community comes from positive patient COVID-19. But if you do take each care, including hand washing and holding social space, you may still be in a situation where you are embarrassed virus exposer. Instead, self-sufficiency is only required if you are sensibly doubtful you are contaminated with the virus. That's WHO recommends that patients with COVID19-positive contacts be quarantined 14 days from the last time the patient was exposed [2]. There are several IoT implementations up until the date designed to monitor the health status of remote patients. As in this case, IoT should do more useful as hospitals can track self-hospitalization patient condition without having to visit his house. This Covid-19 distribution may be limited. In the next segment, we illustrated the causes of Covid-19 spread, need/IoT position, its different software, and IoT problems Grip on the pandemic.

Literature Survey

In today's smart healthcare systems the concepts of the Internet of Things (IoT) and cloud computing are widely used. IoT based health monitoring systems keep the records of a patient's health by considering various health parameters and utilizing body sensors to collect health-related data using the Raspberry Pi board. Through the website the health data of the patient can be displayed that can be accessed by the doctors and patient for better communication without any physical presence [3]. Data related to the health of the patient can be access from any locations which can be helpful for the patients who belong to the rural areas where medical facilities are not easily available. In the Remote health monitoring system using IoT, Body wireless sensor Network (BWSN) is used to transmit the patients' health parameters collected through Raspberry Pi microcontroller to the physicians and caretakers wirelessly [4]. Being long-range wireless technology, the emergency of the patient's health is quickly detected and timely intervention leads to save the life of the patient. Owing to costlier healthcare and long waiting time in hospitals, the concept of the in-home patient monitoring system has been emerging in recent years. This system collects data of various body parameters

through Biosensors, wearable devices, and smart textiles and it transmits the data to the central node server securely through Ciphertext Policy Attribute-Based Encryption (CP-ABE) method. In turn, the server shares the collected data to the hospitals for further treatment. The server rings an alarm to the ambulance **[5]** during an emergency. It is very beneficial for elders and chronic patients who require continuous monitoring. The specialized healthcare monitoring system for elderly people is a growing need in the aging population world. This system performs basic health checkups by measuring the body parameters regularly and report the data to the doctors. The result data are then displayed as statements in a web application where doctors and patients can interact with each other **[6]**. Evaluation is of two parts: 1) Qualitative interviewing and 2) Quantitative Survey. The main challenge is to make elders equipped with for growing new technologies and to become familiar with smartphones, computers, etc. IoT based Smart healthcare with the help of smart devices and objects improves the healthcare monitoring system effectively, thus reducing the inefficiencies of the existing healthcare system. Smart devices with new and upgraded technologies enhance the data accuracy to be collected, real-time accessibility of patient's condition, intelligent integration of data collected, maintaining the integrated data smartly through cloud service, etc. **[7]**. IoT along with smart devices reduces complexity and complications in the healthcare system. The penetration of mobile technologies and smart devices over the healthcare system cause a huge impact on the world. The full-fledge utilization of M-health and E-health applications in today's world is made aware of the people for improving and maintaining a good quality of life. Apart from regular monitoring of patients' conditions through the M-health system, the main objective is to educate them through recommendations of healthy eating habits and effective workout routines for improving their quality of healthy life.

Spread and Impact of COVID-19

The COVID-19 disease is seen on a photo year-end 2019. It spreads according to WHO the disease starts in the Chinese city of Wuhan. As indicated in **Fig.1**, It spreads from person to person via tiny droplets in the mouth or nose. As those droplets are fairly large per WHO, don't travel high and fall to the ground quickly. Humans will capture COVID-19 if these are breathable a person infected with the virus gets droplets. Those are droplets that can remain on objects or any surfaces around them anyone wants desks, doorknobs, and hand wheels. The Coronavirus will surface-live over long periods depending on the condition of the surface region. People get infected when they come in contact with Covid-19 patient, surface, or objects **[8]**. Therefore it is recommended that you live at least one meter unlike others in the pandemic situation. Two know the Impact of COVID-19 in the non-immune population two measures can be considered. The first measure is the basic reproduction number (RO) which is a measure of the average number of people that would be infected by an infectious individual and no control measures are implemented. The second measure can be an effective reproduction number (R_{eff}) in which the average number of people are taking into consideration that would be infected by a single infectious person and some public health interventions have been implemented to control the spread of the virus **[9]**.
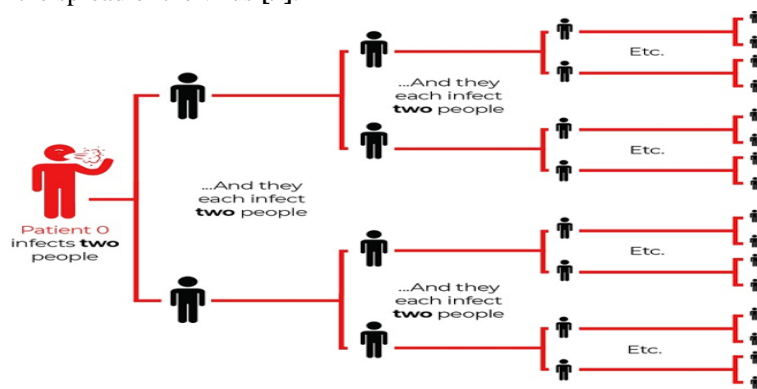
Figure 1. Spread and impact of COVID-19

COVID-19 has a rather distressing effect on the people. It has ruined human life. It is the way we communicate with each other, has changed the Business. Quick all industries, such as manufacturing, Training, etc have been affected because of this.

Impact of IoT in Medical Field

Internet of Things (IoT) has various features. Here we can take into account those features which make IoT applications highly recommended in medical files as seen in **Fig. 2.** With smooth IoT connectivity, medical workers can track applications/appliances COVID-19 patients and individuals who are in self-quarantine from afar **[10]**.
As the number of the medical staff not available against the total number of Infected COVID-19 virus, or suspected. Using data protection of IoT applications, of medical personnel. These patients can collect the requisite parameter at one location and more action to be decided. IoT systems are user friendly and patients can manage such programs by yourself. For fewer implementation prices, IoT software delivers a fantastic precise degree **[11]**. IoT app will operate effectively restrict the contact person who will, in the end, it lowers the COVID-19 distribution. Even though, using these technologies we will save a life of our medical personnel, law enforcement, and public employees. As these are the actual heroes of the pandemic place **[12]**.
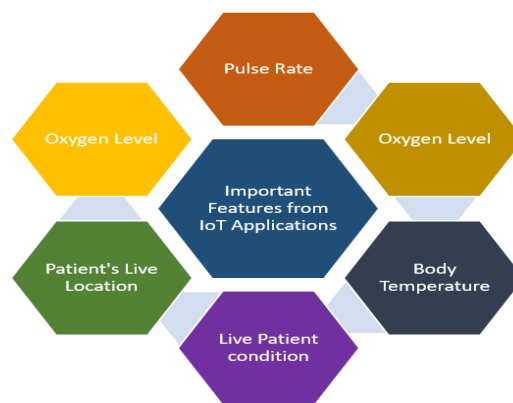
Figure 2. Features of IoT applications used in COVID-19

Various IoT Based Applications in COVID-19

As the application of IoT is widespread, nowadays, it is used as a tool to monitor the essential health parameters of COVID-19 patients in the hospitals and is proved as an effective technology, which helps in good and speedy recovery of the infected patients. Saturated oxygen level, pulse rate of the patient, and body temperature are the fitness parameters which are monitored **[13]**. Furthermore, IoT is broadly used to monitor the other emergency actions such as tracking the live location of the patients, making communication between patients and doctors, sending an ambulance, etc. The basic answer to how this technology works is the doctors and hospitals use the detailed information of the COVID-19 patients which are uploaded on the clouds that include the health parameters monitored by the IoT devices and this ultimately results in speedy recovery of the patients **[14]**. It also possesses the history of the self-quarantined person by the health center. To get real-time data and to monitor health parameters different IoT enabled devices are interfaced with different boards like Node MCU, Android, and Raspberry Pi **[15]**. A health alarm system can be implemented which can remind the patient about his health. The real-time health data can be sent to the doctor available at a nearby hospital. The following are some IoT based applications that can be used to sense the condition of the heart rate of the patient **[16-20]**.

1. ROHM's BH1790GLC Optical sensor
2. BM-CS5R heart rate monitor
3. Wearable heart monitoring inductive sensor.
4. WHMIS sensors

The following IoT based smart health care applications are now widely used to measure the temperature of the body.

1. LM35
2. MAX30205
3. G-TPCO-033
4. NTC thermostats
5. RTD sensors
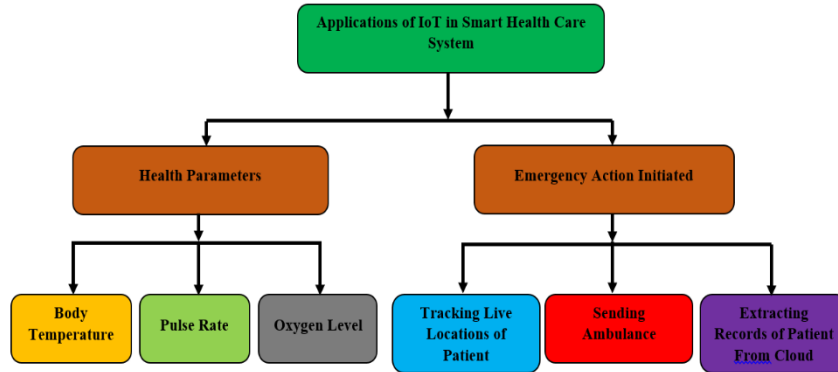
Figure 3. Different parameters monitored by IoT applications

Fig. 3 shows the various parameters that can be monitored by the IoT applications. There are some IoT based applications which are based on ontology methods and are widely used to gather information related to health care. Doctors have widely used ontology methods for better treatment of the patient in the emergency time **[17]**. The real-time data related to patient health can be stored on the cloud that can be accessed in the future by the health experts for analysis and decision making. Various emergency services can be provided by IoT applications such as availability of ambulance, blood, and doctor on call, etc.

Importance of IoT Applications in COVID-19

In the last few years, IoT (Internet of things) has become increasingly popular all over the world, and nowadays it is being used in health centers for medical treatments as well as to discover new medicines and drugs. Sensors and board are the developed networks which manage the healthcare system. Since the information and details of the patients are directly received (without any interaction with people) thus are more accurate and reliable. Also, the uploaded and stored data in the clouds are more secure. Hence, in any type of emergency, this data is very helpful for providing better treatment and facilities to the patients.

IoT Challenges to Handle the Pandemic

Based on the information provided by WHO, people having several chronic diseases such as high blood pressure, diabetes, serious heart disease or severe obesity are more likely to face this global disease COVID-19. Also, Risks are higher for older people (aged 65 and more) **[1]**. The proper handling of IoT devices is not an easy task for these people, hence, there must be requirements of some educated people who can handle all these things and devices for a faultless and accurate reading. But as per available studies, 60%-70% Indians live in rural areas and this itself arises a big challenge against IoT technology. Also, for the successful use of the IoT devices, a good internet connection and electrical power supply is required to upload the data and to communicate in the right time but since there are only 30% - 40% people who are managing sectors like electricity power supply, therefore, they'll need much time to repair in case of any kind of power failure and it may result in loss of network **[9-10]**. Thus to get over this situation, all we can do is spread awareness and education to people.

Conclusions

During the COVID-19 pandemic situation, IoT has been developed more than before and it provided a smart reliable gateway to fight against this situation. At the hospitals/healthcare centers, the monitoring of the collected data is done remotely. These healthcare monitoring devices are connected with a strong integrated network. If IoT devices detect any emergency, it immediately alert the doctors, patients or healthcare center by sending them an automated message. Also, the self-quarantined and confirmed patients of COVID-19 are monitored with IoT devices, which eventually helps to maintain the real-time information on the clouds and prevents the drastic transmission of COVID-19. This stored data will be useful for the statistical analysis and researchers for the better prediction of the impending situation of COVID-19. Undoubtedly, IoT has transformed the healthcare center and it can provide a better healthcare solutions with good medical facilities in future.

References

[1]   WWW.WHO.int/covid-19/information

[2]   Kim, R. Y. (2020). The Impact of COVID-19 on Consumers: Preparing for Digital Sales. *IEEE Engineering Management Review*.

[3]   Jaiswal, S., Katake, R., Kute, B., Ranjane, S. and Mehetre, P.D. (2017). Survey of health monitoring management using internet of things (IoT). *Int. J. Sci. Res.* 5(11), 2243-2246.

[4]   Kajaree, D. and Behera, R. (2017). A survey on healthcare monitoring system using body sensor network. *Int J Innov Res Comput Commun Eng*, *5*(2), 1302-1309.

[5]   Pramila, R.S. and Nargunam, A.S. (2013). A Survey on Effective in-Home Health Monitoring System. *Int. J. Comput. Appl.*, 68(7), 15–19, 2013.

[6]   Thaduangta, B., Choomjit, P. et al. (2016). Smart Healthcare: Basic Health Check-up and Monitoring System for Elderly. *In 2016 International Computer Science and Engineering Conference (ICSEC)* (pp. 1–6).

[7]   Kumbi, A., Naik, P., Katti, K.C. and Kotin, K. (2017). A survey paper on internet of things based healthcare system. *Internet of Things and Cloud Computing. Special Issue: Advances in Cloud and Internet of Things*, *5*(5-1), 1-4.

[8]   Haleem, A., Javaid, M., Vaishya, R., & Deshmukh, S. G. (2020). Areas of academic research with the impact of COVID-19. *The American Journal of Emergency Medicine*.

[9]   Baker, S. B., Xiang, W., & Atkinson, I. (2017). Internet of things for smart healthcare: Technologies, challenges, and opportunities. *IEEE Access*, *5*, 26521-26544.

[10] Singh, R. P., Javaid, M., Haleem, A., & Suman, R. (2020). Internet of things (IoT) applications to fight against COVID-19 pandemic. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*.

[11] Singh, R. P., Javaid, M., Haleem, A., Vaishya, R., & Al, S. (2020). Internet of Medical Things (IoMT) for orthopaedic in COVID-19 pandemic: Roles, challenges, and applications. *Journal of Clinical Orthopaedics and Trauma*.

[12] Guntuku, C., & Pasupuleti, S. K. (2018, February). Secure Authentication Scheme for Internet of Things in Cloud. In *2018 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU* (pp. 1-7). IEEE.

[13] Andreev, S., Dobre, C., & Misra, P. (2020). Internet of thIngs and sensor networks. *IEEE Communications Magazine*, *58*(4), 74-74.

[14] Muthukumar, S., Mary, W. S., Rajkumar, R., Dhina, R., Gayathri, J., & Mathivadhani, A. (2019, January). Smart Humidity Monitoring System for Infectious Disease Control. In *2019 International Conference on Computer Communication and Informatics (ICCCI)* (pp. 1-3). IEEE.

[15] Chatterjee, P., Cymberknop, L. J., & Armentano, R. L. (2017, November). IoT-based decision support system for intelligent healthcare—applied to cardiovascular diseases. In *2017 7th International Conference on Communication Systems and Network Technologies (CSNT)* (pp. 362-366). IEEE.

[16] McDermott, T. (2018, June). Developing Systems Thinking Skills using Healthcare as a Case Study. In *2018 13th Annual Conference on System of Systems Engineering (SoSE)* (pp. 240-244). IEEE.

[17] Kumar, V. (2015). Ontology based public healthcare system in Internet of Things (IoT). *Procedia Computer Science*, *50*, 99-102.

[18] Brezulianu, A., Geman, O., Zbancioc, M. D., Hagan, M., Aghion, C., Hemanth, D. J., & Son, L. H. (2019). IoT based heart activity monitoring using inductive sensors. *Sensors*, *19*(15), 3284.

[19] Lung, C., Oniga, S., Buchman, A., & Tisan, A. (2013). Wireless data acquisition system for IoT applications. *Carpathian Journal of Electronic and Computer Engineering*, *6*(1), 64.

[20] Kazi, S. S., Bajantri, G., & Thite, T. (2018). Remote Heart Rate Monitoring System Using IoT. *Techniques for Sensing Heartbeat Using IoT*, *5*(04).

Impact of Social Distancing on Susceptible-Exposed-Infected-Recovered (SEIR) Model Applied to Epidemic Diseases

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Abstract: To study the spread dynamics of an infectious disease an epidemic model is used. They predict things such as what is the rate of a spread epidemic how bad is the epidemic going to be and so. A simple epidemic model is the SIR model that stands for Susceptible-Infected-Recovered [1]. SIR models formalize what is probably the simplest possible way to think of an epidemic.The SEIR model simply extends the SIR model by adding one additional equation for people who have been exposed. For some significant contaminations, there is an extensive isolate period during which people have been tainted yet are not yet infectious themselves During this period the individual is in compartment E (for exposed)[3]. The paper has analyzed the effect of social distancing factor onto dummy population by applying the SEIR epidemic model over 100 days of spread with rate of timing dt=0.1 (equivalent to 1 day). The results confirm that number of infected people decreases as more social distancing is respected avoiding large gathering and staying at home. An extension of the work is to see the effect of lockdown on curbing the spread of the disease and consideration of larger population and varying parameters.

Keywords: SIR, SEIR, desease, population, model, epidemic.

I. Introduction

Infectious disease can create a chain of infection in a crowd making many people sick The spread dynamics of such disease is analyzed using an epidemic model. The rate of a spread of epidemic, how bad is the epidemic going to be and so, are predicted using the model. A simple epidemic model is the SIR model that stands for Susceptible-Infected-Recovered. SIR models formalize what is probably the simplest possible way to think of an epidemic. The population consists of taking all the people in the world and dividing them into three different categories. The first category is called susceptible. Ssusceptible are all of the people that are capable of becoming sick from an infection. The model assumes to have some sort of infection that is capable of infecting everybody so at the beginning everybody is going to be susceptible. Now we have the second category of people who are Iinfected. When you become infected then you leave the susceptible category. For most diseases after you've been infected you're not now susceptible to get it to a second time. It means you just get infected once and then those who have the infected disease they are going to transition at some point hopefully into a recovered status. They may be removed also from category because of death from disease. I assume that the death rate is small compared to the number that are being recovered. I'll just imagine that this explains everybody is either susceptible which means they could get out or they're currently infected in which case they could go and infect other people or they could go and become recovered in which case they can neither get this particular illness nor can they give it to somebody else those are the assumptions of this model.[4,5]

The model use the symbol S for the number of people who are still at risk of the disease. "S" is short for "susceptible", meaning a person who hasn't had the disease and might catch it. The model think of S as a function of time, that is, we think that as the epidemic progresses, S changes. Therefore the authors write S(t) for the number of suseptibles at time t. The number S(0), which is the number of susceptibles at the start of the epidemic, is a key value in this model. The number of infected people at time t is given by I(t). We assume that I(0)>0, because otherwise the epidemic can't start.[6,7]

Finally, the people previously infected but no longer infectious are called "removed". (Unfortunately, this doesn't mean they've recovered. They may still be ill, or as happens tragically often with Ebola, they may be dead). The model use R(t) to symbolize the number of removed people at time t. It is not necessary for S, I and R to be whole numbers. This is a model, and all the authors want is for the predicted values of S, I and R to be close to what is observed. By close the authors mean within a few percent. In fact, because the models are so simple and the real situation so variable, getting numbers within a few percent is a major achievement.

II. The SEIR Model

The SEIR model simply extends the SIR model by adding one additional equation for people who have been exposed.

165

For some significant contaminations, there is an extensive isolate period during which people have been tainted yet are not yet infectious themselves During this period the individual is in compartment E (for exposed)[1,5]
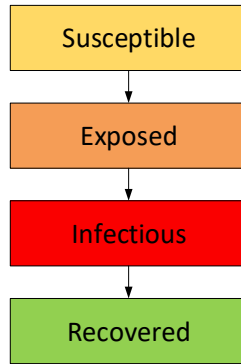
Fig 1: The SEIR Model

The dynamic equations of SEIR model are shown below:

$$\frac{dS}{dt} = -\rho.\beta.S.I \qquad (1)$$

$$\frac{dE}{dt} = \beta.S.I - \alpha.E \qquad (2)$$

$$\frac{dI}{dt} = \alpha.E - \gamma.I \qquad (3)$$

$$\frac{dR}{dt} = \gamma.I \qquad (4)$$

The equations (1),(3),(4) comprise SER model and complete equations from (1) to (4) comprise SEIR model. In equations [8.9]:

- α is anti-proportional of the virus incubation period
- β is the mean contact rate in the population
- γ is anti-proportional of the mean infectious period
- S, E, I, and R represent the fraction of population in the *Susceptible*, *Exposed*, *Infected*, and *Recovered* categories.

The first two equations changes slightly with the introduction of a fourth parameters ρ which represents the social mixing. The higher the ρ the less social distancing. It can have a value from 0 to 1. The modified equations are shown below:

$$\frac{dS}{dt} = -\rho.\beta.S.I \qquad (5)$$

$$\frac{dE}{dt} = \rho.\beta.S.I - \alpha.E \qquad (6)$$

III.   Experiment and Results

The modeling was done in python with anaconda framework and jupyter notebook was created. The initial values for S,E,I,R at time t=0 and parameters are initialized as shown in the table below:

Table 1: Initial values at t=0 and parameters

Initialization			
S(t=0)	1-1/1000	α	0.20
E(t=0)	1/1000	β	1.75
I(t=0)	0	γ	0.5
R(t=0)	0	ρ	0.9

As per the table initial values of S, E, I and R are chosen as 0.999,0.001,0 and 0 respectively. Similarly the parameters values of α, β, γ, ρ are chosen as 0.20,1.75,0.5 and 0.9 respectively. The initial values are chosen because of [2]. The simulation required taking the most recent at $t_{(i-1)}$ and updating values at t_i for S, E, I, and R, and adding the equation multiplied by the time step. This simulation is done using 1000 people in the population with one exposed person and remaining 999 susceptible, zero infected and zero recovered.

Running the simulation for 100 time units (equivalent to 100 days) with dt=0.1 (equivalent to one day).The graph obtained by experiment is shown in Fig 4:
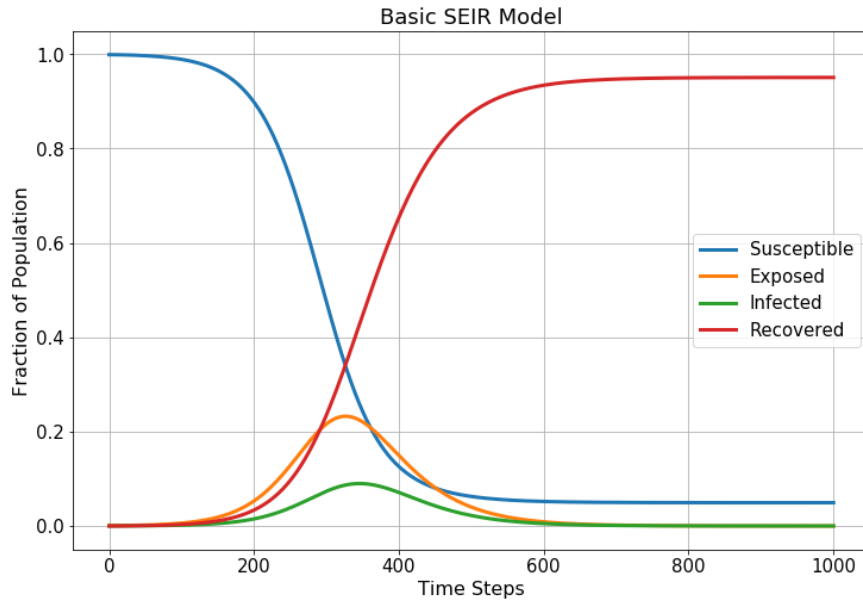
Fig 2: Base SEIR model with ρ=1

Here on y axis researchers have the population represented in fractions. The curve in Fig 3 shows the effect of social distancing in flattening by plotting the E and I curve.
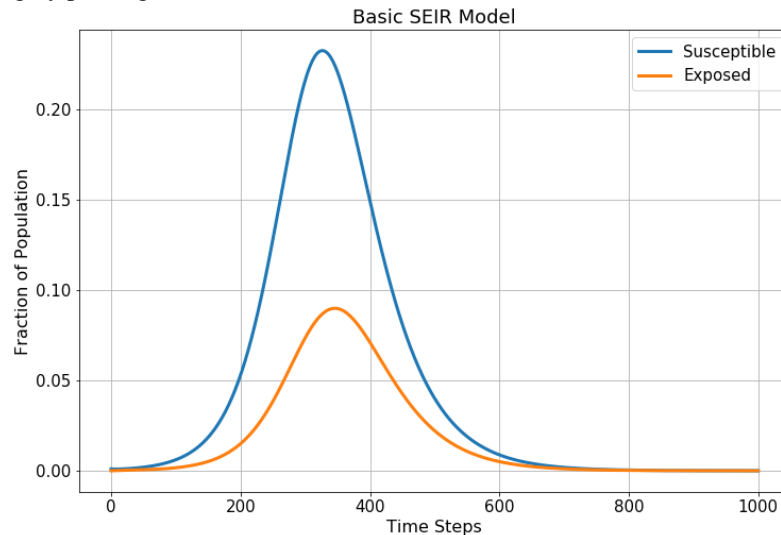
Fig 3: Flattening effect of S and E

The analysis on the base case without social distancing. By analyzing the figure 3, it can be obserbed that, at the peak, after 40 days 10% of the population will be infected with the disease from the first exposure. This unmistakably demonstrates has a decent possibility of being an extreme contamination regardless of whether it is short lived.

167

Effect of social distancing factor

Social removing incorporates dodging enormous get-togethers, physical contact, and different endeavors to alleviate the spread of infectious disease. As indicated by the model, the term this is going to affect is the contact rate, β. As presented in the equations 5 and 6, ρ is the boundary for understanding the impact of social separating on corona. The value ρ=0 implies everybody is secured and isolated while ρ=1 is proportional to standard model.

The effect of social distancing factor on infected population is shown in the Fig 4.
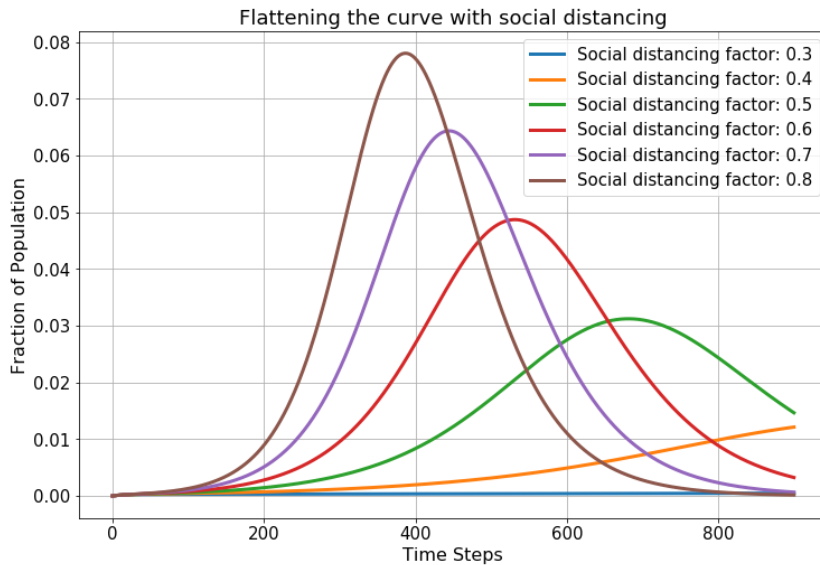
Fig 4: Effect of social distancing factor on Infected population

In the fig 4 the reader can see the straightening impact happen here as more social separating happens all through the populace, which makes natural sense as it decreases the contact rate.

These situations with social separating will probably improve the survivability of the illness by giving more opportunity for medicines and supplies to create while keeping the pinnacles lower.

IV. Conclusion

The paper has discussed about the popular model SIR and its extension model SEIR. The research work has analyzed the effect of social distancing factor onto the infected population using the SEIR model. This has been done by introducing the social distancing factor ρ and equations of SEIR model. The results has been encouraging and confirms that negligence of social distancing lead to spread of the disease and following the social distancing and stay away from gathering and herd reduces the risk of getting infected by the disease. In future the work, the population can be changed to a high number to analyze the effect onto a population of a city or of a country. Further epidemci/pendemic that has happened earlier or in present can be analyzed in real time.

References

1. https://en.wikipedia.org/wiki/Compartmental_models_in_epidemiology
2. Zhou, P., Yang, X., Wang, X. (2020). A pneumonia outbreak associated with a new coronavirus of probable bat origin. *Nature* 579, 270–273. https://doi.org/10.1038/s41586-020-2012-7
3. Li Q, Guan X, Wu P, (2020). Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. *N Engl J Med* https://doi.org/10.1056/NEJMoa2001316
4. Real-time big data report on the epidemic (in Chinese) 2020. Available online: https://voice.baidu.com/act/newpneumonia/newpneumonia/?from=osari_aladin_top1
5. Coronavirus disease 2019 (COVID-19) Situation Report–25 2020. Available online: https://www.who.int/docs/default-source/coronavirus/situation-reports/20200214-sitrep-25-covid-

19.pdf?sfvrsn=61dda7d_2

6. Situation Updates - SARS: Update 95 - Chronology of a serial killer 2003. Available online: https://www.who.int/csr/don/2003_06_18/en/

7. 2019 Data from spring festival (in Chinese) 2019. Available online: http://news.sina.com.cn/c/2019-02-04/doc-ihrfqzka3579637.shtml

8. Combatting SARS 2003. Available online: http://news.sohu.com/57/26/subject206252657.shtml

9. Backer, J. A., Klinkenberg, D., & Wallinga, J. (2020). Incubation period of 2019 novel coronavirus (2019-nCoV) infections among travellers from Wuhan, China, 20-28 January 2020. *Euro surveillance : bulletin Europeen sur les maladies transmissibles = European communicable disease bulletin*, *25*(5), 2000062. https://doi.org/10.2807/1560-7917.ES.2020.25.5.2000062

REST Web Services: A Basic Study

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Abstract: The Current Start of Global Business after settling in their flied and advancing growing their business spreads their services over the internet, with web Application forms, SOAP services, SMS and more recently, REST full Services. The REST full framework provides many Features to the company in terms of JSON and HTTPS secure data so REST has now begun to gather more popularity in the industry so here in this paper key features considered are compliance standards and best commitment practices. A number of drifts are overserved (e.g., wide-ranging JSON support), but, in unison, high variability in services, with only 0.8% of jobs fully compliant with all REST policies. The result can help professionals understand how REST services have been used to create a more effective website and continue to use the API to connect the mobile application and backend services. Investigators can also benefit from the documentation of main research expanses, underwriting to the advance of very useful applications from these services.

1. Introduction

The quantity of services providing freely accessible web Application Interfaces was increasing swiftly [1]. Many researches indicate that developers from SOAP or RPC will download RESTfull web services, as a means for customers to use these services [1] - [4]. This has been directed at major websites such as Facebook, or Twitter, or Google which now use RESTfull services to provide relaxed admittance to their critical data sources, although refining their trades [1]. Perhaps because of these features of HTTP (suitable for REST modernization well), enduring occurrence, and common sense, RESTfull services has develop a common way to provide services on the Net [2]. Apart from this, REST is merely a building style, provided deprived of ordinary dimensions. This means that a number of verdicts have to be made by inventors when it comes to revealing service APIs, which can lead to numerous APIs and, in some cases, banned verdicts (e.g., using a solitary HTTP action to find or remove an app). These decisions will affect the customer case builder, who must adapt to a particular style used, and might also disturb the benefactor (e.g., when functioning an unverifiable service).

The developers of the server case should specify how the API ought to be offered (e.g., uniform resource indicator plan representation to be used), what features it should have or how the documentation should be provided. For example, the latter is problematic because apart from the usual methods of writing APIs, the tendency will be to use text to define an API (often in ordinary linguistic), which might diverge in shape, construction, or deepness and is obviously a customer-engineer delinquent. The books also highlight the art of divination by the way HTTP structures are used, some broadly accepted (e.g. HTTP verbs, status cyphers) & others that pursue to be unnoticed (e.g. HTTP titles) [2], [3]. Too debated was the acceptance of an audio-visual aid policy such as the appliance of submission state for the RESTfull building, which can be widely cast-off [1] - [3].

2. Related Work

Identification of the following two research task groups that deliver material related to web Application programming interfaces: i) Errands that dynamically analyse a customary of web services for precise API structures; and ii) Services that deliver evidence on usual web services, together with open-source and stimulating features. Regarding the dynamic analysis of network services, the exertion in [1] is a fascinating case study that analyses AP2 web documents publicly available, selected on programmableweb.com, as opposed to 20 key Notes. The outcomes display that RESTful web services were extensively accepted in 2010, even though authors highlight that developers often overlook REST principles, which are confirmed by this effort in a key study and almost a era later. In [2], 20 RESTfull web services, certain among APIs with the highest figure of shups from the good web-web.com, are analysed as opposed to 17 key features. The outcomes display that there are probably no real-life applications, other than small data.

The amenities of 3 well-known cloud providers are conducted contrary to the index of the 73 finest practices of the REST APIs strategy [4]. The outcomes show that these cloud sensors have grasped a satisfactory level of adulthood, or are only following ½ to 2/3 of the catalogue rules. The purpose in [3] analyses 286 Conceit API scripts and provides a structural outline for REST APIs to identify key features and shortcomings. About 1/3rd of the 286 APIs managed by Google and that only analyse Conceit texts, authors focus on a specific niche.

In [6] 500 of the most prevalent applications and 15 prevalent android system services are analysed, with outcomes presentation that application dev prefers authorized Development kits to admittance these services in addition to modest HTTP clients. A small collection of 14 services (also engrossed on android apps), so it is worthwhile to have a comprehensive viewpoint on this subject. Ineffective features (e.g., imbursement systems & business replicas) of the 70 Internet services are analysed in [8] for the purpose of determining the necessities of the RESTful API governance model. Authors consider broad exposure of Application Programming Interface restrictions (example, consumer is restricted to specific job areas, to certain payment systems) if the API not controlled by the API Opening. The paper too results in ineffective features, i.e., the presence of imbursement systems & border phone numbers, but aims to deliver a broader emphasis, by analysing a broad set of practical features, counting compliance with REST standards and finest performance.

For services that provide detailed information on Internet services, as well as open source and interesting features. It is worth mentioning the suggestion of how to measure the quality of web services taking into account the user experience of the end of the service featured [5] advanced construction and engineering options. a backup API that can enhance the machine-readable definitions of the API) is discussed as a flexible Ser-vice (QoS) quality management system, identified during long-term suspension testing. The authors does not provide thorough information over the features of the services underneath the bench. Opportunities for software research on Software engineering use of the web API are discussed [9]. The challenges deliberated are: i) service customers who have no regulator over the Internet service (the benefactor may change the service); ii) consumers may not be certain of the legitimacy of the calls in the Application programming Interface during implementation; ii) Development Kits out of synchronize with the service itself; iv) Quality of Service problems. Authors point out a number of study lines (example, a statistical study of review requirements, API sign, cyphering methods & outlines to address Quality of Service variability, the influence of web application API on non-operational objects.

The language of modelling for REST customer server conversations is presented in [7]. The authors point out that most APIs merely disclose low-level HTTPS data lacking the control of hypermedia (which creates barriers to conversations), which are two aspects The Author consider in this work to look at new features. In, the author analyses the emergence of the usage of customer tender technology. The author reviews the technology castoff in internet services and fact out the reasons for misusing RESTfull principles. Authors here emphasize that other building methods (e.g., redesign, OAuth) are more effective in web application API and discuss the importance of the REST web API's definition. In this paper, The Author analyse services in the arena with material indication for these supplementary features. The paper was intended to be read through the aim of knowing the nature of this exercise in relation to the REST web services. The Author provide supplementary and rationalized facts that provision prior work, because of the power of the Internet, such activities are rapidly obsolete, parting staff & researchers with slight understanding in scheming and evolving services, & following investigation on the topic.

3. Methodology

Investigational research passed out throughout the paper is performed to get the Reader a better understanding and Insight to RESTfull Services. The study comprises of following steps:

1) The Best practices for Rest API development.
2) Theory of other Researchers already carried out in regard to REST API Development.
3) Analysis of the major Technical aspects of REST service API's.
4) Result Verification.

The key components are gathered to provide a simpler view and presentation:

1) REST Architecture- A Basic Architecture used for mostly all the Web Based Service are depicted by the Data flow Diagram.
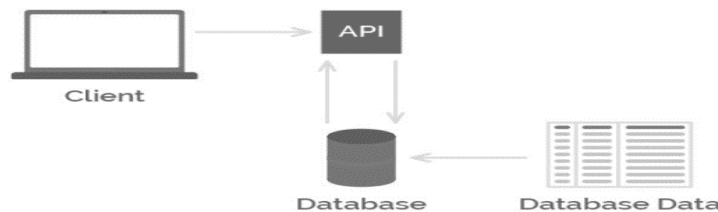
Figure 1: REST Architecture.

The flow diagram is self-explanatory as it shows how the client makes a request to the REST API and the API fetches the Data from the Backend Services i.e., DATABASE and respond the data in JSON format which is further converted to POJO format to make it available for the end user or client therefore the client is served with the output as requested in the Input.

2) Development Support- It cover the Input/output and SDK support of the service.
3) Security- This refers the authentication mechanism and encryption techniques provided by the API.

4. Result and Discussion:

The Result here signifies how to connect to the backend services using GET or POST request to the server in java using the http classes. Java is preferred here because requesting web services is easy and fetching data and converting data to make it useful is pretty much easier in java as it can be done by directly using the inbuilt classes of java.

```java
public static String downloadUrl(RequestPackage requestPackage) throws Exception {
    InputStream inputStream=null;
    String address=requestPackage.getEndPoint();
    String encodedParams=requestPackage.getEncodedParams();
    Map<String, String> headers = requestPackage.getHeaders();

    if (requestPackage.getMethod().equals("GET")&& encodedParams.length()>0){
        address=String.format("%s?%s",address,encodedParams);
    }
```

Figure 4.1: If the Application gives a GET Request to the Server.

```java
if (requestPackage.getMethod().equals("POST")&& encodedParams.length()>0){
    OutputStreamWriter writer=new OutputStreamWriter(connection.getOutputStream());
    writer.write(requestPackage.getEncodedParams());
    writer.flush();
    writer.close();
}

connection.connect();

int responseCode=connection.getResponseCode();
```

Figure 2. If the Application gives a POST Request to the Server.

After connecting to the backend services using REST API the Data is Collected in JSON format. And then the JSON data is converted to Plain Old Java Object (POJO) to work on that data to perform some functions which is easily readable in java.

Conclusion and Future Scope

This work went through all the major aspects of REST API with an approx. of 25 aspects, mainly collected from literature, understanding the level of compliance with REST policies, general performance decisions, and adherence to REST's programs for developing best practices. The information provided by this activity, i.e. a low level of practice, can provide useful school search guides (example sympathizing how REST progression tools disturb submission with principles or finest practice) & applied guiding principle Practitioners (example validation of the most widely used user authenticity mechanisms). In future the emphasis will be given on the tasks recognized, preliminary analysis of RESTfull APIs development Kits.

References:

[1] M. Maleshkova, C. Pedrinaci, and J. Domingue, "Investigating Web APIs on the World Wide Web", 'Eighth IEEE European Conference on Web Services', 2010, pp. 107–114.
[2] D. Renzel, P. Schlebusch, and R. Klamma, "Today's Top 'RESTful' Services and Why They Are Not RESTful", Web Information Systems Engineering- WISE', 2012, pp. 354–367.
[3] F. Haupt, F. Leymann , A. Scherer, and K . Vukojevic-Haupt, "A Framework for the Structural Analysis of REST APIs", IEEE International Conference on Software Architecture (ICSA), 2017, pp. 55–58.
[4] F. Petrillo, P. Merle, N. Moha, and Y. -G. Guéhé neuc, "Are REST APIs for Cloud Computing Well-Designed? An Exploratory Study", Journal of Service-Oriented Computing, 2016, pp. 157–170.
[5] D. Bermbach and E. Wittern, "Benchmarking Web API Quality", 'Web Engineering', 2016, pp. 188–206.

[6] M. A. Oumazizetal., "Empirical Study on REST APIs Usage in Android Mobile Applications", ' Service-Oriented Computing', 2017, pp. 614–622.

[7] A. Ivanchikj, C. Pautasso, and S. Schreier, "Visual modeling of RESTful conversations with RESTalk", Software System Model, 2016, pp. 1–21.

[8] A. Gamez-Diaz, P. Fernandez, and A. Ruiz-Cortes, "An Analysis of RESTful APIs Offerings in the Industry, 'Service-Oriented Computing', 2017, pp. 589–604.

[9] E. Witternetal., "Opportunities in software engineering research for web API consumption", Proceedings of International Workshop on API Usage and Evolution, 2017, pp. 7–10.

173

A Study on Implementation of Announcing Google Flutter

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Abstract:
Flutter is an app SDK for generating increased performance, high-fidelity apps for iOS, Android, web, and desktop from a single codebase. Flutter is Google's portable user interface (UI) framework for building modern, native, and reactive applications for iOS and Android. This paper helps in understanding the working of Flutter framework and developer works. Flutter uses widgets to create the UI, and Dart is the language used to develop the applications. Widgets are drawn by using rendering engine in flutter. Elements have a reference to the widget and are responsible for comparing the widget differences. In coding, a linear model exists with different lifecycle events by using developer, in sequence of every stage is completed.

Keywords: Flutter, Google Flutter, Android

1. Introduction

Flutter is a new and challenging platform. It has entranced the attention of wide-ranging companies and released their apps. As compared to developing web applications flutter is better because of its simplicity. It does not use native UI components because components are implemented in Flutter. In flutter, components are known as widgets [1]. Between the viewer and the code, no communication layer exists. All the buttons, media elements, text fields, backgrounds are all drawn from the graphics engine of Flutter. So, games strike the best speed for their graphics out of the Smartphone's. Generally, Framework has integrated Hot-reload when the state has been changed. Flutter framework has the power to rebuild the widget tree automatically and the effect changes quickly. Flutter delivers high-performance applications on different platforms [2] [3].

(a) Principles
It gives highly productive applications and creates a beautiful and highly customized user experience. Components are used to design, build, test, and debug these Hybrid apps. Core principle is to understand the widgets. It provides documentation and community. A framework consists of a layer of material, widgets, rendering, animation, painting, gestures, foundation, text, and dart.

(b)Widgets
The widget is the unified object model derived from flutter. These are basic building blocks to the user interface.

- A Design attributes. Example- a button or menu
- A Fashionable entity. Example- a font or color scheme
- A Design of layout framework. Example- padding

As shown in fig 1, runApp() : Root of the widget tree, it uses the Widget manages state. To handle this it uses two widgets.

  i. Stateless Widget
  ii. Stateful Widget
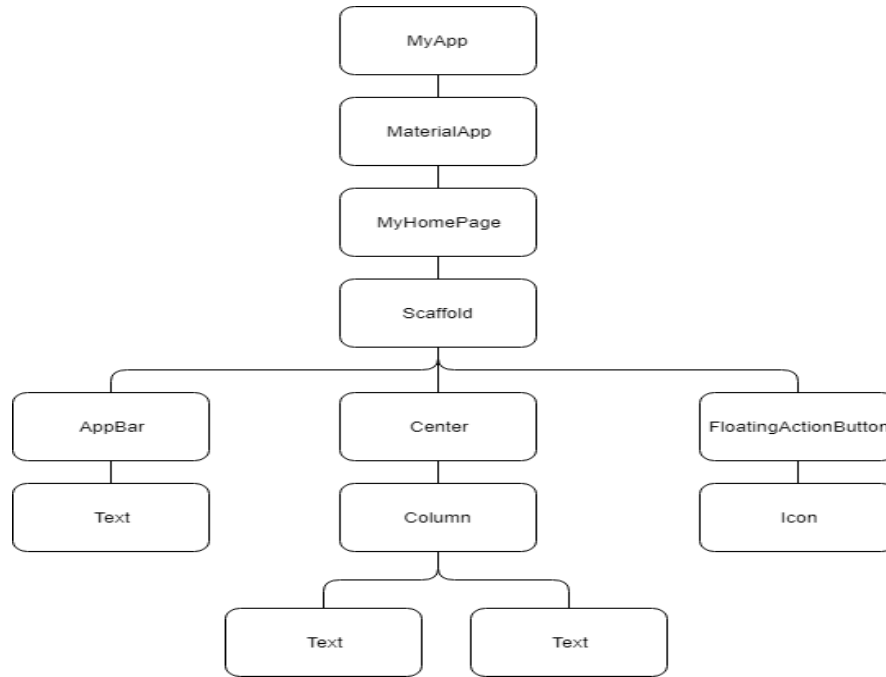
Figure1: Widget Tree [11]

2. Features of Google Flutter:
a) **High productivity**: This aims to time and resources consumption because it uses the same code base for both iOS and Android apps.
b) **High performance**: Flutter has its own OEM widgets so there is no need to access it and Dart has one feature so it compiles into native code, which results in less mediated communication between the app and the platform.
c) **Fast and simple development:** *Hot reload* which permits to visualise the changes made in the code on emulators, simulators, and hardware. Thus, changed code is reloaded in a second so the app is running without a restart.
d) **Compatibility**: widgets are not part of the platform; these are part of the app. On different Operating System versions, low or can say no compatibility issues will face. It concludes less time spent on testing [3].
e) **Open-source**: Flutter can be seen in any online platform, provides extensive documentation and community support to help out with any issues whenever it encounter, even in case of Dart as well.
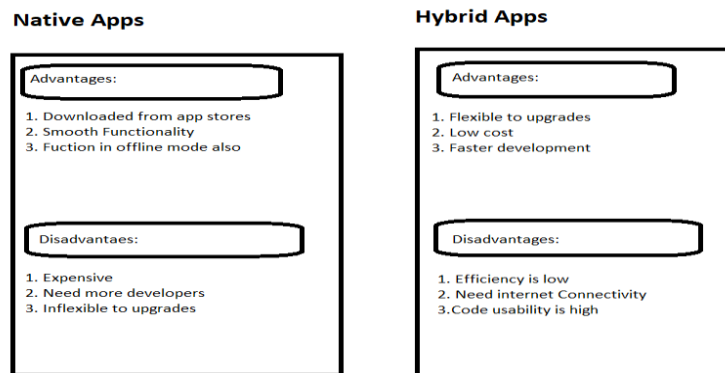
Figure2: Difference between native apps and hybrid apps [4]

175

3.Comparison with Native App Development
For Android app development, Flutter might replace Java. As compare to java it is more popular [4].

(i) Productivity: To develop an app it is faster than java.

(ii) Cross-platform performance: Flutter gives a very good performance as native apps on Android and iOS equally but, they use Flutter SDK for app development [8] [9].

(iii) Dart is much more like Java and not like JS: Dart is a compiled programming language used to avoid performance issues caused by the requirement for JavaScript bridge, Flutter uses a different approach. To communicate with a particular platform, Dart permits Flutter does not using any JavaScript bridge for context switching. To improve app start-up time it compiles the native code [6] [7].

4. Implementation as an Application of Flutter
The application is being developed by using the flutter technology [10]. Here layout and the developed piano are shown in fig 3 and fig 4 respectively ,when one taps to the key whether it is white or black, it will write the key number on console and will be stored into a stack. Every key has a unique number. The width of the key can be changed and it shows its different labels. Users can change the theme according to their choice.
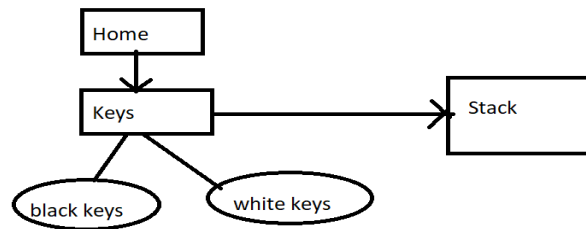
Figure 3: Working of Piano
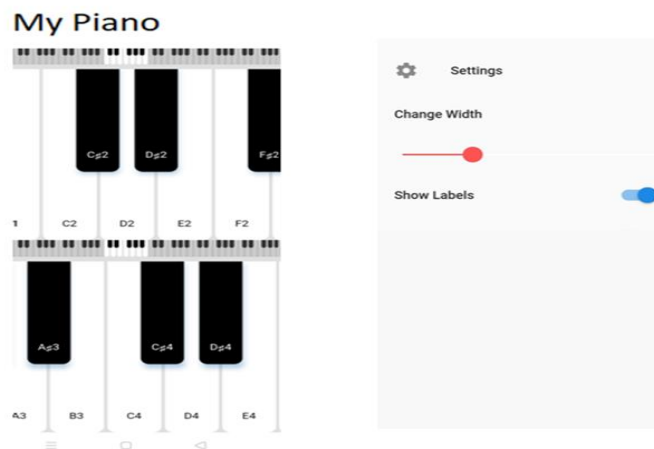
Figure 4: Implementation of Flutter as in piano keys

5. Challenges of flutter Implementation
Flutter is competing with native app development frameworks like Java, Swift.

  a) Flutter apps are looking quite similar to native apps.

176

b) Flutter gives priority to Android platform support so cross-platform experience gets suffered because of that.
c) Flutter support Dart only for the GUI (Graphical User Interface) which is developed on chrome. Dart is used as JavaScript in the browser so there is no DOM.
d) Though this framework has limited community support.

An experimental study has shown to describe the idea of flutter [5]. This paper is about an application of flutter where speed was measured in wind tunnel tests for sheet paper and web paper of various materials, sizes, and tensions. The large data sheet was used to identify the parameters of flutter such as speed, rigidity, mass ratio, and tension. An experiment was done for mode and air-flow around fluttering paper for further analysis.

6. Conclusion and Future Scope
Flutter framework provides an excellent way to build mobile applications. It's a platform independent technology which provides simplicity in the development process, high performance to get mobile applications both Android and iOS platforms. Soon, it will try to enable plenty of new developers to develop high performance and feature with full mobile application.

References

[1]. Napoli,M.L.(2019).Introducing Flutter and Getting Started. Wiley Online. https://doi.org/10.1002/9781119550860.ch1.
[2]. https://flutter.dev/docs/resources/technical-overview
[3]. https://www.mindinventory.com/blog/google-launched-flutter-to-simplify-app-development/
[4]. https://www.techcronus.com/blog/is-flutter-likely-to-replace-java-for-android-app-development/
[5]. Watanabe, Y. Suzuki, S., Sugihara, M. and Sueoka. Y. (2001). Journal of Fluids and Structures, Volume 16, Issue 4, Pages 529-542
[6]. Madhuram. ,Kumar A. , Pandyamanian. (2019). Cross Platform Development using Flutter. IJESC. Volume 9 Issue No.4.
[7]. Flutter Developer Tools - https://flutter.dev
[8]. Dart Packages- https://pub.dartlang.org/
[9]. https://www.educative.io/blog/flutter-tutorial
[10].Olsson, M. (2020). A comparison of performance and Looks between Flutter and Native Applications. http://www.diva-portal.org/smash/get/diva2:1442804/FULLTEXT01.pdf
[11].https://medium.com/flutter-community/widget-state-buildcontext-inheritedwidget-898d671b7956

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Literature Review : A Detailed Review of Partitioning Methods in a Variety of Databases

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Abstract: Organizing data into the table spaces and disks is a very important aspect of data base design. Proper partitioning helps to not only improve the overall system performance, this also ensures the scalability and manageability of the system. Dividing the incoming and existing data into appropriate partitions based on predefined proven techniques is essential in modern world to handle huge volume of data with variety.

In this literature survey authors have analysed the various partitioning methods with suitable examples to get best in class system performance from user and developers' point of view. This paper aims to answer the questions on versatility and benefits of partitioning methods in distributed and other types of data bases and the impacts of not selecting right partitioning for storing the data into the table spaces. In this literature survey authors have also analysed if we have hybrid partitioning algorithm available for large volume of data.

This literature survey does not answer the question if in case we have changes in dimension of the data in data base then how to get the same level of performance without reorganizing the data or changing the partitioning method.

Keywords—Data base, partitioning, table spaces, Query Performance

Introduction: Data partitioning plays a key role to decide the overall performance of the data base and enables the scalability of the application. With the emergence of a variety of data types in modern world where data in to the data bases is not limited into typical row, column RDBMS structure, selecting the best partitioning technique becomes very important. At the end of the day it's going to impact the performance of the application and the overall user experience as well. Using these partitioning techniques, SQL performance can be improved via two methods, first method is to use appropriate method to distribute data into partitions, this partitioning can be done smartly to ensure that our SQL is not accessing unwanted data/partitions. Second method is to partition the data across multiple disks where we can achieve this parallelism in way where query is using multiple partitions in one go. Parallel hints in oracle is a very good example of this method. [1] Partitioning techniques can help to achieve significant improvement on database performance if we are joining multiple tables in a single SQL. This performance improvement comes by breaking up a large join into smaller joins where the data base engine can retrieve its content faster compare to the complex join. Therefore, the breaking technique can be applied when we use partition key as a join key in the SQL. Apart from this, partitions provide objects independence that further enables the high availability of data.
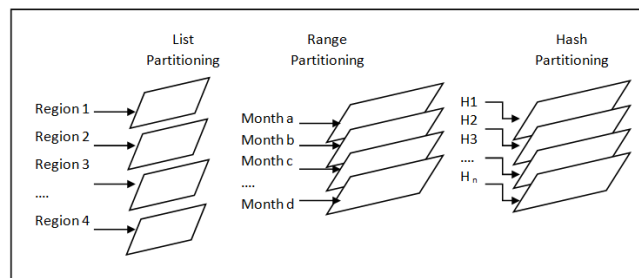
Figure 1. Data partitioning techniques [1]

The objective of this literature study is to get insights into the major partitioning techniques developed so far for to ensure maximum performance and stability of the data base and overall application. This review gives a brief of the papers studied in order to get various details about the process of selecting and applying the appropriate partitioning method based on the dimensions of the input data set.

This paper has been divided in two major sections: Section 1 elaborates the review methodology used by authors. Section 2 elaborates the crux of the papers reviewed. Finally, the conclusion provides a summery of the findings of this literature review.

Review methodology: The review methodology followed for reviewing major studies done so far for the various

methods of data partitioning techniques in a variety of data bases that includes distributed data bases like Oracle, DB2, Teradata etc or advance data base architectures like Bigdata, OLAP and cloud. The review methodology is broadly divided into three steps, the first is the initial state after that extraction of facts and analysis is the second step, and the third and final one is review writing. These three steps further consist of several sub-steps.

The review methodology is designed by keeping in mind the review questions that form the basis for conducting this literature review. The review questions are:

1.What is the benefit of applying partitioning in data bases?

2.What studies and research have already been conducted for partitioning in data bases?

3.What are the different areas that are still open for research and improvement?

4.What are the different datasets available and what are the sources of data collection?

5.What are the various data base attributes that are most frequently used for applying partitioning in data bases?

6.Is there any way to automate the partitioning at the run time instead of applying it in advance in data base architecture?

Authors have also explored the broad categories the partitioning parameters [12]:

a)**Frequency:** This type of partitioning helps to create best SQL explain plan by utilizing the log files stored on data base server. This method identifies the attribute that can be used in where clause or can be used maximum number of times which is a very resource intensive and complex task.

b)**Space:** In this method partitioning method creates a statistical table that contains the frequency of each value of specific fields. SQLs utilizes this table and based on frequency of each field we can get good SQL performance.

Crux of the papers reviewed

Khaled Saleh Maabreh (2020), Explained the query performance on three phases. Process populates data gradually into the partitions and on each step, we can evaluate the query performance. Initially in phase 1 we don't partition the table and in phase 2 partitions will be filled with small amount of data and in phase three we fully utilize the partitioning and fill the partitions with full volume. After putting enhancement's with more than 20% researchers has observed that partitioning is significantly impacting the query performance. Researchers has also experienced that specially on large volume of data partitioned tables outperformed the non-partitioned tables with 35% more efficiency. That's concludes that with large data sets partitioning is a critical step for good performance. [1]

Jiang Wang, Cheng Zhu, Yun Zhou, Xianqiang Zhu, Yilin Wang and Weiming Zhang (2018), discussed Partition-based cclustering and density-Based Clustering ; Clusters with Diverse Shapes and Densities can help to find clusters with divers shapes quickly in case of spatial data bases , researchers proposed a unique special clustering method called KMDD this method helps to quickly discover the clusters with diverse shapes using partition and merge strategy. KMDD is first method of its kind that involves the distance and density-based concept to aggregate the cub clusters which is generally not possible with the traditional agglomerative hierarchical clustering methods. Researchers has performed regression tests on simulated and real-world data sets and proved that KMDD is able handle scalability and dimensions more effectively when we compare this method with widely used spatial clustering methods. [2]

Yoon-Min Nam, Min-Soo Kim and Donghyoung Han (2018), proposed a unique graph-based data base partitioning method called GPT that can help to achieve good query performance by only adding a small amount of data in to the table spaces. This method identifies an undirected multigraph instead of identifying a tree or a forest which is different than the traditional partitioning method PREF. GPT partitioning technique identifies that partitioning scheme based on cost and analyzing the trad off between flawless join and data redundancy. This partition method avoids repartitioning of data and enables to include many tables in the join operation without impacting the performance. [3]

Alexandru Turcu, Roberto Palmieri (2016), proposed a partitioning methodology that enables auto partitioning using a Granola-based Distributed Transactional Memory. Using an independent transactional model researcher performed static byte-code analysis that identifies the classes of transactions. Researchers also used the test results to suggest partitions that will enable transactions which are independent. Researchers took a machine learning approach to assign partitions on the fly. Researchers evaluated the system on five basic bench marks and found improvements in both the ratio of distributed transactions and transactional throughput. [4]

Anita Brigit Mathew (2015), Dealing with velocity, variety, volume and versatility of Big data systems have become critical when data is stored at different places this also increases complexity in retrieval of data from these systems. Data is becoming out of control of in-house IT departments when it's getting stored in cloud and social networks. This extensive growth of big data establishes the need to reliable and rapid NoSQL data base services. For example Facebook uses Cassandra, HBase, Ne04j and twitter uses the FlockDB, Cassandra, HBase, Ne04j NO SQL data bases .[5]

179

Hao Wang, Jing Zhang, Da Zhang, Sarunya Pumma, Wu-chun Feng (2017), There cannot be one generic partition technique for all applications. In this paper researchers proposed a framework to apply application specific partition method. This framework takes two inputs in the form of configuration files and formalizes the workflow of partitiong as a key-value sequence operations and map to implementations. This also utilizes the MapReduce framework. As MapReduce is being utilized, this resolves the problem of partition in big data applications as well. Researches used a couple of case studies (muBLASTP and PowerLyra) to demonstrate user defined partitioning techniques. [6]

Elaine Naomi Watanabe, Kelly Rosa Braghetto (2018), discussed about the data intensive applications and proposed a partition method which were evaluated on a cluster of amazon cloud, relation and NoSQL DB (MongoDB), based on real world data sets that included more than 20 million data objects in 21 different simulations. Researchers suggested a annotations based method to model the data retrieval activities and to propose how data will be ingested in the activities. This method improves the parallelism during I/O and at the end this method drastically brings down the workflow execution time without hitting the cost (I/O and monitory) .[7]

Emad Taha Khalaf, Muamer N. Mohammad and Kohbalan Moorthy (2018): In modern world indexing and classification becomes more important from security and performance standpoint when we are dealing with biometric data and storing it in the image data bases. When there are many bio metric systems widely available, iris-based bio metric system has an edge over others because it cannot be copied or manipulated via some surgery or other methods. Researchers proposed an iris modality-based method which utilizes the local features of iris image. This method uses three algorithms DCT, DWT and SVD. This method extracts the local features and then divides it into 8 by 8 blocks and after this algorithm's will be applied. [8]

Xiaoming Huang and Zhen Shen (2018), reviewed an Adaptive Chunk Tool for Database Partition in Shared-nothing Distributed Database. In this paper, researchers proposed ACTDP, an adaptive chunk. Tool for database partition in shared-nothing distributed database. By adaptive aggregation vertices into chunk, our tool limited the number of vertices in the database workload graph, made a very good performance improvement on common partition management system. [9]

Stefan Halfpap & Rainer Schlosser (2019), performed a Comparison of Allocation Algorithms for Partially Replicated Databases. Researchers explored three portioning allocation algorithms based on work load and volume. This method reduces the memory consumption of a replication cluster and maximizes the throughput by evenly distributing the load. By analyzing different allocation concepts researchers benchmarked the configurable workloads. Steps by steps visualization, demonstration and comparison enables to come up with important structural insights. And potential for improvement. [10]

Nway Yu Aung, Kyawt Kyawt San, Swe Zin Hlaing (2020), Researchers focused on execution time issues on huge amount of data and proposed a method which utilizes Apache Spark framework. Apache spark is one of the best open source frameworks for cluster computing. This paper prosed a hybrid approach which identifies the best optimal initial medoids and involves frequency-based Bat algorithm as well. Data sets used to evaluate the performance of this hybrid approach was ranging from 100 MB to 2 GB. Experiments proved that traditional methods performed better on small amount of data but this hybrid approach performed better on large volume data sets. [11]

Abhishek Nair.M, Aman Dewangan and Geetha Mary A (2019): This paper talks about effective data extraction from Cloud Databases using Hash Partitioned Buckets. Researchers have proved that the data retrieval can happen in a much more efficient manner by maintaining multiple buckets instead of just moving the entire data set between the cloud and the user side, back and forth as explained in the existing system. Researchers have also shown the results that our proposed model has taken less time to extract data. Like other methods, there exist some disadvantages, the existing system may scale well vertically (when number of records increased) but not horizontally (When there is an increase in number of attributes). [12].

The literature review table summarizes some of the most recent studies done for analyzing and applying partitioning techniques in data bases. It provides the methods used, the databases used and the performance evaluation parameters used by different studies. The literature review table summarizes some of the most recent studies done for analysing and applying partitioning techniques in data bases. It provides the methods used, the databases used and the performance evaluation parameters used by different studies.

Table 1: Literature Review table

Conclusion: Data types and data dimensions are getting changed rapidly in data base environments. We should not stick to one traditional method of data partitioning and we can continue thinking about new innovative ways of partitioning our data so that we are always future ready. This literature survey provides a comprehensive view on how can we develop our own partitioning technique in parallel to the in-built methods provided with the data base environment. This paper helps us to understand features of various partitioning techniques that significantly enhance

data access and improve overall data base performance. There is a huge impact for the applications that access tables and indexes with millions of rows and gigabytes of data. When we are discussing partition methods, we should also talk about problem of skewness. In case tables are partitioned, if partition method is not correct, huge amount of data will be collected into one partition and rest of the partitions will become empty. This problem is very dangerous for

Year	Authors	Partition Methods	Data base	Performance Evaluation Parameters
2020	Khaled Saleh Maabreh	List, Range and Hash	Distributed Data Base	Region, Range and Hash Key
2018	Jiang Wang, Cheng Zhu, Yun Zhou, Xianqiang Zhu, Yilin Wang and Weiming Zhang	Density based clustering	Spatial Data base	partition-and-merge method, diverse shapes and densities
2018	Yoon-Min Nam, Min-Soo Kim and Donghyoung Han	Graph Based Database partitioning	OLAP Query Processing	hash-based multi-column (HMC) partitioning method
2016	Alexandru Turcu, Roberto Palmieri	Automated data partitioning	Distributed Data base	Highly Scalable and Strongly Consistent Transactions
2015	Anita Brigit Mathew	Graph based partitioning	Social Networks Using NoSQL Data base	Data Management and Query Handling
2017	Hao Wang, Jing Zhang, Da Zhang, Sarunya Pumma, Wu-chun Feng	Parallel data partitioning and Hybrid-Cut Graph Partitioning	Big data applications (MapReduce Framework, Hadoop)	A new framework to generate application-specific partitioning algorithms
2018	Elaine Naomi Watanabe, Kelly Rosa Braghetto	Hash and Range Partitioning	Distributed Data base	A directed acyclic graph (DAG) is generated via a workflow which is data centric and to represent the data processing nodes can be used and to define the flow of data, edges can be used.
2018	Emad Taha Khalaf, Muamer N. Mohammad and Kohbalan Moorthy	Robust partitioning and indexing	Iris biometric database based on local features	Illumination, rotation noise, and scaling
2018	Xiaoming Huang and Zhen Shen	Adaptive Chunk Tool and Graph Partitioning	Shared-nothing Distributed Database	Mapping table Graph conversion module, Partition plan conversion module, Adaptive vertex aggregation module
2019	Stefan Halfpap & Rainer Schlosser	Fragment allocation algorithms	Partially Replicated Database	Measured fragment sizes, query execution costs, query frequencies, and the number of replica nodes.
2020	Nway Yu Aung, Kyawt Kyawt San, Swe Zin Hlaing	k-medoids clustering.	OLAP Systems	Apache Spark Framework
2019	Abhishek Nair.M, AmanDewangan and Geetha Mary A	Hash Partitioning	Cloud Data base	Padding, Partition, Query Parser, Decryption

stability and performance of the data base application.

Table 1. Literature Review table

References
[1] Khaled Saleh Maabreh (2020): Optimizing Database Query Performance Using Table Partitioning Techniques
[2] Jiang Wang, Cheng Zhu, Yun Zhou, Xianqiang Zhu, Yilin Wang and Weiming Zhang (2018) : From Partition-Based Clustering to Density-Based Clustering: Fast Find Clusters With Diverse Shapes and Densities in Spatial Databases ,Science and Technology on Information Systems Engineering Laboratory, National University of Defence Technology, Changsha 410073, China
[3] Yoon-Min Nam, Min-Soo Kim and Donghyoung Han (2018): A Graph-based Database Partitioning Method for Parallel OLAP Query Processing ,2018 IEEE 34th International Conference on Data Engineering

181

[4] Alexandru Turcu, Roberto Palmieri (2016): Automated Data Partitioning for Highly Scalable and Strongly Consistent Transactions: IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS, VOL. 27

[5] Anita Brigit Mathew (2015): Analysis of Data Management and Query Handling in Social Networks using NoSQL Databases, 2015 International Conference on Advances in Computing, Communications and Informatics (ICACCl)

[6] Hao Wang, Jing Zhang, Da Zhang, Sarunya Pumma, Wu-chun Feng (2017): PaPar: A Parallel Data Partitioning Framework for Big Data Applications, 2017 IEEE International Parallel and Distributed Processing Symposium

[7] Elaine Naomi Watanabe, Kelly Rosa Braghetto(2018) : Improving Parallelism in Data-Intensive Workflows with Distributed Databases , 2018 IEEE International Conference on Services Computing

[8] Emad Taha Khalaf, Muamer N. Mohammad and Kohbalan Moorthy (2018) : Robust partitioning and indexing for iris biometric database based on local features , IET Biom., 2018, Vol. 7 Iss. 6, pp. 589-597 © The Institution of Engineering and Technology 2018

[9] Xiaoming Huang and Zhen Shen (2018): ACTDP: An Adaptive Chunk Tool for Database Partition in Shared-nothing Distributed Database

[10] Stefan Halfpap & Rainer Schlosser (2019): A Comparison of Allocation Algorithms for Partially Replicated Databases ,2019 IEEE 35th International Conference on Data Engineering (ICDE)

[11] Nway Yu Aung, Kyawt Kyawt San, Swe Zin Hlaing (2020): Hybrid Partition Around Medoids Algorithm for Large Volume of Data, University of Information Technology, Yangon, Myanmar

[12] Abhishek Nair.M , AmanDewangan and Geetha Mary A (2019): Efficient Retrieval of Data from Cloud Databases using Hash Partitioned Buckets , 2019 Innovations in Power and Advanced Computing Technology (i-PACT)

Webcam Motion Detection using Frame Differencing and Background Subtraction

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Abstract: It is the capability of humans and as well as vehicles to automatically detect object level motion that results into collision less navigation and also provides sense of situation. This paper presents a technique for secure object level motion detection which yields more accurate results. To achieve this, python code has been used along with various machine learning libraries. The detection algorithm uses the advantage of background subtraction and fed in data to detect even the slightest movement this system makes use of a webcam to scan a premise and detect movement of any sort; on the recognition of any activity it immediately sends an alert message to the owner of the system via mail. Any person requiring a surveillance system can use it.

Keywords: Motion Detection, OpenCV, Background Subtraction, SMTP Library.

Introduction
Formally, Motion Detection refers to the recognition of any kind of activity in the vicinity of an installed security system. In other words, a camera is used to capture any sort of activity in a susceptible environment. Motion detection is usually a software-based monitoring algorithm which, when motion is detected signals the surveillance camera to begin capturing the event, also called activity recognition. Though, an advanced motion detecting security system can analyse the kind of motion and verify it to check if it deserves an alert. This paper on the other hand proposes a system that can detect even the slightest motion and alert the owner of the security system regardless of the severity, it has aimed to create a highly sensitive system.

OpenCV: Open Source Computer Vision, OpenCV in short, is a library that is primarily used for real-time computer vision. It aims at providing computer vision for machines to decipher an image as humans naturally do which basically makes it a target when it comes to the concept of Machine Learning and Artificial Intelligence. Open CV was originally developed by Intel and later supported by others. The library is cross-platform and permitted for use under the open-source license. It fascinatingly also supports deep learning frameworks, like TensorFlow, Torch/PyTorch and Caffe, again a field of vast exploration [1]. One of the disadvantages of using OpenCV is that it can only be deployed locally, and extending it to the web or having a server-side execution is a challenge that does not need immediate dealing.

Literature Review
As technology has been on the up-rise people have started taking the view of reducing the trouble of having to install or recruit security in the system which they consider susceptible. Security systems which can detect any sort of activity, is the need of the hour. For one, it reduces the stress of the owner; another reason could be to reduce the burden of security guards also, if a person has trust issues that keep her/him awake, this system is certain to help her/him rest well. A security system that can motion detection is not a brand-new concept. In the past many project of similar kind have been constructed and been used efficiently.

A. Motivation and present state of Research
The various methods today being used for image and video processing are Frame differencing, Optical flow and Background subtraction. To detect the moving objects the Frame differencing method uses subtraction of successive frames, the same way a comparison is done, which help identify what in the background or frame has changed, within the few milliseconds that the difference is identified, the frame is declared as the proof of movement or intrusion. As well there are cascade classifiers which can be converged with either

183

background subtraction or with optical flow [2]. This approach is straightforward to implement and easily adaptable to dynamic environments, but it cannot always extract the complete edges of the object.

One of the other popular techniques is the optical flow method [2]. This method has two steps. First finding the image optical flow, which is simply the movement or shift of individual pixels on the target image plane, and then performing grouping process with the obtained optical flow features. It performs accurately well in the detection process but the shortcoming is the increased number of calculations. The third method is background subtraction [3]. The principle that is used in background subtraction algorithm, is to model a background something similar to how a green screen works, and compare it with the current frame to detect objects i.e., zones where significant changes occur [4][5]. This leads the background subtraction algorithm to detach the moving objects i.e., the foreground part, from the static part of the frame i.e., the background.

B. Proposed Webcam Motion Detection System
This paper puts forward the idea of using Background Subtraction, also known as Foreground Detection; wherein Gaussian Mixture-based Background / Foreground Segmentation Algorithm (MOG2) is applied [6]. The algorithm is fed into a texture separator to further find contours, in this way it incorporates the frame differencing method. On the recognition of contours, the webcam is potentially sensitized to the movement, making it successful in noting an intruder within the possible pixel range of any camera that the algorithm is deployed on.
This paper suggests, a program that will detect the motion using open-cv and python and notify the owner about the activity through a mail using Gmail, in this case particularly. The video will be captured with the help of web camera. The program will also click some pictures of the activity and send a picture with an alert mail as attachment to the mail id of the owner provided. The other pictures of the activity are stored in a folder in the system on which the program is executing.
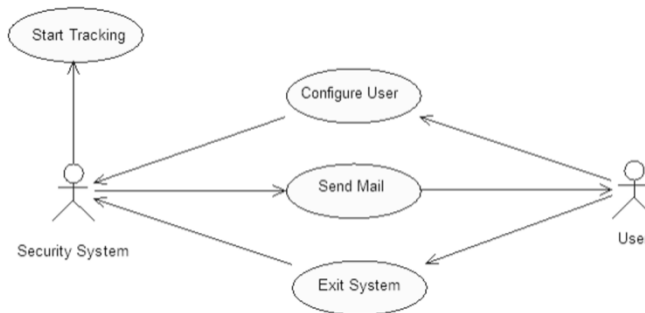
Figure 1. Use Case Diagram for Proposed System

Methods of Motion Detection

   a)Frame Differencing
In the technique of Frame Differencing, the computer / camera compares the pixels of the images in two consecutive frames. The motion detection system is alerted the moment a shift in the pixel positions is recognized. This method is not vastly used in terms of security systems, though it is on the rise with many researchers working it out. The objective of the approach is to detect the moving objects from the difference between the existing frame and the reference frame. The frame difference method is the common method of motion detection. This method adopts pixel-based difference to find the moving object [7].

Figure 2. Frame Differencing Example [8]

b)Optical Flow

Optical flow is the outline of apparent motion of image objects between two successive frames caused by the movement of object or camera. It is a two-dimensional vector field where each vector is a displacement vector showing the shifting of points from first frame to second [9][10]. This technique also makes the use of OpenCV. This method has an extension called Lucas-Kanade, which offers a set of equivalences and variables which can help derive the algorithm working in the motion detector making it a potentially better way of object detection.

Figure 3. Example for Optical Flow [11]

c)Background Subtraction

Background subtraction is a common and widely used technique for generating a foreground mask (namely, a binary image containing the pixels belonging to moving objects in the scene) by using static cameras [12]. This method requires two major tasks: one, the initialization and two, the update. The basic task is to subtract the background in the process of extracting the foreground, by performing subtraction in the current frame. Compared to all the other motion detection techniques, this one is preferred the most in terms of use and effectiveness. The steps undertaken in the background subtraction method is as follows:

1. Train the algorithm to recognize movement by applying a cascade classifier.
2. Using the OpenCV module, cv2, import the background subtraction module, MOG2 in this case.
3. Apply the frame differencing method and loop the algorithm to run the same way.
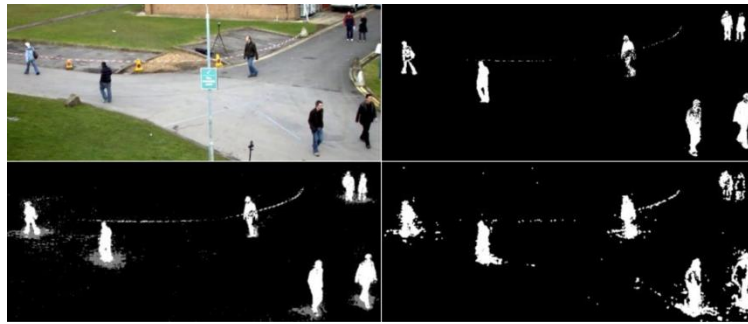
Figure 4. Background Subtraction Example [13]

MOG Background Reduction

Background subtraction is a major pre-processing step in many vision-based applications. For example, consider the cases like visitor counter where a static camera takes the number of visitors entering or leaving the room, or a traffic camera extracting information about the vehicles etc. In all these cases, first you need to extract the person or vehicles alone. Technically, you need to extract the moving foreground from static background, doing so helps in determining if there exists some movement that is worth noticing.

Mixture of Gaussian: The idea here is to extract the moving foreground from the static background. One can also use this to compare two similar images, and immediately extract the differences between them [14]. One important feature of this algorithm is that it selects the appropriate number of gaussian distribution for each pixel. It provides better adaptability to varying scenes due illumination changes etc [15].
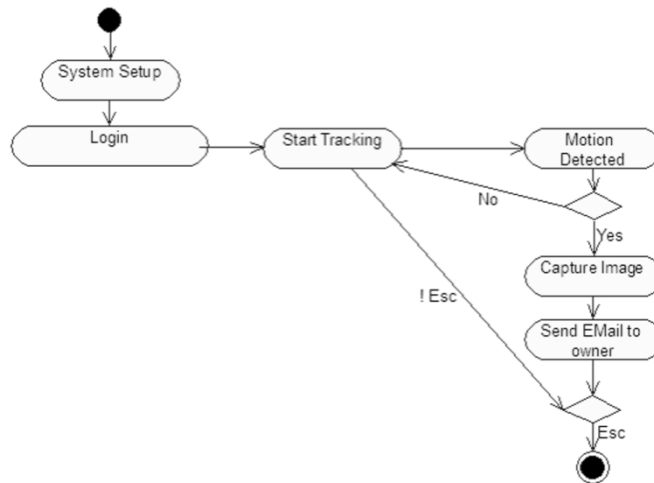
Figure 5. Activity Diagram for Proposed System

Experimental Results:

The method used in this paper is background subtraction. The experiment results have been satisfactory as the system has the user notified on the detection of motion.

The interface for a user to get configured has been created. When the tracking begins and the vicinity is without activity, the webcam does not do much, the moment activity is detected, and it creates red coloured rectangles around the moving object. This is followed by the capturing of the pictures and sending a mail to the configured user.
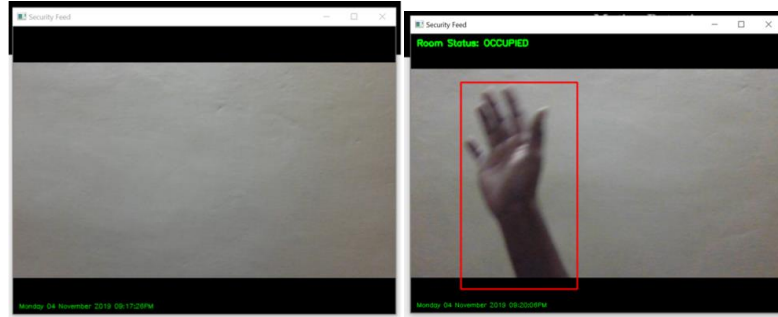
Figure 6. Motion Detector without Activity   **Figure 7**. Motion Detector with Activity
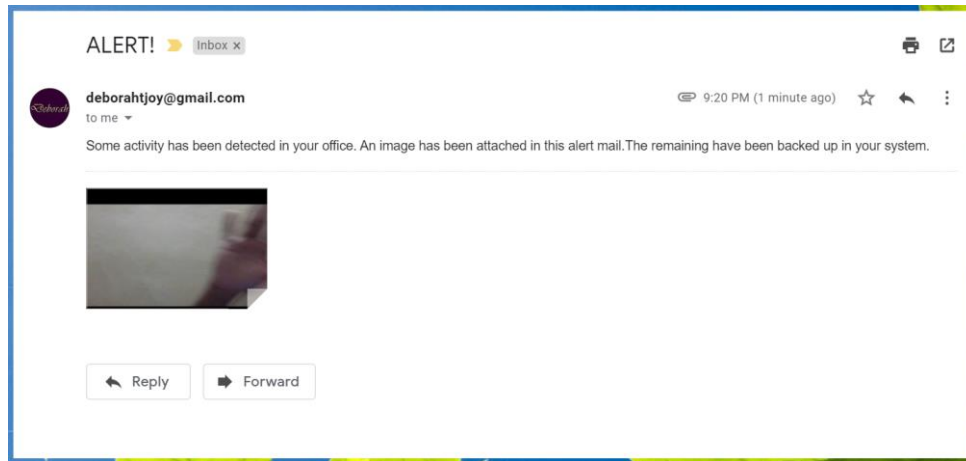
Figure 8. Alert Mail Received by the User

Table 1. Motion Detection Time Of Proposed And Other Methods

Techniques	DSO	GPP	BS	FD & BS
Time in Sec	0.4	2.0	2.7	0.8

Table 1 presents the comparable results of various approaches. DSO approach provides better results than the frame differencing and background subtraction approach, the one discussed in this paper, but DSO has its own limitations which are covered by over here. For instance, sequential frame convergence or the user interface and frequency of use.

Table 2. Motion Detection Accuracy

Image Background	Accuracy
Less Motion	0.97
Intermediate Motion	0.89
Heavy Motion	0.80

Table 2 shows accuracy measures of the proposed approach. It is quite obvious that all three forms of fluctuation are easily determined by the background subtraction and frame differencing.

Conclusion and Future Work
The interface for a user to get configured has been created. When the tracking begins and the vicinity is without activity, the webcam does not do much, the moment activity is detected, and it creates red coloured

187

rectangles around the moving object. This is followed by the capturing of the pictures and sending a mail to the configured user. The Foreground Extraction done using Webcam has been a success. The alert mail via SMTP Library, sent to the configured user has been a success. The system has been successful in saving the images captured of the motion detected. Finally, there is the accuracy score hitting 0.97 with a minimum of 0.80 Motion Detection in Security Systems is a blooming concept. But there is still much to uncover. Some of the aspects of motion detection are not optimal, and with changing technology in a fast paced and impatient world, AI can look forward to heights that now seem unattainable. The future scope of this paper ranges from being able to classify whether the object detected is stationary or moving or maybe from what the object detected by the webcam is; all the way to being able to define how hostile the detected object is and whether it poses a threat to the security system or even to another human being.

References:
[1] Mahamkali, Naveenkumar & Vadivel, A. (2015). OpenCV for Computer Vision Applications. Conference: Proceedings of National Conference on Big Data and Cloud Computing (NCBDC'15), March 20, 2015At: Trichy Project: Human Action Recognition.
[2] P.Gao, X.J. Sun, and W. Wang. Moving object detection based on kirsch operator combined with optical flow. In International Conference on Image Analysis and Signal Processing, pages 620–624, April 2010.
[3] Rupalli S.Rakibe and Bharati D.Patil. 2013. Background subtraction Algorithm based Human motion detection. International Journal of scientific and research publications.
[4] Joshan.J Athanesious and Suresh .P.2012.Systematic survey on Object Tracking Methods in Video. International Journal of Advanced Research in Computer Engineering and Technology.
[5] Sen Ching S. and Chandrika Kamath.2011.Robust Techniques for background subtraction in urban Traffic Video.
[6] Zivkovic, Zoran & Van der Heijden, F.. (2006). Efficient adaptive density estimation per image pixel for the task of background subtraction. Pattern Recognition Letters. 27. 773-780. 10.1016/j.patrec.2005.11.005.
[7] D.Venkata Siva Prasad1; Ch.Niharika2; R. Vishwaja3; R.Srinidhi;4A.Preethi.5 Object Detection and Tracking using Image Processing. IJCRT_194371
[8] SamLow. Ball-Tracking for Amateur Sports. A CS Project from Bristol, UK. squawkfly.wordpress.com/2015/05/31/frame-differencing/
[9] Abhishek Kumar Chauhan and Prashant Krishan. 2013.Moving Object Tracking Using Gaussian Mixture model and Optical flow. International Journal of Advanced Research in Computer science and Research Engineering.
[10] M.P. Patel and S.K. Parmar. Moving object detection with moving background using optic flow. In Recent Advances and Innovations in Engineering (ICRAIE), pages 1–6, May 2014.
[11] Lucas-Kanade method. Optical Flow. Lucas-Kanade Optical Flow in OpenCV. opencv-python-tutroals.readthedocs.io/en/latest/py_tutorials/py_video/py_lucas_kanade/py_lucas_kanade.html
[12] Z. Zivkovic, "Improved adaptive Gaussian mixture model for background subtraction," Proceedings of the 17th International Conference on Pattern Recognition, 2004. ICPR 2004., Cambridge, 2004, pp. 28-31 Vol.2, doi: 10.1109/ICPR.2004.1333992.
[13] Background Subtraction using open computer vision. opencv-python-tutroals.readthedocs.io/en/latest/py_tutorials/py_video/py_bg_subtraction/py_bg_subtraction.html#:~:text=Background%20subtraction%20is%20a%20major,information%20about%20the%20vehicles%20etc.
[14] Ruolin Zhang and Jian Ding.2012.Object Tracking and Detecting based on Adaptive Background Subtraction. International Workshop on Information and Electronics Engineering.
[15] C. S. Royden and K.D. Moore. Use of speed cues in the detection of moving objects by moving observers. Vision Research, 59(0):17 – 24, 2012

Biometric Attendance Systems Logs on Mobile Based Application Using Raspberry Pi

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Abstract: Biometric based application is getting more into the limelight. It is extensively used for identification of an individual in real time .This project work is done using Raspberry Pi 3 which is a Linux based embedded system. The finger print reading, matching finger print, creating databases for storage of the data and authentication are done using python which is entirely performed on Raspberry pi 3. Recognizing fingerprints using raspberry pi is still a very difficult task but is more efficient which empowers Internet of Things. This device is then connected to a server where a demonstration of the power of Internet of things with a connection to a cloud and full stack technology is shown. Our work discusses the standardized authentication model which is capable of extracting the fingerprints of individuals and store that in a database. Then the use of final finger print to match with others in finger prints present in the database and sending the real time notification to the inspector or faculty by creating an application using the Full Stack Technology and even sending an automated email as push notification to respective inspector or faculty.

Keywords: Biometric, Raspberry Pi, Full Stack Development, Http Protocols, Cloud Computing.

Introduction

For unique identification of the person is an important in various places where like universities, hospitals, work places, hotel. Earlier people used to take attendance on muster or note book for any employee in the company, attendance of the staff in the super market and student attendance in the class room attendance of the doctor in the hospital, So administrative person who were in charge to manage the attendance used muster, which led him to spend their energy, time and he has to do put extra effort in manual work in comparison to the automatic system. So here in this research of ours the group has shown a unique finger impression scanner based biometric framework that records the presence subsequently. Raspberry pi 3 development board is used in order for the development of the Student Attendance Management System With logs. So here a system is developed using latest technology and power of Internet of Things in which all student have to enroll himself into our database for once and upon enrollment each student he will get message with that student registered successfully. Further to verify the student presence, student has to put his finger in front of the scanner which will get scanned and the record is then check whether the student record exists in the database or not. If student record is existing then make present of the student otherwise it give the message that record is not existing. By developing this biometric system many issues are solved in terms of saving time, less efforts is required by the faculty, Its accuracy result is more in comparison to the manual records. As all finger prints are unique so no one can make attendance of the another student because here for the identification , unique identification as finger print of the student is used. To develop this system the group used Raspberry-pi 3, Python programming language and full stack technology. In order to track the record of all the attendee record an application is connected which will give an easy access to the inspector or faculty to monitor the attendance of persons even if the faculty or inspector is not physically present.

Related Work

The group had researched some of the research paper on the biometirc based system and internet of things. Some of the research paper are based on the Yu-Sheng Lin, Shu-Chu Tung, and ShihMiao Huang in the year 2018, Firebase Real-time Database [5] by Wu-Jeng Li, Chiaming Yen, .These papers design a system based on Internet of Things known as JustIot. ThingSpeak is an IoT platform that enavles us to collect and store the sensed data in the cloud and develop IoT applications.For IoT thingspeak provides a cloud platform that can analyze and visualize our data and based on that act on our data. Devices be it ours or any device or application; they can communicate with ThingSpeak using RESTful APIs. It also enables us to keep our data private or make it public. Hence, ThingSpeak is used to analyze and act on our data.

Proposed Methodology

In the Figure 1 below created a data flow of the biometric system is created, database and server connection.
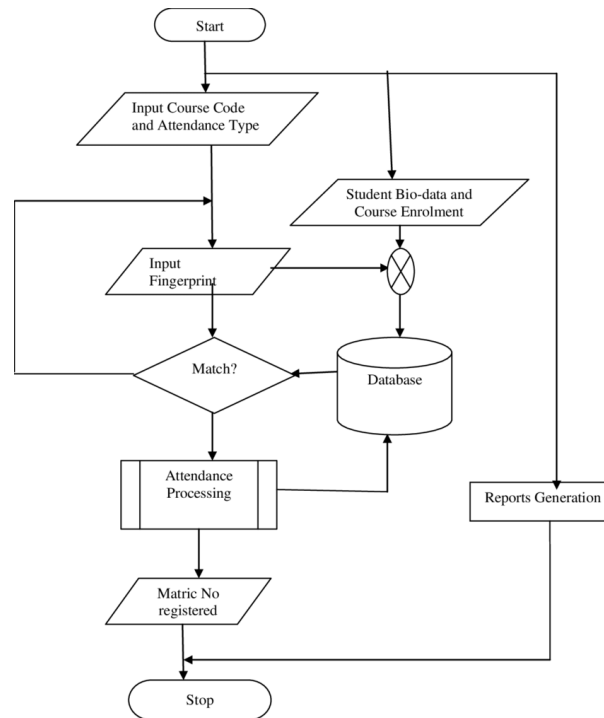
Figure 1. Block Diagram of attendance recording process

A. Hardware & Software

The hardware includes the most important component known as Raspberry pi 3 which is used as a development board in Pi series. It is a single board computer that is using the LINUX operating system. The board has a terrific processing speed and also provides many inbuilt features that make it suitable for working with advanced applications. Pi board is generally developed for people who are highly interested in LINUX systems and IoT (Internet of Things), be it engineers or hobbyists. Technical Specifications of Raspberry Pi also indicates that it has an inbuilt Wi-Fi which helps in transmitting data to the server. Node Javascript and python are used to interact with ThingSpeak as our programming language. The attendance can be retrieved on a Web Application directly from thingspeak.

B. Biometric Module

In our biometric module, the sensor takes the finger image as the students enroll their new finger print as well as it also detects already existing finger print. The Finger print data is stored in the fingerprint reader known as R307. R307 module is capable of finger reading or finger enrollment and also fingerprint matching. It is the process of matching finger images, generating a template of the finger based on the processing results and store the template. When a finger is to be passed through finger matching, the optical reader generates a template of the reading finger and compares with the template stored in the finger library.

For 1:1 matching, the fingerprint processing works in two parts firstly, system will compare the live finger with specific template designated in the module; for 1:N matching, or searching, system will search the entire finger library int he database for the matching finger. In all circumstances, system will return the matching result, success or failure. (1: N) function. R307 can be accessed by using PyFingerprint

C.Application Using FullStack

This application receives the data from raspberry pi server through the REST API deployed on the cloud and real time data is accessed by the HTTP Protocols. This application sends the details of students who had marked the attendance and push notification will be send via Email through the SMTP server.

Functional and Non-Functional Requirements

Functional Requirements- In order for the application to work there are some hardware and software requirements. They are:-

Hardware requirements: Raspberry-pi 3, Finger print sensor, Switch circuit, Operating System SD Card, Android Phone

Software requiremnts: Python programming language, Angular/Ionic Framework programming, NodeJavaScript, Mongo DB

Cloud requirements: ThingSpeak , Heroku , Zoho SMTP Server

Figure 2. Optical Finger Print Reader
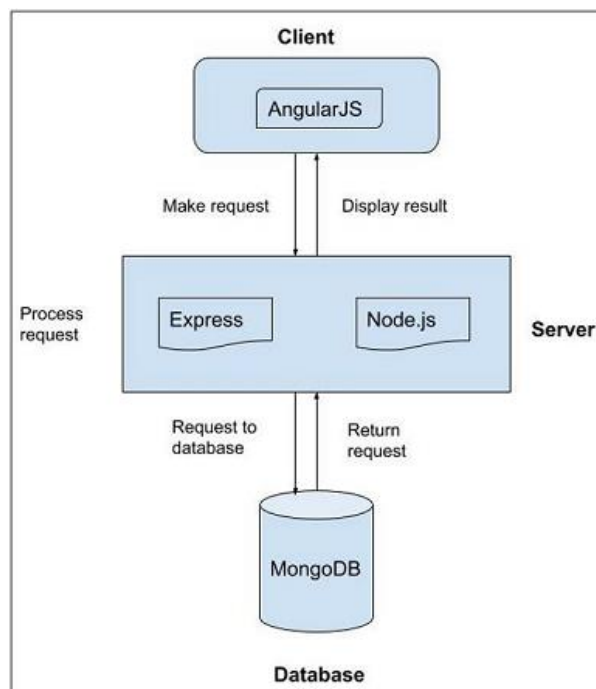
Figure 3. Mean Stack

1. Non-Functional Requirements are Usability, Scalability and Reliability.

2. Input Sensor
For the proposed system having module – Biometric Recognition, different inputs to the system.are provided .
  A.   Biometric Recognition

191

Figure 4. Fingerprint Samples

Fingerprint is provided as the input for the biometric recognition. The finger is taken as the input to the biometric module and then it is converted into a greyscale image which is as shown in Figure 4. Biometric Recognition is required in 2 parts of the system. First, while registering the fingerprint for the first time, the process takes places as shown in Figure 4.
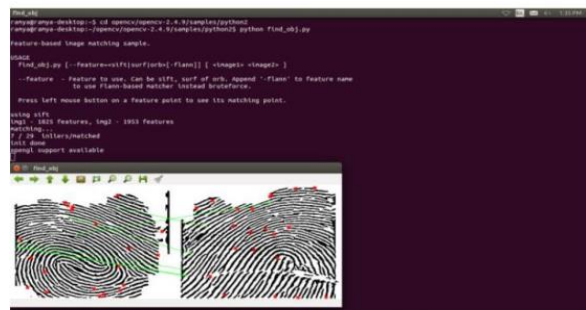
Figure 5. Biometric Recognition

Second, Biometric Recognition is required while marking the attendance. The procedure of marking the attendance is as shown in Figure 5.

Conclusion

Biometric technology as known is an effective tool to verify and validate the identity of a person and also enables us to detect fraudulent issues if any. Analysis confirmed that the biometric data can be set and confirm the identity of the user. Biometrics when expanded to an organization would be able to enhance the ability to detect fraudulent issues in the presence of the students in class or employees in an organization. By comparing the present methods and the traditional methods, the present method is way more feasible and efficient than the traditional methods of Attendance System. Since, it uses a web based application approach, the data is well monitored and kept safe among the organization even in the absence of the faculties. This system is user-friendly and very reliable. Therefore, it can be implemented either in organizations or educational institutions. The attendance management system can be updated by providing the features of marking a student or a faculty late for arriving later than the reporting time. Some of the

future enhancements for this are to extend the database fields and upgrading of cloud services to store the complete details of the student and faculties. The system can be enhanced to track the arrival and exit time of the student or employee for additional monitoring.

References
[1] Jennifer C. Dela Cruz, Arnold C. Paglinawan, Miguel Isiah R. Bonifacio, Allan Jake D. Flores, Earl Vic B. Hurna, "Biometrics Based Attendance Checking using Principal Component Analysis", School of EECE, Mapúa Institute of Technology Intramuros, Manila, Philippines,
[2] 2015Yash Mittal, Aishwary V arshney, Prachi Aggarwal, KapilMatani and V. K. Mittal, "Fingerprint Biometric based Access Control and Classroom Attendance Management System", Indian Institute of Information Technology Chittoor, Sri City, 2015
[3] Dr. Vinayak A. Bharadi, V. J. Kaul, SameerAmrutia, "End-to-end Encryption based Biometric SaaS", Thakur College of Engineering and Technology Mumbai, India, 2015
[4] Shailendra, Manjot Singh, Md. Alam Khan, Vikram Singh, AvinashPatil, SushmaWadar, "Attendance Management System", Army Institute of Technology, Pune, India,
[5] 2010Wu-Jeng Li, Chiaming Yen, You-Sheng Lin, Shu-Chu Tung, and ShihMiao Huang, "JustIoT Internet of Things based on the Firebase Real-time Database", 2018

Feature Selection using PCA for Twitter Sentiment Analysis

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Abstract: The sentiment analysis has emerged as a revolutionary domain in the area of Natural Language Processing, where sentiments represent candid opinions of user about specific products and services. These customer reviews are generally posted on social media and now they have become an indispensable tool to judge a service's or product's quality; and thus act as major catalyst when users make their buying choice. As, this data generated by customer is immensely huge, hence manual data analysis can be a daunting task. For this purpose, machine learning has surfaced and is highly successful in opinion mining. However, plethora of features are present in reviews and they need to be narrowed down, hence using Principal Component Analysis with word embedding can prove fruitful. The effectiveness of the approach is evaluated using various classification algorithms like Support Vector Machine, Naïve Bayes, etc.

Keywords: Machine Learning, Feature Extraction, Opinion Mining, Principal Component Analysis (PCA), Sentiment Analysis.

Introduction

With the colossal growth of social media in the modern world, the data has turned into big data. Now, there is no need to conduct surveys by the marketing companies to get into the customer minds. The customer themselves are taking selfies, writing reviews, sharing snapchat stories, Facebook posts and sharing tweets about everything they do and everywhere they visit. Hence, the marketing paradigm has taken a perpendicular shift and now the computers are doing all the herculean stuff to get inside the customers' mind. This broad area of analyzing the mundane people opinion is called the sentiment analysis or opinion mining[1].

Sentiment analysis is the contextual mining of text to identify the user opinions about any particular product or service. The text recognizes and extracts subjective information in source materials and helps companies understand the social sentiments of their brands, products or services while monitoring online conversations. When sentiment analysis studies the user's views on products, services, events, people or ideas, it studies the issues of articles (such as posts and comments) uploaded by users on social media platforms, technical forums and internet websites. There are countless tools that can analyze social references, user feelings, and the linguistic they use to describe certain products and services to identify sentiment analysis[2].

Figure 1. Sentiment Analysis through Social Media[3]

There can be numerous aspects in the opinion mining, which are needed to be narrowed down, so that the non-important aspects are ignored and hence only the vital features are included. Hence, it can be said that the aspect extraction is the primary task of sentiment analysis[4]. The main aim here is to excerpt the important opinionated texts from the whole text. Let's say there is a review about Ford Mustang car "The Mustang is so expensive, but it's so fast". In this text, there are two features which are prominent: price and speed.

Literature Review

The two most traditional feature extraction methods used in sentiment analysis are Linear Discriminant Analysis (LDA) and Principal Component Analysis (PCA). On one hand, LDA is a supervised technique based on the class

distinction and it requires data to train and then give results based on the trained data. On the other hand, PCA is an unsupervised method that produces more relevant aspects and hence the lesser related features are ignored. An important point here is that PCA does not work well for classification purposes as some features with lower variance are ignored[5].

PCA is the eigenvalue disintegration of data along the direction of maximum alteration of the data. PCA represents the preferred aspect space because the features of PCA show a high grade of energy compression. After the eigenvalues and eigenvectors calculation, all these values are organized in descending order. The principal features or aspects can be fabricated by conjoining the eigenvectors matrix with linear alteration of data[6].

In the research article published "Design of Core Components and SVM-PUK in Mining" by Devi et al. (2018), a novel functional selection method, aiming to reduce the dimensionality factor is proposed, that uses SVM-PUK as a classification process. In this framework, a comparative analysis was done on tweets generated and movie reviews dataset using some well-known classifiers such as Naïve-Bayes, Support Vector Machine (SVM), etc[7].

Another research paper titled "Feature Selection and Construction Integration: A Two-Step Approach to Spatial Analysis" by Akhtar et al. (2017) illustrates a basic structure for aspect extraction and optimization using Particle Swarm Optimization (PSO). Three classification algorithms namely SVM, Maximum Entropy (ME) and Conditional Random Field (CRF) are used for checking the algorithm efficiency, which was yielded better in comparison[8].

An imperative paper by Iqbal et al. (2019) "Hybrid framework for sentiment analysis using genetic algorithm-based feature reduction", proposed an integrated environment that works both on rule-based methods as well as machine learning approaches. This hybrid approach yields improved results by using PCA and Latent Semantic Analysis (LSA) aspect reducing methods[9].

"Feature Selection Using Random Forest Analysis Methods" paper published by J. Jotheeswaran and S. Koteeawaran (2016) aims at improving efficacy by 12.49% implementing Inverse Document Frequency (IDF), Learning Vector Quantization (LVQ), Decision Forest and Principal Component Analysis (PCA) on the twitter data. The overall resuts show that this ensemble methodology is most suited for product reviews, sentiment detection and classification[10].

An additional article by Liu et al. (2019) "Attention Based on Basic Emotions-Attention of Affective Sediments", focuses on traditional text processing, aspect-based opinion mining and deep learning. This article recommends a multidisciplinary model called "AS-Reasoned" to escalate the delinquent of how it shakes the straight discourse consultation with data scientists[11].

Proposed Methodology
This section explains how the machine learning techniques can be implemented along with feature extraction procedures to do the aspect-based sentiment analysis on twitter data. The dataset taken into account is the Twitter Combined Car Dataset, which comprises of 20983 tweets downloaded for numerous renowned cars like Aston Martin, Rolls Royce, Mercedes Benz, BMW, Ferrari, Ford, Audi, Porsche and Toyota. All of these tweets are downloaded using Tweepy API, which is a prominent interface to download tweets by creating a twitter development account.

Then, the data is pre-processed which consists of several steps like removing the hashtags, hyperlinks and special symbols like @, etc. from the tweets. Also, words of every other language than English are removed and consequently, tokenization is done. Finally, all the stopwords (frequent words with less relevance) are removed, followed by stemming or lemmatizing the tokens, etc., and eliminating duplicates so that data is prepared for the sentiment classification.

The next process is the aspect extraction and for that an ensemble technique is used involving POS tagging and dependency parsing. Subsequently the Principal Component Analysis (PCA) for feature reduction i.e. reducing nearly 10K features into tens, so that the machine learning classification can be applied here. Multiple classifiers are applied to the data now like K-Nearest neighbors, Naïve Bayes, Random Forest, Decision Tree and Adaptive Boosting Classifiers for sentiment classification. The whole process can be described as follows:
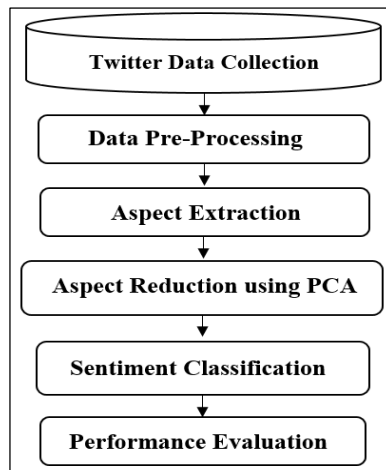
Figure 2. The Twitter Sentiment Analysis Process

Results and Discussion

The dataset considered here is the collection of plethora of tweets downloaded for numerous celebrated cars used across the globe. There are total 20, 983 tweets about 10 big car manufacturers. This dataset contains all the related information like tweet id, tweet text, creation date, username, user location, retweet count, name of car, etc. After the data pre-processing, the tweets are arranged according to a particular automobile and also the duplicate entries are dropped. Then, the sentiment distribution among the tweets are checked and visualized for better user understanding. As shown in figure 3, the nearly half of the tweets convey a positive sentiment about the car mentioned in the tweet.
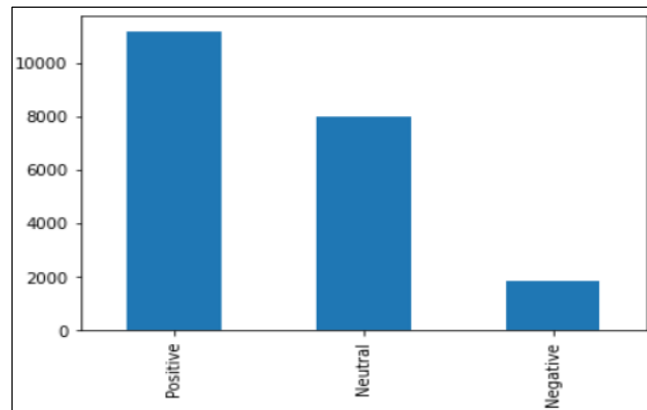
Figure 3. Sentiment Visualization of Dataset

Following that, Term Frequency- Inverse Document Frequency (TF-IDF) vectorization is applied on the data, so that the frequent words that do not actually convey more meaning are eliminated. But, there is one downside of using TF-IDF i.e. it produces a high-dimensional data representation. To counter this and lower the dimensions, PCA is used to reduce the features. The data can also be visualized after this phase (as shown in figure 4). Finally, the numerous classification algorithms are applied namely K-Nearest neighbors, Naïve Bayes, Random Forest, Decision Tree and Adaptive Boosting which yield 74.2%, 74.1%, 72.7%, 63.5% and 75.8% accuracy respectively. Hence, it is quite evident that the Adaptive Boosting classifier works best for this specific data of car tweets downloaded.

Conclusion

This paper proposes the usage of PCA modelling in Twitter Sentiment Analysis. The Twitter Combined Car Dataset was used (tweets downloaded from Tweepy API) and features were extracted from the customer Principal Component Analysis for feature reduction reviews. TF-IDF vectorization is employed on the data then to generate the word embeddings and the Principal Component Analysis for aspects reduction. For classification purposes, various machine learning algorithms like KNN, Naïve Bayes, Decision Tree, Random Forest and Adaptive boosting were implemented. It was noticed that most of the machine learning classifiers gave nearly same accuracy except the Decision Tree which

196

yields the lowest value of correctness. Adaptive Boosting gave the utmost accuracy, which is nearly 12% higher than the Decision tree classifier. The bottom-line is that Adaptive Boosting machine learning algorithm surpasses all its rival classifiers for the given tweets on multiple Cars downloaded from Twitter.
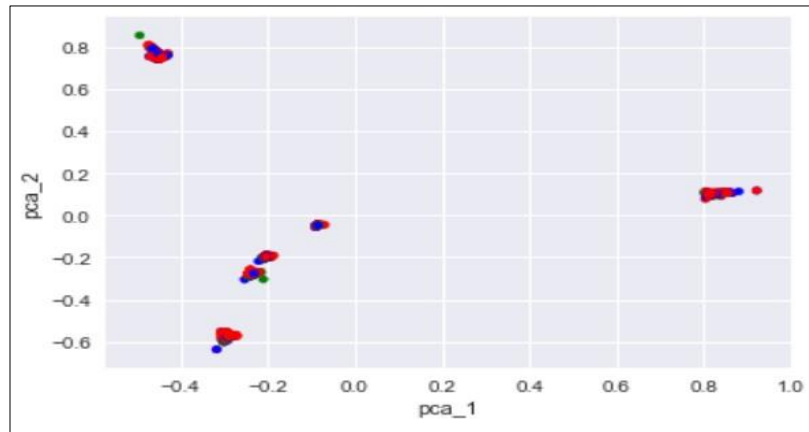
Figure 4. Plotting the features using PCA

References

[1] Liu, B. (2017). Many facets of sentiment analysis. *A practical guide to sentiment analysis,* Springer, Cham, 11-39.

[2] Vyas, V., & Uma, V. (2018). An extensive study of sentiment analysis tools and binary classification of tweets using rapid miner. *Procedia Computer Science*, *125*, 329-335.

[3] Dragoni, M. (2013). Opinion Mining and Sentiment Analysis. Retrieved August 5, 2020, from https://pdi.fbk.eu/opinion-mining-and-sentiment-analysis

[4] Rana, T. A., & Cheah, Y. N. (2016). Aspect Extraction In Sentiment Analysis: Comparative Analysis and Survey. *Artificial Intelligence Review*, *46*(4), 459-483.

[5] Collobert, R. (2014). Word Embeddings through Hellinger PCA. *Proceedings of the 14th Conference of the European Chapter of the Association for Computational Linguistics*.

[6] Avellaneda, M. (2019). Hierarchical PCA and Applications to Portfolio Management. *SSRN 3464376*.

[7] Devi, K. A., Edara, D. C., Sistla, V. P. K., & Kolli, V. K. K. (2018). Extended correlated principal component analysis with SVM-PUK in opinion mining. *Turkish Journal of Electrical Engineering & Computer Sciences*, *26*(5), 2570-2582.

[8] Saleem, G., Akhtar, M., Ahmed, N., & Qureshi, W. S. (2019). Automated analysis of visual leaf shape features for plant classification. *Computers and Electronics in Agriculture*, 157, 270-280.

[9] Iqbal, F., Hashmi, J. M., Fung, B. C., Batool, R., Khattak, A. M., Aleem, S., & Hung, P. C. (2019). A Hybrid Framework for Sentiment Analysis using Genetic Algorithm Based Feature Reduction. *IEEE Access*, *7*, 14637-14652.

[10] Jotheeswaran, J., & Koteeswaran, S. (2016). Feature Selection using Random Forest Method for Sentiment Analysis. *Indian Journal of Science and Technology*, *9*(3), 1-7.

[11] Liu, C., Osama, M., & De Andrade, A. (2019). DENS: a dataset for multi-class emotion analysis. *arXiv preprint arXiv:1910.11769*.

Security & Complexity Analysis of DNA Indexing Standard

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Abstract: DNA encryption is considered as the most contemporary branch of cryptography, which promises to provide some robust algorithms for achieving utmost security. It amalgamates the traditional encryption approaches with the biological methods to strengthen the underlying encryption standard. In this work, the security and complexity analysis has been performed on the newly proposed VG1 and VG2 ciphers for text and image data respectively, using the theoretical analysis and execution time measurements.

Keywords: Complexity, DNA encryption, DNA Indexing, Genetic databases, One-Time Pads(OTP), Symmetric Encryption.

Introduction

With the massive growth of IT industry in the modern times, the data generated has also grown immensely. This has caused a havoc in the information security sector as the data is in variant media and formats, which must be confidentiality ensured. A major tool implemented to attain the above goal is Cryptography, which protects our data from the prying eyes of the unwarranted persons. Encryption is an imperative process which basically scrambles the data to convert it into meaningless and garbled form, so that an eavesdropper may detect it, but unable to uncover its real message. One emerging domain of cryptography is DNA cryptography, which basically does merger of encryption and biology[1]. This unusual combination provides profound security to the modern day encoding needs.

The central dogma of DNA are the four nucleic bases Adenine (A), Cytosine (C), Guanine (G) and Thymine (T) combined by the hydrogen bonds. In 1963, Watson & Crick, found its double-helix structure and gave the complementary rule i.e. Adenine always combine with Thymine, while Cytosine always chain with Guanine. Earlier, only means to deal with DNA was of biological labs, but the concept of storing DNA in electronic form revolutionized the whole concept. There are lot of publicly available genetic databases from where, fellow researchers can access the DNA sequences[2]. The DNA structure is shown in the figure 1 below:
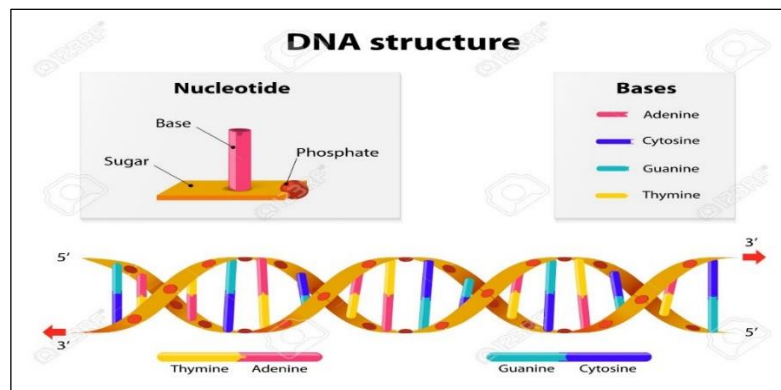
Figure 1. DNA Structure[3]

The concept of implementing DNA in electronic media also gave the idea of using DNA in the area of information security. This novel idea not only gives better security, but also presents immense opportunities for the encoder as the data can be encrypted in copious means. For example: the vast availability and random nature of DNA makes it an ideal candidate for generation of OTP schemes. As Claude Shannon described, the OTP cryptosystems must have the following four properties: truly random key, used only once, not shared with any 3rd party and most importantly it must be equal to greater than the text in plain form[4].

DNA computation inkling was given by Leonard Adleman, who solved the it for solving the Travelling Salesman Problem and later on, Ashish Gehani et. al explored the area further and introduced the notion of DNA cryptography[5]. DNA encryption basically alters the DNA sequences by using either the traditional mathematical

operations or the biological processes. In the latter case, the plaintext is first converted into the DNA sequences and then the biological procedures like Translation, Transcription, Gene Splicing, Polymerase Chain Reaction(PCR), etc. are applied in the wet labs[6]. The DNA cryptography is primarily divided into following parts: symmetric, Asymmetric, OTP and Indexing systems.

VG1 Cipher - A DNA Indexing Cipher

The DNA-based encryption standard discussed in this work is VG1 Cipher, presented in [7]. This encryption standard is not implemented through biological laboratory, but through digital means. It is a symmetric encoded system i.e. the process of encryption and decryption are identical and opposite of each other. VG1 cipher is a DNA Indexing cipher which makes use of the immense randomness present in the DNA stored in the genetic databases like GenBank, NCBI, DDBJ. As the genetic databases contain zillions of DNA chromosomes, hence only the trusted parties know the exact DNA sequence needed to decipher the ciphertext for obtaining the plaintext. The DNA coding principle states that every byte of plaintext in digital form can be transmuted into four DNA nucleotide bases[8]. As these four DNA letters are often repeated in an extremely long DNA sequence, its various positions can be noted and stored in a table, as shown in the following table.

Table 1. Key Indexing of Genetic Database[7]

GGTA	58, 80, 249, 619, 645, 671, 896, 1197, 1605, 2766, 2958, 2972
AGAG	130, 161, 242, 453, 1011, 1442, 1458, 1512, 1997, 2295, 2789
AATA	27, 458, 611, 656, 924, 1059, 1332, 1518, 1521, 1539, 1584, 1647, 1695, 1698, 1734, 1767, 1770, 1885, 1933, 2166, 2225, 2365, 2401, 2625, 2700, 2754
AACT	271, 746, 1062, 1188, 1250, 1259, 1409, 1466, 1470, 1491, 1581, 1616, 1701, 1882, 1984, 2095, 2118, 2151, 2198, 2382, 2622, 2655, 2684
CTGC	10, 246, 366, 666, 1182, 1375, 1461, 1527, 1590, 1593, 1955, 2238, 2338, 2606, 2812, 2864
GGTG	521, 1754, 1877, 1992, 2422, 2531, 2618, 2675

This DNA encoding system reads the plain data from the input file word wise, convert it ASCII code and then arrange these decimal numbers according to their frequency. Subsequently, the binary conversion takes place, followed by DNA coding. Then, the DNA indexing process is followed to form a stout homophonic cipher which harvests stronger ciphertexts.

Complexity Analysis of the VG1 Cipher

For a newly proposed algorithm, finding its complexity is always a very vital task as it reveals its efficacy in the real world. For this task, complexity theory methods are deployed and the results are verified. The competence of any algorithm denotes the degree at which it solves a given problem of a particular size 'n' and it is measured by the amount of resources it uses i.e. time and space[9]. The space complexity compromised of the fixed instruction space and the variable space for the data and stack operations. The complexity may vary from being constant $O(1)$, logarithmic $O(\log n)$, linear $O(n)$, polynomial $O(n^c)$, exponential $O(2^n)$ to factorial $O(n!)$. Figure 2 explains the myriad complexity variations for an algorithm.
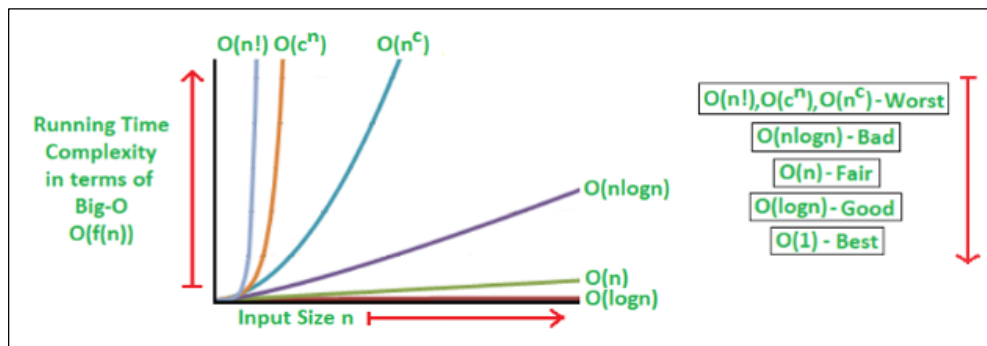
Figure 2. Algorithm Complexity Variations[10]

The complexity of the cryptosystem are judged for three major processes: encoding process, Key indexing computation and the decoding process. The complexity for encryption and decryption methods is same i.e. O(n), where 'n' is the input size. However, the key indexing calculation is done in 2 * 256 * n operations, where 256 is the possible values for a byte; hence making the complexity linear (O (n)) again. Overall, it can be said that the computational time for the whole algorithm was linearly proportional to the input file size.

To verify the accuracy of the assessed complexity, the experiments were conducted with different input sizes i.e. 'n'. The succeeding table and figure 3 represent enciphering execution times with many file sizes:

Table 2. Time complexity for VG1 Encryption

Plaintext Size (in Kilobytes)	Execution Time (seconds)
256	13.27
512	28.59
768	40.23
1000	64.65
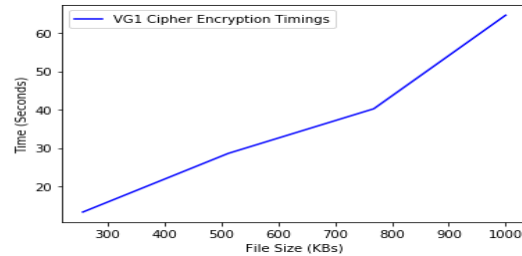
Figure 3. Encoding Time Calculation of VG1 Cipher

As evident from the table and the graph, the complexity is linear, hence it is confirmed that encoding time complexity is O(n). Similarly, the deciphering time is depicted in the following table and figure 4, below:

Table 3. *Time Complexity for VG1 Decryption*

Plaintext Size (in Kilobytes)	Execution Time (seconds)
256	15.74
512	30.11
768	41.68
1000	66.63
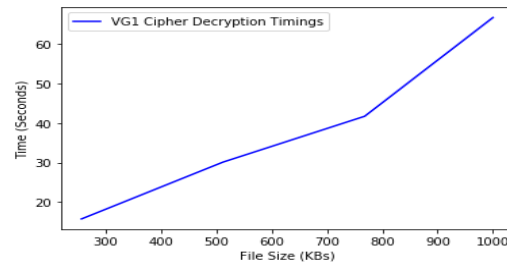
Figure 4. Decoding Time Calculation of VG1 Cipher

The experimental results confirm the linear complexity O(n) of the decryption process of the VG1 cipher. The next section discusses the security aspects of the discussed cryptosystem.

Security Analysis of the VG1 Cipher

The most significant facet of an encryption algorithm is its robustness against the possible attacks and it depends upon several features. The first point of consideration here is the statistical distribution of ciphertext. Theoretically, it should dispense the plaintext such that no obvious pattern is visible in the ciphertext. The experiments show that the ciphertext obtained after the VG1 cipher implementation is no way close to the plaintext and does not give any plaintext pattern. Moreover, the homophonic nature of this algorithm makes sure that the ciphertext for the same repeated plaintext is always dissimilar. Due to diverse array of substitution values, a set of ciphertext-plaintext pairs will not be beneficial for cryptanalysis. Thus, it can be said that the cipher under consideration is quite impervious to the known-plaintext attack and known-ciphertext attacks.

The next imperative trait required is the colossal key-space for any cryptographic algorithm. It is a desired characteristic that prevents the cryptosystem against the brute-force attacks. Dealing with digital encryption, the key-space is 2Size(Key), where Size(Key) is the key length in bits and as a bit can have only two values (0 & 1), the base is 2. Theoretically, in brute-force all likely combinations need to be tried for successful cryptanalysis, however practically it may take just half attempts. When dealing with DNA encryption, the base becomes 4 (due to 4 values: A, C, G & T). Also, the DNA indexing requires the genetic sequence, which may further contain plethora of nucleotide bases. This cipher has taken a genetic sequence from NCBI which contain 163 million nucleotide bases from 108 million individual sequences[11]. Hence the total number of possible combinations that need to be tried are 4163,000,000, which makes the task of attacker a pretty herculean task. The attacker also needs to find out the genetic database from which DNA sequence has been taken and he also needs to trace which out of millions of DNA sequence, is used for indexing. If the attacker tries to decipher the text by probing the DNA sequence exhaustively, it will take

200

ages. Another imperative deliberation is that instead of choosing a whole long DNA sequence, its sub-part can be selected which will further add the perplexity as the attacker will have a very hard time finding the exact starting and ending point of the DNA sequence. Furthermore, these DNA sequences need not be stored and shared via insecure channel, rather their sequence ID only needs to be shared. Finally, the usage of binary alteration operations along with the enigmatic mathematical function to transform the decimal numbers to the binary sequence depending upon its frequency is adding another layer of security. Henceforth, it can be said that the VG1 cipher provides security on the mathematical, binary and biological fronts to safeguard the confidential data against attacks.

Conclusion

This paper analyzed the complexity and security of DNA Indexing algorithm – VG1 cipher. This novel cryptosystem combines the advantages of biology and traditional mathematical processes to gain better sanctuary for transferring the private data over the insecure transmission channel. The encoding system takes advantage of the indexing process, which has variety of ciphertext substitution options for any given plaintext letter or word. As the genetic databases are electronically available widely and these databases contain immensely long and random DNA sequences, which will be used for enciphering and deciphering of data. The experimental results show that the VG1 cipher provides utmost security and at many levels for safekeeping of data. Also, the computational complexity of the DNA based encoding system is linear in nature, which makes it very competent with the modern standards.

References

[1] Lander, E. S. (2011). Initial Impact of the Sequencing of the Human Genome. Nature, *470*, 187-197.

[2] Karthiga, S., & Murugavalli, E. (2018). DNA Cryptography. *International Research Journal of Engineering and Technology*, *5*(3), 3987-3991.

[3] DNA Structure: Nucleotide, Phosphate, Sugar, and bases (thymine, adenine, guanine, and cytosine). Retrieved August 11, 2020, from https://www.123rf.comphoto_42302952_stock-vector-dna-structure-nucleotide-phosphate-sugar-and-bases-thymine-adenine-guanine-and-cytosine-.html

[4] Zheng, G., Gengfa, F., Shankaran, R., & Orgun, M. A. (2015). Encryption for Implantable Medical Devices using Modified One-Time Pads. *IEEE Access*, 825-836.

[5] Kahate, A. (2012). *Cryptography and Network Security,* Tata McGraw Hill, New Delhi.

[6] Cui, G., Wang, Y., Han, D., Wang, Y., Wang, Z., & Wu, Y. (2015). An Encryption scheme Based on DNA Microdots Technology. *Journal of Computational and Theoretical Nanoscience*, *12*(7), 1434-1439.

[7] Kaushik, A. & Thada, V. (2020). VG1 Cipher – A DNA Indexing Cipher. *International Journal of Innovative Technology and Exploring Engineering*, *9*(3), 221-226.

[8] Kalso, S., Kaur, H. & Chang, V. (2017). DNA Cryptography and Deep Learning using Genetic Algorithm with NW algorithm for Key Generation. *Springer Journal of Medical System*, *42*(1), 17.

[9] Hastad, J. (1988). Lower bounds in computational complexity theory. *Notices of the AMS*, *35*(5), 677–683.

[10] Sivaram, M., Yuvaraj, D., Amin Salih, M., Porkodi, V., & Manikandan, V. (2018). The Real Problem Through a Selection Making an Algorithm that Minimizes the Computational Complexity. *International Journal of Engineering and Advanced Technology*, *8*(2), 95-100.

[11] Kaushal, A. (2019). Symmetric Key Encryption Based on DNA Cryptography (Doctoral dissertation).

Cloud Computing With Big Data: A Study of Security Issues

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Abstract: Cloud is an image of "the internet" which provides On-demand computing resources over the internet on a pay-per-use basis. It provides SaaS, PaaS, IaaS services for cloud users. Cloud computing offers several benefits and titanic opportunities to understand organizations. On the other hand, an operation on big data in the cloud brings the challenge of merging two clashing design principles. Privacy and security is major anxiety while working on the cloud. In this study, cloud computing along with some discussion of Big Data is reviewed and highlights its trends as well as research challenges. In addition to that, it investigates well perceptive of cloud computing and discovers different research guidelines in the future.

Keywords: SaaS, PaaS, IaaS, IoT, Cloud Computing

Introduction
"**Big Data**" is a huge collection of data while cloud computing is a mechanism that can access this data and perform different operations by using the SaaS model. Big data can be described through 5 V's. [2]
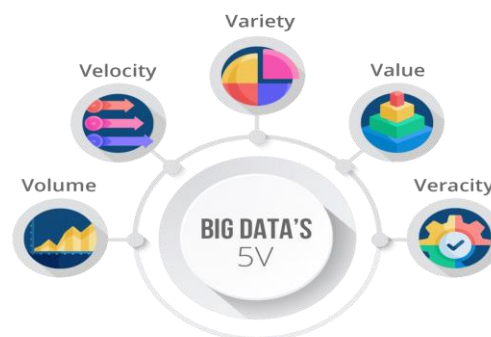
Figure 1. Big Data Platform

- Volume – Amount of data at rest position.
- Velocity – Amount of data in moving position
- Variety – Data available in different forms
- Veracity – Data in Doubt (Data confidentiality & Availability)
- Value – Money has to pay per use of data.

Cloud Models
Cloud computing provides benefits for any size of organization or business. For moving all or a part of computer resources, need to decide which type of cloud will be the best suit the organization's need.[1]
There are different types of cloud models with their own benefits and issues:
1. Public Cloud
2. Private Cloud
3. Hybrid Cloud
4. Community Cloud

Hybrid cloud having features of both the Public cloud and Private cloud and Community Cloud is built to fulfill the specific requirements of organizations.
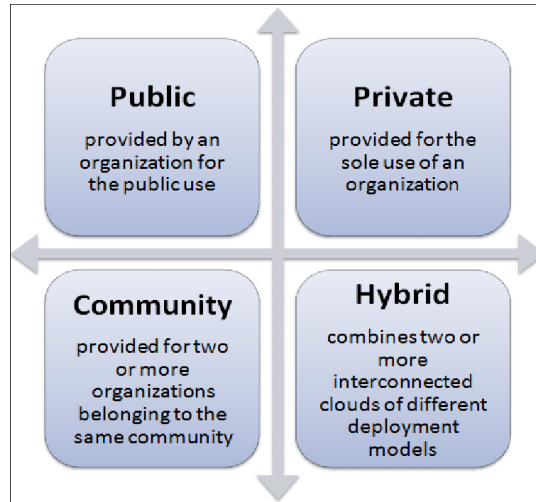
Figure 2. Cloud Models

The proportional scrutiny of the best deployment models:

Table 1. Deployment Models Scrutiny

	Public	**Private**	**Community**	**Hybrid**
Use & Setup	Trouble-free	Require IT expertise	Require IT expertise	Require IT expertise
Protection & confidentiality of data	Near to the ground	Far above the ground	Comparatively Far above the ground	Far above the ground
Control of data	Slightly Low	Far above the ground	Comparatively Far above the ground	Comparatively Far above the ground
Reliability	Vulnerable	Far above the ground	Comparatively Far above the ground	Far above the ground
Scalability & Elasticity	Far above the ground	Far above the ground	static talent	Far above the ground
Cost	Cheapest	Most expensive	Shared between members of the community	Cheaper than the private model but more costly than public model
In-house hardware	Not require	Depends on demand	Depends on demand	Depends on demand

Cloud Computing research Challenges
 Cloud computing is very famed and commonly used by lots of industries and companies but the research on cloud computing is still in the groundwork phase. Lots of challenges can be addressed entirely; On the other hand, new challenges are growing while working in big data. [20]
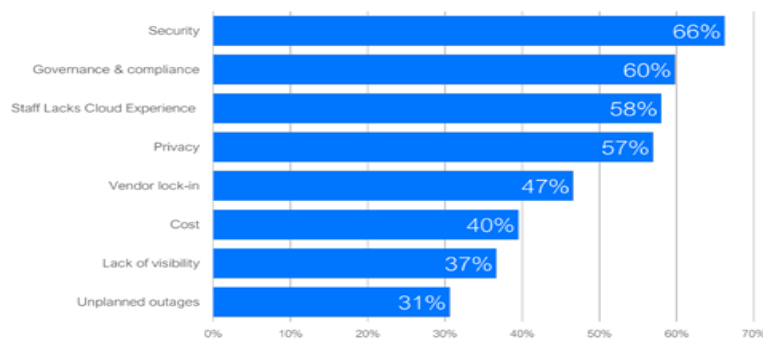
Figure 3. Cloud Challenges

1.Security

Because of the wireless medium, the communication system in the cloud is unusually susceptible to attacks. [5]

In view of the fact that at the beginning of the public cloud model the risk of security was a major concern that has not yet changed. It is the number one challenge that is cited by the respondents. 77 percent of organizations claiming that cloud security is a challenge which includes that 29 percent who called it a major Cloud Computing challenge of 2020. [3]

Even cybersecurity experts are concerned about Cloud security. Even research partner surveys discovered that approximately 90 percent of the security experts are concerned about cloud security. Even worries about data loss, privacy and confidentiality, and data breaches. [7]

Classification and subcategories of security challenges:

Confidentiality:

Data confidentiality

Virtualization Confidentiality

Integrity

Data integrity

Virtualization Integrity

Availability

Data availability

Virtualization availability

2.Managing cloud Spending

At present , Organizations and IT workers are doing mistakes to forget the turn of a cloud instance which was turned in for a short time. Even many organizations find themselves blocked by pricing schemes of cloud because they are not availing the offers providing with the multiple opportunities. [3]

Lots of solutions are available to companies for managing cloud spending e.g. cloud vendors offer many management tools like cloud cost management solutions, auto-scaling, containers, automation, server less series which may help to decrease the challenge.[5] Some organizations found benefits by establishing a central cloud team to manage uses and expenses.

3.Deficiency in Resources & its expertise

Deficiency in resources & its expertise ranked behind the cost management amongst the top challenges in 2020.[18]Apart from resource deficiency there is a deficiency of expertise also in developing countries.

Aim of Cloud Computing is to reduce organizational efforts from Non-IT people for both technologies (such as Cloud API & Virtualization) and regulatory compliance (Laws, tax, Payment & Data compliance).[9]

The deficiency of expertise is a strong barrier in utilizing public cloud contributions and cannot be crammed in a short time.[17]

4.Management of Multi-Cloud Environments

In the present time most organizations are working on multiple clouds. Organizations are integrated with both public as well as a private cloud.[8]

Cloud computing future challenge is a prediction that provides a difficulty faced by IT teams. To beat these challenges good practices like research, re-thinking processes, employee training and tooling are recommended by experts.
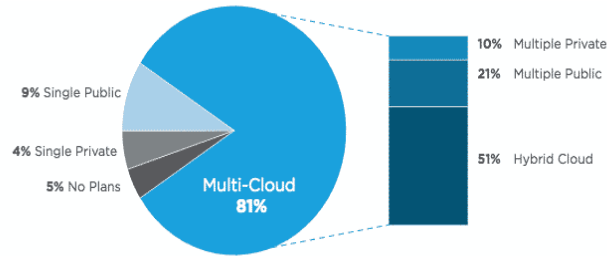
Figure 4. Multi-Cloud Environment

5.Migration

Induction of a new application in cloud in Cloud is a simple process by which existing applications can be moved to new development in the Cloud Computing background.[11] Some organizations have reported it very time consuming, slow data transfer, difficulty in synchronizing data, getting trouble in migration, and even the downtime during the application process.

A major challenge in migration is the Hackers, spammer and other criminal take advantage and launches various attacks such as key cracking, password, etc. [16]

6.Vendor Lock-In

In the present time, Google cloud platform, Amazon web services, IBM Cloud and Microsoft Azure are top service providers of the cloud. These providers secure the vision of vendor lock-in for the analysis of IT leaders and enterprise.

When customers are reliant on a particular service provider and can't move simply to a different vendor, this situation is known as the vendor lock-in. Customers can't shift to a special hawker without substantial cost, legal constraints, and technical compatibilities e.g. Microsoft Azure and Amazon EC2.[8] Whenever a company tries to change service provider Locked-in situation arises and not able to transfer application or data among different cloud services because of the mismatch of services and semantics of resources. Technical inappropriateness occurs because of this heterogeneity which is the reason for portability challenges. This makes portability, collaboration, manageability of data and services, and interoperations a very difficult and indefinable task. Because of these reasons, it is very important from the business point of view to maintain the elasticity to provider change as per the business concerns or even keep handy some components that are less difficult to security issues. Vendor lock-in can be avoided with portability and interoperability. It is the way toward the cloud provider's competitive market. [14]

7.Integration

At any phase, data can be corrupted so integrity monitoring is mandatory in cloud storage. It can maintain through constraints and transactions of the database. Transactions should follow ACID (Atomicity, Consistency, Integrity, and Durability) properties. [16]

Whatever the data cloud computing services are generating always kept in the cloud but by this user may lose control of their data and depends on cloud operators to implement access control.

8.Virtual Machine Migration :[12]

When resources of one single physical computer shared among various computers within itself is known as the VM migration.

VM's offer flexibility, scalability and liveliness to the cloud resources by permitting vendors to perform operations like copy, move and operate their VM,s but have to keep in mind that malicious attackers can find ways to change valuable data and can breach the security of cloud environment. The scenario of Cloud computing is not as transparent. The service user does not have access to the data. They don't know how the data is processed and stored. Anyone can access data through VM and can take an illegal copy of the whole system. [16]

Research Gap

There is still a clear gap in the area of big data that requires more efforts: [4]

205

Table 2. Research Gap[4]

Research Gap	Description	Technique	Proposed Solution
Efficiency of Randomization	Measurement of Privacy preservation	Maximization Algorithm	Reconstruction algorithm for Privacy-Preserving Data
Protection from malicious attempts	Privacy caused by data indexing	Portable Data Binding	Three-tier data Protection Architecture

Conclusion

Issues of privacy and security are rising in the area of interaction. To activate the latest technologies like IoT & Big data cloud computing introduced as the base technology. In the future, can plan to reconstruct the algorithm for Privacy- Preserving data that rely on the network security with the intend to enhance the privacy & security issues and work as a security wall between users cloud server or a three-tier data protection Architecture can be proposed for protection from malicious attempts.

The main aim of this proposal is to eliminate the issues. Concluding study can be considered the way in direction of enhancing the knowledge of big data and grant an attempt in the direction of improving and achievement of big vision on the domain of big data.

References

[1]Amir Taherkordi, Feroz Zahid, (2018), "Future Cloud Systems Design: Challenges and Research Directions", IEEE

[2]Qusay Kanaan Kadhim , Robiah Yusof , Hamid Sadeq Mahdi , Sayed Samer Ali Al-shami , Siti Rahayu Selamat,(2018), "A Review Study on Cloud Computing Issues" , 1st International Conference on Big Data and Cloud Computing (ICoBiC), IOP Conf. Series: Journal of Physics: Conf. Series 1018.

[3]Hamed Tabrizchi, Marjan Kuchaki Rafsanjani, (2020),"A survey on security challenges in cloud computing: issues, threats, and solutions", Springer Science+Business Media, LLC, part of Springer Nature.

[4]LjupčoKocarevGoceJakimoski, (2016), " Logistic map as a block encryption algorithm", Physics Letters A, Elsevier,

[5] Fariba Ghaffari, Hossein Gharaee, Mohammad Reza Forouzandehdoust, (2016), "Security Considerations and Requirements for Cloud Computing", 8th International Symposium on Telecommunications, IEEE .

[6] Nalini Subramanian , Andrews Jeyaraj,"Recent security challenges in cloud computing",(2018),Computer and Electrical Engineering, Elsevier.

[7] R.Barona, E.A.Mary Anita, (2017), "A Survey on Data Breach Challenges in Cloud Computing Security: Issues and Threats", International Conference on Circuit ,Power and Computing Technologies (ICCPCT), IEEE.

[8] Chirag N. Modi · Kamatchi Acha,, (2016), "Virtualization layer security challenges and intrusion detection/prevention systems in cloud computing: a comprehensive review", The journal of super computing, Springer.

[9] Bala M. Balachandran* and Shivika Prasad, (2017), "Challenges and Benefits of Deploying Big Data Analytics in the Cloud for Business Intelligence", International Conference on Knowledge Based and Intelligent Information and Engineering Systems, Marseille, France

[10] Chaowei Yang, Qunying Huang, Zhenlong Li, Kai Liu & Fei Hu, (2017),"Big Data and cloud computing: innovation opportunities and challenges", International Journal of Digital Earth ISSN: 1753-8947 (Print) 1753-8955 (Online).

[11] Samir A. El-Seoud, Hosam F. El-Sofany, Mohamed Abdelfattah, Reham Mohamed,(2017)," Big Data and Cloud Computing: Trends and Challenges", International Journal of Interactive Mobile Technologies (iJIM).

[12] Simar Preet Singh, Anand Nayyar, Rajesh Kumar, Anju Sharma,(2019), "Fog computing: from architecture to edge computing and big data processing", The Journal of Supercomputing, Springer.

[13] Nabeel Zanoon , Abdullah Al-Haj , Sufian M Khwaldeh,(2017), "Cloud Computing and Big Data is there a Relation between the Two: A Study", International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 17 (2017) pp. 6970-6982 © Research India Publications.

[14] Ngo Yang Chong,(2019), "Cloud Computing Challenges in a General Perspective", Journal of computing and management studies ISSN 2516-2047. Issue 1. Volume 3.

[15] Peshraw Ahmed Abdalla, Asaf Varol, (2019)," Advantages to Disadvantages of Cloud Computing for Small-Sized Business", 7th International Symposium on Digital Forensics and Security (ISDFS), DOI: 10.1109/ISDFS.2019.8757549.

[16] Robail Yasrab, (2018),"Platform-as-a-Service (PaaS): The Next Hype of Cloud Computing", Jounal "archive" (arXiv), volume={abs/1804.10811} , ISSN 2331-8422.

 [17] Divya Kapil, Parshant Tyagi, Sonu Kumar, Mr. Vinay Prasad Tamta, (2017), "Cloud Computing: Overview and Research Issues", International Conference on Green Informatics, 978-1-5386-2280-3/17, IEEE.

[18] Jacob Picart,(2020), " 5 tips for multi-cloud strategy and management success", (2018), International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 7, Issue 4, ISSN: 2278 – 1323.

Automatic Evaluation of Descriptive Answers: A Review

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Abstract: In recent times, technology has progressed so rapid that almost everything has been automated but the subjective evaluation of answers. None of the attempts made so far has been applicable globally and it is still an open problem. This paper presents a systematic review of what works have been done in recent times, their assets, liabilities and the scope of future improvements. Most of the researches have been carried out using dimensionality reduction techniques (LSA, SVD, etc.), while some have used different classifiers (Random-Forest, KNN). A thesaurus-based approach (WordNet) is also used and the most popular similarity criteria being cosine similarity. A wide range of accuracies have been achieved ranging from as low as 60% to as high as 95%. But there is still a scope of improvement so that a state of complacency could be achieved.

Keywords: Subjective answers evaluation; automatic evaluation; text similarity; natural language processing.

Introduction

Education is a very powerful tool with which an individual can even do extraordinary things. In today's world technology is making exponential progress, that is all because more people are getting educated. But education alone is not the key, it must also be tested that what kind of knowledge is gained through education. For that all schools and universities conduct examinations and numerous amount of students take examinations every year. Most of the examinations are subjective in nature and requires human intervention for the evalution process which means the amount of pressure on human evaluators, being low in numbers, is huge and many times this also results in mood swings of the evaluator which leads to unfair marking. So as to tackle these problems many attempts have been made in order to automate the answer checking mechanism with various artificial intelligence and machine learning techniques. Many different categories of questions have been considered viz., short answer type, long answer type and essays.

There are quite a few hinderances in the bigger picture of automaitng the evaluation sysem. These could range from deciding which aspects of the answer should be given more importance, to checking spellings, grammar, etc., or every individual has their own way of expressing things and hence a unique dimension of writing an answer and in addition one could use any number of synonyms.

In the past two decades, abundant work has been done in the field of Natural Language Processing (NLP), be it creating dictionaries of stop words, spell-and-grammar checkers and even a lexical database called WordNet. Now, so as to address the bigger picture, many different approaches with algorithms like KNN0, RandomForest classifer[2], word order vectors[3], information gain[4], lesk algorithm[5], LSA[4][6] and GLSA[7][8][9] have been proposed. The developed models have been able to get really good results, but none of them has been applied at a larger scale. Though most of the mathematical modelling is done by making word representations in the vector space[10], which is a thing that could be relied upon. Since this problem deals with a sensitive issue which could be a deciding factor for a number of students, hence needs more precise results.

The paper is organized as follows: the next section discusses about Methodology, following which are the discussions and the final section is conclusion.

Methodology

Machine Learning approaches are highly data centric and needs humungous amount of data. Most of the processing evolves around the data units. This section presents a methodology for the automatic evaluation of descriptive answers. In an NLP problem (as the case is) there are two general mandatory preprocessing steps,

- Tokenization: This is the process of splitting a bigger document or sentence into smaller pieces consisting of words, characters, etc., known as tokens.
- Stop word removal: There are certain words which do not contain semantics of a sentence and can be discarded from the corpus of text. Such process is refered to as stop word removal.

Further preprocessing steps are application-sensitive, some of the other techniques include, taxonomy verbs filtering, lemmatization, normalization, stemming, etc.

As discussed in the preceeding sections, the question types can be broadly categorized into three types viz., short answer type (50-100 words), long answer type (150-300 words) and essay type (400-500 words or above). After extracting the different question solutions also identified as "corpus" and applying preprocessing, the primary step should be to represent the corpus mathematically i.e., plot the words on the embedding space in the vector form as it would be easy for the machine to interpret and draw connections between different words. Following this, an algorithm could be proposed in the form of a classifier or a model which will have some specific roles. Firstly, it could be used for prediction of the structure of the answer, question classifier[5][6] so that similar pattern could be searched for in the answer to be evaluated. Secondly, it may also be used to generate a feedback[4] for students so as to ease their improvement process. And finally, it should be able to predict the score of the student answer, which stands the main objective of the model.

Discussions

In this section, a discussion on all the algorithms and models deployed, their assets, liabilities is done and finally a inference would be given following this section upon which future work may be conducted.

First a word order and similarity matrix based model is studied[3], which deploys a generative approach as the generated answer vectors make up the similarity matrix and has implemented a word to word syntactic measure. The model is purely based on semantics and keyword matching with the generated solution-vectors. This approach focuses more on the syntactics of the pre-graded generated answers provided[5] and there tends to be a problem if a student writes an answer in a different dimension than the generated vectors.

The automatic assessment tool developed by Nehete, C. et al.,[11] performs almost as good as a human evaluator in terms of grading an answer based on keyword matching. Spelling and grammar are also considered as parameters when evaluating an answer and in addition, the tool is also capable of detecting spam answers i.e., the answer containing just the keywords. Though the synonyms and antonyms of the keywords are also taken into account but this might prove to be a liability and instead if domain specific database like WordNet is used it would become far more reliable. Furthermore, this system has the same shortcoming as the prior, knowledge base dependency.

The most widely used technique is LSA (Latent Semantic Analysis) as the state-of-the-art claims that it correlates with human evaluator's way of marking[6]. LSA generally deals with the modelling of term-document matrix and reduction of the dimensions with SVD (Singular Value Decomposition) as more dimensions makes the document ambiguous[6]. LSA's accuracy increases proportional to the size of the document[3] and hence tends to give better results on a longer answer. Further there are more architechures proposed, with LSA as the core algorithm, one being in integration with WordNet[4]. This allows all the synonyms and antonyms be taken into account while creating the term-doc matrix. The other being Generalized LSA (GLSA) where an n-gram by document matrix is calculated[7], which helps to preserve the juxtaposition of words, but it is computationally more expensive and there is not a significant increase in the accuracy to compensate the computation and hence LSA could be considered superior[4].

Another technique which is found giving satisfactory results is the RandomForest classifier, which is an enhanced Decision Tree and is able to overcome its traditional hurdle of overfitting[12]. A supervised learning algorithm is proposed with the RandomForest classifier on a dataset consisting of pre-evaluated answers. A one-hot-encoder based filter is also taken into account so as to equalize all the answer-vectors' dimensions[2].

As the words are represented in the embedding space in all the models, therefore, cosine similarity is used as a metric to calculate the similarity index of the vectors with one another. Simple rule based on vector algebra is followed under this i.e., the vectors having more similar features tend to have less inclination with one another and vice versa. KNN is also used along with cosine similarity so as to somewhat limit the similarity index and it doesn't gets overwhelmed[4].

After taking a dive into all the models, it is derived that if the structure of answer to be written is predicted before evaluating the answer, it could assist in evaluating the answers in a better way and hence a question classifier has been proposed by [5] and [6]. The question classifier is prone to error as there might be more than one headword, which is used to classify the question. The classifier could be trained in order to classify even complex questions and make the system even more reliable. Furthermore, a feedback mechanism could be implemented which will provide students with a detailed report of their answer sheet showcasing their shortcomings so that students can improve in a better way[4].

The corpus selected to train the classifiers should be strictly domain specific and should also be large enough so that all words are converted to embeddings else the algorithm would not perform up to the mark and might lead to unsound results. Such is the case of RandomForest classifier, if trained properly on a well operated framework, even a person from non technical background would be able to use and evaluate the answersheets[2].

One common gap which is observed across the algorithms is that only the answer provided by the faculty is taken into consideration for the evaluation process but what if the student does not write the solution according to the answer

key provided, given the student answer is not completely irrelevant, human evaluator would still be able to map the answer with some kind of extra knowledge, but as the computer evaluator is supplied with only the answer key, it would only be able to map the answer as "incorrect".

Table 1. Consolidated performance evaluation.

Algorithm	Features	Accuracy
LSA[4][6]	Term-frequency, inverse document frequency, term-doc matrix, SVD, WordNet	(38 – 81) %
G-LSA[7][8][9]	n-gram by document matrix, SVD	(34 – 91) %
KNN[1]	Term and inverse document frequency, nearest neighbors	76 %
Syntactic similarity[3]	Syntactic similarity, word order vector	70 % (approximated)
Random-Forest[2]	Supervised (train-test) learning, one-hot-encoder filter	(61 – 96) % (high accuracy)

Conclusion

After going through the various models and approaches discussed in the previous sections it could be concluded that there is a scope of improvement on at-least three aspects in the currently available evaluation systems:

- The RandomForest classifier which achieves the maximum accuracy, close to 95%, could be processed with word sense disambiguation and combined with a domain specific WordNet to get even better results.
- A feedback system should be developed which could be used by students to get hold of the areas in which they lack and work accordingly to improve in a more efficient way.
- The common problem addressed in previous section could be resolved and instead of just supplying the computer evaluator with the answer key, some more relevant information must be supplied so that even the slightest knowledge gain or creativity does not go in vain. This can be integrated with RandomForest as well as LSA to achieve the desired accuracy and precision.

References

[1] Bin, L., Jun, L., Jian-Min, Y., & Qiao-Ming, Z. (2008, December). Automated essay scoring using the KNN algorithm. In 2008 International Conference on Computer Science and Software Engineering (Vol. 1, pp. 735-738). IEEE.

[2] Dubey, R., & Makwana, R. R. S. (2019). Computer-Assisted Valuation of Descriptive Answers Using Weka with RandomForest Classification. In Proceeding of the Second International Conference on Microelectronics, Computing & Communication Systems (MCCS 2017) (pp. 359-366). Springer, Singapore.

[3] Paul, D. V., & Pawar, J. D. (2014, December). Use of syntactic similarity based similarity matrix for evaluating descriptive answer. In 2014 IEEE Sixth International Conference on Technology for Education (pp. 253-256). IEEE.

[4] Sakhapara, A., Pawade, D., Chaudhari, B., Gada, R., Mishra, A., & Bhanushali, S. (2019). Subjective answer grader system based on machine learning. In Soft Computing and Signal Processing (pp. 347-355). Springer, Singapore.

[5] Nandini, V., & Maheswari, P. U. (2020). Automatic assessment of descriptive answers in online examination system using semantic relational features. The Journal of Supercomputing, 76(6), 4430-4448.

[6] Kaur, A., & Kumar, M. S. (2019). Performance Analysis of LSA for Descriptive Answer Assessment. In Innovations in Computer Science and Engineering (pp. 57-63). Springer, Singapore.

[7] Islam, M. M., & Hoque, A. L. (2010, December). Automated essay scoring using generalized latent semantic analysis. In 2010 13th International Conference on Computer and Information Technology (ICCIT) (pp. 358-363). IEEE.

[8] Guruji, P. A., Pagnis, M. M., Pawar, S. M., & Kulkarni, P. J. (2015). Evaluation of Subjective answers using GLSA enhanced with contextual synonymy. International Journal on Natural Language Computing (IJNLC), 4(1).

[9] Ratna, A. A. P., Artajaya, H., & Adhi, B. A. (2013, August). GLSA based online essay grading system. In Proceedings of 2013 IEEE International Conference on Teaching, Assessment and Learning for Engineering (TALE) (pp. 358-361). IEEE.

[10] Mikolov, T., Chen, K., Corrado, G., & Dean, J. (2013). Efficient estimation of word representations in vector space. arXiv preprint arXiv:1301.3781.

[11] Nehete, C., Powar, V., Upadhyay, S., & Wadhwani, J. (2017). Checkpoint--An Online Descriptive Answers Grading Tool. International Journal of Advanced Research in Computer Science, 8(3).

[12] Sharma, P. (2014). Comparative analysis of various decision tree classification algorithms using WEKA. International Journal on Recent and Innovation Trends in Computing and Communication, 3(2), 684-690.

Software Refactoring and its Effects on Software Complexity: Model-Based Approach

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Abstract: Source code of any software determine its quality. To adapt the old version of software into new environment or fulfil the new requirement of user software developer regularly spend time to improve quality. For this, software maintenance is done, which is never ending process. To maintain or to improve quality of software, software developers regularly do refactoring. To analysis the effect of refactoring on software quality or to know does refactoring improve or degrade the quality of software 91 versions of an open source system eclipse JDT has been taken, to evaluate the impact of revisions on the software to its complexity. To identify early changes in the software complexity.

Keywords: Software quality, Refactoring, Code smell

Introduction

Software metrics are the mirror of software quality and these metrics are mainly used to evaluate the quality of the software. The output of these metrics helps the software developers to identify which software parts need to alter/modify or reengineered. This reengineering is done by using refactoring techniques. Refactoring means "doing modification in the software system in this manner that external behaviour of software remains the same while the internal structure of the software gets improve".

The remaining paper is organized as follows: section 2 gives a brief introduction of software quality factors that directly or indirectly affect the software quality. Section 3 provides how refactoring improves the quality of the software as well as reduces the maintenance cost up to some extent. Section 4 describes the output of research work on how refactoring affects the line of code, coupling, cohesion, and the complexity of the software. Section 5 concludes the research paper as well as highlight the future work.

Software quality factors

Software quality is the measure the software holds a suitable combination of different factors. It is hard to measure the software quality factor. The factors which impact the software quality is broadly divided into two categories first is internal quality attributes which can be directly measured for example fanIn, fanOut, DIT, NOC, RFC, CBO, WMC, LCOM, NOM, LOC and second is external quality attributes which can measure indirectly for example usability, Maintainability, Reusability, Testability. Some of the software quality factors are discussed in Table 1.

Table 1. Software Quality Factors with their Description

Software Quality Factor	Description
Efficiency	Customer satisfaction and response time
Integrity	The extent to which software is not accessed by an unauthorized user
Reliability	Stability of a software
Usability	Satisfaction level, completion rate
Correctness	The extent to which software satisfies user requirements
Maintainability	Easily modification of software
Testability	Number of technologies needed to test
Flexibility	The effort required to modify a software
Interoperability	The effort required to merge two or more system
Reusability	Modules of software can be reused to build new software
Portability	The effort required to transfer software in a new environment

Refactoring

212

In the software development life cycle (SDLC) maintenance is considered as one of the costly activities [1-2]. There are few factors due to which maintenance cost is high they are the structure of software program and bad software design quality. Maintenance is a never-ending process, software gets upgraded, alter and new demand always emerges. During the maintenance phase of the software, various code smell/bad smell (introduced by the Beck & flower) accidentally introduced by the software developer. This code smells may deteriorate the quality of the software. To preserve the good quality of software, software developer applies refactoring techniques on software, after applying refactoring techniques software quality can be improved in terms of adaptability, maintainability, understand ability, reusability, and testability [3], as well as software developer, may reduce the maintenance cost up to some extent and also improve the developer productivity.

Refactoring was introduced in 1992 by Opdyke [4]. Refactoring means reorganized the source code in such a manner that it improves the software's internal structure without altering its external behaviour of the software [5]. According to flower, there are more than seventy refracting treatments are available with the help of which software engineer improve the software quality. Refactoring help in reducing bug from software by eliminating the bad smells from the source code, improve designing and readability of the software. Ample of tools are available for calculating software metrics and carry out automated refactoring on source code that simplifies the maintenance part as well. Software metrics help in predicting the quality of the software. It means software developers continuously perform refactoring to enhance the quality of software.

Table 2 represents the relationship between software external qualities attributes with code metrics where the positive symbol (+) represents positive correlation whereas negative symbol (-) represents the negative correlation between software quality attributes and software metrics. Software Under test is 91 versions of Eclipse JDT Core

Table 2. Relationship of the software quality attributes with code metrics

Quality Attribute	DIT	NOC	CBO	RFC	WMC	NOM	LOC
Adaptability	-	-	-	-	+	-	-
Maintainability	-	-	-	-	+	-	-
Understandability	-	-	-	-	+	-	-
Reusability	-	-	-	-	+	-	-
Testability	-	-	-	+	+	+	+
Code Smells	+	+	+	-	-	+	+

Effect of refracting on software quality

Effect of refracting on the line of code Figure 1 represents as software functionality increases line of code also increases the process of doing refactoring also keeps increasing.

Effect of refracting on cohesion and coupling as software developers apply refactoring on the software cohesion increases whereas coupling decreases and this improves the quality of the software. Figure 2 represents how refactoring affects coupling and cohesion.

Effect of refracting on cyclomatic complexity as the software versions increase line of code (LOC), weighted method per class (WMC), depth of inheritance (DIT) increases as well as the binary decision in the class increases which result in increases in the complexity of the software. Figure 3 represents the impact of versions on software complexity.
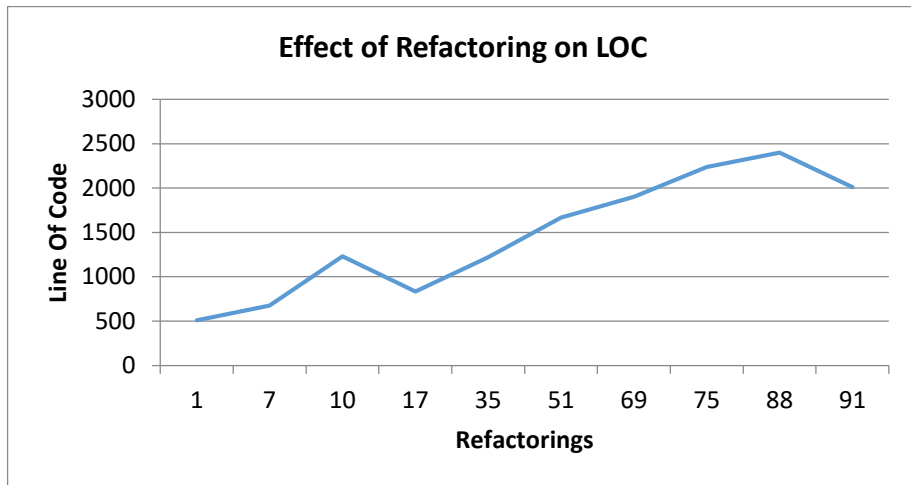
Figure 1. Effect of Refactoring on Line of code
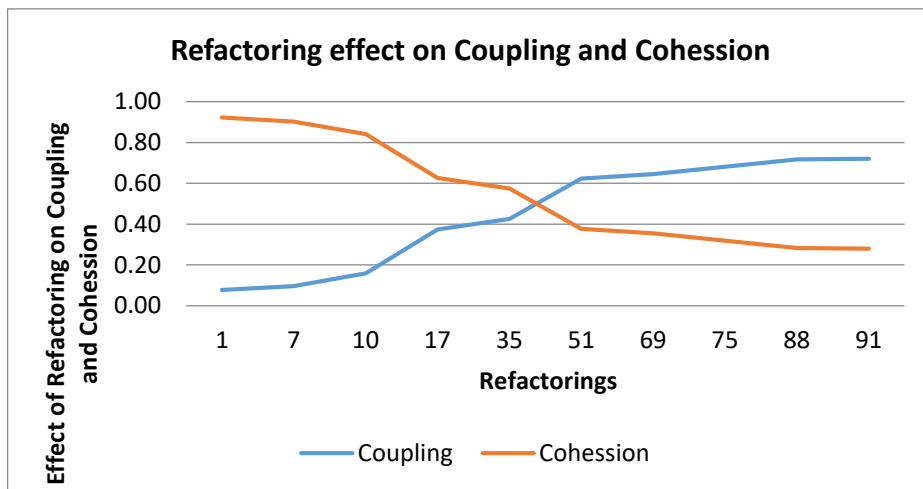
Figure 2. Refactoring Effect on Coupling and Cohesion
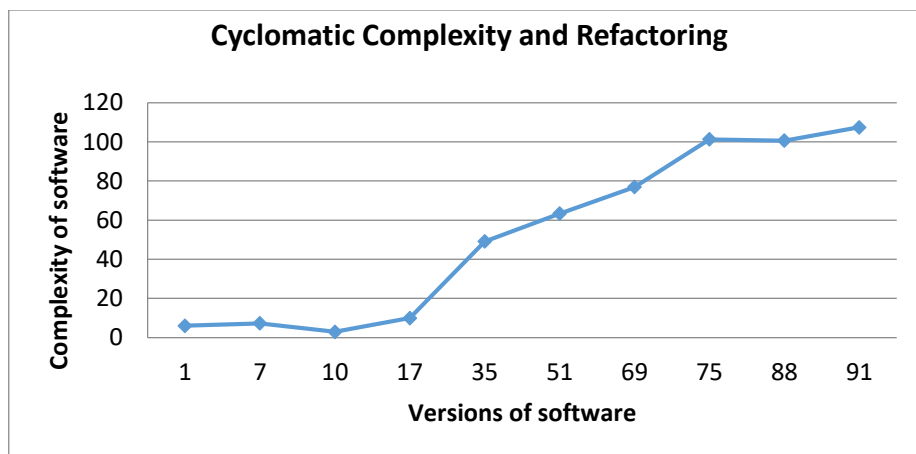
Figure 3. Refactoring on Cyclomatic Complexity

Software Under test is 91 versions of Eclipse JDT Core and the metric dataset was taken from

Conclusion and Future Work

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This paper focused on a case study to validate the hypothesis that refactoring can impact the software complexity. In this paper various metrics such as LOC, Coupling, cohesion and the cyclomatic complexity has been used and analyses of 91 versions of an open source system eclipse JDT has been done. Eclipse the Java IDE to evaluate the impact on revisions of the software to its complexity. After comparing 91 versions it has been observed that several revisions where the refactoring were not the only changes applied to the code but also increased underlying complexity of the software. To identify early changes in the complexity. In future code and model metric based analysis will study, where the complexity at UML level will be consider instead of the single class system will be done.

References

[1] H. van Vliet, "Software engineering: Principles and practice," *second edition, John Wiley and Sons, Chichester*, 2000.

[2] R. Zarnekow and W. Brenner, "Distribution of cost over the application lifecycle-a multi-case study," In *Proc. European Conference on Information Systems*, 2005, pp.1-13.

[3] Alshayeb, M. (2009). An empirical investigation of refactoring effect on software quality. *Information and software technology*, *51*(9), 1319-1326.

[4] Sunil Sikka, Priyanka Makkar,Anshu Malhotra. (2020). A Systematic Study of UML based Metrics and their uses. *International Journal of Advanced Science and Technology*, *29*(06), 7924-7937.

[5] W.F. Opdyke, "Refactoring: A Program restructuring aid in designing object-oriented application frameworks," *Ph.D. thesis, Univ. of Illinois at Urbana-Champaign*, 1992.

[6] Kaur, S., & Singh, P. (2019). How does object-oriented code refactoring influence software quality? Research landscape and challenges. *Journal of Systems and Software*, *157*, 110394.

[7] Stroggylos, K., & Spinellis, D. (2007, May). Refactoring--does it improve software quality? In *Fifth International Workshop on Software Quality (WoSQ'07: ICSE Workshops 2007)* (pp. 10-10). IEEE.

[8] Szóke, G., Antal, G., Nagy, C., Ferenc, R., & Gyimóthy, T. (2014, September). Bulk fixing coding issues and its effects on software quality: Is it worth refactoring? In *2014 IEEE 14th International Working Conference on Source Code Analysis and Manipulation* (pp. 95-104). IEEE.

[9] Malhotra, R., Chug, A., & Khosla, P. (2015, August). Prioritization of classes for refactoring: A step towards improvement in software quality. In *Proceedings of the Third International Symposium on Women in Computing and Informatics* (pp. 228-234).

[10] Bibiano, A. C., Fernandes, E., Oliveira, D., Garcia, A., Kalinowski, M., Fonseca, B & Cedrim, D. (2019, September). A quantitative study on the characteristics and effect of batch refactoring on code smells. In *2019 ACM/IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM)* (pp. 1-11). IEEE.

Reviewing Fake News Classification Algorithms

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Abstract: Fake news is a terminology that has a different meaning to different people. At its core, the authors are defining fake news as those news headlines or articles that are not true. The facts are molded in such a way that, source of the news is never known**.** Sometimes the spread of these fake news is a planned move that is intentionally prepared to deceive the reader. In recent years, fake news stories have surged via social media, in part because they are so easily and quickly shared online. In this paper the authors propose a method of classifying fake news using Passive Aggressive classifier(PAC) and afterwards compare the results given by this model with the other machine learning classification algorithms like Naïve Bayes, Decision Trees Classifier(DTC), Random Forest Classifier(RFC), K Nearest Neighbor(KNN), Support Vector classifier(SVC), Logistic Regression and Deep Learning algorithms like Long Short Term Memory(LSTM) and Bi-Directional LSTM. The authors will be using both 'Bag of Words' and TF-IDF technique to convert the textual data into vectors.

Keywords: Fake News, Machine Learning, Deep Learning, Classifier, Passive Aggressive Classifier

Introduction

The transfer of raw data or information across the world has become very fast and efficient with the help of the high- speed internet. Within a matter of few seconds huge amount of information can be transmitted from one corner of the world to another corner. In today's time, even a five-year-old with a phone in his hand can generate data and spread information. A large number of citizens in many countries do not watch television or read newspapers, instead they receive their news from social media[2]. An example of such country is USA, where approximately 62% of the citizens receive news via social media.[2].

Fake news gets transmitted so fast because its content is attractive. The fake news creators make sure that public or viewers are attractive to their content. With the surge in social media usage, Fake news makers have made it their main platform to share their content. Fake news could be related to anything like politics, sports, technology, entertainment industry etc. Turns out that, the creators of fake news make huge amount of money by doing this fraudulent work. One type of misstatement is fake news, consisting of false information that is proclaimed as factually correct to deceive the audience using traditional or social media. Fake news on any media can affect a society or individual in different ways. It can have severe repercussions in terms of financial and political decision making as well as destroying an individual's social standing [1]. Example of a recent fake news transmission in India: There was a post on social media that 'Any social media post related to covid-19 is a punishable offence'. Many people believed that this was a genuine news but later the truth came out on social media itself claiming that it's a fake news. The US presidential elections 2016 was the major time when a lot of fake news was being spread across the country on various social media websites namely, Facebook, Twitter, Instagram etc. As compared to real news, fake news spreads quickly by making it more appealing on the viewers end. It gets difficult to distinguish between the fake news and real news.The difference between this paper and other papers on the similar topics is that in this Passive Aggressive classifier is specifically, being used for the purpose of fake news detection and the authors have compared the accuracies given by this classifier with the accuracies given by other machine learning and deep learning classifiers. Whenever we have a dataset with millions of records, it is basically a combination of fake news and real news. It is a real difficult task for humans to segregate fake news and real news. It is almost impossible for humans to do this task. It will take a huge amount of time for humans to do this and thinking practically, it is not a feasible way to classify fake news and real news. To do this task scientists has come up with very feasible different types of supervised and unsupervised machine learning and deep learning algorithms which classifies fake and real news with quite good accuracy. To see the accuracy, the authors will be looking at different accuracy metrics like accuracy score, precision, recall and F1 score.

Passive Aggressive Classifier

The passive-aggressive algorithms are a family of algorithms which are designed for large-scale learning. They are similar to the perceptron in a way that they also do not require a learning rate. However, the difference is that they include a regularization parameter 'C'.

Working:
- **Passive:** If the prediction is correct, keep the model and do not make any changes. i.e., the data in the example is not enough to cause any changes in the model.
- **Aggressive:** If the prediction is incorrect, make changes to the model. i.e., some change to the model may correct it.

Important Parameters:
- C: This is the regularization parameter, and denotes the penalization the model will make on an incorrect prediction
- mixite: The maximum number of iterations the model makes over the training data.
- tol: The stopping criterion. If it is set to None, the model will stop when ($loss > previous\_loss – tol$). By default, it is set to 1e-3.

Dataset and Pre-processing
The dataset is taken from Kaggle. Our data set is an Excel sheet that consists of 20,800 records and 5 features. These records are the mixture of fake and real news. Data cleaning is performed on this dataset i.e. null values are removed, stopwords are removed, stemming is performed and all the data is converted into lower case. After the data cleaning is performed, the authors are left with 18,285 records in our final corpus. After this step, the corpus is transformed into an array format using bag of words model. After implementing this step, the dataset gets converted into 18285*5000 matrix. Next step is to split the data into training and test part. The authors allocate 33% of the data for testing and 67% for training part with 'random state' parameter set to zero. There are different parameters related to different ML models. For instance, in RFC the authors are specifying the parameters 'n_estimators' equal to 200 and criterion as entropy, in passive aggressive classifier the authors are specifying 'max_iter' equal to 50, in Logistic Regression, SVC and DTC the authors are specifying 'random_state' equal to 42. These parameters can be changed or updated according to the problem statement. In Deep learning (DL) algorithms the authors are using Sequential models to create the classifier. In this, the authors will be taking 100 neurons in LSTM layer. The authors will be using One Hot Representation to convert text into vectors. After converting text into vectors, the authors perform padding process. Padding is a process which makes the length of each vector equal. Since this is a binary classification problem, the authors are considering binary cross entropy as the loss parameter and are using Adam optimizer to optimize the classification model. The authors are using sigmoid activation function in the dense layer because this is a binary classification problem. The authors also observe the accuracy of our models by adding an additional layer i.e. the dropout layer. Sometimes the addition of dropout layer can give very good results in terms of accuracy.

Results and discussions: In this section, the authors discuss about the accuracies given by the different ML and DL models.

Table 1. Accuracies given by different ML models while using Bag of words model to convert text into arrays/vectors.

Model	Precision	Recall	F1 score	Accuracy_ score
Passive Aggressive	93	92	93	91.91
Decision Trees	100	60	75	77.54
Random Forest	97	91	94	93.20
SVC	98	89	93	92.92
Naïve Bayes	92	90	91	90.19
KNN	84	64	78	80
Logistic Regression	95.5	99.3	97.4	97.7

Table 2. Accuracies given by different ML models while using TF-IDF model to convert text into arrays/vectors:

Model	Precision	Recall	F1 score	Accuracy_ score
Passive Aggressive	100	100	99.9	100
Decision Trees	65.3	99.9	79	77.1
Random Forest	100	100	100	100
SVC	100	100	100	100
Naïve Bayes	71	98	82	76.63
KNN	44	100	61	68
Logistic Regression	89.7	99.7	94.4	95

Table 3. Accuracies given by DL models:

Model	Precision	Recall	F1 score	Accuracy_ score
LSTM	93	92	92	91.18
Bi Directional LSTM	91	92	91	90.30

Table 4. Accuracies given by DL models after addition of dropout layer:

Model	Precision	Recall	F1 score	Accuracy_ score
LSTM	92	92	92	91.48
Bi Directional LSTM	93	91	92	90.91

Conclusion and Future Scope

After observing all the the four tables the authors could conclude that among all the ML models that are considered, PAC, RFC, SVC with TF-IDF vectorization are performing in a great way as they are giving us 100% accuracy on the test set and the authors can also conclude that DTC is the worst performing ML model with this specific dataset.

The models which are giving 100% accuracy could also lead to the problem of overfitting.

Among both the DL models, the authors can say that both the models are equally good after the addition of dropout layer. There is not even a difference of 1% in the accuracy scores of both the DL models. However, the accuracies of other models could be increased by performing hyperparameter optimization using Randomized search CV or Grid search CV. In DL models accuracy could be increased by increasing the number of layers between the input layer and output layer. Fake news is a major problem in the current time, still many researchers are working and trying to find new algorithms so as to detect the fake news with much better accuracy.

References

[1] Tayyaba Rasool, Wasi Haider Butt, Arslan Shaukat, M. Usman Akram. (2019). Multi-Label Fake News Detection using Multi-layered Supervised Learning, 11th International Conference on Computer and Automation Engineering - ICCAE 2019.

[2] Vitaly Klyuev, Fake News Filtering: Semantic Approaches, (2018), 7th International Conference on Reliability, Infocom Technologies and Optimization (ICRITO) (Trends and Future Directions)

[3] Wenlin Han, Varshil Mehta, Fake News Detection in Social Networks Using Machine Learning and Deep Learning: Performance Evaluation, (2019), IEEE International Conference on Industrial Internet (ICII)

[4] Arvinder Pal Singh Bali, Mexson Fernandes, Sourabh Choubey, Mahima Goel, Comparative Performance of Machine Learning Algorithms for Fake News Detection, (2019), International Conference on Advances in Computing and Data Sciences(ICACDS)

[5] Abdullah-All-Tanvir, Ehesas Mia Mahir, Saima Akhter, Mohammad Rezwanul Huq, (2019) 7th International Conference on Smart Computing & Communications (ICSCC)

[6] Shlok Gilds. (2017). Evaluating Machine Learning Algorithms for Fake News Detection, IEEE 15th Student Conference on Research and Development (SCOReD)

[7] Thiago S. Guzella, Walmir M. Caminhas. (2009), A review of machine learning approaches to Spam filtering,
Expert Systems with Applications, Published by Elsevier

[8] Supanya Aphiwongsophon, Prabhas Chongstitvatana. (2018), Detecting Fake News with Machine learning Method, 15th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology

[9] Akshay Jain, Amey Kasbe (2018), Fake News Detection, IEEE International Students' Conference on Electrical,

Electronics and Computer Sciences

[10] Feyza Altunbey Ozbay, Bilal Alatas (2019), Fake news detection within online social media using supervised artificial intelligence algorithms, Physica A, Published by Elsevier B.V.

A Technical Evaluation of Machine Learning And Deep Learning Methods For Natural Language Processing In Security Requirements Classification

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Abstract: The need for Classification of Security Requirements has been triggered by the increase in cases of malicious attacks on systems and sensitive information. Solutions are being explored in various domains to ensure systems are developed with adequate security to withstand attacks. Deep Learning and Machine Learning techniques are becoming popular in Natural Language Processing (NLP) tasks in various domains including the area of Security Requirements Engineering to classify Security Requirements which are normally stated in Natural Language. Deep learning methods have been yielding spectacular results better than those achieved using shallow machine learning models. This paper presents an evaluation of the performance of various Machine Learning, Ensemble and Deep Learning methods for Natural Language Processing applied to Security Requirements Classification. The Ensemble methods yielded better results than simple Machine Learning ones. Ada Boost had 95.2% while LSTM a Deep Learning model yielded the best results, 96.51% accuracy.

Keywords: Natural language processing (NLP), Deep Learning, Text Classification, Security Requirements Classification

Introduction

Natural Language Processing (NLP) enables the development of methods to build computational algorithms for automatic analysis and representation of human language[1]. This is a sub-area of Artificial Intelligence that deals with the Natural Language Understanding and Natural Language Generation[2]. NLP has largely been supported by another area of Artificial Intelligence known as Machine Learning which allows systems to automatically learn patterns from data without having to be explicitly programmed on how to perform tasks. These methods are still being applied in a myriad of application areas that are diverse including predicting employee attrition rates in Human Resource Management, Targeted Marketing in Retail Industry, Stock Market prediction in Financial Analysis, Sentiment analysis from customer reviews, crop disease prediction in Agriculture, Network Intrusion Detection, Fraud Detection and News Categorization, among many others. However, a number of problems are associated with these traditional Machine Learning methods including overfitting, use of hand-crafted features, overly time-consuming, limitations in handling data with high dimensionality which affects the performance of these techniques in analysis and representation of human language according to various researches[3].

Recent developments in Artificial Intelligence and Machine Learning have seen Deep Learning methods which are a type of Machine learning based on Neural Networks, becoming ubiquitous in NLP applications[4]–[8]. Deep-learning methods are representation-learning methods composed of multiple processing layers that represent data at multiple levels of abstraction thereby enabling the automatic learning of feature hierarchies [9]. Several pretrained language models exist which have been applied with remarkable results.

The application area of Security Requirements Engineering is a very important one as efforts are exerted to ensure that the Security Requirements are classified correctly as this will assist developers in designing the correct Security mechanisms for each system to be developed. It is important to understand that one size does not fit all in as far as systems security is concerned. Specific security mechanisms are required for each type of system and the environment it is to be used. Deep Learning methods come in handy to this end to ensure that security expertise is modelled despite the possible lack thereof in the developers. However, these methods have not yet been thoroughly tested in this area. This research aims to evaluate various Machine Learning, Ensemble Learning and Deep Learning methods in the area of Security Requirements Classification as part of the roadmap towards development of more robust and secure software.

This paper is organized as follows. A review of related work is presented in Section 2. Section 3 illustrates the Research Methodology. In Section 4, experiments on the most commonly used machine learning models, such as Multinomial Naïve Bayes, Logistic Regression, K-Nearest Neighbours and Decision Tree, Ensemble ones that is Random Forest, Ada Boost, Bagging and Extra Trees classifiers and also CNN and LSTM Deep Learning techniques are conducted on the Tera Promise dataset of Software Requirements and results presented. Section 5 looks at discussion of the results. A Conclusion will come in the final section.

Related Work

Several researches have applied Machine Learning Techniques with methods such as Support Vector Machine and Naïve Bayes Classifiers being popular [10], [11]. Findings from these and other researches point out a few challenges encountered in applying these methods. The challenge of pre-processing and also handcrafting of features hinders accurate classification of requirements in traditional Machine Learning [10]. Hand-crafted features result in a laborious feature engineering and analysis to enhance performance[12]. Furthermore, there is need for some domain knowledge for extracting these features which becomes rather pre-defined. Deep Learning methods offer more adaptive ways of handling NLP tasks. These methods have been successfully applied to NLP tasks such as named-entity recognition, Semantic Role Labelling, Parsing and Parts of Speech tagging [10] and applications in Speech Recognition, Lexical Analysis, Machine Translation, Question Answering, Social Computing and Sentiment Analysis [1].

Examples of Deep Learning models for NLP, include MLP, CNN, RNN, LSTM, and Transformers [12]. In these methods, text data is first converted into numerical form before it is classified by the relevant classifier. Calculating TF-IDF matrix has always been applied with traditional Machine Learning [13]. Deep Learning models can also learn vector representation of given words using embeddings like Word2Vec (which has two architectures: Continuous Bag of Words and Skip Grams) [14], Glove2Vec and Doc2Vec. Recent advances have seen the strengths of some of the Deep Learning models being combined and applied to NLP problems with improvements in performance. C-LSTM is proposed in Zhou et al. [15] for sentence representation and text classification. And it is able to capture features of phrases (CNN) and sentence semantics both temporal and global (LSTM). A CNN-GRU for detecting hate speech is presented in Zhang et al. [16]. In the area of Requirements Engineering a few researches have applied Machine learning to Security Requirements classification tasks [17] [18]. Other researches considered non-functional requirements [19] and some looking at Software Requirements in general [20][21] [22]. The scarcity of literature on the application of Machine Learning and more so Deep Learning for NLP tasks in the area of Security Requirements makes it imperative to explore these techniques in this area.

Research Methodology

Security Requirements Classification is an NLP task that is performed as part of Security Requirements
    Analysis
as shown in Figure 1 below.
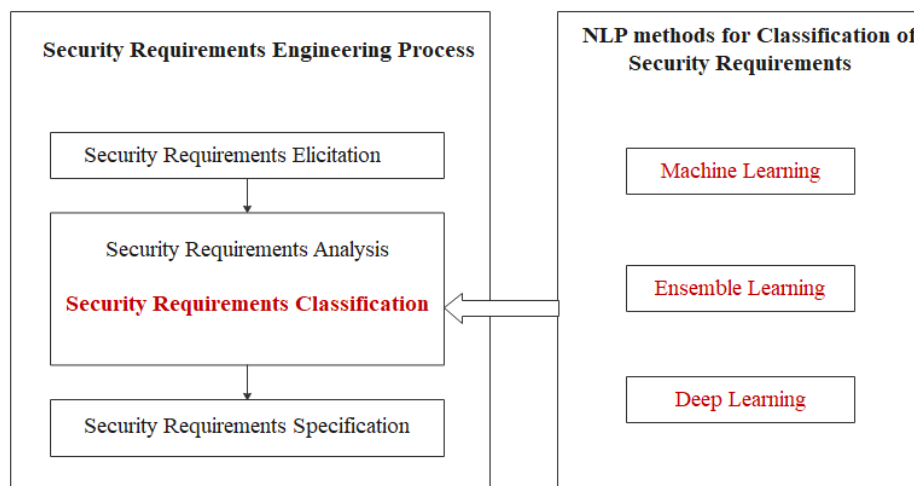
Figure 10. Research Structure

Machine Learning, Ensemble Learning and Deep Learning methods are applied to the classification task. In the experimental work, the first part involves importing relevant libraries which are needed for the pre-processing tasks, model creation and visualisations. Software Requirements dataset which is the labelled Tera Promise dataset is loaded and the requirements are pre-processed using Natural Language Processing techniques from the popular NLTK Machine Learning library. Next step is transformation of requirements into vector form so that they are understood as the models work on mathematical data. The dataset is then split into Train data and Test data so that after training on the training data, evaluation of performance can be done on the test data. This determines if a prediction was correct i.e. True Positives and True Negatives and if it was wrong i.e. False Positives, False

Negatives. The classification model is identified fitting of the model on training data. The model is evaluated on Evaluating model on test data.

221
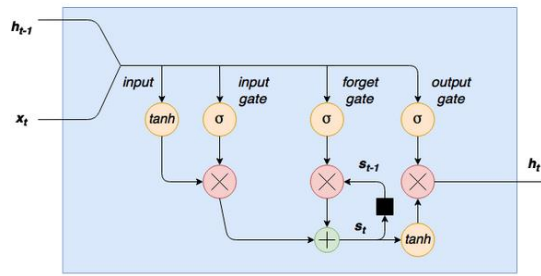
Figure 11. LSTM [23]

The input which is a new word/sequence value *xt is* combined with the *ht−1*, output from the previous cell. This combined input is passed through a squashing tanh layer then the input is passed through an input gate. The output of this layer is multiplied by the squashed input. A recurrence loop is created to maintain the internal state of the cell which allows previous internal state to be combined with output of the forget gate through pointwise multiplication and that output being added with the output from previous step to give the current internal state *st*. Addition instead of multiplication has the effect of reducing the risk of vanishing gradients problem associated with RNNs. This helps in determining what to keep in memory and what to forget. The output gate gives *ht* which becomes *ht−1* into the next cell[23] .

Mathematical Model for LSTM

First, the input is squashed between -1 and 1 using a *tanh* activation function. This is given as:
$$g = tanh(b^g + x_t U^g + h_{t-1} V^g) \qquad (1)$$
Where U^g and V^g are the weights for the input and previous cell output, respectively, and b^g is the input bias.
Element-wise multiplication of squashed input
$$i = \sigma(b^i + x_t U^i + h_{t-1} V^i) \qquad (2)$$
The output of the input section of the LSTM cell is then given by: $g \circ i$
Where the ∘ operator depicts element-wise multiplication.
The forget gate output is expressed as:
$$f = \sigma(b_f + x_t U_f + h_{t-1} V_f) \qquad (3)$$
The following expression gives the output of the element-wise product of the previous state and the forget gate.
$$s_{t-1} \circ f$$
The output from the forget gate / state loop stage is:
$$s_t = s_{t-1} \circ f + g \circ i \qquad (4)$$
The output gate is expressed as:
$$o = \sigma(b^o + x_t U^o + h_{t-1} V^o) \qquad (5)$$
So the final output of the cell , with the *tanh* squashing, can be shown as:
$$h_t = \tanh(s_t) \circ o \qquad (6)$$

Convolutional Neural Networks (CNN)

CNN was originally designed for application in computer vision, but was later applied to NLP problems with great success. A CNN is composed of three types of layers: the convolutional layers, which applies a sliding kernel to a text segment for feature extraction, the nonlinear layers, which applies an activation function to the feature values; and the pooling layers, which aggregates local features into global features. CNN has the advantage of being easy to train due to its application of the weight sharing mechanism achieved through the use of the kernels in the convolutional layer [12].

Results and Discussion
Experiments were carried out on the Promise Dataset which is made up of various types of Software Requirements. The dataset is unbalanced and it contains 557 Non-Security Requirements and 68 Security Requirements. As such the measures used are accuracy, precision, recall and F1-measure. Precision (P) is the proportion of correctly predicted classifications against all predictions for the classification under test:
P=TP/(TP+FP).   (7)
Recall (R) is the proportion of classifications found for the current classification under test:

222

$R = TP/(TP + FN).$ (8)

F1 measure is the harmonic mean of precision and recall, giving equal weight to both.

F-Score $= \frac{2*\text{Recall}*\text{Precision}}{\text{Recall}+\text{Precision}}$ (9)

Classification Accuracy is the ratio of number of correct predictions to the total number of input samples.

Accuracy $= \frac{TP+TN}{Total}$ (10)
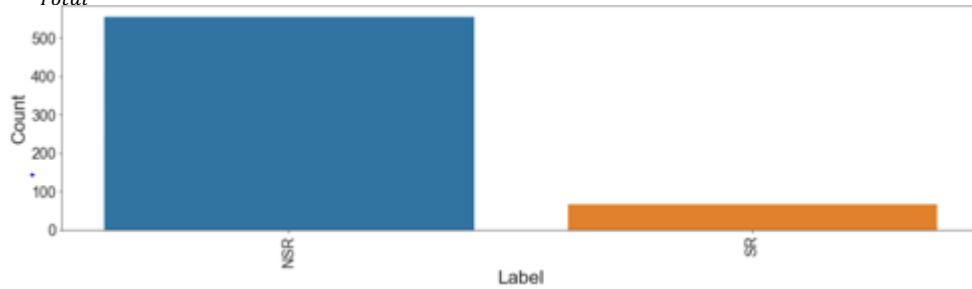
Figure 12. Non-Security Requirements vs Security Requirements in the dataset

The results for Machine Learning Algorithms are shown in Table 1 below. The values remained the same throughout a number of runs. This was noted for both traditional Machine Learning algorithms that is Multinomial Naïve Bayes, Logistic Regression, K-Nearest Neighbours and Decision Tree as well as the Ensemble ones that is Random Forest, Ada Boost, Bagging and Extra Trees classifiers. Among the Machine Learning algorithms, the Ensembles achieved the best performance with Ada Boost topping the list at 95.2 Accuracy score followed by Extra Trees classifier with 93.6, the same score achieved by SVM.

Table 3. Machine Learning Results

Model	Accuracy Score	Model	Accuracy Score
SVM	93.60	Random Forest Classifier	92.80
MultinomialNB	90.40	Ada Boost Classifier	95.20
Logistic Regression	92.80	Bagging Classifier	92.80
KNNeighbors Classifier	86.60	Extra Trees Classifier	93.60
Decision Tree Classifier	91.20		
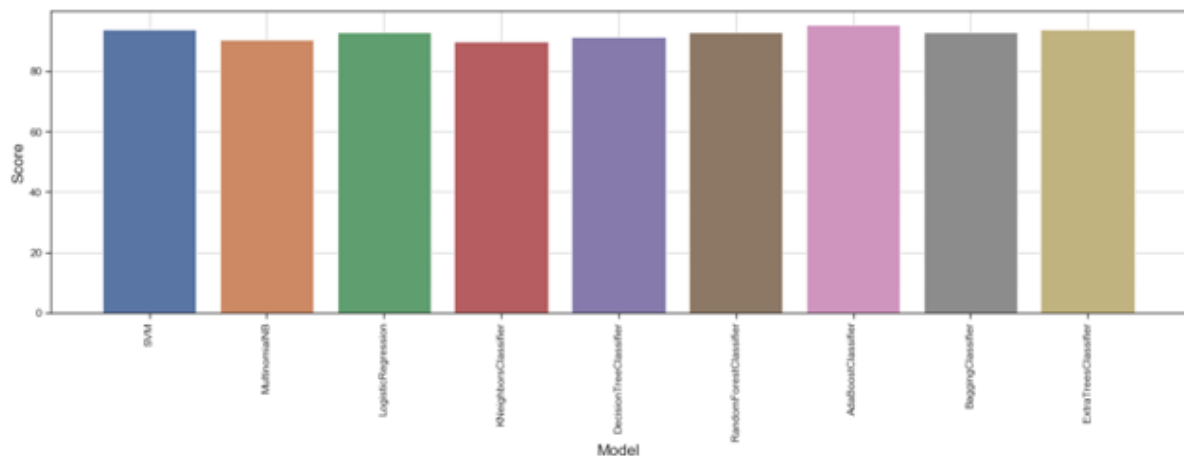
Figure 13. Model Performance

In Deep Learning, the loss function used to evaluate the set of weights is the cross entropy. The optimizer is used to search through different weights for the network and in this work the efficient stochastic gradient descent algorithm "**adam**" was used. The Accuracy score, Precision, Recall and F1 score are the performance metrics used to evaluate the model performance since our data is unbalanced. The experiments were done in cycles. Different results were obtained at each cycle. The best result was recorded for LSTM with an Accuracy of 96.81.The lowest for LSTM was 86.17. CNN had a highest result of 91.49 and a lowest of 82.98.

Table 4. Deep Learning Results

Classifier	Performance	Runs								
		1	2	3	4	5	6	7	8	9
CNN	Accuracy	90.43	87.23	89.36	82.98	87.23	91.49	84.04	91.49	92.55
	Precision	0.90	0.76	0.80	0.70	0.83	0.92	0.72	0.91	0.91
	Recall	0.90	0.87	0.89	0.83	0.87	0.91	0.84	0.90	0.93
	F1-Score	0.89	0.81	0.84	0.76	0.83	0.89	0.78	0.88	0.91
LSTM	Accuracy	87.23	89.36	90.43	86.17	88.30	92.55	88.30	90.43	**96.81**
	Precision	0.86	0.88	0.89	0.86	0.86	0.92	0.90	0.91	**0.97**
	Recall	0.87	0.89	0.90	0.88	0.88	0.93	0.88	0.91	**0.97**
	F1-Score	0.84	0.88	0.88	0.86	0.86	0.91	0.85	0.90	**0.97**

The challenges highlighted by [24] have not spared our work. Issue of reliance on outdated training datasets negatively impacts on the model perfomances especially for supervised learning approaches. Also the size of the dataset has a huge bearing on the overall performance of a Deep Learning model. In this case, the manual creation of similar datasets is an expensive process because they need to be sufficiently large for Deep Learning algorithms to learn the different classes. Furthermore, errors may occur affecting the classification performance.

The proposed Model aids the automatic extraction and classification of SR. It rides on the recent successes in NLP using Deep Learning techniques. This model, if successfully implemented will assist the Software Engineers in the process of identifying the level of security required by each individual software product uniquely, especially in a case where the Engineer lacks security expertise. That will further make the process of identifying suitable security mechanisms easier with the intent of 'building security in' and also reduce the need for human intervention in classifying Security Requirements stated in natural language when software systems are developed.

Conclusion

Experiments conducted showed that LSTM yielded very good results. There is need to apply hyperparameter tuning to improve on the result for LSTM. We also need to increase the size of the dataset through augmentation to improve the classification performance of the models. The task of classification of Security Requirements is a challenging one due to the fact that these requirements are stated in natural language and are usually combined with all other requirements. Security expertise is required to analyse these requirements and it is not always available. The Machine Learning methods evaluated are Multinomial Naïve Bayes, Logistic Regression, K-Nearest Neighbours and Decision Tree as well as the Ensemble ones that is Random Forest, Ada Boost, Bagging and Extra Trees classifiers have been applied to this area. However, these have shortcomings including limitations in ability to process raw high dimensional textual data, requirement of domain knowledge to support pattern recognition from the supplied input and also handcrafting of features. This negatively affects the performance of these techniques in the classification problem. In this work an evaluation was conducted on Machine Learning, Ensemble Learning, as well as on Deep Learning techniques that can be applied in Natural Language Processing tasks for Security Requirements classification. LSTM scored the highest with LSTM with an Accuracy of 96.81% followed by Ada Boost, an ensemble technique with 95.2%. In the future work, more Deep Learning and Reinforcement Learning techniques are going to be explored on the Tera Promise dataset as well as another larger dataset currently being built for the same domain.

References

[1] L. Deng and Y. Liu, *Deep learning in natural language processing*. Springer International Publishing, 2018.

[2] T. Mikolov, "Using Neural Networks for Modelling and Representing Natural Languages," *Faceb. AI Res. COLING*, 2014.

[3] L. Q. V. V Sutskever I , Vinyals O, "Sequence to Sequence Learning with Neural Networks," *Adv. Neural Inf. Process. Syst*, pp. 3104–3112, 2014.

[4] X. Zhao and C. Li, "Deep learning in social computing," in *Deep Learning in Natural Language Processing*, Springer International Publishing, 2018, pp. 255–288.

[5] D. Tang and M. Zhang, "Deep learning in sentiment analysis," in *Deep Learning in Natural Language Processing*, Springer International Publishing, 2018, pp. 219–253.

[6] L. Deng and Y. Liu, "A joint introduction to natural language processing and to deep learning," in *Deep Learning in Natural Language Processing*, Springer International Publishing, 2018, pp. 1–22.

224

[7]   Y. Liu and J. Zhang, "Deep learning in machine translation," in *Deep Learning in Natural Language Processing*, Springer International Publishing, 2018, pp. 147–183.

[8]   G. Tur, A. Celikyilmaz, X. He, D. Hakkani-Tür, and L. Deng, "Deep learning in conversational language understanding," in *Deep Learning in Natural Language Processing*, Springer International Publishing, 2018, pp. 23–48.

[9]   Y. Lecun, Y. Bengio, and G. Hinton, "Deep learning," *Nature*, vol. 521, no. 7553. Nature Publishing Group, pp. 436–444, May 27, 2015, doi: 10.1038/nature14539.

[10]   R. Collobert, J. Weston, J. Com, M. Karlen, K. Kavukcuoglu, and P. Kuksa, "Natural Language Processing (Almost) from Scratch," 2011.

[11]   M. Hafeez, O. Technical, M. Firdaus, and Z. Ministry, "Ambiguous software requirement specification detection : an automated approach Ambiguous Software Requirement Specification Detection : An Automated Approach," no. June, 2018, doi: 10.1145/3195538.3195545.

[12]   S. Minaee, E. Cambria, and J. Gao, "Deep Learning Based Text Classification: A Comprehensive Review," 2020, doi: 10.1145/nnnnnnn.nnnnnnn.

[13]   R. J. A. Jindal, R; Malhotra, "Automated Classification of Security Requirements," *Intl. Conf. Adv. Comput. Commun. Informatics*.

[14]   T. Mikolov, K. Chen, G. Corrado, and J. Dean, "Distributed Representations of Words and Phrases and their Compositionality," *Adv. Neural Inf. Process. Syst.*, pp. 3111–3119, 2013.

[15]   C. Zhou, C. Sun, Z. Liu, and F. C. M. Lau, "A C-LSTM Neural Network for Text Classification," Nov. 2015, Accessed: Aug. 15, 2020. [Online]. Available: http://arxiv.org/abs/1511.08630.

[16]   Z. Zhang, D. Robinson, and J. Tepper, "Detecting hate speech on Twitter using a convolution-GRU based deep neural network," 2018.

[17]   A. Yazidi, H. Hammer, A. Bai, and P. E. Engelstad, "On the feasibility of machine learning as a tool for automatic security classification: A position paper," 2016, doi: 10.1109/ICCNC.2016.7440588.

[18]   M. Riaz, J. King, J. Slankas, and L. Williams, "Hidden in plain sight: Automatically identifying security requirements from natural language artifacts," in *2014 IEEE 22nd International Requirements Engineering Conference, RE 2014 - Proceedings*, Sep. 2014, pp. 183–192, doi: 10.1109/RE.2014.6912260.

[19]   J. Slankas and L. Williams, "Automated extraction of non-functional requirements in available documentation," in *2013 1st International Workshop on Natural Language Analysis in Software Engineering, NaturaLiSE 2013 - Proceedings*, 2013, pp. 9–16, doi: 10.1109/NAturaLiSE.2013.6611715.

[20]   G. Sandhu, A. B. Cse, S. Pal, B. Cse, and P. Pal, "Knowledge Extraction in Requirement Engineering with Machine Learning Perspective," 2015.

[21]   D. Zhang and D. Zhang, "Applying Machine Learning Algorithms In Software Development," *Proc. 2000 MONTEREY Work. Model. Softw. Syst. Struct. A FASTLY Mov. Scenar.*, pp. 275--291, 2000, Accessed: Aug. 15, 2020. [Online]. Available: http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.23.7953.

[22]   A. Vogelsang and M. Borg, "Requirements Engineering for Machine Learning : Perspectives from Data Scientists," 2019.

[23]   "Keras LSTM tutorial - How to easily build a powerful deep learning language model - Adventures in Machine Learning." https://adventuresinmachinelearning.com/keras-lstm-tutorial/ (accessed Aug. 15, 2020).

[24]   G. Apruzzese, M. Colajanni, L. Ferretti, A. Guido, and M. Marchetti, "On the effectiveness of machine and deep learning for cyber security," in *International Conference on Cyber Conflict, CYCON*, Jul. 2018, vol. 2018-May, pp. 371–389, doi: 10.23919/CYCON.2018.8405026.

COMMUNICADO – Messenger Using Adhoc Infrastructure

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Abstract: Authors believe that using dynamic adhoc network architecture can provide secure network communication at places where there is internet monitoring or no physical infrastructure. This paper deals with setting up of communication between devices in a wireless-adhoc environment. Here, Multiple client-side devices can communicate with multiple server-side nodes in an adhoc manner. Such a network would help in avoiding monitoring from Internet Service Providers, Government Entities, and prevent Man-in-the-middle attacks and provide an instant internet replacement for communication. Thus, communication can be established between multiple clients connected with the node. Emergency communication over radio channels can also be implemented in the future on the device by utilizing the LoRA module for long-range data transfer at a lower baud rate. This network is secure due to our use of state-of-the-art encryption protocols to provide end-to-end protection for every message.

Keywords: Wireless adhoc, Security, Raspberry-pi Zero W, Communication, Privacy.

Introduction

Amidst the increase in control over the Internet from Government agencies and large multi-million corporations, communication has become hugely dependent on applications provided by them or indirectly under their control. Such a level of control makes it hard to communicate information that is against them either as a journalist or to criticize them. This spying makes it almost impossible for citizens to form an awareness campaign or carry out peaceful protests which, in turn, hinders the right of freedom of speech and opinion.

Most of the major services can be monitored by these giants and those which cannot be monitored are dismissed, it makes communicating a dire task. When the entire internet is being monitored, there is no other option but to keep the communication off the internet by building a network, a network that is decentralized and under citizen's control.

This paper tries to provide a solution to such a situation by implementing a hardware-based dynamic ad-hoc network that will decentralize the communication and will be separate from the Internet. This network provides secured data transmission and has checks to maintain data integrity. Furthermore, this network's range increases by increasing the number of nodes.

Literature Survey

The main issues with existing systems are the security issues and the power consumption of devices that utilize wireless-adhoc on their devices directly. The constantly changing nature of the network topology coupled with data transmission in an open medium makes it highly susceptible to attacks and increases energy consumption due to its dynamic nature. Security issues concerning data confidentiality, availability of systems and applications, authentication, system integrity are just as threatening as in conventional networks. [1]

Vulnerabilities can lead to message eavesdropping, injection of fake messages, denial of service attack, or poor monitoring of routing information. MITM (Man-in-the-middle), Eavesdropping, Sybil Attack, Impersonation are some of the major attacks that can compromise such a network that is based purely on adhoc without using a node relay mechanism**.** [2, 6]

Challenges, Motivation and Objectives

No centralized administration entity is available to manage the operation of the different mobile nodes, so autonomous administration is required. Devices need to be able to connect and disconnect randomly and it should not affect the network, so implementation of dynamic topology is necessary [3]. Device discovery needs to be done to inform the connection of new users. Limited transmission range imposes a constraint on the usage and thus, it needs to be increased without too great a loss in quality of service. The device needs to run on limited resources and should be scalable to support more devices easily.

Motivation

Having all those implementations on user devices can be difficult as it increases the power consumption and causes the user's device to heat up while also decreasing its routing capability. Thus, adhoc devices need to be separated into nodes to facilitate all these without causing unnecessary strain on user devices.

Objectives
To separate the routing and network maintenance services from communication services for easy scalability.
This will make the end-user deal only with communication while the nodes separate from the user deal with the heavy lifting of maintaining the network.

Concrete objectives

- Creating a set of nodes via arm-based devices that will dynamically link with each other and an application that communicates on these nodes in a decentralized fashion to share data that can be encrypted.
- Protect network connectivity over multi-hop wireless channels.

Methodology
This project has two major bifurcations, one involving devices with arm-based architecture and other involving devices used to interact with them, such as smartphones.
For the hardware devices, raspberry pi zero will be used as nodes and will act as the endpoints for connecting devices such as smartphones which will be further mentioned as the client device.
        The client device will have the front-end of the application which will encrypt the message with the PGP key and the encrypted message will be transmitted to the nearest node of the ad-hoc mesh. This node will act as the messenger node and then pass on the data with its encryption (AES-256) to its next node to pass on the information to the node which is nearest to the destination client. The end node will send the decrypted message to the destination client and the client's device will perform the last decryption using its PGP key to get the resulting message.

This is done by building this using small raspberry pi zero devices using custom ad-hoc routing algorithms which will be used to send the information to the nodes, for the client an application will be used to facilitate the communication.

Hardware Nodes
The software for routing is built with a Linux base built with Debian derived operating system and thus the source code will use a combination of C, C++, and Bash for the binary and the code will also use Python and Nodejs for the various library frameworks required for ad-hoc message transmission.
This device architecture will be replicated with all the other nodes and the resulting mesh network will from now on be referred to as the secured mesh. This secured mesh will only allow the nodes which have communicated its key and have been verified as a secure node. Each secured node will have a dynamic number of nodes determining on its latency of transmission.

Software Client
The software client will be handling the message transmission to other clients and the first of two-point encryption, which is GPG. The client when connected to the adhoc network will get the required IP from the node in which it is connected and after getting the IP the client will provide a socket address from the running service in the node. This running service will then associate the node in question with the established socket address in a HashMap and when another client requests to connect to this client it will be provided with a socket address and thus they can start communication between each other.
For the GPG, the client will have to register itself to provide and publish its key details to the keyserver. When a device needs to send a message to another client this message will be encrypted with the public address of the recipient and thus only the recipient will be able to decrypt the message with their private key.

Flow and Functionality
First, a node is created with the predetermined subnet with pre-shared access key and the adhoc network is established, after the network is established and visible, this node will start the messaging service on one of its fixed ports after checking for free ports. This service will handle the connection handling between the client devices and provide the socket address of the client when it is requested. It does this by maintaining a record of all the connected devices in a HashMap and then returning the port of the client from the registered client list. The registered client list can be hard coded if it is a private network so no new clients other than the ones registered are served.
Multiple such nodes can be established by connecting to this barebone network which enables increases in range, this creates a network of hardware nodes waiting for clients to join and register their details.
 The network infrastructure can be seen in Figure 1, here a client connects to the adhoc network and registers its details

with the node, providing its address. When another client joins the network and wants to communicate with this client, it requests for connection based on the client details and it will be provided the socket address and thus both the clients are connected with the help of the node.

The client-one will then send a message which is encrypted with a PGP key of the client-two user to the node which then encrypts if it's more than one hop away with AES and if it's less than one hop away then transmits it to client-two without AES encryption. The client-two will receive a message from the client-one which then decrypts with its PGP key to receive the message. In a more than one node network, when the message is sent to the entry node and the node checks for the location of the client (further referred as client-three) and determines that it is more than one hop away. It encrypts the data with AES and sends it to the nearest node (entry node). This node will forward the message until the node where the client-three is situated. The final node (destination node) will decrypt the AES message and forward the message to client-three who then proceeds to decrypt the PGP message.

This type of message will thus have end-to-end encryption and will be secure from a man-in-the-middle attack. Though the Quality of Service will decrease due to a bit of latency unless the message is very huge and the client a lot of hops away it would not be too bad.

This can be run on a small power bank as shown in Figure 2.
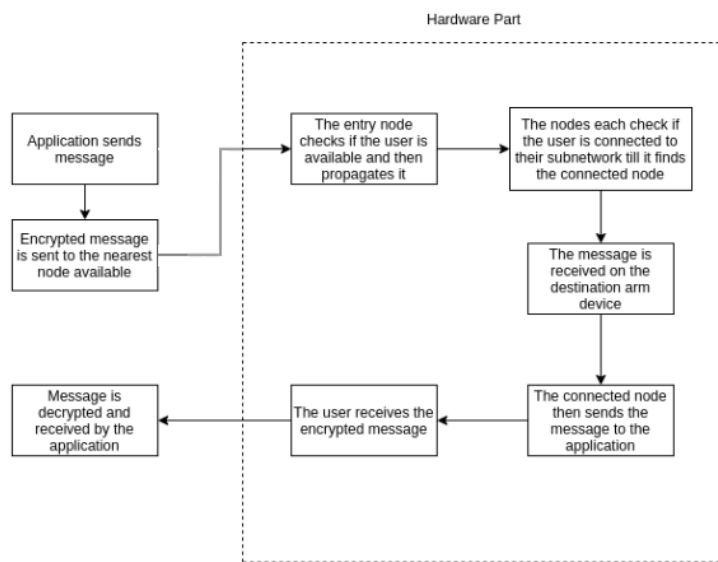
Figure 2. Raspberry pi zero node running on a power bank

Results and discussion

This network architecture can be used for places with active internet monitoring or areas within remote regions where communication is difficult or the cost to set up the network infrastructure is high.

228

This product can be coupled with other similar devices to extend the range of the network but adding more nodes would result in more latency and the Quality of Service (QoS) decreases significantly due to the security overhead as well as the transportation of the data to multiple nodes. Thus it is found that even with the decreased cost of the device and easy configuration it is not feasible to be used for a large number of users spread over a large distance unless it uses better wireless adapters with much farther range than available on the cheap ready to use devices. A NodeMCU can be utilized if a raspberry pi zero (Rpi zero) is not available and range needs to be increased urgently. This will lower the transmission speed, refer Figure 3, but it can be used at places when a suitable arm-based device is not available. Any wireless extender device can be utilized but the authors have considered NodeMCU as it is cheap and widely available and utilizes similar or lower power consumption to raspberry pi zero.

The network runs on very low current and can be used with a power bank, so it is very portable. Thus, energy consumption of the device is very minute and can be deployed as soon as required without any infrastructure delay.
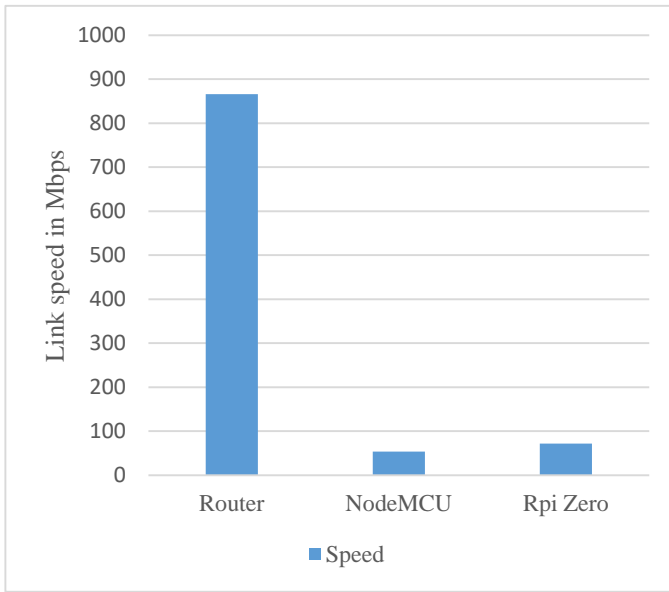
Figure 3. Comparison of network speed
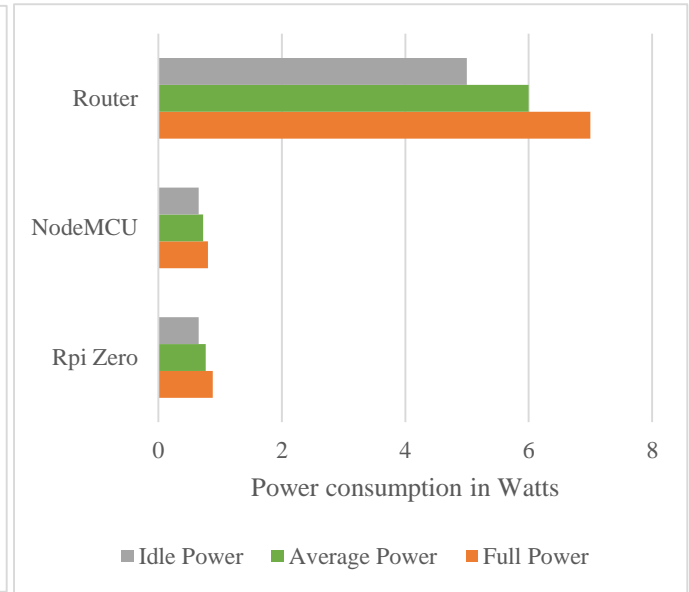
Figure 4. Comparison of power consumption

Table 1. Comparison of Power consumption and network speed

Comparison	Raspberry pi zero	NodeMCU	TP-Link (Gigabit Router)
Link Speed	72Mbps	54Mbps	866Mbps
Avg Power	0.765W	0.725W	6W

As Figure 4 suggests, these nodes consume almost 10 times less energy than a traditional router. Thus, it can safely be assumed that a small battery pack of 1000mAh will be sufficient to run a device for more than one day. This when coupled with its speed, refer Table 1, provides the portability to carry it around easily.

Conclusion

It is understood that its range and QoS are the main bottleneck for such a device and thus it is recommended to use this architecture at places where this would not have a drastic effect.

At a place where there is no network at all, it is much better to utilize a lower bandwidth device which is cheaper than no devices at all. This architecture can be improved much further with various new devices to make communication easier and secure at lower costs.

This architecture can be replicated on larger range devices instead of Wi-Fi which might be a bit more expensive but would provide such a large improvement in the range that it can be utilized for mountainous regions like parts of Uttarakhand, India (where it's very difficult to build a network tower due to landslides and cost). Here, devices that support LoRa (Long-range WAN) can be used and place it near possible areas for cheap and easy replacement.

References

[1] Security Issues with Mobile Ad-Hoc Networks. (2019, February 13). Retrieved from
    https://study.com/academy/lesson/security-issues-with-mobile-ad-hoc-networks.html.
[2] Reddy, K. R. K. (2018). Improved protocol design with security and QoS over MANET. *International Journal of Scientific Research in Computer Science, Engineering and Information Technology*, *3*(1), 735-739.
[3] Asma, A. (2013). Energy efficient routing algorithm for maximizing network lifetime of MANETs. *International Journal of Innovative Research in Computer and Communication Engineering*, *1*(8), 1683-1687.
[4] Sharma, M., Singh, M., Walia, K., & Kaur, K. (2019, October). Comprehensive Study of Routing Protocols in Adhoc Network: MANET. In *2019 IEEE 10th Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON)* (pp. 0792-0798). IEEE.
[6] Arora, S., Nagrath, P., & Aneja, S. (2017, July). Secure encryption protocol for ad hoc networks. In *2017 8th International Conference on Computing, Communication and Networking Technologies (ICCCNT)* (pp. 1-7). IEEE.
[7] Stieglitz, S., Fuchß, C., & Lattemann, C. (2007). Mobile learning by using ad hoc messaging network.
[8] Othman, N. E., Hassan, R., & Hasan, S. S. (2014, December). The impact of mobility models on nodes cooperation in mobile ad hoc networks. In *2014 IEEE Student Conference on Research and Development* (pp. 1-5). IEEE.
[9] Zhang, T., Xu, C., Wu, M., Zhen, Y., Zhang, Q., & Wen, J. (2010, May). Implementation of Ad Hoc Network management system based on embedded ARM-Linux platform. In *2010 International Conference on Networking and Digital Society* (Vol. 1, pp. 167-170). IEEE.

The Evolution of Augmented Reality: A Look Into The Past, Present, and Future

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Abstract: Computers have increased in power but decreased in size. Technology is now mobile and wearable. This modern era of computation has enabled the possibility of the use of Augmented Reality (AR) as a powerful utility tool, enabling millions of users to mix the aspects of the digital world into the physical. The User Interface of Augmented Reality is a new generation of 3D Graphical User Interface (GUI), which is both real-time and context-aware of the environment. Mobile Augmented Reality System (or MARS) provides this service without limiting the user movement. This holds the potential to not only revolutionize the way users interact with technology but also change the means of information presented to us. This article goes into the detailed introduction of AR technology and the subjects surrounding it. This paper starts with a brief overview of its history and origins of Augmented Reality(AR) Technology. It goes through the modern applications which are already beginning to change the way users interact with technology.

Keywords: Augmented Reality, Mixed Reality, AR, Tracking, AR Display, AR Application

Introduction

Augmented Reality is a pseudo interactive experience enabled by machines to enhance real-world environments; the objects in real life may interact with digital objects. This is achieved through computer-generated perceptual information, which is overlaid onto our vision; they may also include auditory interactions to further improve the experience. An AR system must fulfill these three features: It must combine the real world with the virtual world, It must have real-time interactions with accurate 3D registration of the real world around it, and it must overlay sensory information onto the user. Augmented Reality Tracking, Interaction, and Display: A Review of Ten Years of ISMAR [1] Describes Augmented Reality as "a technology that allows computer-generated virtual imagery to exactly overlay physical objects in real-time. Unlike Virtual Reality (VR), where the user is completely immersed in a virtual environment. The main aim of this paper is to look into the lifetime of Augmented Reality and its applications. Discuss how it works and the technologies behind it. This paper hopes to provide an in-depth look at Augmented Reality technology, its history, applications, challenges, and future prospects. Authors have reviewed multiple research papers to look into the technology and software which make Augmented Reality a possibility.

Development of Augmented Reality

One of the first iterations of Augmented Reality(AR) was seen in 1968 by an American computer scientist Ivan Sutherland but the term was later coined by Boeing scientist Tom Caudell in 1990. Louis Rosenberg was the first to create a traditional AR system. It was a fully immersive system is built-in 1992 for the U.S Air Force Research Lab. 1998 would be the first year AR systems would be used for navigation by NASA for their X-38 spacecraft. AR Quake was the first company to showcase an Augmented Reality game in the year 2000. Players had to wear a pack containing sensors. In 2008 BMW was the first company to launch an AR marketing strategy where the printed ads were used to create a 3D model of their car when scanned with their mobile application. 2012 was the year when AR cloud-based systems were spearheaded by Blippar, which enabled internet connectivity. In 2014 Google sold their Google Glass, which was the first attempt at a normalized daily AR experience. Public interest in Augmented Reality hit an all-time high because of Nintendo's hugely popular Pokémon Go, launched in 2016. Millions of players were introduced to this technology, sparking huge research into the field, giving birth to modern AR. The implementation of AR in consumer products requires heavy immersion of the user, thus demands a great refinement of the technology for a un intercepted experience.

Technologies Used in AR

Technologies used in Augmented Reality are varied, there is no standardization as this is a new and upcoming technology. Technologies used in Augmented Reality are looking into more detail below:-
- Hardware: AR hardware components include processor, display, sensors, and input devices. These might also include cameras and MEMS(Micro Electrotechnical Systems) such as Compass(Solid-Stare) and an

Accelerometer equipped with a GPS. Diffractive waveguides and reflective waveguides were used for tracking.

- Display: Technologies used for AR rendering can be Optical Projection system, handheld devices, HUDs or even monitors. These are usually worn on the body of the user. An HMD(Head-mounted device) similar to VR is currently being used in AR.
- HUD: It is a transparent display that presents data in Infront of the user without blocking their line of sight in any significant way. A precursor to the technology was developed to tech pilots for flying planes in the 1950s. It can superimpose visuals over the real world to alter presumption, sensation and the transfer of information.
- Software: Processes such as image registration, computer vision, video tracking enabled by machine learning and AI-enabled AR technology. Recognition consists of two stages: The first stage is to detect interest points and the second step is to identify it.
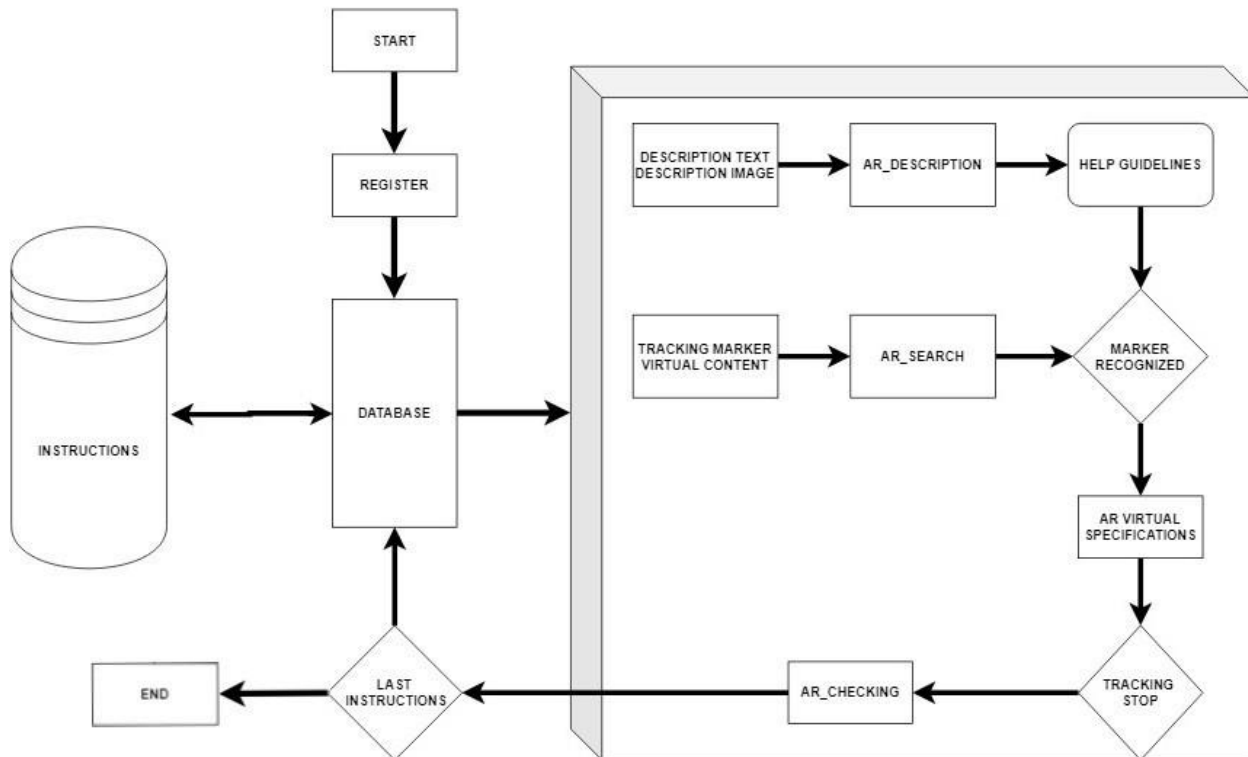
Figure 1. Block Diagram for Augmented Reality (Right Block represents the AR abstraction block)

Related Work

Through the growing adoption of electronics and the Internet, personal computers are becoming all-purpose communication machines, integrating regular tools like telephone, fax, answering machine, and television. Such machines, however, are still limited to the office and will not be accessible to the customer for much of the day. Wearable computing lets users transfer technology from the laptop by creating a networked multimedia device that can be worn as clothing. Augmented Reality focuses on extending the interface between humans and computers via highly developed 3D graphics. In general, however, 95% of the human-computer time is spent on word processing. [9] With the aid of an enhanced wearable environment, word processing is made more interactive and available to users at any time. Besides this watch, text or graphics can be viewed in a proper location, where users find it more convenient. A single-handed chording keyboard is used to enter text in the system described here, though the system can be easily adapted to those instances where speech recognition is appropriate. [3]

AR as an Aid   Remembrance Agents (RA) has many advantages. First, the RA presents the details in good time. If the user writes a paper, then the RA may suggest relevant references. If the user conducts a conversation at a conference with a colleague, the RA could set up relevant associations based on the user's notes. As the RA "thinks"

differently from its user, it sometimes recommends variations that could never be constructed by the user. Thus the RA will function as a "brain-storming" machine constant[3].   While most AR applications target users with normal vision, AR holds the promise to make available a wide range of information to visually impaired people by adding accessible annotations or enhancing physical objects or the environment. The AR enhancement can be provided in a number of ways, for people with imperfect vision, such as speech or audio signals, haptic feedback or image enhancement. OrCam allows the user to point their finger at a location on a document, such as a text region, and have the text read aloud in that region. Lenskart eyewear company, which is an Indian optical prescription eyewear retail chain can be one example that can be observed in our daily lif

AR in Education   Applications for entertainment and education have introduced apps that allow sightseeing and museum guidance, gaming apps using AR interfaces and some smartphone apps that use AR for entertainment and educational purposes. Augmented Reality allows students to walk around the virtual three-dimensional environment and view it from whatever angle the student wants or point of view, much like a real object.   For a variety of factors, the educational experience of Virtual Reality provides is distinctive including:

- Seamless interaction between real and virtual environments is supported.
- Use of tangible interface metaphor to manipulate virtual objects.
- The ability to smoothly transition from Reality to virtual Reality in a seamless Interaction.

Mark Billinghurst 's Truth Increased in Education[2]

AR in the Medical field   Applications in the medical field introduce guiding images and "robot-assisted" surgery.   Numerous projects have been conducted to make AR available with medical imaging aids and resources that improve the cognitive abilities of physicians. The use of different forms of medical imaging and instruments, such as video images captured by an endoscopic camera system displayed on a display that shows the surgical site within the patient, has made a major breakthrough. One of the greatest accomplishments of AR in the medical sector is the use of navigated surgical instruments to improve the physician's view inside the human body during surgery. Teleoperated robot-assisted surgery gives additional benefits to the surgeons with increased precision, flexibility and visualization over minimally invasive surgery.

AR in Assembly of parts during manufacturing   Through AR enabling a sort of virtual visit for engineers and experts proves to be highly beneficial as it saves time if the assembly line unit is in a remote area and requires a long traveling time and it also enables the engineers or experts to virtually visit multiple assembly units in a matter of minutes rather than hours or days of travel. It even reduces the stress of traveling expenses. It indirectly or even directly improves maintenance or efficiency of an assembly unit as engineers and experts can virtually visit in an instance which makes multiple assessments cost-efficient and time-efficient. It proves to be cost-efficient as if a piece of machinery breaks down due to natural or human error it doesn't take much time for AR equipped assessments to assess the error/errors

Training effectiveness in different sectors   Training becomes more effective as somewhat real-time errors can be demonstrated and can virtually be performed without the risk of a real error being present in the practical experiment.
     Real-time training can be done with a bigger degree of freedom and with the luxury of making multiple mistakes without harming the trainee or the equipment.

Rise of Augmented Reality   Up until as recently as the major success of the mobile phone game Pokémon Go launched in 2016 augmented Reality (AR) was brought into the public view, augmented Reality was overlooked against its closely related technology virtual reality (VR). Many in the consumer market were skeptical of AR before Pokémon Go made it popular, and instead, people could see the applications of AR in their daily life.
Niantic's ability to create a game that the vast majority of the fan base of Pokémon could relate to, and the innovative implementation of the technology of Augmented Reality into it, did wonder for the future development of AR and it attracted a lot of investors into this technology. AR went from being unheard of technology to an up and coming technology that one day may even surpass the advancements that VR has managed to achieve. However, such a day is still far away as AR constantly faces challenges throughout its development journey.
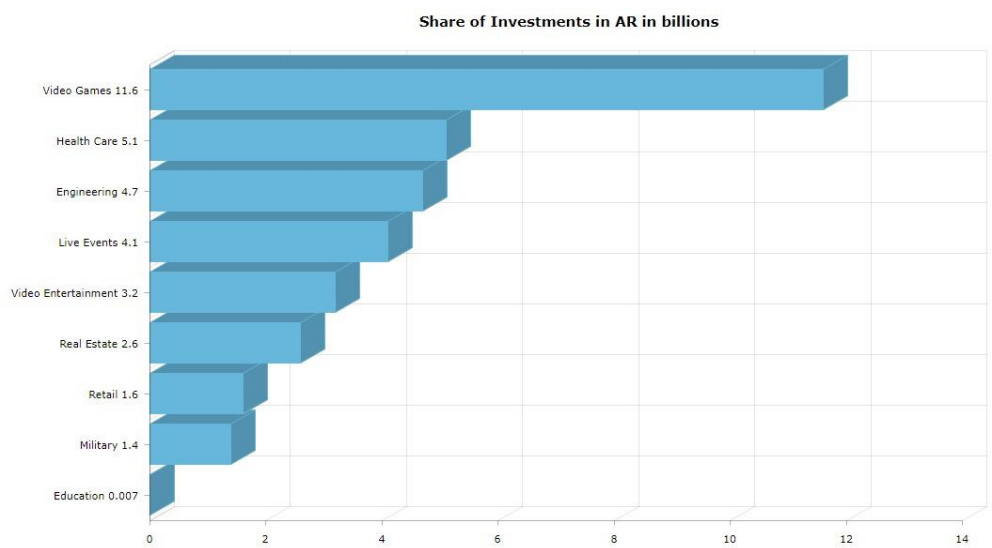
Figure 2. Industrial capital growth in revenue related to Augmented Reality[8]

Restricted Field of View   If one wants to obtain an accurate and meaningful understanding of the surrounding space, a Wide Field of View (FOV) can help a lot. If users are provided with a narrow FOV(field of view), the user is unable to perceive a significant part of their surroundings, and some of it may even be important, for example, the floor or our body. One would lose confidence in oneself if users cannot understand our surroundings correctly. Basic tasks like coordinating hand movements or crossing over a corner may prove to be tricky and challenging when the user is mounted with an AR-enabled camera on their head, with a narrow FOV(field of view), the wider the users' Field of View, the greater will be the accuracy of the depth perception, and the user would be confident while handling themselves. From a young age, users develop a sense of their surroundings and their spatial awareness which must be taken into account when developing for AR as it overlays information over our vision it must be built up and the users must be willing to adapt to this new technology.

Inability to Cast Shadows Accurately   Augmented Reality is still in its developing phases, and despite how well an AR system is developed, currently, it is nearly impossible for it to realistically render shadows to fall on to or cast on real-world 3D objects. This applies to real-time audio-video based augmented reality systems, that have extremely complex real-time and real-world situations. This is a challenge especially with monoscopic videos and even stereoscopic videos, where the shadows need to be projected correctly in order to make the viewing experience enjoyable. A mix-projected shadow or a missing shadow from a mixed reality system can greatly reduce the quality of the produced video.

Privacy Concerns   Privacy Concerns in Augmented Reality Like any other technology that requires video input from users, Augmented Reality has its fair share of concerns that have been raised against it by users. Augmented Reality technologies can see what the user sees; therefore, AR can collect information about who the user is, who do they look like, and what they are doing, in a similar fashion to how social networks collect data about its users. If a hacker with bad intentions gains access to a user's device, that particular user's privacy can be threatened. As people are more inclined to value their privacy, this concern can prove to be a major deterrent to the adoption of the AR technology en masse. One thing that is said to be unique to AR is that not only the user's privacy is affected, but the people in their environment can also have their privacy be affected, as AR technologies automatically screen and process a user's environment. This possible threat of having their privacy affected can have an impact on the relationship of a user of an AR technology with the people around them. In some cases, Google Glass users were assaulted, sometimes physically, by non-users who feared that their privacy was being threatened.

Future scope for AR

It is said that in the coming few years AR will no longer be primarily dominated by Gaming. It is believed by experts that by 2024, healthcare revenue from Augmented Reality will be approximately $6 billion and even some technology

234

insiders have predicted to see the most significant advancements of augmented reality research and development in the healthcare and medical industry. There are numerous AR applications present at hospitals, Surgery and diagnostic doctors, for example, The Accuvein scanner projects via which healthcare works can find suitable veins for IV placement.
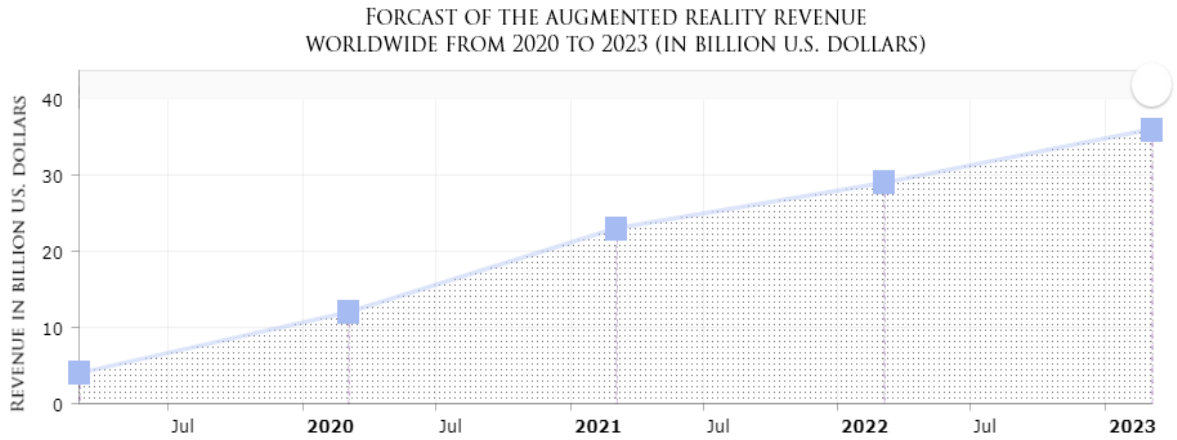
Figure 3. Forecast of Augmented Reality service revenue[10]

Discussions
This paper looked into and gave an overview of Augmented Reality, including its historical developments, current technological and future prospects. When AR becomes commonplace, based on the research data, it will have a significant impact on everyone's daily life akin to mobile phones.
Multiple Research Papers have been studied on Augmented Reality, and the findings are that it is an up and coming field with many areas of interest. There numerous technologies that have made Augmented Reality possible, including but not limited to Machine Learning, Hardware components such as wearable devices, etc. With the rise of wearable computing begins the fulfillment of a truly personal digital technology. Seamless combinations of both the physical world and the virtual realities that would smartly assist the wearer in an intuitive fashion.
There is exciting progress to be made in the areas of computation hardware size reduction (miniaturization) which enables AR devices to be less bulky. The lack of compact batteries has proven to be a significant hurdle for AR deployment to the masses.

Conclusion
This paper has looked at the state of Augmented Reality from its conception in the 1990s to the current date.
Particular focus was placed on the history and applications of AR. Augmented Reality has a huge and widespread potential in all fields and aspects of life. Fortunately, Augmented Reality is getting a massive research influx leading to exponential growth in technologies. It is now extremely easy to create AR enables applications quickly and easily with libraries and APIs like Vuforia which enable widespread use of AR.
The future of AR needs to be growth without compromisation of user privacy and an increase in the ease of use(Comfort). Research and development in the field could have a major impact on not only the basic social structures but also conventions of everyday technology, accompanied by careful consideration of Laws and social equilibrium.

References

[1]   D.W.F. van Krevelen and R. Poelman, A Survey of Augmented Reality Technologies, Applications and Limitations.
[2]   Dusan Tatic and Bojan Tesic, The application of augmented reality technologies for the improvement of occupational safety in an industrial environment.
[3]   Thad Starner, Steve Mann, Bradley Rhodes, Jeffrey Levine Jennifer Healey, Dana Kirsch, Roz Picard, and Alex Pentland, Augmented Reality Through Wearable Computing.
[4] Mark Billinghurst, Hirokazu Kato, Collaborative Augmented Reality.

235

[5]   Julie Carmigniani & Borko Furht & Marco Anisetti & Paolo Ceravolo & Ernesto Damiani & Misa Ivkovic, Augmented reality technologies, systems and applications.

[6]David Drascic and Paul Milgram, Perceptual Issues in Augmented Reality.

[7] Tobias H. Höllerer Steven K. Feiner, Mobile Augmented Reality.

[8]Figure 2: https://lumusvision.com/augmented-reality-trends-infographic/

[9]   Ronald Azuma, Recent Advances in Augmented Reality. HRL Laboratories Yohan Baillot NRL Virtual Reality Lab/ITT Advanced Engineering Reinhold Behringer Rockwell Scientific Steven Feiner Columbia University Simon Julier NRL Virtual Reality Lab/ITT Advanced Engineering Blair MacIntyre Georgia Institute of Technology.

[10] Figure 3: Information gathered from Forbes.com, Author: John Koetsier

[11]   Riccardo Palmarinia, John Ahmet Erkoyuncua , Rajkumar Roya and Hosein Torabmostaedib, A Systematic Review of Augmented Reality applications in Maintenance.

[12]   Feng Zhou1 , Henry Been-Lirn Duh2, Mark Billinghurst, Trends in Augmented Reality Tracking, Interaction and Display: A Review of Ten Years of ISMAR.

[13]Mark Billinghurst, Augmented Reality in Education.

[14]James Coughlan. AR as an Accessibility Tool for People with Visual Impairments

Implementation of Gesture Based Gaming Console in 2D & 3D Games

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Abstract: Game controllers have been planned and improved throughout the years to be as easy to understand as could reasonably be expected. A game controller is a gadget utilized with games or theatre setups to give contribution to a computer game, commonly to control an item or character in the game. Information gadgets that have been named game controllers incorporate consoles, mice, gamepads, joysticks, and so on. A few controllers are intended to be purposely best for one sort of game, for example, guiding wheels for driving games, move cushions for moving games, and light firearms for firing games.The aim here is to create a virtual environment, where the user is appealed by various gesture controls in a gaming application. A Gesture is an action that has to be seen or felt by someone else (here a PC) and has to convey some piece of information. Now obviously, to create a virtual gaming environment, we need to create a real-time gaming application first. We'll be designing our 2D & 3D gaming applications through Unity 3D video game engine. The data used in this project is primarily from the Ego Hands dataset. After an input has been taken, and the consequent action has been performed, we'll use this activity for future development of the model by using TensorFlow. The input will be taken through the webcam of the PC which will be accessed & combined to the gaming application & hands dataset by WebGL. WebGL is a JavaScript API for rendering interactive 2D and 3D graphics within any compatible web browser without the use of plug-ins.

Keywords: Gaming Console, Gesture, TensorFlow, Sensor, WebGL

Introduction

Nowadays virtual environment is considered as a means of efficient human interaction. This is defined by the diversified field of application. The range of applications include phobia therapy, military simulation, medical training etc., We decided to create a button-less model, where we give the commands or inputs to the game by performing gestures in the air. For this, we'll need the help of sensors. The progressive advancements in the field of electronics have led to a still more widening of the spectrum of human computer interaction. The user interface approach of using keyboard, mouse, pen are not catching up to the race. The utilization of hand motions as an information strategy gives human PC cooperation. This will be valuable in controlling gaming applications utilizing hand motions. Game theory is a branch of mathematics that can be utilized to dissect framework tasks in decentralized and self-arranging systems. It depicts the conduct of major parts in a game. Players might be helpful or non-agreeable while endeavouring to boost their results from the game. In such manner sensors deal with their activities regarding power assets gave to detecting and conveying among themselves and with a worldwide regulator to such an extent that the allocated errand could be finished successfully as wanted. In this current work, hand signals are utilized to control 2D and 3D gaming applications.

Literature Review

Keogh B., Queensland University of Technology – Do gesture-based controllers push the right buttons for gamers? [1] — Researchers at Baylor University in the US performed a study that depicted that players get more delight from computer games. Additionally if these computer games utilizes movement and signal regulators which may incorporate Nintendo Wiimote, Microsoft Kinect and Playstation Move or more than from videogames that utilization more customary catch and trigger-based regulators. In a public statement in was educated that their discoveries demonstrate "advancing toward a more normal UI between the player and the game world can make a more vivid, practical, and fun experience".

Pirker J., Graz University of Technology, Austria – Gesture-based Interactions in Video Games with Leap Motion Controller [2] — Introduced in 2013. The Leap Motion is a little gadget. This gadget is to be set confronting upwards with client's console or PC. It use two infrared cameras having a capacity of catching up to 200 casings for every second. Contrasted with Microsoft's Kinect it has a higher movement goal.

The controller is primarily marketed as a device. Later on it was integrated into laptops and other devices by many manufactures like HP. The virtual world enhances with accurate motion detection by use of Leap motion mounted over. The controller is connected to the PC via USB. A software suite is required to be installed ,which contains different playground applications and mini games having simple interactions. These interactions may include activities

loke picking flower leaves and positioning cubes. This paper investigates the Leap Motion controller as motion controlled information gadget for PC games. Human Motion or gesture based connections into two distinctive game arrangements to investigate the appropriateness of this information gadget for intuitive diversion with center around convenience, client commitment, and individual movement control affectability, and contrast it and customary console controls is coordinated. In a first client concentrate with 15 members, they assessed the involvement in the Leap Motion controller in the two diverse game arrangements. The examination results demonstrated ease of use issues. This creates an exhausting experience after around 20 minutes. While the reasonableness for conventional computer games is in this manner depicted as restricted, clients see potential in signal based controls as preparing and restoration devices.

Roccetti M., University of Bologna – Playing into the wild: A motion based interface for gaming openly spaces [3] — Important patterns are unobtrusively rising in the area: game originators, are gradually moving their consideration out of the dividers of gaming fan homes, expanding their inclinations to PC games that can be played in broad daylight spaces, as shows and galleries. Just a restricted measure of examination encounters have considered the issue of delivering PC games, in view of signal based interfaces that well suit such settings. The issue of separating the structure of a signal based interface for a reassure from the issue of planning it for an open space setting has been tended to in this paper. Specifically, it is portrayed the structure and usage of an interface that well suits open vivid situations, since it depends on a straightforward and effective arrangement of calculations which, joined with the insight given by the information on the setting of where a game is played, prompts a quick and hearty translation of hand signals.After realizing what the market currently offers, we thought on this idea of implementing gesture-based gaming using WebGL making the model platform independent. We expected the device to come out as cheap as possible so that it could be mass produced and can be used for number of purposes.

The aim here is to create a virtual environment, where the user is appealed by various gesture controls. A button-less gaming console model is desired to avoid the unnecessary stoppage due to discomfort, and taking the technology in our hands to the next level. This will be achieved by recording user's activity in different types of sensors.
1). Ultrasonic Sensor : It measures distance between an object and the sensor by using ultrasonic waves.
2). Infrared Sensor : It measures the heat of an object as well as detects the motion.
3). Time-of-flight camera (ToF camera) : It is a range imaging camera system that employs time-of-flight techniques to resolve distance between the camera and the subject for each point of the image.
After an input has been taken, and the consequent action has been performed, we'll use this activity for future development of the model by using TensorFlow. TensorFlow is an end-to-end open source platform for machine learning. It has a comprehensive, flexible ecosystem of tools, libraries and community resources.

Now obviously, to create a virtual gaming environment, we need to create a real time gaming application first. This application is designed through Unity 3D video game engine. The language used here is C# (pronounced as C-sharp). A Gesture is an activity that must be seen by another person and needs to pass on some snippet of data. Signal is normally considered as development of part of the body particularly a hand or the head, to communicate the thought or importance. Yet, in this work we are just taking the hand developments in thought. Inspiration for this work originated from a crippled individual who was driving his wheel seat by hand with a considerable amount of trouble. So it was needed to make a gadget which would enable such individuals to drive their seats without wanting to contact the wheels of their seats. Another Objective of this application is to make this gadget straightforward just as modest with the goal that it could be mass-delivered and can be utilized for number of purposes.

Proposed Method
The gesture based gaming console comprises of three major components, gaming applications based on WebGL using Unity Video Engine, hands dataset from EgoHands, and model training using TensorFlow.

Flow of Control & Data
Control and data flow throughout the project that describes the use of various sensors to achieve the target objectives along with steps taken to obtain an accurate classifier.

The control & data flow is illustrated in figure 1. It outlines the basic data flow of the project & how it comes into work. First, an input image of a hand is taken through the PC camera module. Then, the convexity defects of the hand contour are found. It can be depicted as the calculated difference between the convex hull and the contour. The convexity defect is defined as the points farthest from the convex points. So, if the finger tips are considered as the convex points, the trough between the fingers can also be considered as convexity defects. After these convexity

238

defects are found, the fingertips & fingers are determined by studying & analysing the defects & angles. Now that all is in place, hand gestures are identified & recognized using the pinkie, index or thumb. This is how the input is taken, and the corresponding actions is done.
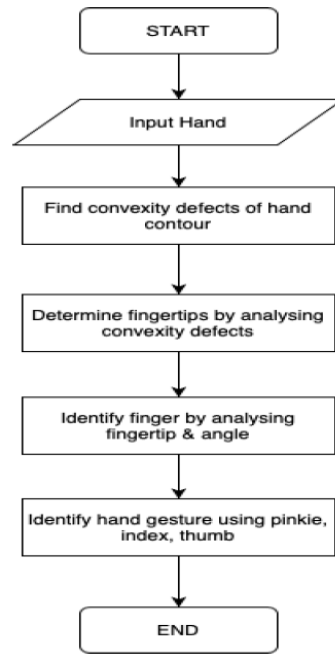
Figure 1. The control & data flow of the model 8

Hands information taken from Ego Hands: The information taken in this work is basically from the EgoHands dataset. This comprises of 4800 pictures of the human hand with jumping enclose explanations different settings (indoor, outside), captured utilizing a Google glass gadget.

Model preparing: A model is prepared to identify hands utilizing the Tensorflow Object Detection API. For this venture, a Single Shot MultiBox Detector (SSD) was utilized with the MobileNetV2 Architecture. Results from the prepared model were then traded as a spared model. Extra subtleties on how the model was prepared can be found here and on the Tensorflow Object Detection API GitHub repo.

WebGL: WebGL is a JavaScript API for delivering intuitive 2D and 3D illustrations inside any viable internet browser without the utilization of modules. WebGL is completely incorporated with other web principles, permitting GPU-quickened use of material science and picture preparing and impacts as a major aspect of the page canvas.

Results
The dataset of the hands and the webcam can be accessed and combined with the code of the games through WebGL. This makes the model cheaper and a lot easier to use for the mass audience. Rather than buying and using all the different kinds of sensors required for gesture controlling, the inbuilt sensors in one's PC can be used as an alternative for a low budget gesture controlled device.
The basic objective of this game is to keep playing as long as one can, pass the levels as they come along. The game itself is very simple. A ball is stuck in a clock. We have to prevent it from touching the hands of the clock. The hour-hand of the clock keep changing its pace and direction randomly. As the player presses a button, or in this case makes a gesture, the ball changes its direction as well and is safe from touching the hour-hand. This keeps going on until the player is unsuccessful to avoid the hour-hand. As we go along, the pace of the hour-hand also increases which makes it harder for the player to avoid contact. Some screenshots of the designed model are shown below. The basic platform designed is shown in Figure 2.
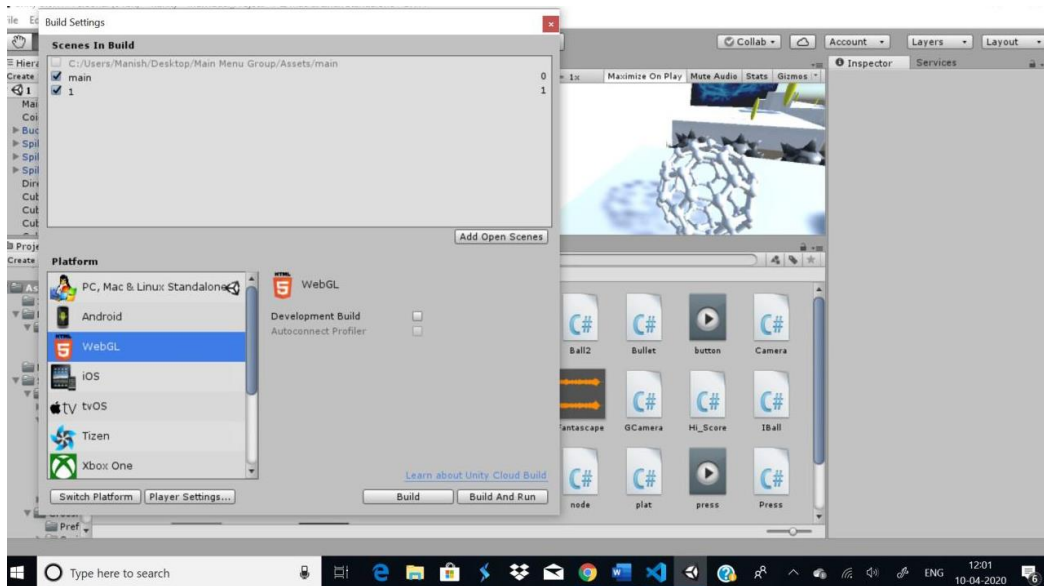
Figure 2. WEBGL platform

A model is trained to detect hands using the TensorFlow Object Detection API. For this project, a Single Shot MultiBox Detector (SSD) was used with the MobileNetV2 Architecture. Results from the trained model were then exported as a saved model. The screenshot for the same is shown in Figure 3. Final layout is shown in Figure 4.
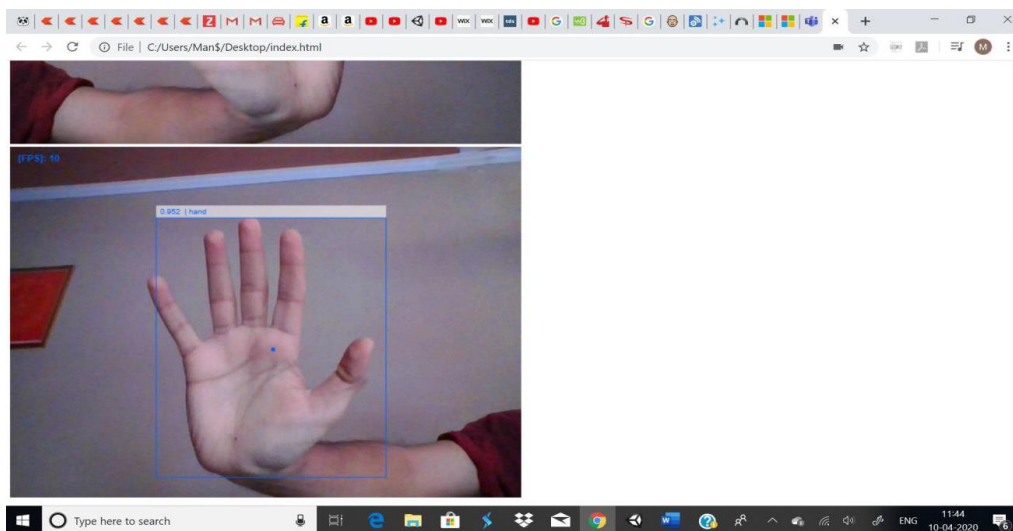
Figure 3. Model training

Conclusions

The objective was met with no extra hardware required. Only a sensors- enabled PC with working webcam is the prerequisite of this model. The code for the 2D & 3D games can be written on Unity using C#. These codes in multiple modules will be combined with the dataset from EgoHands which improves efficiency of the input to the webcam using TensorFlow. The dataset & the gaming application are then accessed by the webcam of the PC, through which the user can input their command for respective movement in an application. Thus bringing out a cheap & ready to make at home gesture based gaming console model. This model can be developed by a normal techie guy with some knowledge about Machine Learning concepts & gaming modules in Unity.

240
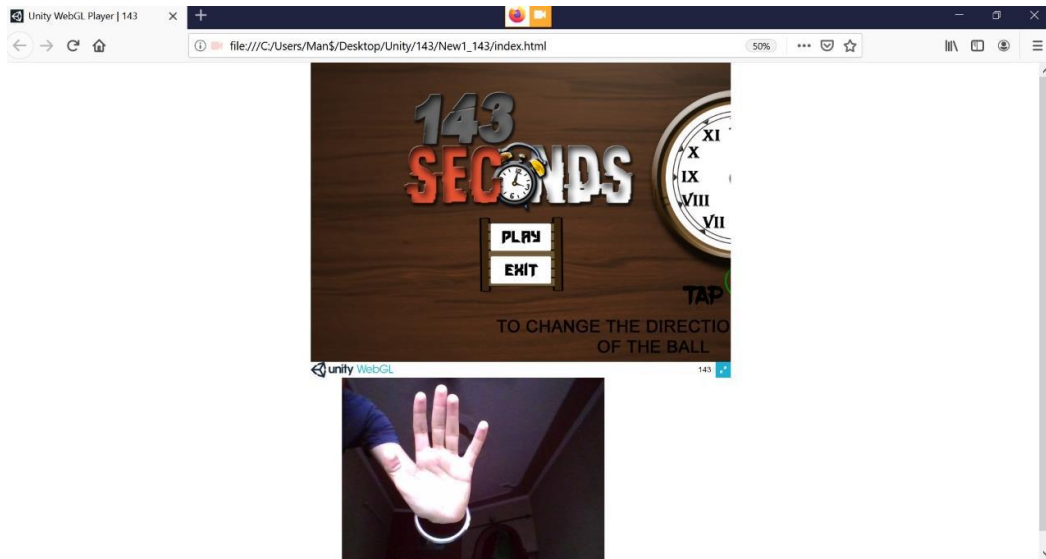
Figure 4. Final layout of the model

References

[1] Keogh B., "Do gesture-based controllers push the right buttons for gamers? "(2012)
[2] Pirker J. et al, "Gesture-based Interactions in Video Games with Leap Motion Controller", International Conference on Human-Computer Interaction (2017)
[3] Roccetti M. at al, "Playing into the wild: A gesture-based interface for gaming in public spaces", Journal of Visual Communication and Image Representation 23(3):426-440 (2011)

The Benefits of Machine Learning in Driving the Business Organizations

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Abstract: Machine learning as a branch of Artificial Intelligence is growing at a very rapid pace. It has shown significant benefits across a number of different industry verticals in helping them improve their productivity and making them less reliant on humans. The success and the growth of any industry depends on the manageability of massive data, using the data for predictions and deriving business value, automating the processes without the need of human intervention, provide satisfactory services to their clients and the security of client's information. Machine learning is a method that provides a way to transform the processes that leads to growth by using the statistical methods. The focus of this paper is to provide an overview of machine learning and highlight the various areas where machine learning is implemented by the business organizations and industries.

Keywords: Machine learning, Supervised learning, Unsupervised learning, Reinforcement learning

Introduction

In today's world, there are a multitude of factors involved in running a business and working towards achieving an incredible growth path. With the processes becoming more complex in nature, there arise a need for leaner, faster and intelligence based decision making activities. Business processes and operational structures need to be efficient as well as effective monetarily. Businesses are processing and generating a huge amount of data with every passing second. Effectively using this data to drive better decision making, providing exemplary customer experience while trying to reduce the underlying costs is the biggest challenge for any organization [1].

The problem lies in creating systems and processes that can understand, process, translate and represent this huge amount of data for the betterment of the organization. The advancement in technology and the evolution of cutting edge technologies like Machine learning, BigData, IoT, Block chain, it has opened a door to drive business intelligence. The e-commerce and retail outlets are generating a massive amount of data with every transaction and machine learning provides an intelligent and scalable way to perform statistical analysis on this data using scientific methods and arrive at any conclusion [2].

Machine learning as a branch of Artificial intelligence is growing at a very rapid rate and business want to cash in any opportunity that they can leverage out of it. Its usage is now in but not limited to manufacturing, educational learning systems, healthcare, banking, agriculture, games etc.

Machine learning can be compared to a human learning. It learns from its experiences without necessary being told to perform a specific task. Machine learning employs the techniques of statistics and uses algorithms to devise a process where the machine tries to learn from its experiences without the intervention of any human being. The main aim of machine learning is to make computers learn automatically. Learning for a computer means findings patterns in data is provided with, process it, and conclude something meaningful [2,3].

Working of Machine Learning Systems

Machine learning works by providing the training data to a learning algorithm. The learning algorithm works on the data and using the inference mechanism, it generates a new set of rules. These set of rules are known as Machine learning model. Generation of a model depends on the kind of training dataset being used. Same learning algorithm can be used to generated different models depending on the input data provided to it [3].

Firstly, the data is acquired from many sources like database, sensors , files and so on with large values , missing values or noisy data to obtain the outcome through time stamps and labels.

Once the data is prepared, The Training process is done by making the system learn with supervised or unsupervised methods like clustering , Classification etc. Hence an appropriate method is chosen to train the model. Since the method is selected, now we need to validate the method through machine learning by generating the results. If the results obtained are as desired, then the process is further send for the analysis.

242
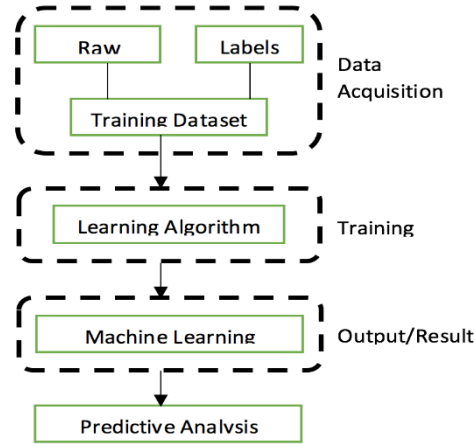
Figure 1. Stages of Machine Learning

In mathematical terms, this can be represented with a linear equation as:

$y = f(x) + e$

It can be described as creating a function which maps the input variable x to an output variable y with possibility of some error anomaly as e. Here, x can be understood as the input data. Function f can be referred to as the learning algorithm and the variable y is the resulting machine learning model getting generated. In order to minimize the value of e i.e. error value, the more data is passed to the learning algorithm, the more accurate is the resultant model.

Components of a Machine Learning System

To the core of any machine learning system lies the machine learning algorithm and the input data, also known as training dataset. In this era of automation, building an enterprise level machine learning systems requires processes, build and deployment pipelines which can automate the whole process. Also, as any business employing the machine learning techniques would require to use more than one such systems. So, the need of processes which can iteratively perform such actions not just save the time, but also the cost required to again start from scratch [4].

For businesses processing a large amount of data, a single machine would probably not be able to provide the computing power to execute the algorithm. A tool to scale up and down the systems in terms of infrastructure fulfills this requirement. The output of all such machine learning systems is to produce a machine learning model as an output which can be used to make predictive analysis [5].
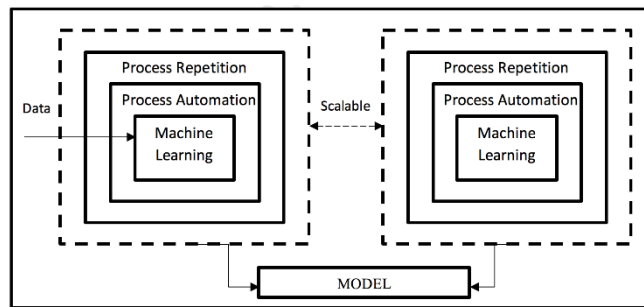
Figure 2. Machine Learning systems

Machine Learning Algorithms

There are different classifications of machine learning algorithms as given below:

1. Supervised Learning: In this method of machine learning implementation, both input and output are provided to the algorithm. Feedback loops are also incorporated. For E.g., an image of a car could be provided as an input and output as a car, it will supervise or help the algorithm to identify the rules to classify any object as a car.

2. Un-supervised learning: In this type of machine learning method, no label is provided on the input data and the algorithm has to find its own ways to discover patterns in the input data.
3. Reinforcement learning: It works on a basic concept of rewards and punishments in which an agent interacts and operates within an environment and automatically determine the best possible action to maximize the performance. An agent is essentially a computer program.
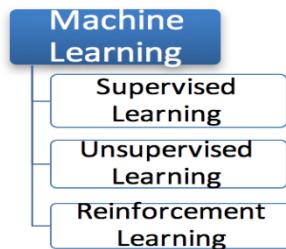
Figure 3. Types of Machine Learning Algorithms [4]

Use of Machine Learning in Business
Businesses today employs a number of sophisticated machine learning methods to aid in decision making, customer satisfaction, fraud detection and even the kind of music someone listens. These systems enable any organization to take informed decisions which are statically calculated and are way faster than the manual decision making processes [5,6]. Businesses which employs the machine learning methods falls within but not limited to agriculture, medical and healthcare, security, fraud prevention, spam detection etc. [7,8]
Some of the major applications of machine learning across different businesses are [9,10,11]:
• *Medical and Healthcare:* There are a number of applications of ML in medical and healthcare research, management, diagnosis etc. Cancer research is one such major area where medical researchers are trying to figure out the exact causes of the disease and also the ways to develop advanced cures. Machine learning methods are playing a major role in the research as for the development of any cure, humongous amount of data has to be processed and analyzed. IBM Watson Genomics is an example of such systems which are helping to detect these otherwise hard to diagnose diseases. These methods are mostly unsupervised learning as no previous patterns or results are known. ML methods are also used to predict chronic diseases, to find ways to reduce the hospital stay of any patient, to reduce the hospital readmissions etc.
• *Agriculture:* In Indian context, agriculture is still mostly dependent on manual labor. Machine learning methods have gained a lot of momentum in agriculture fields recently which could be a game changer in the field. ML methods are being employed to create smart robots which can substitute a human being in the process of picking fruits, germination etc. Automating the irrigation systems is another important application which makes use of the data gathered from soil (moisture, mineral content etc), weather, crop cycles and many more factors to decide the amount of irrigation required for a better yield. This is very useful in recent times seeing the water scarcity problem across the world.
• *Education:* ML systems are helping teachers in student's assessment, gathering detailed insights about the topics where students are lacking, predicting student performance. It is also helping students to make use of customized learning materials according to the preferences and post analyzing the student expertise in a particular topic.
• *Stock Trading Industry:* Companies using cutting edge technologies are using Machine learning models for stock market prediction and algorithmic trading. They heavily rely on the previous trade history, market growth and downfall patterns per stock, using sophisticated statistical techniques specially designed for stock data analysis. ML systems are particularly useful in making decision making very quickly as while doing the trades, even the milliseconds matter to book a good trade. It has provided the capability to automatically buy and sell stocks without the need of any human intervention.
• *Oil and Gas:* Implementations in Oil and Gas are vast and providing cost cutting solutions across the industry. ML systems are being used to analyze the underground mineral deposits, finding the new energy sources, maintaining the oil and gas distribution channels, predicting the energy demands.
• *Transportation:* Cab aggregators are using ML models in a number of activities including booking a cab, prediction of destination, location determination, optimized route based on the traffic data analysis and previous traffic patterns. This has resulted in more accurate pickup and drops.

244

• *Retail:* The applications of ML systems in retail industry, both e-commerce and store based are humongous. Companies are using these systems to analyze consumer shopping patterns, suggestion engines, pricing strategies, spending pattern analysis etc. The data from products being purchased is used to build product development and marketing strategies.

• *Credit Industry:* Credit industries being risk prone business have always used techniques to determine the credit worthiness before approving or denying the loans. This process used to be time taking due to the number of data points the companies had to analyze. ML systems are now being used in many places to determine the credit patterns of a consumer, spending patterns, current financial health and habits to process a loan application.

• *Core Banking:* ML systems are helping banking institutions tackle with money laundering prevention, fraud detection, trade settlements, network security amongst many. These systems are helping banks cut time and money previously spent to perform these tedious tasks.

• *Fashion Industry:* Within the fashion industry, ML systems are providing benefit to customers by providing them suggestions regarding the fashion to opt according to their body dimensions and fashion styles. In addition to this, fashion brands are getting useful insights from the data regarding customer choices, brands and styles that are more in demand, changes required to a particular product as per the fitting sizes.

• *Customer Support Industry:* Chat-bots are the new common while connecting to any major customer service center. Instead of having a human at the end of chats, companies are engaging ML enabled chat-bot systems. These systems use the previous chat history as well as previous interaction pattern analysis to help and support the end customers.

• *Security Industry:* Some of the applications of machine learning in security industry are Image recognition, voice recognition, surveillance. ML systems are proving to be very useful in large scale monitoring where the data to be processed are captured from various sources such as security cameras, voice recordings, drones and then fed into the ML systems to prevent any unwanted or illegal activity. As compared to humans, these systems are capable of processing the data very rapidly and providing more accurate results.

Conclusion

Machine learning as a part of Artificial Intelligence can be compared to data mining to analyze and extract useful information from the available data. The business activities/organizations are dealing with huge amount of data on a daily basis. The growth of these business organizations depend on how qualitative they process this huge data for their growth. Using machine learning methods helps the organizations and industries to take better decisions quickly, define the growth strategy, perform predictive analysis, benefit monetarily in terms of cost reduction and perform operations similar to a human without actual human involvement. Machine learning is showing huge potential in driving future processes.

References

[1] R. Cioffi, M. Travaglioni, G. Piscitelli, A. Petrillo and F. De Felice, "*Artificial Intelligence and Machine Learning Applications in Smart Production: Progress, Trends, and Directions*", Sustainability, vol. 12, no. 2, p. 492, 2020. Available: 10.3390/su12020492.

[2] M. Attaran and P. Deb, "*Machine Learning: The New 'Big Thing' for Competitive Advantage", International Journal of Knowledge Engineering and Data Mining*, vol. 5, no. 1, p. 1, 2018. Available: 10.1504/ijkedm.2018.10015621.

[3] Das, K. and Beher, R.N. (2017) 'A survey on machine learning: concept, algorithms and applications', *International Journal of Innovative Research in Computer and Communication Engineering*, February, Vol. 5, No. 2, pp.1301–1309.

[4] Carvalho, T.P.; Soares, F.A.A.M.N.; Vita, R.; da Francisco, P.R.; Basto, J.P.; Alcalá, S.G.S. *A systematic literature review of machine learning methods applied to predictive maintenance*. Comput. Ind. Eng. 2019, 1, 1–12.

[5] N. Soni, E. Sharma, N. Singh and A. Kapoor, "Artificial Intelligence in Business: From Research and Innovation to Market Deployment", Procedia Computer Science, vol. 167, pp. 2200-2210, 2020. Available: 10.1016/j.procs.2020.03.272

[6] Faggella, "*How to Apply Machine Learning to Business Problems", Emerj, 2020*. [Online]. Available: https://emerj.com/ai-executive-guides/how-to-apply-machine-learning-to-business-problems

[7] C. Services, C. Tool, P. Courage, O. Offerings and D. Platform, "*Real-World Benefits of Machine Learning in Healthcare"*, Health Catalyst, 2020. [Online]. Available: https://www.healthcatalyst.com/clinical-applications-of-machine-learning-in-healthcare.

[8] F. Weber and R. Schütte, "*A Domain-Oriented Analysis of the Impact of Machine Learning—The Case of Retailing", Big Data and Cognitive Computing*, vol. 3, no. 1, p. 11, 2019. Available: 10.3390/bdcc3010011.

[9] L. Mˇaruˌster, "*A machine learning approach to understand business processes*", CIP-DATA LIBRARY TECHNISCHE UNIVERSITEIT EINDHOVEN, 2003, ISBN 90-386-1688-0 NUR 982

[10]Machine Learning for Business", Medium, 2020. [Online]. Available: https://medium.com/mindsdb/machine-learning-for-business-c24cb198dbb5

[11]Wuest, T.; Weimer, D.; Irgens, C.; Thoben, K.D. *Machine learning in manufacturing: Advantages, challenges, and applications.* Prod. Manuf. Res. 2016, 4, 23–45

GST Accounting And Billing System

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Abstract: Goods and Services Tax (GST) Accounting and Billing System is arguably one of the most complex Information Technology (IT) Systems in the world – in terms of scale, size, and complexity. Under Goods and Services Tax, the returns of the buyer's will be auto filled by data from the returns done by sellers and invoices uploaded by him. The software will have to match the data automatically from the returns and uploaded invoices and accept/deny/modify these invoices. The uploading of duplicate invoice is not allowed by the Goods and Services Tax system. All payments, uploading of invoices and filing of returns will have to be done electronically by all taxpayers only through the Goods and Services Tax portal. Access to and use of technology is therefore crucial for all taxpayers registered with the Goods and Services Tax Network, without which they cannot conduct business. This paper intents a proper invoice generation through the software and application that will be uploaded on the Goods and Services Tax Portal for filing Income Tax Returns.

Keywords: Goods and Services Tax (GST), Billing, Accounting, Tax, Calculations

Introduction
Goods and Services Tax is a huge idea that streamlines the bigger indirect tax structure by supporting and upgrading the monetary development of a nation. The software and application are developed for making the tax paying experience smooth for small scale businesses. India adapted a dual GST model wherein transactions within a single state are levies with Central Goods and Service Tax (CGST) and State Goods and Service Tax (SGST) and inter-state transactions are levied with IGST. Introduction of Goods and Services Tax (GST) had various positive and negative impacts on various sectors like Manufacturers, Distributors and Retailers, Logistics, E-Commerce, Textile industry, Agriculture, Automobiles, etc. The two main types of Goods and Services Tax (GST) invoicing for small and medium scale businesses is B2B (Manufacturer and Whole seller) and B2C (Retailers) [Koch, 2017]. B2B includes the invoices which the manufacturer sends to the whole seller on purchase of goods by the whole seller and B2C includes the invoices which the whole seller maintains selling the goods to the retailers. The whole process of tax filing with GST and network comes under GSTN (Goods and Services Tax Network). Management of the whole IT system of GST portal is done by GSTN, and government tracks every financial transaction using this portal, and services such as registration, filing and maintaining all the tax details is provided to the tax.

Tax that is not directly imposed on the supply of good and services is called as Goods and Services Tax (GST). Sectors such as Petroleum, Liquor and Gas are not part of this tax process. The imposition of this tax is at the end of the year, so it is a destination-based tax and not like previous taxes. It is a multi-staged tax as it is imposed and refunded to all manufacturing parties in the process except the final consumer. In India, the administration of this tax is done by both Central and State Governments which is termed as dual GST model.

Literature Review
P Jayalakshmi (2018) specified all the restrictions during the introduction of GST faced by the retailers. The latest GST standards are being followed by the retailers, they will be acquainted with an absolutely new arrangement of documenting their annual Tax return with new section courses of action and this exertion is to be done online utilizing some product for generating bill and afterward transferring it to the GST portal. Along these lines, all the issues looked by the little retailers in the zone of Visakhapatnam and the impact on their business are talked about in this paper [Jayalakshmi, 2018].

R Kanda et al. (2018), published a paper which concentrated on the influence of GST on merchants and suppliers from the area of lower Himachal Pradesh including districts such as Hamirpur, Uma, Mandi, Dharamshala and Bilaspur. To compute the impact of GST some indicators were used such as Alertness about GST, GST's Financial Literacy Level, judgement regarding efficacy of the Taxation system, smoothness provided in assisting in shaving processes by the respective authorities, apparent intricacy of the lawful edifice of this taxation system. The conclusions clearly suggested that small businessmen and retailers in the area suffered due to the introduction of new Taxation system as they did not have a clear idea and proper knowledge about the same [Kanda, 2018].

M Sharma et al (2014) published a paper under the title "A Study on Goods and Services Tax in India" where they discussed about the present status about GST in 2014 and also explained about the various benefits those would come along with GST implementation in India. They also discussed about the current scenario with GST in the country back then and various Cons of GST. They concluded their review with the ending note that after GST implementation there will be reduction of cascading effect problems, evasion of tax and distortion to the maximum [Sharma,2014].

Girish Garg (2014) explained in his article titled "Basic Concepts and features of Goods and Service Tax in India" that what would be the impact on the Tax scenario in India after the implementation of GST. He analysed different types of problems, Pros and Cons, challenges, and the objectives of the implementation of GST in India. The research winded up explaining the GST impact on different variety of industries like FMCG, food, housing, and construction and on the industries providing services financially [Girish,2014].

Proposed System

A.   Problem Statement:

Manual systems are being used for accounting and billing by most of the small and medium scale businessman today which has a lot of shortcomings like manual bookkeeping takes a lot of time. To search for the requested information by the executives, accountants may need to go through multiple documents. Organizations might not be able to keep workers from exploring delicate information in paper records and journals. Additionally, the documents that are duplicated and put away on a PC may likewise be less secure. This may permit the workers to abuse monetary data through misrepresentation or misappropriation.

Mistakes can be very basic in manual accounting forms. Regular blunders are entering data into inaccurate records, translating figures, and recording data in reverse. Since these mistakes are likewise in current bookkeeping frameworks, manual frameworks have no inside balanced governance. Bookkeepers investigating on mistakes frequently go through various hours to find and right these sections. Multiple accountants working in several manual accounting ledgers can worsen these problems.

B.   Objectives:

The system is aimed at generating invoices and internet connectivity is not required for this. It will generate all your invoices of a month and all the GST report of that month will be stored in an excel sheet. GST calculation of the whole month also becomes just one click away as all the data of that month is stored in a single excel sheet.

C.   System Design and its modules:

The proposed system is designed once and the updating can be done several times, so for the maintenance of the software and its usage there is less burden as specific guidelines need to be followed to do it. It can add up to a maximum of two users and perform functions like generating an invoice, adding seller data, analyzing GST, and arranging data (Accounting). When the user creates an invoice for a particular month, an excel sheet of the respective month is automatically created and all the details in the invoices of that particular month will get stored in the excel sheet of that month only. Then, after all the details of the invoices of a month are stored in the excel sheet, GST of that month is calculated.

The modules for the System can be given as below:

Creating an Invoice which takes all the necessary details required for an invoice as input and an invoice is generated in a predefined PDF structure.

Managing Seller Data takes all the seller details and calculates Input Tax Credit. The different formats are used to save the details corresponding to GSTR2 format and distinct excel sheet formats are used to store those files which is termed as 'year' and 'months'.

Calculating GST, this calculates GST for a period of one month and generates a .csv file. This information can then be uploaded to GST offline tool which produces a .json file which in turn is shared on GST portal.

Arrange Data recapitulates over a customer catalog to examine files which are used during the handling of user data. Figure 1 is the flow chart to the architecture for the proposed system with different modules where 'User' is the client using the 'Software' created with platform Openpyxl Python. Moving to the next layer, a new user can be created, customer to the client. This user can be deleted, and details can be edited at any point of time. For the further calculations 'User1' has been created for whom bill creation. The user can create the bill for the registered client, can insert and arrange seller's data and calculate GST for complete month.
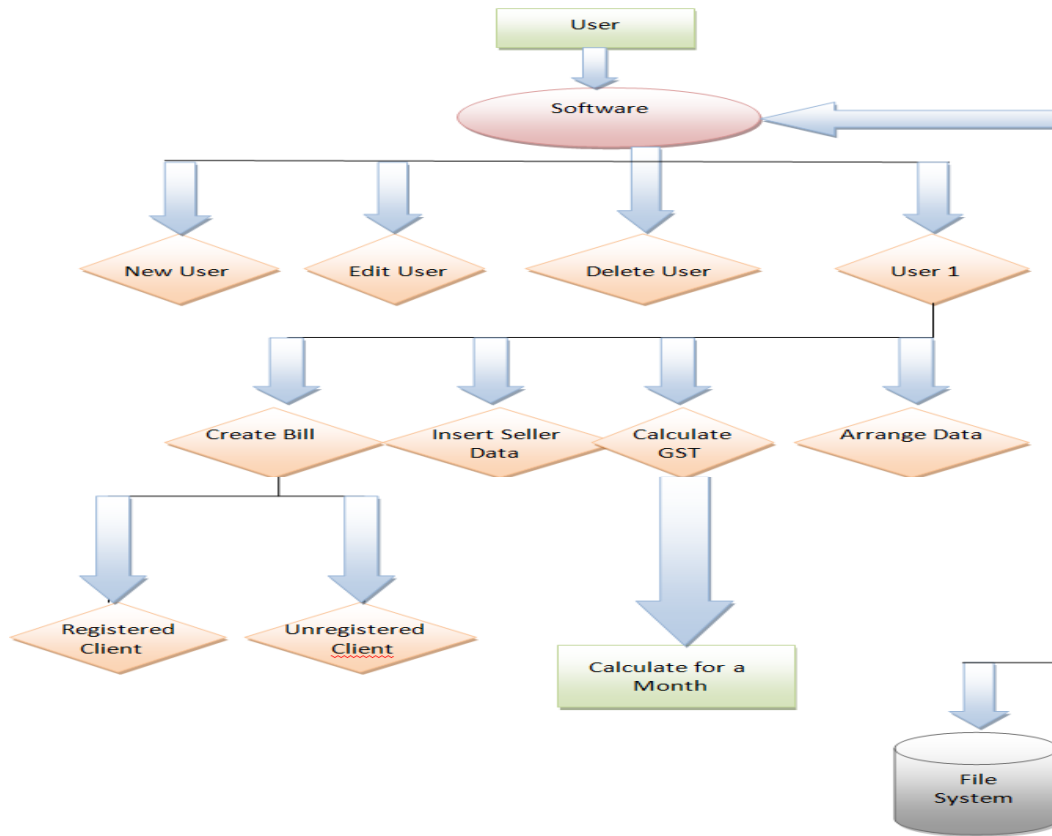
Figure 1. Proposed Architecture

Conclusion

In this plan, an effective method has been proposed for Invoicing and Billing of GST for purchase and sales. The authors have developed a system which Creates Invoices, Calculates GST and Arranges Data and excel sheets of the reports. Doing manual calculation and maintaining reports is a very difficult task which was a very common practice before the introduction of GST, so this system is designed so that manual work is reduces and it will also save time and produce data reports efficiently. It can be used both as software and a mobile application, the difference is just that one cannot maintain records in the application; it is used only for Invoice generation.

References

1. Jayalaxmi, D.P. (2018), "GST- Its impact on Consumer Goods Retailers", International Journal of Research in Education and Psychology, vol. 4, no. 2, pp. 6.
2. Koch, B. (2017), "E-invoicing/E-billing," Billentis, Switzerland.
3. Kanda, R., Handa, H., Kumar, V. and Bhalla, G.S. (2018), "Impact of GST on the Working of Rural India", International Journal of Management, vol. 6, no. 1, pp. 26.
4. Garg, G. (2014), "Basic Concepts and Features of Good and Service Tax in India", International Journal of Scientific Research and Management, vol. 2, no. 2. Retrieved from https://www.ijsrm.in/index.php/ijsrm/article/view/66.
5. Manyal, B. and Nagpal, A. (2014), "GST on e-commerce in retail sector: BOON or BANE", XVII Annual International Seminar Proceedings, pp. 1058-1067.
6. Sharma, M. and Neha (2014), "A study on Goods and Services Tax in India", The International Journal's Research Journal of Social Science and Management, vol. 3, no. 10.

Biometric Systems and Attributes: A Review

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Abstract: Biometrics has become an essential part of our lives. It has evolved significantly over past few decades. From unlocking of phone to marking attendance in office and making bank transactions, everything has been automated with the use of biometrics. A lot of biometric attributes are in use with each having its own pros and cons. This paper presents a study of different biometrics and their features.

Keywords: Biometrics, security, forgery, signature, hand vein, finger print.

Introduction: Security has become an attention seeking concern these days with an advent in the area of information technology. It's an era of secure automations with so much dependency on technology that a small error may lead to loss of personal data. All of these automations require user confirmations to provide the access which can be accomplished by using some sort of keywords or passwords [1].Traditional methods fail to provide the desired security level for highly important and confidential data. So, it was the need of an hour to switch to some other attribute for identification of a person which assures better security along with user convenience.

The best way to improve security is by identifying or verifying the person with some technique. The science of identifying or verifying a person based on physiological or behavioral trait is known as biometrics. Fingerprints, iris, face, veins come under physiological biometrics and gait, voice, DNA comes under behavioral biometrics.

The necessity of biometrics has been imposed by access management system which requires accurate identification of a person for several large scale applications. The most important step in this is the verification of claimer's identity. This is done to protect the important resources from impostors. Traditionally an identity card or password was used for this purpose but it came with the shortcoming of being lost, stolen, shared or forged. Mere forgetting the password or losing the identity card may deny the genuine user to forbid the access. Biometric has emerged as a reliable and automated authentication attribute that can't be shared, stolen, forged or forgotten [2]. Figure 1 shows the traditional and biometrics based authentication system.

In addition to these, biometric system is user-convenient as any identity card or password need not be kept safe or remembered all the times.

(a)   (b)

Figure 1. Authentication Systems (a) Traditional system using ID card and Password (b) Biometric based Authentication System [2]

Biometric Based Authentication System

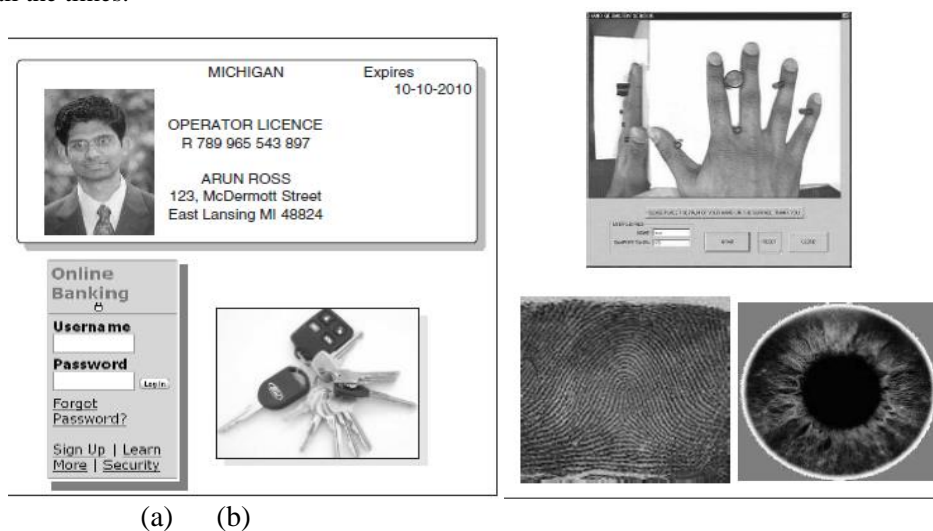An authentication system based on biometric attribute acquires the data from an individual, extracts unique features from it and compares the extracted features with the ones preserved in its database. The decision regarding authenticity of a person is made based upon the comparison result. So, a general authentication system consists of four major modules: data acquisition module, feature extraction module, matching module and database module.

Data acquisition module

An appropriate sensor that may be a scanner or camera is used to obtain the original biometric data of an individual. Figure 2 shows most commonly used biometric attributes for authentication systems.

The quality of data depends upon the characteristics of sensor technology used. Now-a-days, camera is being used to acquire most of the physiological attribute as the data is required in form of images. So, a good quality camera resolves the problem of obtaining a fine data from an individual. Sometimes, a pre-processing algorithm is applied to improve the quality of data. However, in few cases where the quality of data is compromising, the biometric data is collected again from the user.

Feature Extraction Module

The pre-processed biometric data is then processed using some algorithm and a set of unique features is extracted from it. The feature set varies from attribute to attribute and even different feature sets may be extracted from the same attribute by different researchers. For example, in a signature verification system, height, width and area are extracted as features[3]. These feature sets are then stored as template in database during the enrolment phase.

Matching Module

It matches the feature set of presented data with the stored templates and calculates a similarity index between them. This similarity index is used to validate a person's identity.

Database Module

The database module stores all the biometric information. During the enrolment phase, the feature set extracted from the raw samples are stored as templates along with some personal information like name, address, contact number etc. So, every user needs to get enrolled first so that his/her template and personal information gets stored in the database module. After enrolment, he/she may be authenticated to get the desired access.

Commonly Used Biometric Attributes

A lot of physiological and behavioral attributes are used for biometric system. Figure 2 depicts some of the majorly used biometric attributes. The major characteristics of some of these are explained as under:

(a) Fingerprint: Fingerprint is the most widely used biometric attribute. It is preferred due to its uniqueness, ease to capture, performance and cost effectiveness. It is extensively used for forensic applications but it is widely used in other applications like access control, financial transactions, adhaar card etc. With its popularity and demand, it has become an identity card which people carry all the time. This creates a huge demand of automatic fingerprint identification systems. However, it needs to be combined with other biometric traits to increase its reliability at a cost of increased complexity and price [4].A simple cut or moisture in the skin may lead to its failure. The major problem associated with it is forgery. It can be replicated easily which leads to security issues.

(b) Ear: Ear-based biometrics is a relatively new and innovative technique. Ear geometry can be captured easily using a smart phone camera even from a distance and without user's co-operation as it is large [5]. The ear structure is unique and stable over age and facial expressions or all individuals and can be used as a biometric attribute for authentication purpose [6]. This technique is not very well known yet because it is at initial stages of research. Further, the system faces difficulty if the hair covers the ear [7].

(c) Face: Face is the most common physical identity of any individual. It is unique and easily accessible. Even the face of identical twins which can't be differentiated by naked eye differs in terms of minute things like placement of eyebrows, breadth of nose and size of eyes etc. These are the distinguished features which can be utilized by a biometric system to identify an individual[8]. If the face image is captured using a high quality camera and used for matching purpose, it can be used for authentication or verification of a person by using pattern matching techniques. It suffers problems with different pose, background, expressions, and lightning [7].

251

(d) Hand geometry: The spatial geometry of hand is unique for every person and is used for the authentication purpose. The hand or finger dimensions can be utilized for the same. However, owing to the storage requirements, two or three fingers are accessed and measured for matching[7].This can be done with 2D or 3D images of the hand. The dimension parameters like length, width, thickness and surface area are measured and stored as a template[9]. This method is not widely used and suffers problems with hardware requirements.

(e) Retina: The blood vessel pattern in the retina of a person is unique for all individuals and even among identical twins. The retinal style gets altered due to some diseases like diabetes, glaucoma etc but retina remains the same [8]. This strengthens the capabilities of retina as a biometric attribute. This means, the image of retina (blood vessel pattern) can be captured, stored and used as a template for further processing to distinguish the individuals [7]. It is reliable and accurate but it fails to identify or authenticate people having cataracts, astigmatism; people wearing glasses or lens and is not user-friendly in terms of cost and convenience[7], [8].

(f) Hand Veins: The veins pattern present in hand of an individual is unique and possesses characteristics to be used as a biometrics. It can be captured using infra red camera. The captured images can be used for matching process. However, it should be more reliable to seek attention [7]

(i) Signature: Signature in general is the way, a person signs his name. It is a behavioral characteristic of that individual which represents unique variations in hand geometry. Signatures based authentication system is well-known and widely used with numerous applications like bank cheque clearance [3]. This technology extracts features like direction, speed and shape of a signature and uses it for the matching purpose. However, it is not reliable in long term and needs improvement in accuracy [7].

(j)Palm print: Just like the fingerprint, the palm print of an individual is unique. It contains unique information like indents and symbols which can be used to match palm print of two individuals. It can be utilized for forensic, criminal and commercial applications. But it doesn't remain stable over time, working conditions or profession of a person[8] . Further the presence of moisture and wrinkles may affect the accuracy of the system [7].
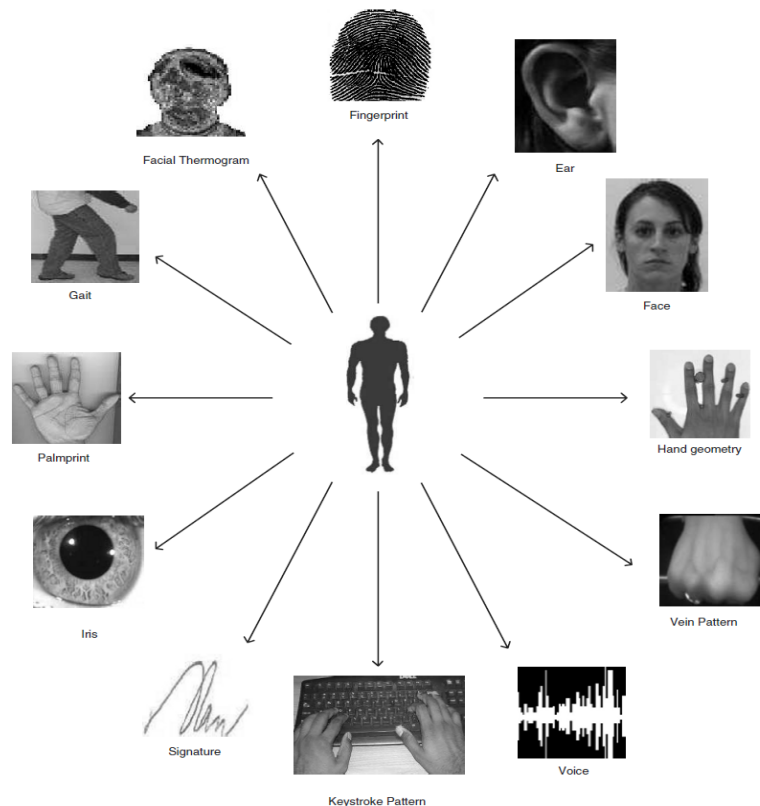
Figure 2. Commonly Used Biometric attributes[2]

252

(k) Gait: It is a behavioral biometric to identify people based on their unique way of walking. Human motion involves movements of many muscles and joints in a synchronized manner. Though the basic movement pattern remains the same, gait varies among individuals in terms of magnitude and timing. Slight variations in gait can be used as a biometric attribute for identification or authentication of a person. The features like step-length, step-width, speed and rotation of various joint like hip, knee and ankle etc are measured and used as features for matching [10].

Selection of a Biometric attribute: A number of biometric attributes each having its own pros and cons are proved to be and are being used as an attribute for authentication purpose. For a particular application, the choice of a biometric attribute is made based upon its characteristics which determine its suitability. These characteristics are:
(a)   Universal: Every person should possess that attribute.
(b)   Unique: The given selected attribute should be unique to each individual among the huge population.
(c)   Permanent: The selected biometric attribute should remain permanent or stable over a period of time.
(d)   Easy to acquire: It should be possible to acquire the biometric attribute without causing any harm or inconvenience to the user.
(e)   Performance: The system should be accurate and compatible with the application specific constraints.
(f)   Acceptable: The target individuals should not have any objection to present their biometric attribute.
(g)   Forgery: The biometric attribute selected should be difficult to forge.
All of these characteristics are hard to find in any one attribute. However, a suitable attribute can be selected based upon the requirements of application.

Conclusion: Different biometric systems are available these days each being good at one or other parameters like user convenience, cost, forgery and accuracy. A particular biometric attribute can be selected and implemented for authentication as per the application. For daily life applications fingerprint is mostly used due to its user-convenience, however for highly secure applications retina is preferred.
Hand-veins are drawing attention of researchers as it is user convenient as well as secure against forgery. A lot of work needs to be done before it being used in commercial biometric applications.

References:
[1] J. N. Pato and L. I. Millett, *Biometric recognition: Challenges and opportunities*. 2010.
[2] A. K. Jain, P. Flynn, and A. A. Ross, "Handbook of Biometrics Handbook of Biometrics," 2007.
[3] C. Jain, P. Singh, and A. Chugh, "An Offline Signature Verification using Adaptive Resonance Theory 1 (ART1)," *Int. J. Comput. Appl.*, vol. 94, no. 2, pp. 8–11, 2014.
[4]S. Member and Z. Miklo, "Based on Triangular Matching and Dynamic Time Warping," vol. 22, no. 11, pp. 1266–1276, 2000.
[5]D. Querencias-Uceta, B. Rios-Sanchez, and C. Sanchez-Avila, "Principal component analysis for ear-based biometric verification," *Proc. - Int. Carnahan Conf. Secur. Technol.*, vol. 2017-Octob, pp. 1–6, 2017.
[6]A. Tariq and M. U. Akram, "Personal identification using ear recognition," *Telkomnika*, vol. 10, no. 2, pp. 321–326, 2012.
[7]K. Dharavath, F. A. Talukdar, and R. H. Laskar, "Study on biometric authentication systems, challenges and future trends: A review," *2013 IEEE Int. Conf. Comput. Intell. Comput. Res. IEEE ICCIC 2013*, 2013.
[8]K. CH, "Various Biometric Authentication Techniques: A Review," *J. Biom. Biostat.*, vol. 08, no. 05, 2017.
[9]D. Bhattacharyya, R. Ranjan, F. A. a, and M. Choi, "Biometric Authentication : A Review," *Int. J. Serv. Sci. Technol.*, vol. 2, no. 3, pp. 13–28, 2009.
[10]   Rawlson   King.   Explainer: Gait   Recognition.   Retrieved   May   26,2020from https://www.biometricupdate.com/201311/explainer-gait-recognition.

Fingerprint Based Authentication for ATM

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Abstract: The development in digital transactions has given rise to research for accurate and efficient authentication tools or techniques. A wide variety of systems has been designed for personal recognition and validation using human personal characteristics. Among these fingerprint based authentication system are more desirable because of their uniqueness and consistency over time. Here, we propose a model for automated teller machine (ATM) authentication through fingerprints. The proposed model has improved the security mechanism of ATMs as there is no risk of stealing or loss of ATM cards.

Keywords: Biometric, Fingerprint; Security; Embedded ATM.

Introduction

Several automated methods are used to recognize a person based on human physical characteristics and are referred as Biometric solutions. These techniques provide solutions for confidential financial transactions, protection from malicious actions and data privacy. The common and famous human features used in most biometric systems are facial patterns, fingerprints, palm veins, iris, retina, vein and speech [1].

Fingerprints are used as person identification since traditional times. They are easy to acquire and provide more accuracy in biometrics because of its uniqueness and consistency. A person fingerprints can never be stolen and change over time. They carry unique examples and attributes. The unique patterns over finger impressions consist of lines called edges with interleaved spaces or valleys. Fingerprints unique attribute is also referred as minutiae and authentication is done on basis of these unique features[2]. Fingerprinting technology uses the illustration of finger patterns during training and validation process.

Finger Scan Technology

Most finger-scan technologies apply five steps during verification and identification. The process begins with fingerprint image acquisition for preparation of database, image preprocessing to remove any noise or reflection, feature extraction to work on specific attributes, creating finger template for each person and validation or template matching [3]. To capture fingerprints, existing systems have used scanners or cameras which help to provide a snapshot of person's fingers. A fingerprint database maintains all these snapshots or images as a minutiae file. Here, image quality is main concern for effective authentication process implementation. It is recommended to have at least 500 DPI (dots per inch) image for better results. Preprocessing phase makes images more clear and ready for further processing. Feature extraction phase helps to keep important attributes for classification purpose. Ridge ending, ridge bifurcation, ridge distribution, finger patterns, pores etc. are some examples of features used in much research work. The enrollment phase or template creation step applies classification algorithms and provide one template for each user. Last phase is matching in which comparison of acquired fingerprints is done with stored templates.

Fingerscan varies for person to person and also finger to finger. Different weather conditions and health problems also affects the design of these systems. For example: there can be physical injury like cuts or burns or other physical health problems like skin disorders etc. This is another important consideration while designing fingerprint based systems. Harsh climates often lead to problems in finger scanning. At cold temperature, oils in the finger tips get evaporated and hence can produce inconsistent results [3]. Sometimes a person does cleaning or repairing or construction work using hard objects which may lead to dull fingerprints or even result in removal of fingerprints. These challenges provide enough research scope in this field.

Literature Review

Fingerprints have vast set of features which make this technology desirable among existing biometric techniques. Its accuracy is best among all biometric techniques. Fingerprint based technologies work on very fine points. Samir Nanavati [3] studied various systems and discovered that finger-scan technologies with pattern matching are better alternative than minutiae matching. The feature extraction and template generation in pattern matching technology

works on series of finger edges which helps to reduce dependence on minutiae points [4]. But, this method often gets affected by placement of the finger during verification and results in big size templates.

Nisha Bhanushali et. al. [5] designed a fingerprint based ATM using SEA/RSA accelerator engines and the embedded non-volatile memory (Flash). Fingerprints templates are stored in flash memory in a serial order. During verification input image is compared with stored templates. If a match is found then user is authorized to use ATM else user cannot proceed further.

Manisha Redhu et. al.[6] worked on the minutiae extraction process to build fingerprint recognition system. Their main contribution is in image enhancement through three algorithms: histogram equlaiztion, fast fourier transform and image binarization. They applied iterative ridge algorithm for minutiae alignment followed by elastic match algorithm to check the final results. The experiments conducted produced FAR and FRR values 30% to 35% respectively.

Amurthy and Redddy [7] also developed a model to ensure security in ATM through an embedded fingerprint system. Finger prints database is prepared by bankers whenever clients' opens an account in bank. Client mobile number was also kept along with finger image. They arranged a GSM modem with a microcontroller which sends a unique 4-digit code generated by fingerprint module when a customer places finger in ATM machine. The client key in the generated code through touch screen into ATM which finally authenticate and validate user for further access.

Methodology
Figure 1 shows working of our proposed model.
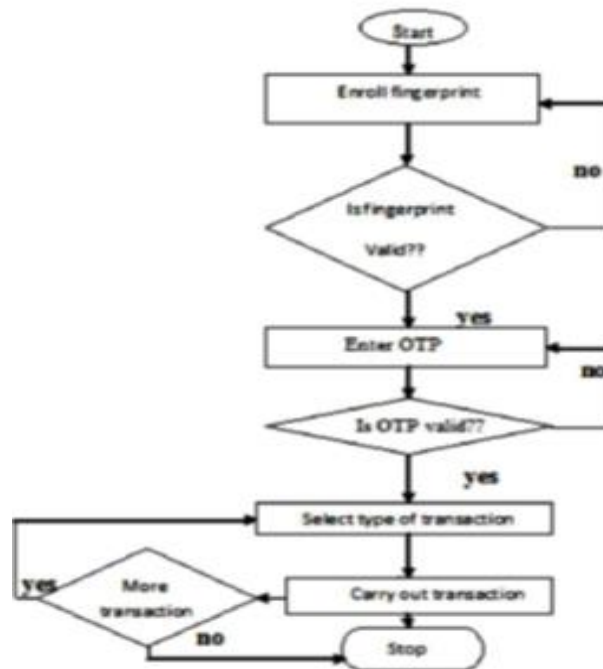
Figure 1. Working of Proposed Fingerprint Based Authentication for ATM System

Our fingerprint based embedded system make use of Secugen hamster pro20, a fingerprint scanner. This biometric device provides high quality fingerprints and is helpful in authentication of person. If scanner does not work, an OTP authentication process will get initiated.

The first step is storage of the fingerprint of a customer to prepare a database. During verification step, a new scanned fingerprint will be compared with stored fingerprints. If a match is found, then ATM will be accessed, otherwise not. Also, we have used "ClickSend", a third party organization which is used to send the OTP message to the registered customers.

255

Image Acquisition

In this project the main process revolve around fingerprint scanning technique and for this process we used hamster pro20 scanner which is a device affiliated by Indian government and it can track a no of records already registered on this device for global use. Finger image can be traceable using to different methods in which one part is that we can take image of finger in naked way or in another one we can take its picture in any covered way, which is a difficult part to take for a scanner, so we used the first way in which the user use a naked, cut free finger so that the bitmap can be created and as well as can be matched to the existing finger in the system.

Interface Designing

For designing purpose, we used .NET framework as it is easy to handle and we can write code in any different languages, it used the code and merge them to perform it as a single unit. For coding purpose we use c# which is very simple and easy to use.

For our system or progress we need to make a database so that our data can be stored for the further verification process, so we implement a connection between dotnet and database using MYSQL connection server.
We have a registration window in which we have provided a no of entries for our record purpose and in the end we use biometric authenticity to make is a unique data.

We have also introduced a mobile no which can be further used for operations of bank if in any case fingerprint scanner does not work properly by just sending a SMS having OTP in it.

ClickSMS

This is the one more special part of the project as our project not just work on fingerprint scanner, we also used an alternative if any case finger does not scan and sometime cut on finger or wet finger also act as barrier for our scanner, so we use a global site CLICKSMS to link with our interface and we can send OTP to our registered mobile no for allowing the person to further proceed with the bank operations. CLICKSMS allow us free 100 sms and afterward it is chargeable for different plans.

Advantages and Limitations

Fingerprint authentication systems are simplest of all biometrics. These are secure and difficult to copy or create. Fingerprints do not change over time. Our system favorable position of finger-filter innovation is exactness. This system has minimum memory requirements.

Any fingerscan system has to be tested over long time period to check accuracy of results as fingertips get exposed mostly to different surfaces, liquids, soaps etc. Climate and work conditions can harm and change fingerprints. There are additional security issues joined to finger-examining advancements. Fingerprint databases need to be kept safe, so that no one should steal and use them for unauthorized activities.

Results

The utilization of fingerprints as a biometric is both the most seasoned method of PC supported, individual distinguishing proof and the most common being used today [8]. In the world today, fingerprint is one of the fundamental factors utilized for authorizing security and keeping up a solid distinguishing proof of any person.
Fingerprints are utilized as factors of security amid casting a ballot, examination, activity of financial balances a among others. They are likewise utilized for controlling access to profoundly verified spots like workplaces, gear rooms, control fixates, etc [9].
The consequence of the review led by the International Biometric Group (IBG) in 2004 on similar examination of fingerprint with different biometrics is exhibited in Figure 1.

Conclusion and Future Scope

"Fingerprint Based ATM" is an application which can be used further as a bank operational process by keeping the point of security for the future generation. It also uses government authorized fingerprint scanner which can be useful to trace the record of the user in a few second of his banking operation by using image recognition.
In future the virtual Cash will be going to take over the world and the paper based money is not going to survive because of the security issues. So it will provide a way towards the betterment of the security purpose. This project is the better version of the already implemented ATM by the different organizations of bank for their operations in remote location so that everybody can access it. For security issue we have cameras in the ATM rooms but we can

use the ATM by just inserting and giving the PIN, but in our project we used the biometric technique that is fingerprint scanning for the further bank operations and we all know that one person fingerprint is unique and also we do not need to remember it every time we go for some banking process. The main benefit or objective of our process is to provide security and need not worry about the cards for the banking process.
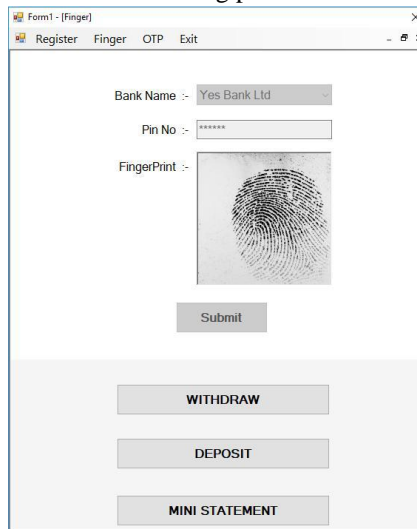
Figure 2. Login Screen Screenshot
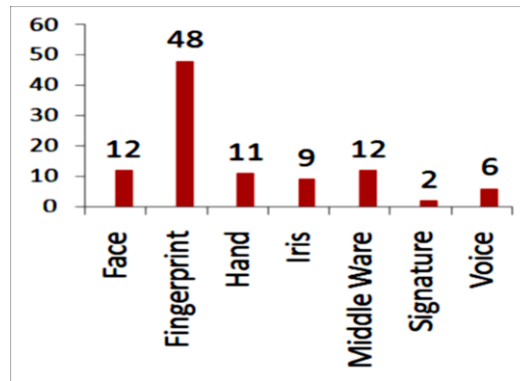
Figure 3. Comparison of fingerprint technology with other biometrics traits

References
[1] The Biometric Consortium, "Introduction to Biometrics", (http://www.biometrics.org),2006
[2] D. Maltoni, D. Maio, A.K. Jain, and S. Prabhakar, "Handbook of Fingerprint Recognition", Springer, London, 2009
[3] Samir Nanavati, Michael Thieme, and Raj Nanavati, "Biometrics: Identity Verification in a Networked World", John Wiley & Sons, 2002
[4] Julian Ashbourn, "Biometrics: Advanced Identity Verification", Springer-Verlag, London, 2002
[5] Nisha Bhanushali, Meghna Chapaneria, Krishani Mehta, Mansing Rathod, "Fingerprint Based ATM System", Journal for Research , Volume 02 , Issue 12 , February 2017.
[6] Manisha Redhu and Dr.Balkishan, "Fingerprint Recognition Using Minutiae Extractar", International Journal of Engineering Research and Applications, Vol. 3, Issue 4, Jul-Aug 2013,pp .2488-2497.
[7] N.K. Ratha, J.H. Connell, and R.M. Bolle, "Enhancing Security and Privacy in Biometrics-based Authentication Systems, IBM Systems Journal, vol. 40, no. 3, pp. 614-634, 2001
[8] L. O'Gorman, "Overview of fingerprint verification technologies", Elsevier Information Security Technical Report, vol. 3, no. 1, 1998

[9] G.B. Iwasokun, O.C. Akinyokun, B.K. Alese, and O. Olabode. "Fingerprint Image enhancement: Segmentation to thinning", International Journal of Advanced Computer Science and Applications, vol. 3, no. 1, pp. 15-24, 2012.

[10] C.   Roberts,   "Biometrics".   Downloaded   February   13,   2012   from http://www.ccip.govt.nz/newsroom/informoationnotes/2005/biometrics .pdf.

[11] C. Michael and E. Imwinkelried, "Defence practice tips, a cautionary note about fingerprint analysis and reliance on digital technology", Public Defense Backup Centre Report, 2006

[12] M. J. Palmiotto, Criminal Investigation, Chicago: Nelson Hall, 1994

Comparative Analysis of Clustering Approaches in Identification of Network Traffic Attacks

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Abstract: Network traffic attacks are very common these days. Intrusion detection systems are focusing on these attacks from past few years. Machine learning and artificial intelligence has uncovered new aspects of research in this area. Supervised and unsupervised category of approaches are utilised for identification of different category of attacks. These approaches are providing remarkable outcomes in terms of accuracy rate, false positive rate etc. This paper has worked on Clustering approach - an unsupervised category of learning. The implementation of k means clustering and density based clustering are performed on the real-time attack traffic dataset. The results have shown that k-means algorithm is able to identify more attacks in comparison to density based algorithm.

Keywords: Traffic Dataset, Intrusion detection, Clustering, Network attacks

Introduction

Information security is the major area of research in which intrusion detection is an important field of research as daily newer attacks are evolving. Machine Learning address a tremendous deal of information and depend closely at the algorithms which are used to train the model according to a certain objective. Various machine learning techniques are being used for identification and prediction of intrusions in the network. Machine learning are classified into two kinds - supervised and unsupervised learning. Supervised techniques are used when output class is known and if it is not known, then unsupervised learning techniques are used. Clustering falls into unsupervised mastering technique. Clustering algorithms are of different types and each of the algorithm is suitable for a specific kind of problem. Clustering deals with unlabelled data. This includes segmenting datasets based on certain common characteristics and identifying data collection irregularities. This simplifies datasets with identical properties by aggregating variables. The key goal is to research the structure underlying the dataset. This paper has used two popular clustering algorithms for identification of attacks in the recent attack traffic dataset.

Background Study

For the development of clustering techniques, many researches have been performed. The k-means clustering technique was used for intrusion detection by M.Jianliang[1]. He has used the technique for dividing the large domain for determining the attack, but the process has many disadvantages includes depending on the clusters only. Another algorithm named Y-means algorithm was given by Yu guan[2] which is also based on clustering. It has removed the disadvantage of K-means algorithm. A hybrid approach was invented by Chitrakar R and Huang chuanhe which has used naive bayes classifier and k-medoids algorithm[3]. This algorithm has given better results as classifier is included in the method. Density based algorithm given by Yang Jian has improved the process of intrusion detection by using the density method for making clusters and combining clusters having small density[4]. Data mining is an efficient approach that has been used in several areas. An improved priori algorithm of data mining was given by Lei Li [5] for intrusion detection. Particle swarm optimisation(PSO) has also been used in this field. The anomaly intrusion detection was given by Zhengjie Li[6] using k-means and PSO algorithm both. K. Wankhade has also used data mining for effecient determination of patterns of the attack[7]. A two stage technique using data mining was given by H. Fatma and L. Mohamed which has improved the accuracy rate of the process[8]. They have used k-means and self-organising map in the first stage and neural technique with fuzzy approach for second stage of algorithm. Support vector machines, neural network and fuzzy approaches have also been used for the purpose of intrusion detection by A.M. Chandrasekhar and K. Raghuveer[9].

Clustering

Clustering is the process of dividing data factors into a couple of clusters of comparable values.Clusters are the collection of similar kinds of data values for attributes that possess same kind of characteristics and clustering techniques define the procedure to make clusters based on certain criteria like centroid etc. When big datasets are involved, a better strategy is to investigate it and first divide the statistics into logical groupings called clusters. In this

259

way the valued features can be extracted from a massive set of unstructured information. It analyses the pattern among the feature values before determining the results.

Organising information into clusters facilitates in figuring out the underlying structure inside the facts. For example, clustering could be used to categorise disease in the discipline of scientific technological know-how, and also can be utilized in purchaser classification in advertising research. Different clustering approaches are applied for the identification of attacks in wireless networks at various levels [10-13].

K-Means Clustering
K-Means is the most famous clustering algorithm for the reason that it is very easy to recognize and observe to a huge range of machine learning problems. The process involves five steps.

The first step is to pick some of clusters randomly, every of which is represented by way of a variable 'k'. In the second step, every cluster is assigned a centroid, i.e., the centre of that particular cluster. It is essential to outline the centroids as far off from each other as viable to reduce variant. In the third step, after all the centroids are defined, each records factor is assigned to the cluster whose centroid is on the closest distance.

In the fourth step, once all facts factors are assigned to respective clusters, the centroid is again assigned for each cluster. In the fifth step, all facts points are rearranged in precise clusters primarily based on their distance from the newly defined centroids. This process is repeated until the centroids stop shifting from their positions.

K-Means set of rules works wonders in grouping new records. Some of the sensible applications of this algorithm are in sensor measurements, audio detection, and photo segmentation.

K-Means has the gain that it's quite fast, on the other hand, the drawback is that K-manner also begins with a random preference of cluster centers and therefore it is able to yield specific clustering consequences on distinct runs of the algorithm. Thus, the consequences may not be repeatable and shortage consistency. Other cluster methods are extra constant.

Density-Based Clustering
This is the another common density-based clustering algorithm.The set of rules chooses an arbitrary place to begin and the neighbourhood so far is extracted by the use of a distance epsilon 'ε'. All the points which can be in the distance epsilon are the neighbourhood factors. If those points are sufficient in wide variety, then the clustering process starts and the first cluster is formed. If there aren't sufficient neighbouring records points, then the primary factor is labelled noise.

For every point on this first cluster, the neighbouring facts factors also are added to the identical cluster. The system is repeated for each point in the cluster till there are not any extra records points that may be brought.

Once the working cluster is done, an unvisited point is taken because the first statistics point of the next cluster and all neighbouring points are categorised into this cluster. This process is repeated until all points are marked 'visited'.

DBSCAN poses some superb blessings over different clustering algorithms. Firstly, it does no longer require a pe-set range of clusters at all. The essential drawback of DBSCAN is that it doesn't carry out as well as others whilst the clusters are of various density. This is due to the fact the setting of the distance threshold ε and minPoints for identifying the community points will range from cluster to cluster while the density varies. This drawback also happens with very excessive-dimensional facts when you consider that once more the gap threshold ε turns into difficult to estimate.

Clustering implementation on Network Attack Dataset
The network traffic attack dataset has been taken for experimental work. UNSW-NB 15 data set[14] has been created after applying 12 algorithms and tools. The dataset has total 49 features including a class feature that determine the occurrence of normal or malicious event[15].

The standard dataset[15] having 45 features is preprocessed before training procedure. The work is done on Weka data mining tool. The Preprocessing step includes the removal of duplicate entries and filling of missing data entries. Dataset is loaded in Weka tool and analysed for the features and its different views. The UNSW-NB15 Dataset has total 45 features.Its features are very large to work with. Thus, feature selection approach[16] Correlation based Feature Selection (CFS) approach is used to reduce the dataset features. The various clustering approaches are performed on the network datasets to classify the attacks[17].

K-Means Result
The k-means algorithm is applied on the resulting dataset. It has clustered the dataset into two clusters, one for normal and other for attack category. It has correctly identified attacks into separate categories. The results of the algorithm are shown in the Figure 1.

```
Time taken to build model (full training data) : 0.1 seconds

=== Model and evaluation on training set ===

Clustered Instances

0      39621 ( 48%)
1      42711 ( 52%)


Class attribute: attack_cat
Classes to Clusters:

    0     1  <-- assigned to cluster
33471  3529 | Normal
    7  3489 | Reconnaissance
   10   573 | Backdoor
  551  3538 | DoS
 5304  5828 | Exploits
   58   619 | Analysis
    1  6061 | Fuzzers
    0    44 | Worms
    0   378 | Shellcode
  219 18652 | Generic

Cluster 0 <-- Normal
Cluster 1 <-- Generic
```

Figure 1. K-means result on Dataset

Density based Result

The DBScan algorithm is applied on the resulting dataset. It has clustered the dataset into two clusters, one for normal and other for attack category. It has correctly identified 56% instances.The results are describe in the Figure 2.

```
Time taken to build model (full training data) : 0.44 seconds

=== Model and evaluation on training set ===

Clustered Instances

0      34232 ( 42%)
1      48100 ( 58%)


Log likelihood: -18.20199


Class attribute: attack_cat
Classes to Clusters:

    0     1  <-- assigned to cluster
27531  9469 | Normal
   51  3445 | Reconnaissance
   16   567 | Backdoor
  632  3457 | DoS
 5443  5689 | Exploits
   58   619 | Analysis
  257  5805 | Fuzzers
    2    42 | Worms
    4   374 | Shellcode
  238 18633 | Generic

Cluster 0 <-- Normal
Cluster 1 <-- Generic
```

Figure 2. DensityBased Algorithm result on Dataset

Conclusion

In this paper, research work has utilised the unsupervised learning algorithms on UNSW-NB 15 data set after transforming the dataset by using correlation based feature selection approach. The dataset is clustered using different clustering approach and the results have shown that the k-means algorithm is correctly classifying more number of instances in comparison to other approach. The performance of the algorithm can be more tuned by applying variation in parameters of algorithm. The network traffic dataset is clustered into two clusters one for normal and other for malicious cluster. The clustering can be used in real-time for network attack detection and anomaly detection for efficient results.

261

References

1. M.Jianliang, S.Haikun and B.Ling. The Application on Intrusion Detection based on K- Means Cluster Algorithm. International Forum on Information Technology and Application, 2009.

2. Yu Guan, Ali A. Ghorbani and Nabil Belacel. Y-means: a clustering method for Intrusion Detection. In Canadian Conference on Electrical and Computer Engineering, pages 14, Montral, Qubec, Canada, May 2003.

3. Chitrakar, R. and Huang Chuanhe, "Anomaly detection using Support Vector Machine Classification with K-Medoids clustering" In Internet (AH-ICI), 3rd Asian Himalayas International conference, 2012.

4. Yang Jian, "An Improved Intrusion Detection Algorithm Based on DBSCAN", Micro Computer Information, 25,1008-0570(2009)01- 3- 0058-03, 58-60,2009.

5. Lei Li, De-Zhang, Fang-Cheng Shen, " A novel rule-based Intrusion Detection System using data mining", In ICCSIT, IEEE International conference, 2010.

6. Zhengjie Li, Yongzhong Li, Lei Xu, "Anomaly intrusion detection method based on K-means clustering algorithm with particle swarm optimization", In ICM, 2011.

7. Kapil Wankhade, Sadia Patka, Ravindra Thool, "An Overview of Intrusion Detection Based on Data Mining Techniques", In Proceedings of 2013 International Conference on Communication Systems and Network Technologies, IEEE, 2013, pp.626-629.

8. H. Fatma, L. Mohamed, "A two-stage technique to improve intrusion detection systems based on data mining algorithms", In ICMSAO, 2013.

9. A.M. Chandrasekhar, K. Raghuveer, "Intrusion detection technique by using K-means,fuzzy neural network and SVM classifiers", In ICCCI, 2013.

10. C. Barakat, P. Thiran, G. Iannaccone, C. Diot, P. Owezarski. (2003), Modeling Internet backbone traffic at the flow level, IEEE Trans. on Signal Processing Special Issue On Networking, 51(8):2111-2124.

11. A. Moore, D. Zuev. (2005), Internet Traffic Classification Using Bayesian Analysis Techniques, SIGMETRICS'05, New York: ACM Press, pp. 50-60.

12. S. Zander, H. Nguyen, G. Armitage. (2005). Automated Traffic Classification and Application Identification Using Machine Learning, Proceedings of The IEEE Conference on Local Computer Networks 30th Anniversary, Washington: IEEE Computer Society, pp. 250-257.

13. J. Erman. M. Arlitt, M. Anirban. (2006). Traffic Classification Using Clustering Algorithms, Proceedings of the 2006 SIGCOMM Workshop on Mining Network Data, New York: ACM Press, pp. 11-15.

14. Moustafa, Nour, and Jill Slay.(2015). UNSW-NB15: a comprehensive data set for network intrusion detection systems (UNSW-NB15 network data set). Military Communications and Information Systems Conference (MilCIS), 2015. IEEE.

15. Moustafa, Nour, and Jill Slay.(2016). The evaluation of Network Anomaly Detection Systems: Statistical analysis of the UNSW-NB15 dataset and the comparison with the KDD99 dataset. Information Security Journal: A Global Perspective : 1-14.

16. M.A. Hall, G. Holmes (2003). Benchmarking attribute selection techniques for discrete class data mining, IEEE Transactions on Knowledge & Data Engineering.

17. P. Indira Priya,Dr. D.K.Ghosh. (2013). A Survey on Different Clustering Algorithms in Data Mining Technique, International Journal of Modern Engineering Research (IJMER) ,Vol.3, Issue.1, Jan-Feb. pp.267-274 ISSN: 2249-6645.

Role of ICT in Spreading Awareness About Covid-19

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Abstract: The rapid and widespread spread of the COVID-19 epidemic has become a major cause of concern for the entire globe. The aim of the study is to identify the role of ICT (Information and Communication Technology) in spreading information/awareness regarding the Covid-19 outbreak among people. ICT has played an essential role to facilitate safe relief and treatment of the affected population and has made its role in this pandemic very important. ICT has played a role of a bridge among people to stay connected in the time of crisis when physical interaction is not possible. It is the time when many industries were shut down to overcome the spread of COVID-19 , few sectors like education , IT did not stop their functioning instead adopted ICT as a major weapon for smooth functioning and even in a much better way.

Keywords: ICT, Role, Awareness, COVID-19

Introduction
(The World Health Organization (WHO) announced a new Corona virus disease outbreak in China on January 2020 and declared it to be an epidemic that affects 100+ countries around the world. On 30 January 2020, India saw its first COVID-19 case in Kerala. COVID-19, is currently a threat to millions of people globally. Social media platforms have adopted many ways to share information with incredible speed, reach and penetration. Scientists currently working on the corona virus are using social media to connect directly to the public, share accurate information, and discuss awareness, security measures, and leaders to build networks.

COVID-19 and its Spread
The corona virus (COVID-19) is an infectious disease caused by a newly discovered virus, Corona. The new strain of corona virus is called SARS-CoV-2. People who are infected with the corona virus feel slow to moderate respiratory disease and they recover without the need for any kind of treatment, they recover by their immunity, the presentation of the disease at an older age. People are more likely to be severe, and people with underlying medical problems such as heart disease, diabetes, chronic respiratory disease, etc. The virus that causes COVID-19 is mainly spread through droplets produced when an infected person coughs, sneezes, or passes out. These droplets are too heavy to hang in the air, and quickly fall on floors or surfaces [1]. A person can get infected by breathing in the virus if he comes close to someone who has COVID-19, or by touching the contaminated surface.

Background & Objectives
The rapid and widespread spread of the COVID-19 epidemic has become a major cause of concern for professionals in healthcare [3]. Huanan Seafood Market is the place where early virus cases are found and hence this virus is considered to be the origin of non- human living species. The virus that causes this epidemic is a newly discovered virus closely related to bat coronaviruses and SARS-CoV.
Scientists say that COVID-19 has a natural origin. The infection is from bat-to-human.
The first known person with symptoms of Covid-19 later fell ill on 1 December 2019, and the person did not have a direct connection with the wet market cluster. Early in that month, two-thirds were found to have a relationship with the market.

The aim of the study is to identify the role of ICT in spreading information/awareness regarding the Covid-19 outbreak among people. In this time of epidemic when we are in a period of lockdown we are seeing and experiencing the role of ICT in various fields such as working from home and many other things.

Methodology

The research in this report is done from a qualitative point of view and the researchers try to put the entire material near the subject. Material prepared by analysis of primary as well as secondary sources. Graphs and figures are derived from reliable sources used in it and sources of all data are also given. Researchers have tried to find out the role of ICT in this epidemic and also to find out whether social media is informing or misinforming the public regarding the Covid-19 epidemic.

ICT as an Awareness Tool during Pandemic

As ICT changed the exchange of information and enhanced the relationship between people and government globally. In a country like India, where the number of literate and aware people is less than the illiterate and aware people and more they are stubborn. So, this is the best way to connect with people in this outbreak where it is dangerous to go out of the house because who knows if the person is infected with corona virus or not. Corona cases in India are increasing day by day and thousands of patients are reported instead of about 78-80 days of lockdown. Nowadays corona cases are increasing at the rate of 1000-1200 corona positive patients per day which may increase further in future. It is very important or necessary to make them aware with the help of ICT (Information and Communication Technology) as it is a communicable disease. In the midst of this upheaval, ICT has played an essential role to facilitate safe relief and treatment of the affected population and has made its role in this pandemic very important. As a part of ICT, social media spreads local issues at a global rate and plays an important role in this epidemic. ICT has played a role of a bridge among people to stay connected in the time of crisis when physical interaction is not possible. It is the time when many industries were shut down to overcome the spread of COVID-19 , few sectors like education , IT did not stop their functioning instead adopted ICT as a major weapon for smooth functioning and even in a much better way. ICT has opened doors, and has provided everything for everyone from anywhere at all times. Information and communication technology (ICT) plays an important role in warning and response activities in this crisis. With technologies like Jio Meet, Zoom, Webex, Google meet, which are becoming common on the Internet, social networks have gained immense importance, especially in recent times (symbols of video conferencing & meeting App is shown in fig.1). Public participation in this field is emerging in a wide range. Traditional broadcast media, such as newspapers, radio and television, have been taken up by individuals, public and / or private enterprises on social media platforms. For example: news comes in newspaper already come in many social platforms so that will decrease the use of newspaper. People are influenced by the developments in these social media, Jio Meet, Zoom, Webex, Google meet, etc. and also share threats as well as opportunities through them. ICT transformed the exchange of information and enhanced relations between people and governments globally [2]. Social media is used as an online tool that provides a global platform for the dissemination of information, content and opinion, and also promotes social interaction. Therefore, the improvement of communication technologies and systems has created new communication platforms that lead to economic, political, social and cultural change in many ways.

Technical Industries and COVID-19

The telecommunications and technology industries are realizing the impact of corona viruses, but they have also found opportunities to help because what matters most is keeping people safe and healthy by using videoconferencing technology more widely available, to governments to give accurate information about the virus to the citizens. And using smart city technologies to fight the epidemic.

1) Supply chains have faced the clearest and the immediate business impact because of coronavirus pandemic.
2) The proliferation of COVID-19 led to the cancellation of the most important technical meetings as many companies were loose partnership options.
3) The increasing need for remote interaction between the COVID-19 epidemic makes us feel the need for 5G technology.
4) Investment in smart city solutions will continue to increase as technology has proven to be a valuable tool in crisis management.

XR is a combination of virtual, augmented and mixed reality training, through which it can handle expensive equipment and better visualization product assembly. In Fig. 1 the percentage of growth of different regions is given using XR.

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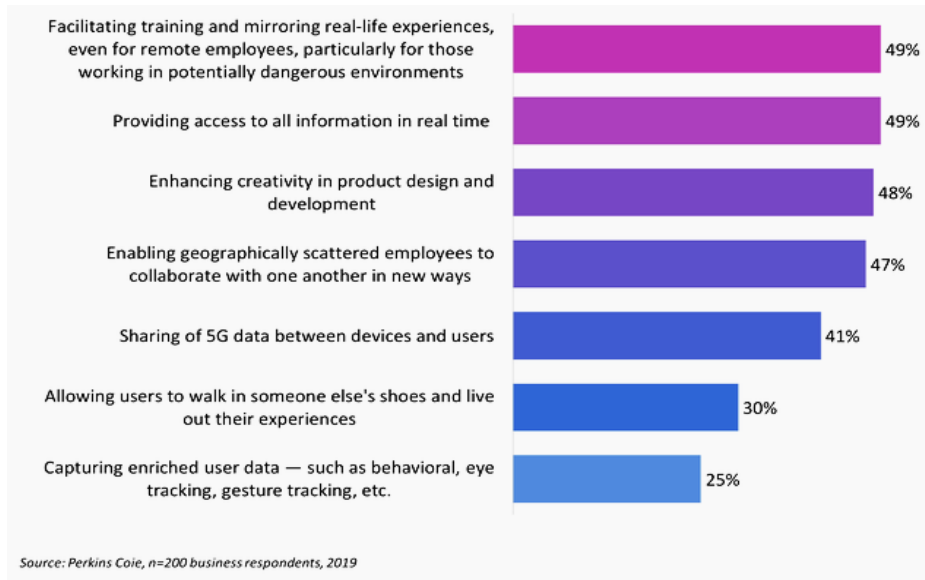
Figure 1. Top Workforce Development Benefits Of XR

Pandemic in Social Media Era

In today's modern society, information creation, dissemination and manipulation are activities that permeate many aspects of our cultural, economic and social life. The Internet and social media are considered tools to collect health information. Coronavirus outbreaks are not the first epidemics seen in the social media era, there are three other epidemics that have also occurred in the last decade such as H1N1 virus (swine flu in 2009), Ebola virus (Ebola in 2014) and Zika virus (2015, Zika virus disease), which are known worldwide. About 10 years ago non-governmental organizations (NGOs) were not necessarily equipped with technology to communicate information online. People looked for directions on social media, but due to lack of information and carelessness they were mostly eliminated from unreliable and informal sources. By the time verbal communication came into existence, people kept lying to each other, and exciting lies spread faster than truths because some unnecessary and spicy news people liked and were liked by most people. Accurate and reliable dissemination of the correct information about the virus can help control the spread of the virus and related concern in the population. Initiatives and achievements of the Ministry of Health and Family Welfare: A one-year review in late 2016 made it clear that health organizations planned, planned, prepared and launched their campaigns, and also those affected by it, benefited. Social networks still have trouble dealing with and identifying wrong ones. With tremendous efforts, social networks have grown and matured in terms of their functionality. Big organizations improved online communication and people got better at identifying the truth from the mass imagination after the 2016 misinformation campaigns.

Social media spreads local issues at a global rate and plays an important role in this epidemic. In the current scenario of the COVID-19 outbreak, social media platforms are also spreading information around the world in lockdown because it does not require contact with people because it is a two-way communication that is done without contact with the other. can go. person. According to The Center for Disease Control and Prevention, the World Health Organization (WHO), a large number of health organizations and magazines are regularly posting awareness and guidance on hosts of online platforms. Social media as an online tool provides a global platform for dissemination of information, content and opinion, and also promotes further social interaction between individuals and organizations. Facebook is changing its newsfeed function to direct users to websites of WHO and local health officials. Google Scholar has highlighted major medical journals and other sites related to the outbreak. Social media sites such as Twitter are specialized in referring individuals who search for corona virus-related content to reliable resources. Healthcare organizations, physicians and social media direct the affected to online traffic from reliable sources. WHO is working with Facebook, Pinterest, Twitter and Tencent to provide timely correct information to the public and eliminate misinformation and disruption. Meeting apps are used virtually by experts to talk about this epidemic with people and teach us the role we have to play during this epidemic [5]. It is also the right time for social media platforms to play their role in public health and educate users, about the importance of proper hand washing and social distance. This approach will increase the likelihood of millions of people seeing similar messages, while using different platforms, even if they forget to access trusted sites such as WHO's website.

265

ICTs and Public Health in the Context of COVID-19

The world is currently in the grip of the deadliest and most widespread pandemic that it has faced in a century. In which our country is currently one of the top countries in terms of COVID-19 patients after China, America and Italy. The world is not only facing increasing fear and death cases among the people, but has been forced to accept the points of tension in its economic and social clothing which had long been overlooked because no one in this world even the country is not rich enough to feed its citizens or fight this epidemic without opening and running its economy. In the midst of this upheaval, ICT has played an essential role to facilitate safe relief and treatment of the affected population. ICT has also shown to be necessary to promote long-term estrangement against future epidemics and to solve secondary challenges emerging within socially distorted environments such as winding up of companies, factories, various plants, government offices, etc. However, the inclusion of ICT in relief and prevention in epidemics, along with it, is a set of challenges related to transparency, accountability and privacy. Governments that implement ICT should ensure that far-reaching crisis measures do not spread permanently in society, and measures that are taken are considered appropriate, proportionate and equitable.

Role of ICT in Fighting the COVID-19 Pandemic in India

ICTs are offering a lot of solutions when it identifies-contact-trace-treatment cases.. Mobile and web technology is helpful in spreading awareness about COVID-19 and is also the fastest way to send and receive information in this modern world where almost everyone has mobile phones and most of them are social sites and platforms for communication Use, which facilitates contact tracing. It is helpful to inform outsiders and people who are corona positive to people close to the suspect, so that no other person is infected, who has an infection, the covind COVID-19 suspects could be tracked. To break this communicable chain, real-time monitoring of congestion, remote monitoring of corona patients and much more. Drones are being used to implement strict quarantine and social disturbances and for disinfection purposes as there are people who do not follow the rules and instructions given by the government and doctors and play a major role in spreading the virus. Robots helping treat corona patients and clear corona wards. Telemedicine is offering solutions for e-health checkups. Big data and artificial intelligence are being used for the purpose of research and development.

Government of India launched an app named AROGYA SETU APP to make its citizens aware of this epidemic. It shows us the number of infected people in the 10 km range. It updates on daily basis how many people are Corona positive, how many of them have recovered and how many cases have increased that day. It gives data of each state of the country in both numerals and graphs. Anyone can assess themselves by answering the questions asked by the app. It also gives an e-pass certificate to come from outside in the lockdown period, which will be issued only when there is an emergency. There is a website of the Government of India which is mygov.in in which all the information about government works and schemes are available. The government hereby gives all the necessary details and makes its citizens aware of COVID-19. You can see it clearly from the [7] images of this website below.

Role of ICTs as a support during COVID-19 and Post-Pandemic Economic Recovery

 COVID-19 creates economic crisis due to public health crisis. Given there are two crises, first one is public health & economic crisis that needs to be around instituting a public health strategy that deal with the Covid-19 crisis at one hand and on the other hand to think about gradual and the strategical thought though the economic strategy of opening up the way of economic recovery. If the government opens indiscriminately, then we can lose all the gains made in a very difficult period of social distancing. Economic recovery will be painful and time consuming. But we must do this very carefully and there will be no place for negligence in it.

 The digital world has proved to be very helpful during this Covid-19 epidemic, there are many examples:
 1) Public health interventions in the nCoV pandemic (case management, tracking and so on)
2) Government support services-there are websites and helpline numbers given by the government
3) Work from home (when feasible) nowadays the most famous thing among many companies and their employees.
4) E-commerce-one of the most use thing in today's era.
5) Distance learning: online school and college classes coaching and the academic and competitive examinations are done on online platforms. And
 6) Telemedicine: to provide access to health assessment, diagnosis, intervention, consultation, supervision and information across distance.
Areas of the economy that stand to lose this Covid-19 epidemic (where ICTs cannot help): travel; Tourism; hospitality industry; Restaurant / Bar; Small business and manufacturing. Places across the country which are crowded with

tourists, are now completely empty due to fear of Covid-19 and it causes a huge decline in the country's economy. Our country earns crores on tourism which is now completely halted [8].

ICTs that have become so impervious to us and cannot imagine our lives without them and have recently been developing disruptive exponential technologies such as IoT, AI, RPA, 3D printing; 3D visualization; VR, sensors, mobile internet and cloud; Big Data Analytics; And block chain etc. will also help save a lot of the world economy, but at the cost of making many old jobs obsolete and creating lots of new jobs. Post COVID-19 world will probably be a very different world in which ICT has an even bigger role than before.

When we think about the above discussion, we will find out that the recovery made on the basis of ICT is meant only for those who have knowledge about communication and technology and also do jobs in this field. The illiterate or the poor who work and earn on a daily basis like laborers, are doomed, have nothing to eat nor money to live in metro cities. Therefore, they decided to come to their village which plays the biggest role in spreading the corona virus.

Steps Taken by Government of India to Fight with COVID-19:

When India entered the 20th day of nationwide lockdown announced by Prime Minister Narendra Modi on March 25, a 21-day lockout was put in place to prevent the spread of novel coronaviruses in the country.

The 3-week lockdown was introduced across the country to break the chain of Covid-19 transition and 'level the curve'. In the past weeks, the government has taken several measures to ensure that the lockdown situation continues and is followed by all citizens. Several steps have been taken to ensure that people from different sectors of society do not feel the pinch of lockdown.

Source: Rabobank, CSO
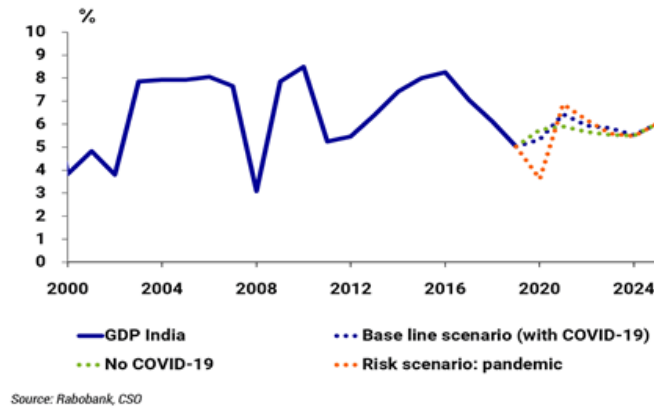
Figure 2. The Economic Impact Of COVID 19 in India

Misinformation in Social Media

As the social media is the modern face of ICT it not only plays good role in the age of pandemic but also the bad role by sharing wrong - information or misinformation. There are several rumors that is running on the online platforms of social media that misleads the people so they take wrong steps unware of what they are doing is right or wrong. Social media has also become a conduit for inciting rumors and deliberate misinformation, and many are deploying sites like Facebook, Twitter, YouTube and WhatsApp to create panic and confusion. With the proliferation of fake news and misinformation in the form of fake news, false, misleading or false medical advice can travel around the world before anyone has a chance to fix it. If we take one of the examples of this pandemic the one of rumour is that the corona virus will not survive the summer but what we are facing now everyone knows. It is not only happening in this period that misleading information sharing is as old as humanity, and the current digital landscape is regrettably disseminated and accelerated dissemination of medical misinformation. Currently, we are facing an unusual crisis of public understanding with social media platforms such as Facebook, Instagram, Twitter, YouTube, Snapchat, WeChat and Tencent. Misinformation may be intentionally promoted or shared on social media. It can spread as fast as wildfire and is very difficult to control because anyone can say almost anything to anyone, with billions of individuals each day, it is full of many digital sources without editorial oversight, this area is widely spread and can easily be trusted or taken. These forums are formulators and therefore multiples of misinformation related to Covid-19. The Director General of the World Health Organization (WHO) noted the urgent measures to be taken to address "Corona Virus Infodemic" and indicated its need. This compromises the response to infodemic outbreaks with increased public contact in relation to relying on information sources. Even after the plethora of the COVID-19 epidemic, governments, public health officials, and digital corporations not only have to promote digital literacy, but also face an age of

267

irreversible truth born of the impact of social media as it looked. It is believed that people easily rely on misinformation without verifying or checking it, and thus not only creates difficulty when they start forwarding them as well. Always misleading posts have been far more popular than people disseminating accurate and relevant public health information about a disease. A natural reaction that sometimes provides clarity or at least an opportunity to blame someone for being all.

Many of the intrigues created by the US (either to destroy the Chinese or to destroy the Chinese) or China (to destroy the Americans) have started with 'being a biological weapon,' the outbreak of China. Was adapted by large technology to reduce the position of. As high-tech manufacturing world capital, 'China wants to rule the world by killing and weakening its enemies with this virus,' COVID-19 is likely to be Chinese food, like bat soup among other foods. "" Test of breath-holding self-test, "" Control is controlled by the government, "" Prime Minister, Modi's Janata curfew was to break the 14-hour transmission chain of coronavirus, "to name a very few. Not only the conspiracy but also the fake treatment and other things are running on social platforms like that it can be treated by hot water,' 'unverified home remedies like vitamin C, turmeric eat this eat those etc. Dr. As Mike Ryan, the head of the WHO Health Emergencies Program rightly said, 'We need a vaccine against misinformation.' Research is needed to better understand the origin and dissemination of misinformation with coordinated efforts to constrain its sources and reduce its detection, removal, and spread.

Results and Conclusions

Covid-19 crisis is still ahead of us and it has become a part of our life now, we are not only living with it but also indulge in doing our regular works like studies, businesses etc. We are taking the given situation without understanding the reality. The way in which we are taking this situation lightly may bring disastrous results. Both, government and corporate organizations use social media more in response to the crisis than traditional media as it is not necessary that traditional media is trusted 100% and also traditional media is a slow way of spreading news than social media. Social media has made the way people across the world communicate instantly and borderless. In the new media era of interconnectedness, the outbreak of Covid-19, the pandemic caused by Corona virus, has been overcome by epidemic-related misinformation spread among millions of people globally. It is difficult to recognize that the real motive behind these reports is to mislead people on a large scale, and if yes, who is actually behind it. However, many news channels are helping the government and people by spreading awareness and telling us about the myth rollout among them. Also, social media must ensure that the right information and data from reliable sources are shared and spread to create the awareness necessary for a positive outcome. The socially responsible citizen should refrain from disseminating false information publicly, verifying and verifying information, and checking the credibility of comprehensive information.

As the virus spreads around the world, we also understand here what it means for the world's education systems. With the need to contain the virus, many countries are implementing measures to reduce congestion in India as only 50 people are allowed to gather at weddings, with parks and gyms closed until any further orders Is done, people are not allowed to gather places. Our schools are not immune to these functions nor to the spread of the virus. Many countries have now implemented measures in their education systems - from banning gatherings to temporary closing of schools that make the use of ICT mandatory if they want to educate their students. Now the whole class is running on a mobile phone or laptop.

At the epicenter of the virus - China - more than 180 million school children are living at home. But when schools are temporarily closed for quarantine, schooling continues. It is just that it is a different kind of teaching. Students are being remotely educated using technology. This is being done through a variety of online courses and electronic textbooks.

To date, almost all countries in Europe and the Central Asia region have directed their primary and secondary school systems to be completely or partially shut down, to prevent possible viruses spreading to students and the general public.

References

1 https://www.msn.com/en-in/news/newsindia/20-days-20-steps-a-look-at-governments-measures-against-covid-19-amid-lockdown/ar-BB12xxTo.

2   https://www.hindustantimes.com/india-news/20-days-20-steps-a-look-at-government-s-measures-against-covid-19-amid-lockdown/story-aUNOgQ9Om2dxQt9WAyEaGI.html

3   https://www.cureus.com/articles/29822-covid-19-awareness-among-healthcare-students-and-professionals-in-mumbai-metropolitan-region-a-questionnaire-based-survey#introduction

4 https://csd.columbia.edu/research-projects/ict-and-covid-19

5   https://covid19.who.int/?gclid=Cj0KCQjwoub3BRC6ARIsABGhnyaQbHsKphfRQLdRHzHn_9DnjBTk29-WugxvNL6ZaDG45G_x-M0SpXAaAqceEALw_wcB
6   https://blogs.worldbank.org/europeandcentralasia/can-technology-help-mitigate-impact-covid-19-education-systems-europe-and
7 https://www.mygov.in/covid-19
8 https://www.businessinsider.com/five-ways-coronavirus-will-affect-the-connectivity-tech-industry-2020?IR=T
9   https://medium.com/@covind_19/unlocking-the-40-day-national-lockdown-in-india-there-is-no-magic-key-de4e43177cb4
10 https://www.kpcw.org/post/saturday-brings-new-high-covid-19-cases-utah#stream/0s.html

Parameters for Measuring Effectiveness of Online Teaching in the Era of Covid-19 Pandemic

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Abstract: The paper discusses the effects of COVID-19 on the education sector. The education sector is a foundation of society. Breaking of education to students for a while has a significant impact on society. There are two major stakeholders in the education: students and teacher. Each stakeholder has a different perspective on the teaching-learning process. The paper looks these two major perspectives; one is student perspective and second is teacher perspective. The paper proposes various parameters separately for students and the teacher. These parameters help in finding the effectiveness of online teaching on students and the teacher. Each parameter has explained and found that it is valuable in the measurement.

Introduction
Covid-19 pandemic changes the world dynamically very fast [1]. Life has been lockdown immediately and every activity is looking stopped for a while. Then slowly, people are adjusting themselves and try to find ways of running their life. Covid-19 affects largely on the education sector [2]. Students had been stopped for attending the regular classes from the colleges. Parents are more conscious about the health of their children instead of their education. Faculty and college authorizes sat back in their homes and were thinking about how to provide the education to the students. Similarly, the students were worried about their course completion and for their examination.

Online teaching emerged as a lifeboat for education both for students and teacher. Nowadays online learning is a promising alternative for busy people in continuing their educations [3]. It was difficult and uncomfortable to start teaching in the online mode for the teacher. Teacher and management adapt the online mode of teaching in a very fast way. The evolution of internet technology has shifted face-to-face peer tutoring [4,5]. Students face difficulty in learning from online teaching. Teacher and students both are important resources for education. Teachers are required to prepare themselves for online teaching mode. They are preparing themselves in many folds. They need to prepare the teaching material for online teaching. It is not easy for them. Specifically for those who are not comfortable with the computer system. Both students and teacher are to purchase the resources for online teaching. It incurs an extra cost to them.

It was a new learning model for college authorities to implement that attracted to review the college polices [6]. It was like waiting and watching the situation. The major problem with college authorizes was to call students for the classes and ensure students attendance in the online teaching classes. The college has to define a new schedule of the classes and how the teacher will take classes. The college has look for the effectiveness of online teaching. How the faculty will transfer the knowledge to students. Utilizing online teaching only can't provide sufficient support for modern education [7]. College-level online learning started in a big way in 2012 and It has an impact on every department and teacher [8].

Student evaluation of the teaching effectiveness of a nationwide innovative education program is required [9]. Teaching effects using online mode should be considered separately for students and the teacher. The paper considers two stakeholders students and teachers perspective in terms of the teaching-learning process.

The paper discusses the first importance of education. It then explores the merits and demerits of online teaching. It follows the proposed work, discussion and conclusion.

Education
Education consists of two major areas of learning which are technical skill and managerial skill. Education provides

student to explore knowledge while interacting with the students in the physical classroom. Students have many questions when they are learning particularly in conducting the experiments of the subjects. Teacher enhances their subject knowledge while teaching to students and it provides new scope of the research in their subject. Experiment and research are a core part of the education system. The learning of schoolchildren in rural areas is in demand [10]. Introduction of online teaching in the education system opens many possibilities for the teaching-learning process while at the same time it opens many issues that need to be handled properly [11].

Teacher and students have different aspects of online teaching mode. Issues related to student engagement with the course should be addressed [12]. It is important to assess those aspects of finding the effectiveness of online teaching. Because of varying aspects of the students and the teacher; it should be understood separately for the student and the teacher. Findings revealed that online vocation education is student-centred, but student-student learning opportunities were rated lower than teacher-student practice [13].

Merits of online teaching for students
Students get the opportunity to start their studies during lockdown situation using online teaching mode. They stay at home and able to take precautions for their health also. They need to arrange the resources like laptop/computer system and internet connection for learning. It leads to the learning of new equipment and associated software. Students are also getting the opportunity to stay with their parents and helping them while the classes are over.

Demerits of online teaching for students
Students are facing the problem of not seeing experiments of the subject physically. Assessing the laboratory sessions of the subject is important [14]. Online teaching reduces the interaction of students with the teacher. It provides less time for students for a discussion on the topic. Online teaching reduces the attention of the students because of being in the home with flexibilities. Those students who were not regular in the physical class, it is difficult for them to tune with the online classes regularly. The content of the subject can not be explored in depth by the students.

Merits of online teaching for teacher
Teachers learn a new way of teaching. The Internet of Things enables the exchange of information at any time [15]. They explore how to present the content of the subject to students in online teaching mode. They sharp their teaching skills and align it with the online teaching approach so that students can understand the content easily. They got the opportunity to learn new resources/equipment used in the online teaching model. They stay in their home and able to save conveyance time and effort in reaching the college. The online teaching mode provides flexible timings for teaching. However, colleges are putting the schedule for conducting the classes for smooth running. They are the software that is used in the delivery of the content.

Demerits of online teaching on teacher
The teacher has to ensure that students attend the classes for the entire duration that engage in maintaining the classes than delivering the content of the class. Experiments that need to be performed in front of students in the lab can not be explored properly. A discomfort occurred during the initiation of online teaching mode. The instructional time and effort are required to teach the same course online mode [16]. Technical issues create breaking in teaching flow that disturbs the attention of the student. Communication to all students is not uniform because various technical issues other ends also. Taking attendance is an important activity for teachers. It takes a long time for marking and ensuring the attendance of the students in the class. During the classes, it becomes necessary to ensure that students are present at their end. Generally, two methods are followed for it. One is to call the student during the classes and second is to ensure the students on their camera. The content of the topic needs to be developed under online teaching mode that reflects putting more effort and time.

Online teaching has merits and demerits both related to students and teachers. Therefore, it is necessary to find out the effectiveness of this teaching method for the organization. Therefore, parameters of assessment of online teaching are proposed. There are two categories of parameters: parameters for student and parameters for the teacher.

Proposed work
Parameters to be measured for students and teachers are shown in Table 1 and table 2 respectively.

Table 1. Parameters for students.

Parameters	Description
1. Content understanding	How students understand the content which is delivered by the teacher
2. Exploration of the content	How students explore the content that they are learning. The content exploration means students can think various parts of the subject and able link various topics of the subjects
3. Asking of the questions	How students feel free in asking the questions in online teaching classes
4. Learning from answers	How students learn from answers given by the teacher
5. Interaction duration	How long students able to interact with the teacher
6.Comfortably with resources	How students are comfortable with resources they are using in online classes
7. Conduct of experiments	Whether students understand the experiments
8. Concentration in the class	Whether students maintain their concentration in the class
9. Schedule time of the class	How much schedule is comfortable for students
10. Regularity in the class	How students are regular in the class

Table 2. Parameters for teachers.

Parameters	Description
1. Comfortably with types of equipment	How a teacher is comfortable with online teaching equipment
2. Delivery of the content	How effectively teacher delivers the content of the topic to students
3. Interaction with students	How effectively a teacher interacts with students
4. Knowledge enhancement	Whether online teaching is enhancing the knowledge of the subject
5. Discipline of students	How students maintain the disciple in the class
6. Attendance of the students	How effectively teacher marks the attendance of the students
7. Conducting Experiments	How effectively teacher conduct the experiments
8. Solving the student's query	How effectively teacher solve the query of the students
9. Duration of the class	Whether the duration is suitable for teaching
10. Schedule of the classes	Whether the schedule of the classes is comfortable

Discussion

COVID-19 affects the entire spectrum of activities of the society. Education is an integral and highly important activity. COVID-19 affects student learning and teaching methods of the teacher. Effects of COVID-19 on the education sector are elaborated in the paper. Measurement of these effects is necessary to view various aspects of the education sector in this online teaching environment. By understanding this requirement, the paper proposes parameters for measuring effectiveness for student and teacher. The perspective of the student and teacher varies for online teaching mode. Therefore, different parameters are proposed in this paper for the measurement of the effectiveness of online teaching on students and teachers. Authors interacted with students and teachers and after explorative discussion with them, parameters are proposed in the paper. Each parameter is covering a separate dimension of measuring the effectiveness of online teaching. Parameters may be measured either by numerically and by using probability system.

Conclusion

Online teaching becomes a prominent teaching method in the era of COVID-19. The merits and demerits of online teaching for students and teachers are presented. It becomes important to measure the effectiveness of this online mode. The paper proposes various parameters for measuring the effects on both students and teachers. All parameters are covering various aspects of online teaching mode. The paper concludes that each parameter can be measured and as a result, the effectiveness of online teaching can be obtained. The paper may be further extended for application measuring system on the parameters.

References

[1] Verma, A., Verma, S., Garg, P. et al (2020). Online Teaching During COVID-19: Perception of Medical Undergraduate Students. Indian J Surg 82, 299–300.

[2] Huang J., Pan W., Liu Y., Wang X., Liu W. (2020) Engineering Design Thinking and Making: Online Transdisciplinary Teaching and Learning in a Covid-19 Context. In: Markopoulos E., Goonetilleke R., Ho A., Luximon Y. (eds) Advances in Creativity, Innovation, Entrepreneurship and Communication of Design. AHFE 2020. Advances in Intelligent Systems and Computing, vol 1218. Springer.

[3] Titan, Ferdianto, G. G. F. P. Desak and Lena (2017), "A comparative study of teaching styles in online learning environment," *International Conference on Information Management and Technology (ICIMTech)*, Yogyakarta, pp. 25-30.

[4] N. N. Zulkifli, N. D. Abd Halim, N. Yahaya and H. Van Der Meijden (2020), "Patterns of Critical Thinking Processing in Online Reciprocal Peer Tutoring Through Facebook Discussion," in *IEEE Access*, vol. 8, pp. 24269-24283.

[5] Cong L.M. (2020) Successful Factors for Adoption of Synchronous Tools in Online Teaching at Scale. In: McLaughlin T., Chester A., Kennedy B., Young S. (eds) Tertiary Education in a Time of Change. Springer.

[6] Czerniewicz, L., Trotter, H. & Haupt, G (2019). Online teaching in response to student protests and campus shutdowns: academics' perspectives. Int J Educ Technol High Educ 16, 43.

[7] M. Yu *et al (2018).*, "Research on Integrating Online Learning into Offline Teaching, "*13th International Conference on Computer Science & Education (ICCSE)*, Colombo, pp. 1-5.

[8] D. Rover, Y. Astatke, S. Bakshi and F. Vahid (2013), "An online revolution in learning and teaching," *IEEE Frontiers in Education Conference (FIE)*, 2013, pp. 14-14.

[9] H. Yueh, T. Chen, L. Chiu, S. Lee and A. Wang (2012), "Student Evaluation of Teaching Effectiveness of a Nationwide Innovative Education Program on Image Display Technology," in *IEEE Transactions on Education*, vol. 55, no. 3, pp. 365-369.

[10] T. Kao, Y. Chen and Y. Kang (2015), "A Study of Online Tutors' Teaching Efficacy and Effectiveness in Eastern Taiwan, "*IIAI 4th International Congress on Advanced Applied Informatics*, Okayama, 2015, pp. 287-290.

[11] Beierle, C., Kern-Isberner, G (2012). Aspects of Universitarian Distance Teaching and Online Learning. Künstl Intell 26, 305–306.

[12] G. Burke, C. Mac, Bhaird and A. O'Shea (2012), "The impact of a monitoring scheme on engagement in an online course," in *Teaching Mathematics and Its Applications: International Journal of the IMA*, vol. 31, no. 4, pp. 191-198, Dec. 2012.

[13] Cox, D., Prestridge, S (2020). Understanding fully online teaching in vocational education. RPTEL 15, 16.

[14] I. Pardines, M. Sanchez-Elez, D. A. C. Martínez and J. I. Gómez (2014), "Online Evaluation Methodology of Laboratory Sessions in Computer Science Degrees," in *IEEE Revista Iberoamericana de Tecnologias del Aprendizaje*, vol. 9, no. 4, pp. 122-130.

[15] R. Machhamer *et al*. (2019), "Online Offline Learning for Sound-Based Indoor Localization Using Low-Cost Hardware," in *IEEE Access*, vol. 7, pp. 155088-155106.

[16] W. L. Worley and L. S. Tesdell (2009), "Instructor Time and Effort in Online and Face-to-Face Teaching: Lessons Learned," in *IEEE Transactions on Professional Communication*, vol. 52, no. 2, pp. 138-151.

Integrated Hyperbolic Curve Cryptography (IHCC) For Cloud Security

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Abstract: Cryptography is considered an effective approach for providing security to the Intrusion Detection System (IDS) of Wireless Sensor Network (WSN). In this paper, proposed an Integrated Hyperbolic Curve Cryptography (IHCC). The proposed IHCC integrates symmetric and asymmetric key maintenance for security in WSN. The IHCC combines Hyperbolic Curve Cryptography (HCC) and the Advanced Encryption Standard (AES). It provides guaranteed high-security performance in terms of integrity, authentication, primitives, and confidentiality.The comparative analysis of proposed IHCC with the existing technique stated that the proposed IHCC provides reduced encryption time, decryption time, and energy consumption.

Keywords: Intrusion Detection System (IDS), Key generation, Encryption, Decryption, Hyberbolic Curve Cryptography (HCC).

Introduction
Cloud computing provides a platform based on the requirement of users and offers a significant factor for sharing and calculation of resources based on the location. Cloud architecture offers a template for provision of appropriate and access towards the Internet, in the collective pool of grid programmable environment such as software, servers, amenities and storage which can be emancipated effectively through minimal communication and supervision of service providers". The processing characteristics are illustrated in figure 1 as follows with consideration of on-demand self-service, High-performance access to the network, rapid elasticity, Pooling of resources, and measured services. Cloud infrastructure composes of deployment models such as Public Clouds, Private Clouds, and Hybrid Clouds.

Security is considered as a major factor for cloud computing since it is involved in delaying and other challenges in the cloud [2, 3]. Cloud security is involved in a huge set of methods for securing data through controls, policies, technologies, and methods based on the consideration of application related to infrastructure it resides. Generally, other challenges related to cloud security are multi-tenancy, federation for securing the cloud, Service level agreement, control loss, the integrity of data and privacy, availability of services, elasticity, and so on [4]. One of the major concerns in the cloud is security since the transmission of information over cloud threats affects the control in the network. Cloud provides data access but it is necessary to ensure other does not theft the data. Globally, cloud computing occupies 69% of Internet [5,6] users for storing data online or web-based software applications whose functionality is located on the web. This cloud computing resides on several cyberspaces which allows access to users through connected devices. Security management of cloud involves several technologies such as operating systems, virtualization, management of transactions. Balancing load, management of memory, and concurrency control [7].

Data security in the cloud involves data encryption through the incorporation of appropriate policies with the enforcement of effective data sharing mechanism. Additionally, the allocation of resources and memory management scheme also needs to be secured [8]. The developed cryptography technique involved in utilization of AES and HCC for the generation of keys. In hyperbola based on fixed points, different points in the plane are estimated based on consideration for the selection of positive points for public key generation. Those points in hyperbola are utilized for the exchange of keys between the sender and receiver. Once the keys are generated based on the plain text information are encrypted. The performance of the proposed approach is estimated with encryption time, decryption time, and energy consumption. Simulation results demonstrated that proposed IHCC exhibits improved performance rather than the existing technique.

Related Works
Cloud computing technology has been widely applied in a distinct number of applications but it is subjected to several security concerns. In [6] proposed a scheme based on attributes defined as Secure Independent-update Concise-expression Access Control (SICAC). The proposed scheme aimed to incorporates improved cloud authentication and authorization based on Video on Demand (VoD). The proposed scheme is based on an independent key update policy of KP-ABE for key updates and provides an effective key update mechanism. The proposed scheme illustrated that the proposed scheme is effectively involved in resource-constraint and mobile devices. In [7] proposed a scheme for cloud-based on a secure, lightweight, robust, and energy-efficient approach. The proposed approach involved in High-

Efficiency Video Coding (HEVC) for Intra encoded the streaming of videos. In another research, [8] developed an intelligent cryptography approach known as Security-Aware Efficient Distributed Storage (SA-EDS) model. Through which users able to perform partial data operation for effective classification of data.

For mutual authentication [9] proposed a light-weight protocol with the incorporation of the HCC key exchange scheme. Mutual authentication is evaluated in [10] with the inclusion of session keys for mutual authentication of system resources in the network. To improve the performance of the cloud model in [11], [12] developed a cloud architecture. Based on the authentication scheme in the cloud in [13] involved in the CapBAC authentication scheme. In [14] developed a Capability-Based Access Control (CapBAC) with access rights and granularity of information. In [15] constructed a framework for improving cloud security and authorization of access through digital certificates and integrity checks. In the case of healthcare application. In [16] proposed a fine-grained context-sensitive access control approach. In [17] proposed a CapBAC framework based on HCC incorporating key management for the M2M local Cloud platform. However, this scheme is higher weights to data transmitted which demand minimal encryption and decryption scheme.

Cloud Architecture

In cloud environment resources are scaled up and on demand resources are allocated. By means of self-service model within the Internet service provider are allocated with resources in the network. By this means, cloud offers innovation, pricing and technical benefits to users.

As per standard of NIST, cloud architecture comprises of five components for improving security in cloud. In figure 1 security challenges in the cloud are presented. As this research concerned about the security of cloud in figure 2 highlighted the major security-related challenges in cloud architecture. Also, this research emphasis authentication challenges in the cloud.
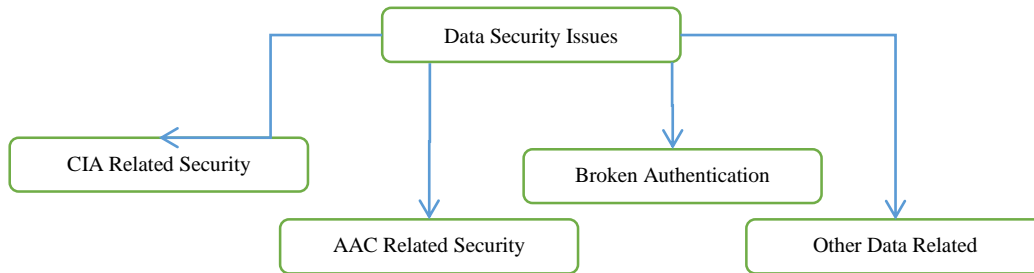
Figure 1. Security Issues in Cloud

System Design

In this section presented about cryptographic mechanism for cloud security through proposed IHCC. The proposed IHCC involves k^p is implemented based on the consideration of binary fields in elliptical curve. The security architecture involved in consideration of prime fields (Fp) with binary finite field element of F_2^m. This results improves the performance in binary finite fields by means of K^p architecture. The performance of proposed IHCC impact on finite fields of security modules based on different field element size. The finite field elements involved in reduction of computational process.

Hyberbolic Curve Selection

Cryptography act as security scheme for data transmission in cloud environment. Even though several security scheme are exists some are subjected to certain issues hence this research intended to develop attributes based cryptography for key generation. The selected cryptography technique involved in generation of keys HCC. This hyperbola concept includes various point in plane of hyperbola between two fixed points in the network with consideration of positive point those are utilized for selecting public key in the cryptography process. The fixed point in the hyperbola is defined as foci which can be separated in to branches known as separate calls. The point where two points in hyperbola intersect are utilized for generation of secret key in the encryption and decryption process even those are defined as vertices in hyperbola.

Consider finite binary field of $F_2{}^m$ with element length of m with elements d_1 and d_2. Here, the elements $d_1 \neq 0$ and $d_2 = d_1{}^2 + d_1$, where d $\neq 0$. The IHCC binary coefficient values are represented as d_1 and d_2. In hyperbolic process, finite field element value is represented and points are identified using equation (1) represented as follows:

$$x^2 - Dy^2 = 1 \tag{1}$$

Where, D denotes the non-square integer, this is used for generation of public key with consideration of co-ordinates x and y. Some researchers stated that D is also an perfect square.

Consider convergent point in hyperbols as h_i/k_i for selecting integer at point of intersection for generation of public key. The coordinates value in the hyperbola are utilized for hashing at it will be always integers those are represented as in equation (2):

$$x_k + y_k \sqrt{D} = \pm \left(x_0 + y_0 \sqrt{D} \right)^k ; k > 1 \tag{2}$$

In equation (2), k represented selected integer for public key generation. The above equation is utilized for performing generation of public and private keys based on the hyperbola point co-ordinates in the cloud platform.

In field of engineering e^x and e^{-x} based on that combinations are represented in terms of sine, cosine, hyperbolic, sinh and cosh this exhibits similar trigonometric characteristics. Hyperbolic functions are widely used in vast range of applications. The function related to hyperbola is defined as conical section. In algorithm 1 proposed IHCC encryption and decryption process is presented.

Algorithm 1: Proposed IHCC Encryption and Decryption
Input: HCC co-ordinates point
Output: Generate key H and T
1. Select hyperbolic curve x^2-Dy^2=1 over finite field Fn.
2. Identify the point G=($x0$,$y0$) with order r and this gives us G^r=E.
3. Selects an integer m and m<r.
4. Computes B=G^m mod q.
The public keys is identified with (G,B) and transmitted with private key of HCC is represented as m.
To encrypt any message w to Alice, Bob does the following:
1. Randomly chooses the secret integer k.
2. Computes H=G^k mod n and T=B^kw mod n.
3. Produces the cipher text (H,T).
4. Sends (H,T) to Alice.
To decrypt the cipher text (H,T), Alice needs to do the following:
1. Computes R=H^m mod n.
2. Recovers w=T/R mod n.

The proposed IHCC incorporates binary coefficient based on incorporation of affine transformation with geometric transformation which preserves point with in straight line which technique represented in equation (3) as follows:

$$E_{d1,d2} : d_1(x + y) + d_2(x^2 + y^2) = xy + xy(x + y) + x^2 y^2$$
$$and \quad x, y \in F_{2^m} \tag{3}$$

The IHCC incorporates two constants such as $\{d_1, d_2\}$ with valid parameters $d_1 = d_2$. Based on the consideration of $\{d_1, d_2\}$ focused on improving efficiency for minimizing storage.

Binary Curve

The domain parameters measured for domain factors are represented in equation (4) as follows:

$$F_2^{251} = F_2[t]/\left(t^{251} + t^7 + t^4 + t^2 + 1\right)$$
$$d_1 = d_2 = t^{57} + t^{54} + t^{44} + 1 \in F_{2^{251}}$$
$$x, y \in F_{2^{251}} \tag{4}$$
$$E_{d1,d2}(k) : d\left(x + x^2 + y + y^2\right) = \left(x + x^2\right)\left(y + y^2\right)$$

The curve in IHCC involved in identification of large possible set of values of d. The IHCC involved in pentanomial factor with excellent value. For the implementation values the value of d is set as constant with consideration of constant value of variable length with appropriate parameter design.

Simulation Results

Simulation analysis of proposed IHCC is implemented for security analysis. The performance of proposed IHCC involved in consideration of finite field element for generation of keys. The generated keys are utilized for encryption of keys for secure data transmission. The performance metrics considered for analysis are encryption time, decryption time, packet dropping rate and energy consumption.

Encryption and Decryption Time

The performance of proposed IHCC algorithm is measured in terms of encryption time and algorithm with generation of plaintext. In table 2 and table 3 for different plain text encryption and decryption time are comparatively presented with existing techniques. The performance is measured comparatively with AES and Elliptical Curve Cryptography (ECC) technique. In figure 3 comparative analysis of encryption time and in figure 4 comparatively presented about decryption time are presented. Due to convergence plain text encryption time is not converged for ECC and IHCC for analysis.
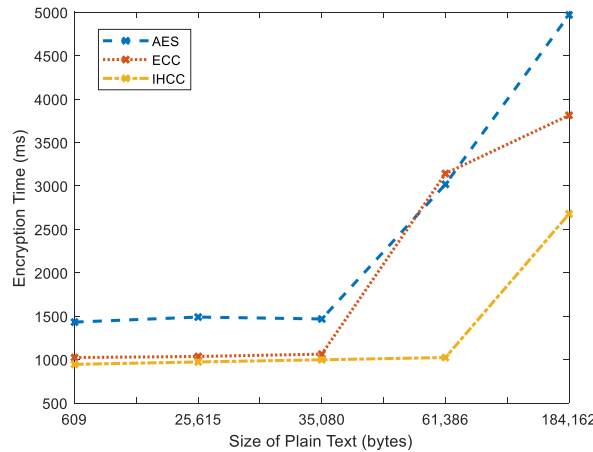
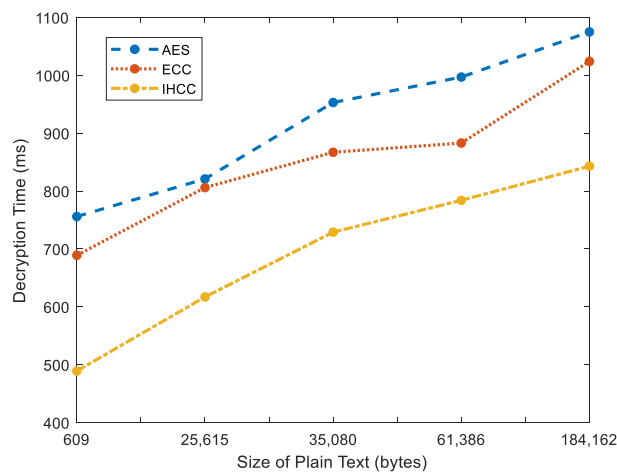

Figure 2. Comparison of Encryption Time

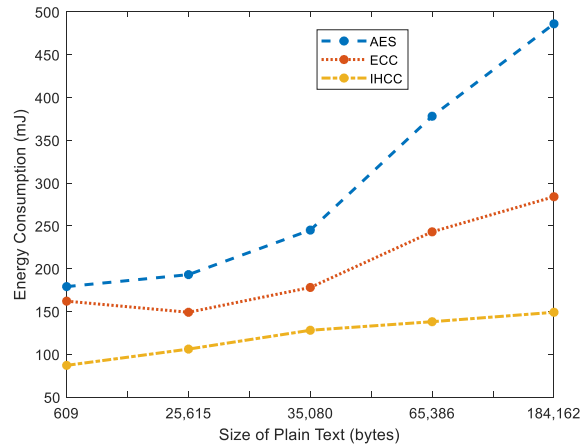**Figure 3.** Comparison of Decryption Time

277

Figure 4. Comparison of Energy Consumption

From figure 2 and 43it is observed that proposed IHCC exhibits reduced encryption and decryption time. The analysis of AES and ECC exhibits higher encryption and decryption time than proposed IHCC. The performance of proposed IHCC is approximately 40% higher than AES and 30% higher than ECC. In table 4 energy consumed by the proposed IHCC with AES and ECC are presented comparatively. In figure 4 comparatively illustrated energy consumption rate of existing AES and ECC with proposed IHCC. The figure 5 stated that proposed IHCC provides minimal energy consumption rather than conventional AES and ECC techniques. The analysis stated that proposed IHCC exhibits minimal energy consumption rate approximately 30% lower than AES and approximately 25% lower than ECC.

Conclusion
Cryptography is an emerging concept for the cloud environment due to the increased number of attacks on the cloud platform. Several techniques are proposed in existing for improving security in the cloud platform but those techniques involved in providing security for a specific term with consideration of encryption and decryption. But those existing technique does not offer security for file components in the cloud. This paper, presented about attributes-based cryptography technique for improving security in the cloud. This proposed technique involved encryption and decryption in the cloud with the provision of access to users after getting verified. Simulation analysis is performed comparatively with existing technique AES and ECC. From the analysis, it is observed that the proposed approach exhibits significant performance in terms of encryption time and decryption time rather than AES and ECC. It is concluded that the proposed IHCC approach offers significant security to the cloud file.
In the future, this research can be further extended to a dynamic environment or real-time application where files are dynamically uploaded environment. The evaluation of the developed algorithm significantly improve the real-time scenario such as social media which has a burst of data. This key management concept can also be extended to mutual trust [18] establishment between two nodes communicating with each other for confidential data transfer.

References
[1] Torkura, K. A., Sukmana, M. I., Cheng, F., & Meinel, C. (2020). CloudStrike: Chaos Engineering for Security and Resiliency in Cloud Infrastructure. *IEEE Access*.
[2] Yang, C., Tan, L., Shi, N., Xu, B., Cao, Y., & Yu, K. (2020). AuthPrivacyChain: A blockchain-based access control framework with privacy protection in cloud. *IEEE Access*, *8*, 70604-70615.
[3] Barry, P. J., Dyer, S. E., & Goldshmid, S. (2020). *U.S. Patent No. 10,554,758*. Washington, DC: U.S. Patent and Trademark Office.
[4] Mishra, A., Gupta, N., & Gupta, B. B. (2020). Security Threats and Recent Countermeasures in Cloud Computing. In *Modern Principles, Practices, and Algorithms for Cloud Security* (pp. 145-161). IGI Global.
[5] Singh, G., & Garg, S. (2020, June). Fuzzy Elliptic Curve Cryptography based Cipher Text Policy Attribute based Encryption for Cloud Security. In *2020 International Conference on Intelligent Engineering and Management (ICIEM)* (pp. 327-330). IEEE.
[6] Qazi, R., & Khan, I. A. (2020). Data Security in Cloud Computing Using Elliptic Curve Cryptography.
[7] Santoso, K. I., Muin, M. A., & Mahmudi, M. A. (2020). Implementation of AES cryptography and twofish hybrid

algorithms for cloud. In *Journal of Physics: Conference Series* (Vol. 1517, p. 012099).

[8] Suresha, K., & Karthick, P. V. (2020). Enhancing Data Security in Cloud Computing Using Threshold Cryptography Technique. In *Advances in Cybernetics, Cognition, and Machine Learning for Communication Technologies* (pp. 231-242). Springer, Singapore.

[9] Lara, P. D. M., Maldonado-Ruiz, D. A., Díaz, S. D. A., López, L. I. B., & Caraguay, Á. L. V. (2019). Trends on Computer Security: Cryptography, User Authentication, Denial of Service and Intrusion Detection. *arXiv preprint arXiv:1903.08052*.

[10] Sohal, M., & Sharma, S. (2018). BDNA-A DNA inspired symmetric key cryptographic technique to secure cloud computing. *Journal of King Saud University-Computer and Information Sciences*.

[11] Prabha, K. M., & Saraswathi, P. V. (2020). Suppressed K-Anonymity Multi-Factor Authentication Based Schmidt-Samoa Cryptography for privacy preserved data access in cloud computing. *Computer Communications*.

[12] Kaaniche, N., & Laurent, M. (2017). Data security and privacy preservation in cloud storage environments based on cryptographic mechanisms. *Computer Communications*, *111*, 120-141.

[13] Kumar, V., Ahmad, M., & Kumari, A. (2019). A secure elliptic curve cryptography based mutual authentication protocol for cloud-assisted TMIS. *Telematics and Informatics*, *38*, 100-117.

[14] Zhou, L., Varadharajan, V., & Hitchens, M. (2014). Secure administration of cryptographic role-based access control for large-scale cloud storage systems. *Journal of Computer and System Sciences*, *80*(8), 1518-1533.

[15] Wang, X. A., Ma, J., Xhafa, F., Zhang, M., & Luo, X. (2017). Cost-effective secure E-health cloud system using identity based cryptographic techniques. *Future Generation Computer Systems*, *67*, 242-254.

[16] Ferretti, L., Marchetti, M., Andreolini, M., & Colajanni, M. (2018). A symmetric cryptographic scheme for data integrity verification in cloud databases. *Information Sciences*, *422*, 497-515.

[17] Opara-Martins, J., Sahandi, R., & Tian, F. (2016). Critical analysis of vendor lock-in and its impact on cloud computing migration: a business perspective. *Journal of Cloud Computing*, *5*(1), 4.

[18] A Jain & Khushboo Tripathi (2019). Malicious Detection using Secure Mutual Trust Based Routing on an Intrusion Detection System in WSN, International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878.

279

A Systematic Review of Code Smell

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Abstract: A code smell is any characteristic in the source code of a program that possibly indicates a deeper problem.Code smells arewell-known indicators of violation of good software design principlesin software development. Developers and researchers are using them as structural characteristics to find out the scope of refactoring of code to make it more maintainable. This paper presents research questions base study of Code Smells in terms of its causes, impacts, types and taxonomies to categorize similar code smells.

Keywords: Code Smell, Software Quality, Maintainability

Introduction

Code smells indicate software design principlesviolation thereby negatively impacting the quality of software. It differs from bug as unlike bug it does not affect the functioning of program. Code with smell may be correct and working properly. Software continuously requires updation due to many reasons such as correction of defects, changing user requirements, adopting new technology etc. These continuous changes or evolution in the software systems frequently occur under time pressure leading developers to use inferior programming practices and principles to deliver relevant but still imperfect product in the shortest time possible [1,2]. As a consequence of this practice software quality is badly impacted.Code Smell occurrences represent structural inconsistencies that often make the program hard to read and hence less adaptable to changes. Although software design principles violation is may occur during the software development process itself but post development changes are considered as the major source of such violations. One of the symptoms of such violation is code smell.

The term "code smell" was introduced by Kent Beck in relation to identify quality issues associated with the code which can be refactored to improve thesoftware maintainability.Code Smell are labelled as a potential design problemand refactoring technique is recommended to eliminate code smells.22 different types of code smells were defined [3]. Fowler defined refactoring as "the process of changing a software system in such a way that it does not alter the external behavior of the code yet improves its internal structure". The motive behind refactoring was to improve the internal structure (design) of the software so that future problems (mainly during maintenance) could be avoided. Refactoring techniques have been presented for many situations, some techniques are "extract method", "move method", "replace data value with object", and many others.

There have been many attempts in literature to provide an overview of the existing knowledge about code smells. The studies in considerationeither discuss some or all the 22 code smells presented by Fowler. This paper presents aquestions based survey of code smell for its detailed understanding and further research. The aim of the current study is to explore concept of code smells in terms of its causes, impacts, types and taxonomies to categorize similar code smells.

Rest of the paper is presented in three sections. Section 2 framed the four research questions which are answered and discussed in Section 3. Finally Section 4 presented the conclusion of paper.

Research Objective and Questions

The study aims toprovide an integrated yet vast overview of software smells covering their causes, types, impacts and taxonomies on various aspects of software development. The study selected relevant papers, extracted data by performing a systematic literature review and analyzed the results to answer following research questions:

RQ1: What are the different kinds of code smells?

Impact of code smells on quality of the software varies from one smell to other. Hence to understand this better a detailed knowledge about the different types of code smells is required. The studyalso explored the extent to which various code smells have been studied over among the researchers.

RQ2: What are the various factors that cause code smell?

There are many factors that cause the code smell. It is essential to know these causes before handling them. This question is framed to understand these causes in detail and provide a comprehensive list of causes.

RQ3: What is the impact of using code smell on various aspects related to software development?

This question aims to understand the impact of code smells on various other aspects related to software development along with the impact on software quality.

RQ4: What are the various taxonomies of code smell?

Various taxonomies have been proposed to categorize similar code smells in order to make the code smells more understandable and recognize the relationships between smells. This question is aimed to find out various code smell taxonomies available in the literature along with their comparisons.

Results and Discussion

The detailed study of various research contents corresponding to each research question formulated in the previous sectionlead to various observations. The knowledge gathered regarding each research question is documented in this section.

RQ1: What are the different kinds of code smells?

The concept of code smell was first introduced by Kent Beck to identify the poor qualitycode and was later well addressed by Fowler to use itas a refactoring indicator for improving code quality. Many researchers identified various types of code smells but the 22 most popular types of code bad smells indicating various software refactoring opportunities were given by Fowler [3]. Table 1 presents the code smells along with their definition and the number of papers studying it.

Findings illustrate that not all code smells have received equal attention by the researchers. Large class, Duplicate code, Long method and Refused Bequest are discussed more as compared to the others.Figure 1 depicts the code smells distribution based on the number of papers in which each smell has been studied.
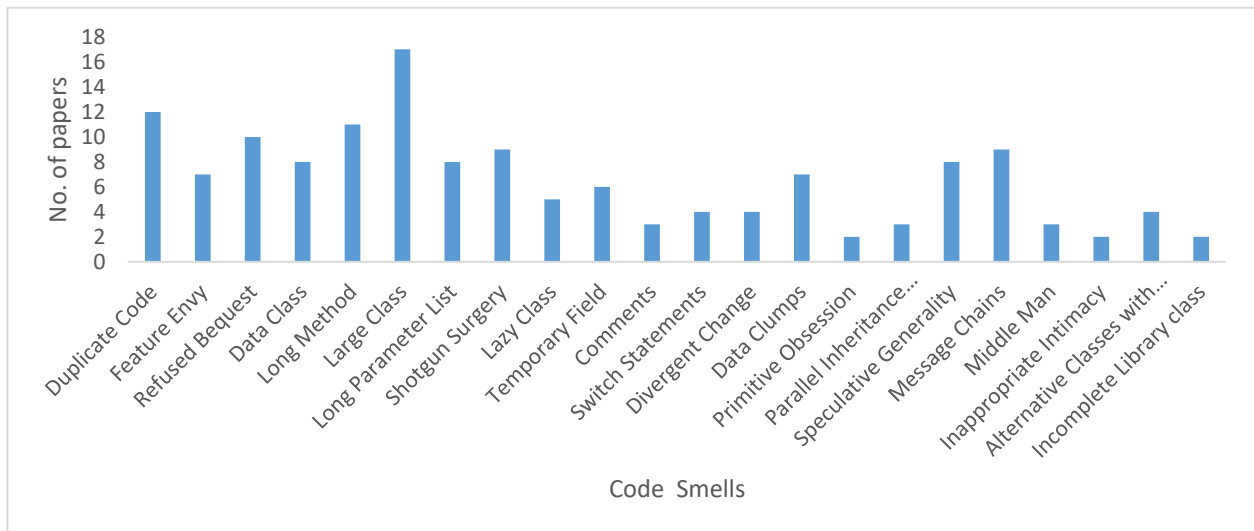
Figure 1. Code Smell Distribution

RQ2: What are the various factors that cause code smell?

Generally it is considered that code smells are introduced during the evolution of the software butnot always asmost of the code smell are introduced at the time of development of software[4]. In the literature review it has been found there are many causes of code smells, major causes includeSkill or awareness shortage, Changing requirements, Limitations of language, platform, or technology, Incomplete Knowledge, Processes, Pressure of deadline, Giving preference to features over quality, Influence of politics, Team culture and Poor allocation of human resources.

Quality of the code is impacted by the skill set of development team. Lack of required skill set causes code smell. Frequently changing user requirements is one of the major causes of code smell. Poor design decisions is also the important cause of code smell. Meeting time deadlines given by management always put a pressure on developers, therefore developers focus on delivering the functional code rather than quality code. Fully or partially unavailability of documentation also leads to code smells. Selection of ineffective process can also cause of code smell.

Table 1. Code Smell Description.

Code Smell	Definition	No. of papers studied the Code Smell
Duplicate Code	If the same code expression is duplicated at many places within a software system making the code difficult to maintain.	12
Long Method	It is a result of a procedure that is too long to understand, change and extend thereby impacting the code readability and reusability.	11
Large Class	When a class is trying to do too much, it often shows up as too many instance variables. Hence it impacts the code reusability and readability.	17
Long Parameter List	When a method requires too many parameters to be passed making the method difficult to understand and use.	8
Divergent Change	It is a consequence of making changes commonly in a class in different ways for different reasons. Divergent change impacts the code readability and reusability.	4
Shotgun Surgery	When one type of change causes a lot many changes in various different classes making the code difficult to maintain.	9
Feature envy	The method of a class is more interested in some other class rather than the one in which it actually is. This smell makes the code difficult to maintain.	7
Data Clumps	When a group of variables are passed around together (in a clump) throughout various parts of the program. It makes the code more difficult to maintain and impacts reusability.	7
Primitive Obsession	When instead of using small classes for small tasks primitive types are used more.	2
Switch Statements	Whenthe presence of switch statements in a program results into duplication of code at different places in a program. It makes the code very difficult to maintain and impossible to reuse without major refactoring.	4
Parallel Inheritance Hierarchy	It is a manifestation of Shotgun surgery in which making a subclass of one class requires making a subclass of another.	3
Lazy class	When a class is not performing enough functionality to justify the cost incurred to maintain and understand it. It makes code difficult to maintain.	5
Speculative Generality	When an unnecessary abstract class is created making things difficult to understand and maintain.	8
Temporary Fields	When only in some definite circumstances an instance variable of an object is set.	6
Message Chains	When a particular class is highly coupled to other classes in chain-like delegations. It makes the code difficult to maintain and impacts readability.	9
Middle Man	When a class delegates the majority of work to another class. It makes code difficult to maintain.	3
Inappropriate Intimacy	When one class uses the internal fields and methods of another class.	2
Alternative Classes with Different Interfaces	When two classes perform identical functions but have different method names.	4
Incomplete Library Class	When a library class doesn't fulfill the requirements of a user completely.	2
Data Class	When a class acts as a data holder which except for having only fields along with the getting and setting methods for the same does nothing else.	8
Refused Bequest	When a subclass uses only a few methods and properties offered by its superclass and reject the rest.	10
Comments	Unnecessary comments are superfluous and are treated as a code smell.	3

RQ3: What is the impact of using Code Bad Smells?

Smells have a varied impact on the software product and its quality. Generally, smells impact maintainability,reliability, testability, performance and change-pronenessof the software [5-22]. Presence of large number of smells in a product impact the outcome of a process; for instance, a high number of smells in a piece of code may lead to pull request rejection [19]. Due to the presence of a high number of smells, the morale and motivation of the development team is also impacted, thereby leading to high attrition [23,24].

Code smells lead to increase in change and fault-proneness, decrease of software understandability and maintainability [5,6,21,22,25,26].

Howevernot all code smells lead to a negative impact on software, e.g., duplicated code can increase the reliability of software, and data class, refused bequest and feature envy are not associated significantly with software faults or the particular severity level of software faults, but the reason for this is still unclear [27-30].

RQ4: What are the various taxonomies of Code smell?

Various taxonomies are available in literature proposed many researchers includingMantyla et al. [31,32], Wake [33], Lanza et al. [34] and Moha et al. [35]. One of the most widely used taxonomy by Mantyla et al. [31,32]classifies the code smells into categories including Bloaters, Encapsulators, Change Preventers, Couplers, Object-Orientation Abusers, Dispensable and others.

Bloaters represent code smellswhich occur due to large size of code, Object-Oriented Abusers includes the code smells which are responsible for inappropriate use of object-oriented principles, Change Preventers include the code smells which include structures of code that hinder the modification of software, Dispensable includes the code smellswhich represents the unnecessary code such as duplicate code, lazy class etc., Encapsulators includes the code smells that deal with data communication mechanisms, Couplers represents the code smells which occurs due to coupling. All other code smells are categorized into the Others category.

1. Conclusion

This paper presents a systematic literature review to explore the current status of knowledge about code smells. This study presents a consolidated overview of code smells and the various quality attributes which are affected by code smells. The study explored various factors that cause code smells and the impact of code smells on the software quality. The survey also presents different kinds of code smells and the various taxonomies for classifying them. Our study also shows that Large class, Duplicate code, Long method and Refused Bequesthave received more attention fromthe researchers in comparison to the others. The existing literature survey provides the theoretical insight of the code smell however a quantified view of code smell is required for its detailed understanding.

References

[1] Brown,N.,Cai,Y.,Guo,Y.,Kazman,R.,Kim,M.,Kruchten,P.,Lim,E.,MacCormack,A.,Nord,R.,Ozkaya,I.,Sangwan, R.,Seaman,C.,Sullivan,K., &Zazworka,N. (2010). Managing technical debt in software-reliant systems. *In Workshop on Future of Software Engineering Research (FoSER'10),18th ACM SIGSOFT International Symposium on Foundations of Software Engineering (FSE),*pp. 47–52.

[2] Kruchten,P.,Nord,R.L., &Ozkaya,I. (2012). Technical debt: From Metaphor to Theory and Practice. *In IEEE Software: Vol. 29(6)*, pp. 18–21.

[3] Fowler,M., Beck,K., Brant,J., Opdyke,W., &Roberts,D. (1999). *Refactoring: Improving the Design of Existing Code*. Addison-Wesley.

[4] Tufano,M., Palomba,F., Bavota,G., Oliveto,R., Penta,M.D., Lucia,A.D., &Poshyvanyk,D. (2015).When and why your code starts to smell bad. *In 37th International Conference on Software Engineering (ICSE'15): Vol. 1,* pp. 403-414.IEEE Press.

[5] Yamashita,A., &Moonen,L. (2013). Exploring the impact of inter-smell relations on software maintainability: an empirical study. *In2013 International Conference on Software Engineering (ICSE'13),* pp. 682-691.IEEE Press.

[6] Yamashita,A., &Moonen,L. (2012). Do code smells reflect important maintainability aspects?.*In Proceedings of the 2012 IEEE International Conference on Software Maintenance (ICSM'12),* pp. 306–315.

[7]   Bavota,G., Qusef,A., Oliveto,R., Lucia,A.D., &Binkley,D.(2012). An empirical analysis of the distribution of unit test smells and their impact on software maintenance. *In IEEE International Conference on Software Maintenance (ICSM'12),* pp. 56-65.

[8]   Perepletchikov,M., & Ryan,C. (2011). A Controlled Experiment for Evaluating the Impact of Coupling on the Maintainability of Service-Oriented Software. In *IEEE Transactions on Software Engineering: Vol.37 (4)*, pp. 449-465.

[9]   Soh,Z., Yamashita,A., Khomh,F., &Gueheneuc,Y.(2016). Do Code Smells Impact the Effort of Different Maintenance Programming Activities?.*In 23rd IEEE International Conference on Software Analysis, Evolution, and Reengineering (SANER),* pp. 393-402.

[10] Jaafar,F., Gueheneuc,Y., Hamel,S.,&Khomh,F.(2013). Mining the relationship between anti-patterns dependencies and fault-proneness.*In Proceedings of the 20th IEEEWorking Conference on Reverse Engineering (WCRE),* pp. 351-360.

[11] Hall,T., Zhang,M., Bowes,D., & Sun,Y. (2014). Some Code Smells Have a Significant but Small Effect on Faults. In *ACM Transactions on Software Engineering and Methodology (TOSEM): Vol.23 (4)*, pp. 33-39.

[12] Zazworka,N., Shaw,M.A., Shull,F., &Seaman,C. (2011). Investigating the impact of design debt on software quality. *In Proceedings of the 2nd Workshop on Managing Technical Debt (MTD'11).ACM,* pp. 17-23.

[13] Bavota,G., Qusef,A., Oliveto,R., Lucia,A.D., &Binkley,D. (2014). Are test smells really harmful? An empirical study. In*Empirical Software Engineering: Vol.20 (4)*, pp. 1052-1094.

[14] Monden,A., Nakae,D., Kamiya,T., Sato,S..,& Matsumoto,K. (2002). Software Quality Analysis by Code Clones in Industrial Legacy Software. I*n Proceedings of the 8th IEEE International Symposium on Software Metrics (METRICS '02),* pp. 87-94.

[15] Khomh,F., Penta,M.D., Gueheneuc,Y.,&Antoniol,G. (2012). An exploratory study of the impact of antipatterns on class change and fault-proneness. *In Empirical Software Engineering: Vol. 17 (3)*, pp. 243-275.

[16] Chen,T.H., Shang,W., Jiang,Z.M., Hassan,A.E., Nasser,M.,& Flora,P. (2014). Detecting performance anti-patterns for applications developed using object-relational mapping. *In Proceedings of the 36th International Conference on Software Engineering (ICSE'14). ACM*, pp. 1001-1012.

[17] Hecht,G., Moha,N., &Rouvoy,R. (2016). An empirical study of the performance impacts of Android code smells.*In Proceedings of the International Workshop on Mobile Software Engineering and Systems (MOBILESoft'16). ACM*, pp. 59-69.

[18] Sharma,V.S., &Anwer,S. (2014). Performance antipatterns: Detection and evaluation of their effects in the cloud. *In Proceedings of the 2014IEEE International Conference on Services Computing,* pp.758-765.

[19] Silva,M.C.O., Valente,M.T.,& Terra,R., (2016). Does technical debt lead to the rejection of pull requests?.*InProceedings of the XII Brazilian Symposium on Information Systems.*

[20] Olbrich, S., Cruzes, D. S., Basili, V., Zazworka, N., Aug. (2009). The evolution and impact of code smells: A case study of two open source systems. *In 3rd IEEE International Symposium on Empirical Software Engineering and Measurement (ESEM),* pp. 390-400.

[21] Khomh, F., Penta, M. D., Gueheneuc, Y. (2009).An Exploratory Study of the Impact of Code Smells on Software Change Proneness.*In 16th IEEE Working Conference on Reverse Engineering,* pp. 75-84.

[22] Khomh, F.,Penta, M. D., Gueheneuc, Y., Antoniol, G. (2012).An exploratory study of the impact of antipatterns on class change and fault-proneness. *InEmpirical Software Engineering: Vol. 17 (3)*, pp. 243-275.

[23] Tom, E., Aurum, A., Vidgen, R.(2013). An exploration of technical debt. *Journal of Systems and Software : Vol. 86 (6)*, pp. 1498 – 1516.

[24] Suryanarayana, G., Samarthyam, G., Sharma, T.(2014). *Refactoring for Software Design Smells: Managing Technical Debt, 1st Edition,* Morgan Kaufmann.

[25] Abbes, M.,Khomh, F.,Gueh´ eneuc, Y., &Antoniol, G. (2011). An empirical study of the impact of two antipatterns, Blob and Spaghetti Code, on program comprehension. *In 15th IEEE European Conference on Software Maintenance and Reengineering (CSMR'11),* pp. 181–190.

[26] Sjøberg, D. I. K., Yamashita,A. F.,Anda, B. C. D., Mockus, A., and Dyba, T. (2013). Quantifying the effect of code smells on maintenance effort. *InIEEE Transactions on Software Engineering: Vol. 39(8),* pp. 1144–1156.

284

[27] Kapser, C.J., &Godfrey, M.W. (2008). Cloning considered harmful: patterns of cloning in software. *Empirical Software Engineering, 13(6)*, pp. 645–692.

[28] Li, W., &Shatnawi, R. (2007). An empirical study of the bad smells and class error probability in the post-release object-oriented system evolution.*InJournal of Systems and Software, 80(7)*, pp. 1120–1128.

[29] Monden, A., Nakae, D., Kamiya, T., Sato, S., & Matsumoto, K. (2002). Software quality analysis by code clones in industrial legacy software.*In the Proceedings of Eight IEEE Symposium on Software Metrics*, pp. 87–94.

[30] Shatnawi, R., & Li, W. (2006). An investigation of Bad Smells in object-oriented design. *In theThird International Conference on Information Technology: New Generations (ITNG 2006)*, pp. 161–165.

[31] Mäntylä, M., Vanhanen, J., &Lassenius, C. (2003). A taxonomy and an initial empirical study of bad smells in code. *In IEEE International Conference on Software Maintenance (ICSM 2003),* pp. 381–384.

[32] Mäntylä, M., Vanhanen, J., &Lassenius, C. (2004). Bad smells - humans as code critics. In 2*0th IEEE International Conference on Software Maintenance (ICSM 2004),* pp. 399–408.

[33] Wake, W. C. (2003). *Refactoring Workbook,Ist Edition.* Boston, USA. Addison-Wesley Longman Publishing Co., Inc.

[34] Lanza, M.,&Marinescu, R. (2006). Object-Oriented Metrics in Practice. *Springer-Verlag*.

[35] Moha, N.,Gueheneuc, Y. G., Duchien, L., &Meur, A. F. L. (2010). DECOR: A method for the specification and detection of code and design smells. *InIEEE Transactions on Software Engineering, 36(1)*, pp.20–36.

Web Scraping with Python- A Review

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Abstract: People own electronic devices and resource-rich companies are becoming milestones for data factories that inject incredible amounts of information into the World Wide Web (WWW) every day. This myriad volume of data is allocated across huge numbers of websites and their applications. The Web Scrapers' overlooking principles and approaches are juxtaposed, it describes with respect to the operation of how the scraper is planned. This artwork is allotting three portions - the web scraper pile-up the preferred web-links, afterwards the data is gathered to procure the desired data from those sources and eventually depositing that data to a CSV file for further referencing. Here, the Python language is applied for the accomplishment of this task. Resultantly, consolidation of these with the conscientious of libraries and pushing on their proficiency, and acquire the desired contents using this suitable scraper. Because of a vast group and library assets of Python and the magnificence of codes in python programming language, it is best suited for retrieving the intended information from the anticipated website. Being so, the demand and connotation of extracting the data from the stupendous connectivity all over world is successively fitting user friendly.

Keywords: Web scraping; Web harvesting; Web content extraction; Python; Information retrieval.

Introduction

Modifications and developments are nimbler than ever, with amending analytics and evolving digital world producing latest travel styles. Modern clients are more economically awaken than earlier, and contemporaneous fashion mirrors that.

In the term of tourism, customers' cognitive processes, potential clients can approach web as a scheme for reservations, for eruditions and further recommending some guidance. Nowadays, the tourism service is a vital sector in the developing countries. Being a significant job and income provider, this calls for some great modernization and aftercare. The tourism industry, thus, is a zestful field with the incessant demanding customers. The competitors in this discipline require to face the challenging vogue in this industry, the preferences of the frequenters and yet on their past capabilities, to achieve satisfactory levels as the time advances. Therefore, apparently the institutions in travel sector involve wealthy data from collective founts and a well-defined process to analyses that facts for further recommendations. One of the widely embraced techniques for accumulating preferred information is data scraping from the websites available on the internet. Data web scraping is a constitutive segment of all industries and their businesses that trails an erudition acting upon data.[1]

World Travel and Tourism Council's (WTTC) contemporary research alongside Oxford Economics, reveals that the Travel & Tourism sector cracked 3.5% heightening in the past year, surpassing the world's wealth of around 2.5% for the ninth successive term. Over recent years, one-fourth of introduced vacancies were generated by this sector, promoting it as the leading associate of government in inducing employment as well as revenue.[2]

Astray droids, artificial intelligence (AI) is bustling in more actions too. Feasibly, the frequent application within this industry as a help line, with chatbots procuring such intelligence with prompt feedback to all the questions. It is further adept to ceaselessly grasp from the conversations. These AI machines are transforming to the peak. Different sorts of machine intelligences are currently managed over the tourism sector. The aforesaid chatbots, with its proficiency to automate and simplify most of its sales in conjunction with the customer feedback services. As the clients hope for a rapid and appropriate responses, these bots assist the users 24x7. Whilst the constraints in their performance, interactive bots can yield a plenitude of serviceable support for the end users. Other than this, the application of machine learning enables these mechanisms to master all probable discussions and perpetually enhance itself. AI is also extensively implemented in data gathering and its interpretation, accompanying fundamental tools for elevating ability, dependability and satisfaction of clients.[3]

The economy is multiplying in association with tourism sector. But this zone always needs improvements, thus, needs to be reconstructed. It should be zealous inside the nation itself. Information and Communication Technologies (ICT) are examining to authorize this progression, providing tremendous cooperation respecting the transforming formula of tourism, hence, proffer some additional pleasing travel practices to a huge scale of vacationers, who are growingly inviting more and more customized tour-plans. Customers wait for an admissible and appealing information that concurrently is faithful and handy. A quick-witted traveler expediting system alleviates a venue much unchallenging

ever more and plan reversals would turn down. In addition, an uncomplicated user interface will be preferable for a productive usage of this service.[4]

Web Scraping

Online network takes the lead in providing the data. It has been a prolonged tactic to derive some desired information from multiple sources scattered all over the internet, but there were myriads of procedures, so none were recognized at the beginning. Gradually, these data extraction processes unfolded, and advancements came in the technologies, thus method of web scraping was discovered.[6]

The computerized harvesting of archives from the information highway is just as matured as the online world itself. However, web scraping by no means is another word, earlier, the conduct turns out to be better known as data mining, screen-scraper, web harvesting, etc. In this thesis, web scraping is the procedure of assembling the precise data with all methods except for a program engaging with an Application Program Interface (API, or, undeniably by one employing an internet browser). A sound way is by coding an automated script that appeals a web server, calls for data (often organized as HTML and similar files that comprehends web pages), and then construes the data to unsheathe the demanded queries. In practice, web data extraction embraces a great diversity of planning approaches as well as technologies, such as data mining, analysis over it and on top of that protection of data, i.e. related to cyber security.[7]

As an alternative to visualization of sequential pages via small screen, one can directly access the data banks covering millions of webpages at the very spot. Likewise, web scrapers can reach-out sites that conventional searchers cannot find. A Google search for "Cheapest flights to Delhi" will conclude a heap of promotions and favored flight portals. Google merely realizes as these pages exhibits, not the precise impacts of separate queries inputted in a flight search engine. Anyhow, a sophisticated web harvester can tabulate the expenditure of a flight to Delhi after a while, crosswise a broad range of sites, and recommends the best suited to price.

Well, APIs mayhap remarkable, if a suitable one is found. They might grant a favorable string of proportioned figures from a webserver to another one. Usually, it is advantageous to go with an existing API, instead of building a bot for the same. Still there are diverse causes due to which an API does not subsist: The origin site might not be having the framework or troubleshooting capability to establish an API. Albeit an API exists, the bid volume and bandwidth, the datatype, or some other data related parameters that it allocates might be short for the motives. There comes web scraping, accompanied by some anomalies, within web browsers, this can be acquired via a Python script. So, when a webpage is retrieved, the complete data could be preserved into a Comma-Separated-Values (CSV) file or other preferred file formats as in a database. And the stored data can be further analyzed and be implemented to many more researches.

Techniques

The standard Ctrl C and Ctrl V: The users' copy-paste method, also a human trial, is the prime practicable data retrieval strategy. Yet, it may cause inattentive fallacies, and obviously is a monotonous task when the netizen needs to inspect the page and accumulate loads of data and compile it as dataset/s.[8]

Ubuntu and regular expressions: A uninvolved and vigorous proposal to collect data from different websites. This method of working is based on some UNIX commands or regular expression pairing possibilities of this programming language.

HTTP method: This is a way of extracting information from static and dynamic contents of websites. These specifics shall be derived by running the Hyper Text Transfer Protocol (HTTP) request calls to the remote located webservers using the socket programs.

HTML Parsing method: The partially structured queries, like Hypertext Query Language(HTQL), and could be deployed to parse the Hypertext Markup Language(HTML)webpages to claim the data.[6]

Software: There exists many appreciable tools useful for personalizing the web data extracting provisions. This software tool perchance aims to systematically realize the collected facts, built of the page or propound an interface that eliminates the relevance to write computerization code, or a remarkable scripts that can allow pulling out of content and transfer them to the designated databases.

Computer vision scanners: Implementing machine learning together with computer vision, seek to detect and excerpt the piece of information from the visited websites by elucidating the webpages observable by the intelligence of device but not by a human.

Relevant Python Libraries

Comparatively, all the recent web data extraction programs running on the net are just a variation of automated bots in practical terms. Moreover, these intelligent scripts are liable for deducing the markup language of an internet site and then bringing altogether into a well-ordered data.

Requests library - The most introductory library offered by python for this impulse. It is ideally suited for possessing the matter from a mere non-recurrent or static webpage only. In another words, it disapproves to scrape the material from an asynchronous web application alike AJAX (Asynchronous JavaScript and XML). With a beautifully designed documentation, the library leads that, it encloses supremely standard authentications to pitch into the domains. In summation, this directory streamlines by establishing HTTP requests or HTTP(S) proxy supports, nonetheless, it could not parse through the formerly retrieved HTML contents. For HTML parsing, lxml library and its enhancement, BS4 package are introduced later. And Requests package could not get pass the JavaScript (JS) enabled sites. Also, contrary to other libraries, the overall processing of this turns out to be astonishingly fast with minimizing the consumption of CPU and memory.[9]

Lxml library - As already highlighted in the latter part, lxml took effort for parsing the HTML body. With a driven pace in accordance with CSS and XPath selectors, it invigorates to tolerate the HTML. While the endorsed documentations by the developers that may not be self-evident leading to difficulties in recommencement, the sturdiness of element trees therein python enabling it to scrape few large datasets from any systematic HTML web page. Even so, lxml library is confined to the dynamic websites only.

Selenium library - yet another web driver, remarkable as a convivial with a digestible documentation for a novice web scraping user. Bizarrely, selenium was not intended for crawling. Vast majority of the sites are amply implementing JS, this library was configured to parse such JS-validated info from the webpage in a slower but steady method. Parsing of every web-accessible dynamic script implies that it automates the web browser, and thus, accounts an inordinately high memory and unwillingly slower. Therefore, realized that it is unfit for scraping major websites.

BeautifulSoup library - or BS4, designed to extract data from both HTML and XML documents. Along with lxml library, they become congruent to act upon inadequate HTML web-pages, yet slower as compared to the plain lxml, since this collaboration absorbs the profusion of CPU usage.[7]

Scrapy framework - A mature python solution to meet the challenge of fetching asynchronous massive datasets from all kind of websites. Collectively, with an excellent documentation and combination all above mentioned python libraries, in association with the Splash library, they deftly provide the spider crawlers processing multiple HTTP requests in parallel, saving the valuable time for downloading the HTML contents in an average amount of memory, and then go through the raw data for further transfigurations and saves as a purposeful format like CSV, JSON or XML files.

Beyond these popular python libraries, there are few more platforms for such activity – Import.io, a Software as a Service (SaaS) available online for retrieving info and unifying them from a website without programming. This analytical base bestows the user for a prompt product in fraction of minutes or even seconds. The application shows a Point and Click function which makes it possible to identify the precise fields to be worked upon. Once the data is extracted, they are stored into the affiliated cloud-based server and also the file can be converted into any required file format[10].

Architecture and Process

Comparatively, all the recent web data extraction programs running on the net are just a variation of automated bots in practical terms. Moreover, these intelligent scripts are liable for deducing the markup language of an internet site and then bringing altogether into a well-ordered data.

Primarily, taking advantage of Hypertext Transfer Protocol, a GET request is forwarded to the targeted website. Later, the web server handles the request and, when found authentic, the user is permitted to fetch and read the HTML content of that page. A data extraction tool identifies the desired contents and assign those values to some variables. This implies the process as an overview, Although, this elementary practice is further extended to thousands of observations. As these tools being more intricated, the prospects of machine learning and big data evolves with them. Further comprising the commonality with dynamic webpages these days, the harvesters are coerced to rework on their automating tactics in the future.

Conclusion

The paper tries to feature the convenience of automated information capturing tools and their impressive execution in the generation of database with facts and figures for future analysis work. Hence, it is now well known that to acquire some relevant data autonomously from a website, web scraping is the persuasive method. Encompassed by rest of the techniques indicated which are familiar to take out the data, web scraping is more reputable, swift, and computerized.

By applying the python language in such course, the users can effortlessly realize the appurtenant ambiguous information from innumerable websites hosted over internet into a restructured manner as per the deployed python program. Accompanying essential disquisition for framing a web scraper such as challenging environment, legal review, norms of conduction and technicalities were underlined. It can be extrapolated from the discourse that implementation of libraries as a beginner is easy but for the python framework, which require functional as well as technical expertise.

References
[1]   D. R. Fesenmaier, Z. Xiang, B. Pan, and R. Law, *Information and Communication Technologies in Tourism 2010*, no. January. 2010.
[2]   "Economic Impact | World Travel & Tourism Council (WTTC)." [Online]. Available: https://wttc.org/Research/Economic-Impact. [Accessed: 08-May-2020].
[3]   "Travel Trends: 12 Opportunities for the Travel Industry for 2020." [Online]. Available: https://www.revfine.com/travel-trends/. [Accessed: 08-May-2020].
[4]   "Tourism in India - Wikipedia." [Online]. Available: https://en.wikipedia.org/wiki/Tourism_in_India. [Accessed: 08-May-2020].
[5]   "about us | www.makemytrip.com." [Online]. Available: https://www.makemytrip.com/about-us/company_profile.php. [Accessed: 08-May-2020].
[6]   "Web scraping - Wikipedia." [Online]. Available: https://en.wikipedia.org/wiki/Web_scraping. [Accessed: 08-May-2020].
[7]   P. Ashiwal, P. Tripathi, and R. Miri, "Web Information Retrieval Using Python and BeautifulSoup," *Int. J. Res. Appl. Sci. Eng. Technol.*, vol. 4, no. VI, pp. 335–339, 2016.
[8]   S.C.M. de S Sirisuriya, "A Comparative Study on Web Scraping," *8th Int. Res. Conf. KDU*, no. November, pp. 135–140, 2015.
[9]   "Complete Guide to Python Web Scraping Libraries and Frameworks." [Online]. Available: https://info.scrapinghub.com/web-scraping-guide/python-web-scraping-libraries-and-frameworks. [Accessed: 08-May-2020].
[10]   A. V Saurkar and S. A. Gode, "An Overview On Web Scraping Techniques And Tools," *Int. J. Futur. Revolut. Comput. Sci. Commun. Eng.*, pp. 363–367, 2018.

Systematic Review on Design and Development of Energy-Smart Cloud Computing Algorithms

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Abstract: Cloud computing is one of the most used on-demand delivery of IT resources over the Internet. Cloud computing has improved with the development of large scale farms along with the largest server range worldwide. Thus under cloud computing, clouds are taking huge amounts of energy, adding to high operating costs, and greenhouse gases. Strong treatment of virtual machines (VMs) that use live streaming and installing inactive hubs in recovery mode allows cloud providers to strengthen Internet usage and reduce the use of vitality. However, dynamic VM treatment can discourage presentation. In this way, a stronger implementation of the interaction between providing higher notch controllers and reducing power consumption is needed. At the time of this paper, in ovens a large number of host environments for programmed healing of VMs on cloud computing platforms. The aim is to increase the employment of computer assets and reduce energy consumption under the SLA priority with respect to C.P.U., RAM, and distribution capacity.

Keywords: Cloud computing, Virtual machine, Energy Consumption.

Introduction

As a result of the rapid growth in CO_2 level, mankind is experiencing dangerous atmospheric deviation. Power years represent about 50% of the overflow. In addition, traditional electric generation that relies on renewable energy sources becomes increasingly expensive. One way to deal directly with preventing global climate change is to push global community away from the current petrol-based holiday and to use sustainable energy, for example, solar and wind power. One approach is to improve the management of energy creation, distribution and utilization. One piece of the capacity plan is on the adaptable side, where the other unique course of action can be the force systems of the worldwide systems and the dynamic stockpiling frameworks. In any cases, the similarly significant bit of that game plan is on the intrigue side, where new creations and applications that can work with this sort of utilization of baffling force are significant. The distributed computing model depends on the conveyance of a PC as a help, where capacity, programming and data are given to PCs and different gadgets as items of Internet. The advantages of Cloud figuring - diminished costs, expanded reserve funds, expanded interest, and better adaptability - have spurred numerous organizations lately to move their IT activities to the cloud; similar advantages can be utilized to accomplish the most significant future objectives of the Big Smart Grid, for example, vitality protection, double mode correspondence, and asset the executives.

Related Works

There are two procedures to decrease vitality utilization, one is the hardware other one is the software strategy. Programming systems are principally founded on the VM dynamic solidification strategies for ideal asset usage, and in this way decreasing the vitality utilization alongside the cloud server farms. Virtualization is a key segment in the constant exchange of VMs among the physical workers in a server farm. Worker union is the procedure of blending a few under-used or less stacked workers into less ideally stacked workers. It guarantees that solitary hardly any workers are running, others are either placed in low force utilization mode or turned off. Thusly, the force utilization decreases. The main downside of this strategy is that the exhibition of use running into the relocated worker get influenced because of live VM movement [1].

VM allocation is categorized into two parts by Beloglazov [3]. First, allocation of new requested VM and the second, optimization of already existing VMs. The primary problem associated with first part is taken as a bin packing, which is being solved by using the "Modified Best Fit Decreasing (MBFD)". For the second part, four heuristic methods have been proposed which are, Minimization of Migration, Single Threshold (ST), Random Choice (RC), and Highest Potential Growth (HPG).

Study of Energy and SLA-Efficient Resource Management Strategy
Let us now focus on energy and an efficient SLA strategy. For problems related to dynamic VM consolidation, it provides three methods to tackle the overloaded and under-utilized hosts detection, and VM selection. For VM placement it uses the PAFBD method. In figure1 detail working of resource management is explained with a flowchart.
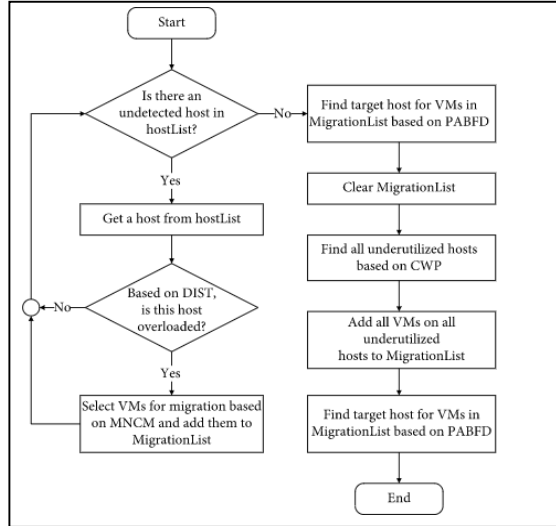
Figure 1. Working of the resource management strategy

From [9] figure 2, it very well may be seen that when a host is recognized as an over-burden have, a portion of the VMs chose in it are placed into a movement list. In any case, all the VMs of the relocation rundown won't be reallocated until all the hosts are recognized. While on account of under-used hosts discovery, reallocation of VMs is done quickly and the recognition cycle of next under-used host begins right away. For easy understanding of the working process, the table 1 summarizes the acronyms defined in figure2.

Table 1. Acronyms of the methods used in figures.

Acronym	Full name
ST	Saturation threshold
VMR	VM maximum amount of resource
VRA	VM resource allocation
VRAR	VM resource allocation rate
VRR	VM resource reservation
HRR	Host resource reservation
HMR	Host maximum amount of resource
SD	Saturation degree
HROR	Host resource occupancy rate
VRO	VM resource occupancy
HRO	Host resource occupancy

The CPU resource utilization of the host must be lower than the α, then only the host can be added to the candidate list. Once this is done, PE value of each host from the host list is calculated. The host with maximum PE value is labelled as the under loaded host.
Since the PA takes into account the power consumption and number of VM migration of a host, it has several advantages when it comes to detecting under loaded host:

291

- Comparing PA to SM, the PA is found to be better in some cases. For example, in a heterogeneous cloud data center, the PA can detect a host with the maximum power consumption with the fewer number of VMs. This cannot be done using SM. The PA detects and switches off the host for saving power consumption.
- Power-aware algorithm takes into consideration the number of VMs running in a host. So two hosts consuming equal amount of energy but with different no. of VMs will have different PE value. The host with higher number of VMs is less likely to be selected as an under loaded host. Also, the process of VM migration itself requires system resources, so if a large number of VM migration is done, it will affect the quality of service and violate the SLA. PA does a good job here as it reduces the number of VM migration by putting the under loaded hosts in sleep mode.

Study of VM Placement Algorithm

A utilization-aware (RuA) algorithm for VM placement is proposed here. It reduces the SLA violation and improves the stability of hosts after VM placement, and it facilitates the placement of VMs on appropriate servers.

Denotations:

1. Ucpu = current CPU resource utilization of PM
2. VMi = denotes the VM running (total VMs = n)
3. y = leftover available CPU resource
4. s = safety parameter for preventing the performance degradation of hosts. For maintaining the consistency of s with LR, it is chosen as 0.17 here.

RuA is divided in two parts

1. Creation of host list by selecting the hosts from cloud data center. The host must have the available CPU resource for the incoming VM. Also, it must be ensured that the underloaded host is not included in the host list. Once this is done, the process of VM placement starts which can be further subdivided in two cases.

Case 1: If the CPU utilization status of a host is UcpuN>yUcpuN>y, the VM with the lesser CPU utilization request than UcpuN can be placed on the host

Case 2: If the CPU utilization status a host is UcpuN≤yUcpuN≤y, the VM with the greater CPU utilization request than UcpuNUcpuN can be placed on the host

After following the steps mentioned above, if some of the VMs are still left for finding a suitable host, PAFBD [4] is applied to complete the migration process. All of the VM migration must be completed while ensuring that no host is getting overloaded. A brief of RuA is presented in the algorithm 1 below.

The objective of RuA is to increase the PM's resource utilization by reducing the number of hosts through VM consolidation. Also, it tries to improve the average resource utilization. Hence, we can see that RuA can be applied under the variable workload conditions as well. The RuA also prevents migrating too many VMs to a single which reduces the possibility of server overloading, and also SLA violations VM consolidation procedure is explained in detail in the [10] algorithm 2.

Algorithm 1: RUA Placement

1:      **Input:** candidate_hostlist, vmlist **output**: migration

2:      for each vm in vmlist do

3:              allocatedHost ← Null

4:      CPU required ← vm.getCPUrequired()

5:      for each: host in hostlist do

6:      if host has enough resources for vm then

7:              CPUration ← CPUrequired/host.gettotalCPU()

8:      if $\frac{U_{cpu}}{N} > y$ then

9:          if CPUratio $< \frac{U_{cpu}}{N}$ then

10:         allocatedhost ← host

11:     end if

13:         if CPUratio $>= \frac{U_{cpu}}{N}$ then

14:         allocatedhost ← host

15:     end if

16:     end if

17:     end for

18:     if allocatedhost ≠ NULL then

19:         migrationsched.add(vm,allocatedhost)

20:     else then

21:         migrationsched.add(PABFD(vm,allocatedhost))

22:     end if

23:     end for

24:     return migrationsched

Framework had been applied on the Laas condition, there is huge measure of host and virtual machine. It is important to mimic the sort of utilizing situation and yield the repeatable outcomes while picking reenactment devices. Besides, it ought to be a totally modified device.

To test the viability of the proposed calculation CloudSim has been utilized for recreation purpose. It is an extensible reenactment toolbox that empowers distributed computing frameworks to be displayed and mimicked, gives the applications' surroundings and supports both framework and conduct demonstrating of cloud frameworks, for example, server farms, virtual machines and asset arrangement approaches.

VI. Workload Data

Simplified In order to make certain the Pa and RUA algorithms 1, the amount of work facts, which are used for simulation 2, are got from the CoMon undertaking, a looking at base structure for planetlab [4]. These facts are about CPU [3] use, which is measured from thousands of virtual 4 machines running on different computers around the earth. The qualities of amount of work facts, which have been presented in [5], are made clear in below table. From the table, we can see that the suggest value of amount of work signs is quite small, most every- day values of the signs are almost zero 5, and these signs (make, become, be) different from 0 to 99. That means we should take into account as the place, position of over-weighted controlling computers in a net-work caused by the not fixed in level amount of work when making a request the VM thing made from others design to amount of work signs.

12:     for each host selected from candidatehostset do

13:         if PA(host) is overloaded then

14:             if RUA(host.getvmlist()) succeeds then

15:                 schedule map.add(RUA(host.getvmlist()))

16:                 switch the host to sleep mode

17:             end if

18:         end if

19:     end for

20:     return schedulemap

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Table 2. Workload characteristics of ten days[4]

Data	The number of VMs	Mean (%)	SD (%)	Most (ratio)	Range (%)
03/03/2011	1052	12.31	17.09	2 (16.6%)	99
06/03/2011	898	11.44	16.83	2 (18.1%)	99
09/03/2011	1061	10.70	15.57	0 (18.2%)	99
22/03/2011	1516	9.26	12.78	0 (18.9%)	99
25/03/2011	1078	10.56	14.14	0 (15.0%)	99
03/04/2011	1463	12.39	16.55	0 (14.2%)	99
09/04/2011	1358	11.12	15.09	0 (17.0%)	99
11/04/2011	1233	11.56	15.07	0 (15.2%)	99
12/04/2011	1054	11.54	15.15	0 (15.4%)	99
20/04/2011	1033	10.43	15.21	0 (17.6%)	99

Performance metrics

Execution assessment is an obligatory cycle that must be performed to check whether a planned procedure is giving wanted outcomes or not. Execution assessment measure contrasts the first exhibition and anticipated one, what's more, its outcomes decide the accomplishment of the given method. Another strategy is assessed based on different execution boundaries in **various testing c**ondition. In this segment, we present some significant boundaries that are as of now utilized by the analysts to assess their RM procedures. Additionally, we are giving their definitions, and equations that can be utilized to compute these boundaries. Execution assessment is an obligatory cycle that must be performed to check whether a planned procedure is giving wanted outcomes or not. Execution assessment measure contrasts the first exhibition and anticipated one, what's more, its outcomes decide the accomplishment of the given method. Another strategy is assessed based on different execution boundaries in various testing condition. In this segment, we present some significant boundaries that are as of now utilized by the analysts to assess their RM procedures. Additionally, we are giving their definitions, and equations that can be utilized to compute these boundaries.

$$SLAV = SLATH \times PDM \tag{1}$$

Where SLAV denotes SLA violation, SLATAH represents SLA violation Time per Active Host, and PDM stand for Performance Degradation due to Migrations. Following equation can be used to calculate SLATAH and PDM and hence CPU utilization of 100%, as is shown in Equation below

$$SLATAH = \frac{1}{N} + \sum_{i=1}^{N} \frac{T_{s_i}}{T_{a_i}} \tag{2}$$

$$PDM = \frac{1}{M} + \sum_{j=1}^{M} \frac{C_{d_j}}{C_{r_j}} \tag{3}$$

where N is the quantity of hosts, Tsi is the time during which assets of host I were 100% used, while, Tai is the dynamic season of host I. M is the quantity of VMs, Cdj is assessed execution debasement of VM j because of relocation, and Crj is the all out limit mentioned by the j.

Results and Analysis

In this part test is directed in a request to lead for better comprehension of the PA and RUA calculation Firstly, we contrast RUA with PA BFD and the usage and least connection (UMC) calculation, which is introduced in [6] dependent on the thought proposed by. Verma. [1] That the higher the connection between applications running on an oversubscribed worker for finishing a similar sort of asset, the higher the likelihood of the worker over-burdening. We isolate five days' outstanding burden from Planet Lab as five variegated sorts of remaining tasks at hand to test the three calculations (PABFD, RUA and UMC), and every sort of calculation is joined with SM to succeed VM

294

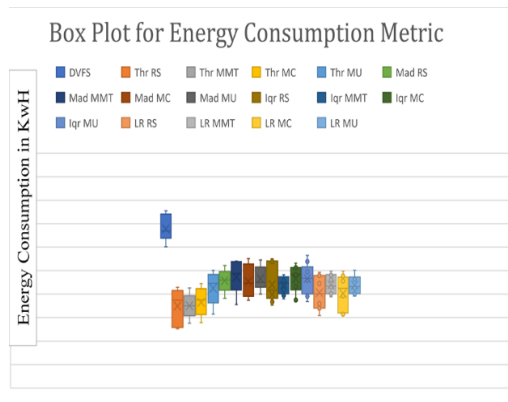combination. Examination results are appeared in Figure 2 and Figure 3

Figure 2. Energy consumption metric on workload traces of PlanetLab servers and random synthetic workload.

Figure 2: it is representation of energy consumption by different algorithm on different workload that are applied on cloud data centers. We get to see that iqr consumption energy is relatively more than other hence would be more costly. CPU, memory and other resource consumption of PMs with cooling of data center require power. It is clearly described in the work done by [5]Choi Tae-Seop, that the power consumption and CPU utilization are co- related with each other in linear manner(Choi Tae-Seop,2007) .
Figure 3: it is representation of VM migration by different algorithm on different workload that are applied on cloud data centers during entire simulation. In process of VM migration virtual machine reallocated from one PM to another PM without any foreign disturbance.

However, it reduces the performance of application executing in a VM. In the proposed work, assumption has been taken that if only 10% of CPU is only used then it is considered as average performance or degraded performance this is also mentioned in research works of different researchers. Whenever when a VM is migrating from overloaded PM, then SLA violations happen continuously till migration is not completed. During migration both PM consume power, one is overloaded and another which is selected for hosting migrated VM. So, deduction in the VM migration count is also an important task to achieve the optimum use of power and minimization of SLAV. More counts of VM migrations decrease the performance of the system; in our method this problem was also addressed. Simulation results described that LrMmtPu is the better algorithm in the context of VM migration.
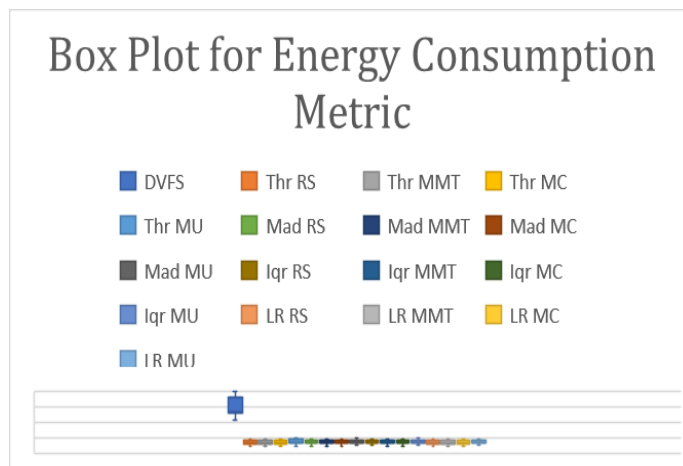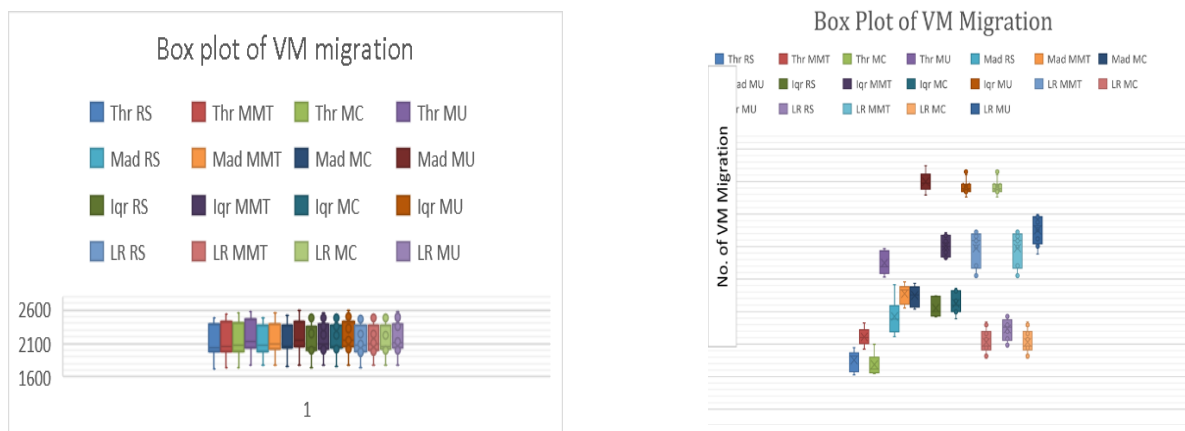
Figure 3. Total virtual machine (VM) migration metric on workload traces of PlanetLab servers and random synthetic workload

Conclusion & Future Scope

Combining VMs to a couple of hosts and turning inactive physical hubs off are the immediate strategies for cloud suppliers to diminish vitality utilization and lessen cloud client's activity cost. In any case, monstrous misrepresented unions can bring about infringement of SLA and discipline of cloud suppliers. In this paper, we talk about the way to deal with decrease vitality utilization and SLAV and propose PA for distinguishing underloaded has, just as RUA for VM situation. The recreation results have indicated that PA/RUA can in reality decrease SLA infringement and improve the framework execution essentially while sparing vitality. Later on, we mean to assess PA/RUA in a genuine cloud framework and to help the cloud suppliers improve the board approaches. Moreover, we intend to talk about the impact of other framework asset on both vitality utilization and SLA infringement and take the virtual machine's correspondence overhead into thought.

References

[1] J. K. Verma, C. P. Katti, "Resource Request Based Energy Efficient Heuristic for Server Offloading in Cloud Computing Environment," Journal of Global Information Management, in-Press, 2017.(p-ISSN: 1062-7375, e-ISSN: 1533-7995)

[2] Beloglazov A., Abawajy J., Buyya R.,"Energy-aware resource allocation heuristics for efficient management of data centres for cloud computing", Future Gener, Computer Syst, 2012; 28:755–768. DOI: 10.1016/j.future.2011.04.017.

[3] J. K. Verma, S. Kumar, O.P kaiwartya, Yue Cao, Jaime Lloret, C. P. Katti, Rupak Kharel, "Enabling green computing in cloud environments: Network virtualization approach toward 5G support", DOI: 10.1002/ett.3434, Wiley.

[4] S. Ashok, R. Banerjee, "An optimization load management applications for the industrial sector", IEEE Transaction on Power System, vol. 16, no. 4, 2001.

[5] Choi Tae-Seop, Ko Kyung-Rok, Park Seong-Chan, Jang Young-Sik, "Analysis of energy savings using smart metering system and IHD (in home display)", Asia Pacific 2009, IEEE Transmission & Distribution Conference & Exposition, pp. 1-4, 26–30, Oct 2009.

[6] L.H. Tsoukalas, R. Gao, "From smart grids to an energy internet: Assumptions architectures and requirements", Proc. 3rd Int. Conf. Elect. Util, Deregulation Restructuring Power Technol., pp. 94-98, Apr 2008.

[7] Wickremasinghe B, Calheiros R, Buyya R," Cloud Analyst: A CloudSim-based visual modeler for analyzing cloud computing environments and applications", Proceedings of the 24th IEEE International Conference on Advanced Information Networking and Applications (AINA 2010), Perth, Australia,pp.446-452,

20–23 April 2010.

[8]   Raghavendra R, Ranganathan P, Talwar V, Wang Z, Zhu X," No 'power' struggles coordinated multi-level power management for the data centred", ASPLOS'08, Seattle, Washington, U.S.A., pp.48-59, 1–5 March 2008.

[9]   Zhang Chi, Wang yuxin,Yuanchen Lv,Wu Hao,Guo He, "An Energy and SLA-aware resource management strategy in cloud data centers", Scientific Programming, Article ID:3204346,16 Pages, November 201November 2019.

G Han,W Que,Jia G,Shu L,"An Efficient Virtual Machine Consolidation Scheme for Multimedia Cloud Computing",Sensors,pp.230-246,DOI:10.3390,February 2016.

Checkers Game Using Reinforcement Learning

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Abstract: Scientists have always been intrigued by games of different sorts, especially board games. This is not coincidental, as board games stimulate and broaden the mind. Games like chess, checkers and go have a reputation for being both challenging and complex. These games played for centuries are still attracting Artificial Intelligence (AI) scientists today. The game of checkers that has been developed by the authors uses a 8*8 board. The application allows a human player to play the game of checkers against a computer agent. The computer agent is trained with the Reinforcement learning technique which allows is to make better decisions as the game progresses. After every move by the computer agent, a feedback is sent back to it which indicates how good or bad the move was. Training with such feedback allows better judgement on the part of the computer and it tends to make fewer mistakes as the game progresses. No dataset is required during training and the AI agent is allowed to learn from it's experience. Following this approach lets the experience of gameplay for each user be personalised and not monotonous which would have been the case if the AI agent followed the same algorithm for each player.

Keywords: Reinforcement Learning, Checkers Game

Introduction

Checkers game that has been developed by the authors of this paper is a popular board game played between 2 parties. Each player has 12 game pieces. The game board is a 8*8 board with alternating blocks of different colours. The game pieces can move diagonally forward in two directions (left and right). A game piece becomes a king once it reaches the last row of the opponent whereupon it can also move diagonally backwards in both directions. The objective of the game is to capture all the game pieces of the opponent by jumping your game piece over the opponent's game piece.

Reinforcement learning is based on the interaction between an agent and the environment in which the agent is situated. Reinforcement learning refers to methods that solve reinforcement learning problems, where a sequence of actions is associated with positive or negative rewards [1]. Reinforcement learning is all about making decisions sequentially in a way in which our computer agent decides it's next move on the basis of the player's previous move. Contrary to, for example, the supervised learning method in which the agent learns from examples provided to him, reinforcement learning enables agents to learn by producing rewards following from actions taken in the environment. This natural approach informs an agent how good the chosen action is. The agent seeks to maximize his reward over the long run.

The essence of RL is learning through interaction. An RL agent interacts with its environment and, upon observing the consequences of its actions, can learn to alter its own behaviour in response to rewards received [2].Numerous game-playing learning agents exhibit superior performance against human opponents in various popular adversarial games, such as Chess, Backgammon, Othello/Reversi, etc [3].

In this course project the authors propose to build a Checkers game with main focus on designing various approaches to the other side of the Checkers game board to make the computer agent learn the moves in various situations that will be encountered as a result of player's move. The model as a result of reinforced learning will provide the best possible move out of all available options. After repeated games, the computer agent will learn from the reward-based learning system that is proposed and hence become smarter and very difficult to beat.

Artificial Intelligence has promoted a lot to the development of science and technology, and as one of the most important branches of Artificial Intelligence, the technology of computer game plays an active role in intelligent decision-making. As a result of its own complicated rule of moving and the smaller average component factor in its formation process, the computer game helps a lot to intelligent decision-making, or to the research of the optimal method of making moves. Based on the rule of checkers, this system implements the construction of the game tree according to the current situation on checkerboard [4].

The authors aim to develop the game board and game pieces by using the turtle library in Python and then using reinforcement learning technique with the help of Q-learning algorithm to decide the moves to be made by the computer agent. The agent will calculate and store all potential rewards/penalties it can get in a Q-table and then choosing a move that will produce the maximum gain or at least the minimum penalty.

298

Design

Designing of the game board and game pieces using Python's turtle library
Turtle: Used for creating graphics and visualizations on the screen. The screen acts as a canvas, while the turtle acts like a pen. A turtle module is imported, window is created, using turtle object different functions such as forward(), right(), penup(), pendown() can be invoked, shapes are created and shapes with particular dimensions are registered under specific names for reusability (circle for coin, square for board, king coin for king coins). The screen is divided into four quadrants. The point where the turtle is initially positioned at the beginning of the program is (0,0). This is called Home. To move the turtle to any other area on the screen, use goto() or setposition().

Q-learning
Q-Learning algorithm is used by the computer agent to decide its next move. It is a reinforcement learning algorithm that seeks to find the best action to take given the current state. The application of reinforcement learning on board games has an impact on the overall performance of the game. Decisions can be reached faster and a more optimized computer agent is developed with each passing move. Once a move is made by the player, the next step is simply for the agent to interact with the environment and make updates to the state action pairs in our Q-table. Q-table is a reference table for the agent to select best action based on q-value and the shape is of a matrix of size (state*action). It follows 3 basic steps:

1. Agent starts in a state (s1) takes an action (a1) and receives a reward (r1)
2. Agent selects action by referencing Q-table with highest value (max)
3. Update q-values

State here refers to the position of the coin on the board as the authors have designed every coin as a structure carrying the row, column, coin colour, coin type and coin number. (Reds[t].setup_coin(i,j,"red","norm",t))

$$\text{New } Q(s, a) = Q(s, a) + \alpha[\, R(s, a) + \gamma \max Q'(s', a') - Q(s, a)] \tag{1}$$

The max function in the formula explores all 4 possible states (diagonally left and right in upward direction, diagonally left and right in backward direction) that the coin might reach, and returns the coin state corresponding to which the q-value is maximum in the Q-table. The q-values are updated for all the coins of the computer agent based on whether a particular move, if considered is bringing coin to the risk or earning a coin capture reward or is just a safe move or earning an immobility score.
α -learning rate
γ -discount factor

A sample Q-table looks as follows:

```
-100    -100    -100    10     -100    10     40     -100    -100    10     -100    -100
-100    -100    -30     -30    -100    -100   10     -100    -100    10     -100    -100
-100    -100    -100    -100   -100    -100   -100   -100    -100    -100   -100    -100
-100    -100    -100    -100   -100    -100   -100   -100    -100    -100   -100    -100
```
Figure 1. Q-table

thusThis is a 4*12 matrix. The 4 rows represent the four directions a coin can move (left and right diagonal in both forward and backward directions) and the 12 columns represent the 12 coins of the computer agent. The value of each cell indicates the possible reward/penalty that can be earned by moving a particular coin in a particular direction.

Step 1: Initialize the Q-Table.
First the Q-table has to be built. There are n columns, where n= number of actions. There are m rows, where m= number of states (matrix of size m*n).
Step 2: Choose an Action

299

Step 3: Perform an Action
The combination of steps 2 and 3 is performed for an undefined amount of time. These steps run until the time training is stopped, or when the training loop stopped as defined in the code. First, an action (a) in the state (s) is chosen based on the Q-Table.
Steps 4: Measure Reward
Action taken and outcome and reward is observed.
Steps 5: Evaluate
Update the function Q (s, a).

The above process is repeated after each move made by the opponent. In this way the Q-Table is updated and the value function Q is maximized. This part is repeated for four possible states, so if the first sate is moving diagonally to left, now considering this to be the new state of the coin, check if the immediate diagonally left position is holding the opponents coin, this would mean bringing coin to the risk and the penalty is rewarded and for that coin the corresponding q-value is updated. This is repeated for all the remaining directions that a coin can take.

Figure1 shows how a coin is captured by the computer agent, here the computer agents doesn't just look for the immediate reward, which would mean the agent would look for coins in the immediate next states, which are (1,-1),(-1,1),(1,-1),(1,1) and would immediately decide which move to make, this approach using reinforcement learning instead looks forward to achieve long term reward and thereby explores coins in its close proximity using the above mentioned method of finding the maximum reward that could be earned so far, considering a given state. This method is repeated for all the coins of the computer agent, and the q-values corresponding to these coins (all rows of a particular column in the Q-table) are updated. Once the Q-table is updated, the maximum reward earned so far is chosen and the coin is moved in that particular direction. After the computer agent makes it's move after consulting the Q-table, the opponent makes a move. Based on the opponent's move, the computer agent again recalculates the Q-table and chooses the best course of action.
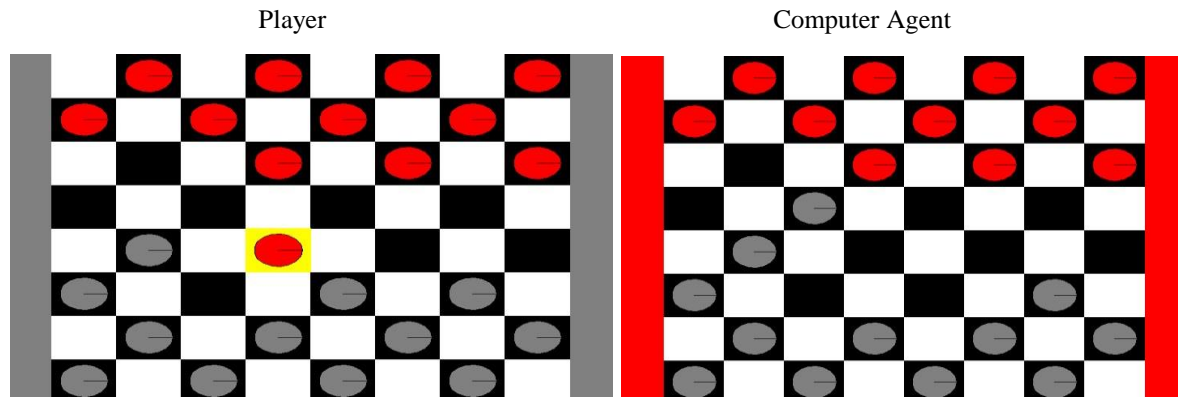
Figure 2. Coin capture

With every move made by the player, the computer agent learns and explores all the possible moves which it can make and this process of learning continues unless either of the sides are left with no coin or is in a fix wherein moving to any possible state would mean losing. The computer agent might not have to explore and store all the possibilities since the algorithm looks for the maximum reward earned so far by examining the Q-table. The Q-table gets updated after every move for all the available coins so that the computer agent doesn't consider the move which is earning a small immediate reward but might cost it a great penalty in the next move. Once a coin reaches the opponent's last row(for red i=7, for grey i=0) it is upgraded to as the the king-coin. This king_coin can move diagnally backward as well, thereby ensuring changes in the Q-table. The turtle pointer uses clearstamps() and setposition() methods to reflect these moves.

Conclusion

This Reinforcement learning model is very similar to the learning of human beings. This technique is preferred to achieve long-term results by correcting the errors that occurred during the training process. Here the model learns dynamically by adjusting the actions based on continuous feedback to maximize a reward. Reinforcement Learning models learn itself continuously so it continually gets better and better doing the task at hand by understanding the opponent's strategies. Learning checkers game can be a tedious task under supervised learning as there are 10^20 legal combinations that should be explored for an 8*8 game board but Reinforcement Learning works swiftly for the same task. The trial-and error method as it attempts its task of choosing the best possible move, with the goal of maximizing long-term reward can show better results here. This reward is the ultimate goal the agent learns while interacting with an environment through numerous trials and errors. The algorithm gets short-term rewards that together lead to the cumulative, long-term one.

References
1. A Panorama of Artificial and Computational Intelligence in Games: Georgios N. Yannakakis, Julian Togelius (2014) IEEE Transactions on AI in Games
2. Deep Reinforcement Learning A brief survey: Kai Arulkumaran, Marc Peter Deisenroth, Miles Brundage (2017) IEEE Signal Processing magazine
3. Efficient Reinforcement Learning in Adversarial Games: Ioannis E.Skoulakis and Michail G. Lagoudakis (2013) IEEE 24th International Conference
4. A Systematic Research About the Computer Game of Checkers Based on Decision Making Of AI: Li Youru, Li Xueiping, Xi Yuting (2015) 27th CCDC

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Analysis of Customer Churn Prediction Using Machine Learning

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Abstract: The retentiveness of customer is an important factor in today's business world, because in today's era it is more difficult to find new customers than to retain the existing ones. It plays a vital role in various domains like telecom industry, banking sector etc. So, companies and service providers are now kind of more aware regarding customer churn as they can take proactive measures before their customer is likely to quit using their services. The aim of this paper is to find out the parameter that is affecting churn at a greater extent. Also, four models have been used namely Random Forest, Decision Tree, XGBoost and Logistic Regression to find accuracy of the prediction.

Keywords: Churn Prediction, Machine Learning, Banking Services.

Introduction

Churn Prediction is a fundamental concept for any company. Customer Churn defines the customer who are likely to quit using any company's services. They not only affect company's income but also put negative effects on other operations of companies. Banking is a sector in which customers stay committed with the company for a very long time. They generally trust the service providers and give their financial business to the company. This establishes a healthy relationship between the provider and the customer. Although in this case the continuous relationships with the customers can be enormous the potential revenue loss due to customer churn. Bolton et al. (2000) suggested that it is theoretically more profitable to segment and target customers on the basis of their (changing) purchase behaviours and service experiences, rather than on the basis of their (stable) demographics or other variables [1]. The goal of this paper is twofold. Firstly, customer churn analysis is done. After that, various models are used in order to find the accuracy of churn rate. Various Machine Learning Algorithms are used to do the analysis. After the introduction, the paper is organised as follows, second section will define literature survey. In third section, working methodology has been explained. Result and analysis have been discussed in fourth section. And finally, the conclusion.

Background

Business world is expanding day by day. Every service provider company has realized that retaining loyal customers are far more important than attracting new customers. Now-a-days, banking service industry have also realized the need of the hour because new customer in bank comes up with many additional expenses like credit searching, advertising, promotional expenses and much more. Therefore, they are now familiar with the term 'churn' completely and learnt the definition of 'churn management' whole heartedly which will help them to retain profitable customers. In recent covid-19 pandemic, people are switching from bank accounts that are far from their sites to the nearest ones so that they do not have to travel unusually for their transactions. Therefore, there is a need to analyse the situation and improve customer services so that companies can retain the customers before they churn. Particular bank can provide more precise services like more interest, improved online services, door-to-door service etc in order to retain their customers. So, this is quite a major issue in this recent pandemic. Chuanqi Wang et al. [2] defined Churn Prediction Model as cost sensitive classification problem. They coined the term cost sensitive because the way the model was designed to classify the customers into churner and non-churner group will decide the maximum profit earned by the company. The proposed work, the authors showed the classification performance and the misclassification rate. So, in this era, business or marketing startegies are stepping into a world where loyal customers are highly preferrable over more and more customers. As the famous term, "Quality is more important than Quantity", fits into this situation completely. So, slowly but gradually, service providers seems to understand this concept with a deep meaning as it can highly help them in preventing their customers from churn.

Working Methodology

This section explains how the analysis of customer churn is done and various models used to check the accuracy. Various Machine Learning Algorithms and Models has been used for the prediction of customer churn behavior. The flow chart in the figure 1 explains the working model. The dataset is from famous official website kaggle.com. The

dataset consists of 28382 rows and 21 columns. There are some missing values for the provided input dataset. Churn is the target variable which notifies whether a particular customer is churned or not. Others are dependent variables that will help in building prediction models.
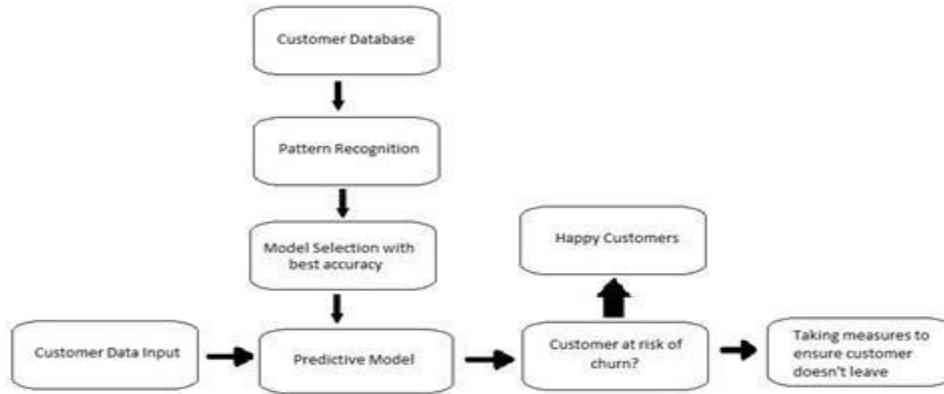

Figure 1. Flow Chart for Customer Churn Model

Decision Tree Model

Decision tree as the name suggests is a kind of a tree according to which decisions are made. Berry and Linoff noted ''a structure that can be used to divide up a large collection of records into successively smaller sets of records by applying a sequence of simple decision rules'' [3]. Accuracy given by decision tree is 83% which is quite good as per the dataset given.

```
from sklearn.tree import DecisionTreeClassifier
from sklearn import metrics
from sklearn.metrics import f1_score
ChurnTree = DecisionTreeClassifier(criterion="entropy", max_depth = 6)
ChurnTree.fit(X_train,y_train)
decisionTree = ChurnTree.predict(X_test)

[ ] print("DecisionTrees's Accuracy: ", metrics.accuracy_score(y_test, decisionTree))

    DecisionTrees's Accuracy:  0.8386950611690077
```

Figure 2. Decision Tree Classifier

Logistic Regression Analysis

It is a statistical technique for finding out relationship among different variables and to find out their dependencies and independencies. It is also known as Logit Regression (LR). It is giving an accuracy of 81%, which is quite lower than decision tree but still a good prediction.

```
[ ] from sklearn.linear_model import LogisticRegression
    model = LogisticRegression()
    model.fit(X_train, y_train)
    logicticRegression = model.predict(X_test)

    from sklearn import metrics
    print("Accuracy:",metrics.accuracy_score(y_test, logicticRegression)*100,'%')

    Accuracy: 81.64929768917082 %
```

Figure 3. Logistic Regression Classifier

Random Forest Model

The random forests method, introduced by Breiman (2001), adds an additional layer of randomness to bootstrap aggregating (''bagging") and is found to perform very well compared to many other classifiers. It is robust against overfitting and very user-friendly (Liaw & Wiener, 2002)[4]. Precision, f1-score, recall and support has been

303

calculated separately for both churners and non-churners and accuracy given is 85% seems to be really good.

```
[ ]  from sklearn.ensemble import RandomForestClassifier
     classifier = RandomForestClassifier(n_estimators=200, random_state=0)
     classifier.fit(X_train, y_train)
     randomForest = classifier.predict(X_test)

 ▶   from sklearn.metrics import classification_report, accuracy_score
     print(classification_report(y_test,randomForest))
     print(accuracy_score(y_test, randomForest))

 ⤶            precision   recall  f1-score   support

        0        0.87      0.96     0.91      3537
        1        0.73      0.44     0.55       877

    accuracy                        0.86      4414
   macro avg     0.80      0.70     0.73      4414
weighted avg     0.85      0.86     0.84      4414

     0.856366107838695
```

Figure 4. Random Forest Classifier

XGBoost
XGBoost is an ensemble technique that uses an iterative approach. Boosting trains models in succession, that means there is no need to train all the models in isolation, instead new model is trained to correct the errors made by the previous ones. So, it is quite a clever approach. Accuracy shown by this model is 85%, somewhat similar to Random Forest Model.

```
[ ]  from xgboost import XGBClassifier
     classifier = XGBClassifier()
     classifier.fit(X_train, y_train)
     xgBoost = classifier.predict(X_test)

 ▶   # Applying k-Fold Cross Validation
     from sklearn.model_selection import cross_val_score
     accuracies = cross_val_score(estimator = classifier, X = X_train, y = y_train, cv = 10)
     print(accuracies.mean())

 ⤶   0.8568511929778408
```

Figure 5. XGBoost Classifier

Result and Analysis
On the basis of various parameters the result obtained are shown in the figures. Firstly, a pie chart shows customer churn rate in which 19.4% of customers are likely to churn. Now, a scatterplot shows criteria between average_monthly_balance and vintage in which customers are likely to churn when average_monthly_balance is below 0.4.
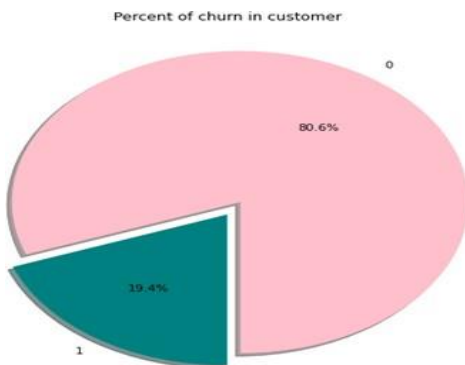

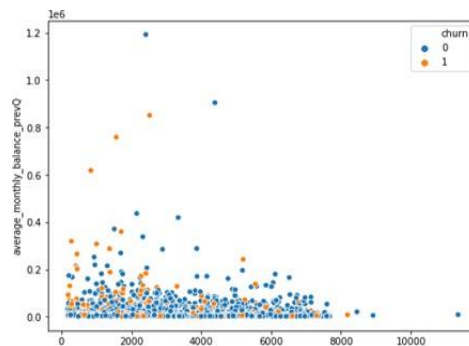**Figure 6.** Pie Chart for Customer Churn   **Figure 7**. Scatterplot for average balance

After that if seen separately, a plot is shown for male and female churn rate with the feature age in which customers between the age 30-50 years are more likely to churn. If another independent feature occupation is taken, a countplot of churn for different categories is shown.
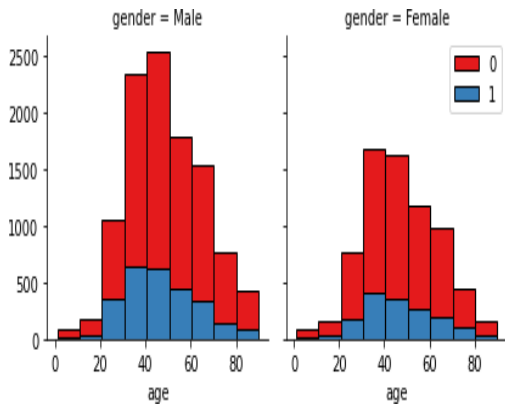
Figure 8. Male and Female Churn rate
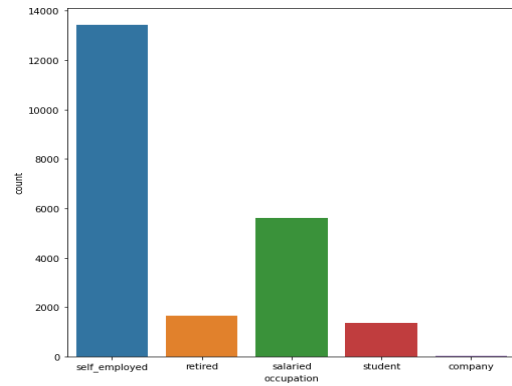
Figure 9. Countplot for feature Occupation

After applying various models for accuracy, the need of the hour is to find the parameter that is affecting churn rate the most, so that proactive measures can be taken to retain the customers.
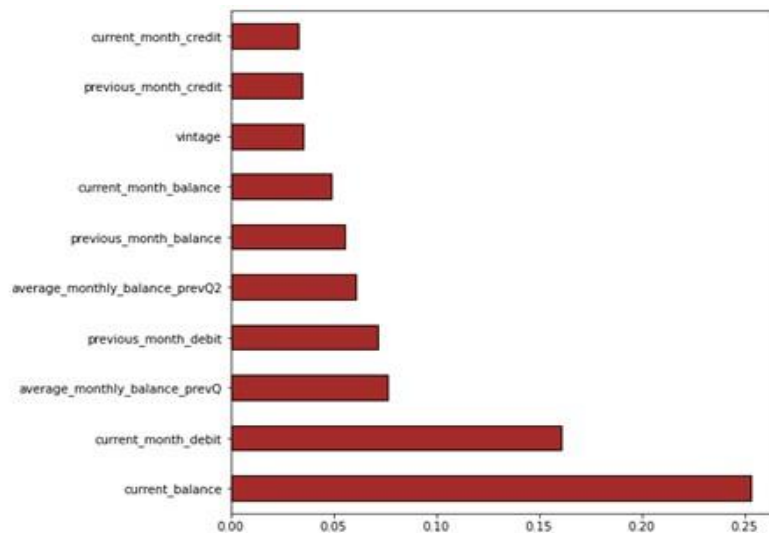
Figure 10. Correlation of Independent variables with dependent variable

A transparency is shown by the above figure that current balance of customer is affecting churn rate the most. So, a deep eye needs to be given to retain the customer accordingly.

Table 1. Comparative Analysis of different Models

MODELS	ACCURACY
Random Forest Model	85%
Logistic Regression Model	81%
Decision Tree Model	83%
XGBoost Model	85%

Conclusion

Customer churn is an important factor in today's competitive world. A customer is likely to quit the services in case of any crisis or difficult situation. So, in this pandemic, the major need is to retain the customer as they are switching rapidly according to their comfort. This paper represents various techniques that can help banking sectors in predicting customer churn and finding out the parameter that is affecting churn rate the most. Only then effective measures can

305

be taken and service providers can stop the customers from switching. Nowadays it is a mandatory situation, so many companies and organizations are more focused on customer churn rather than anything else. Because customer churn not only affects the income of the company but also affects other major operations.

References

[1]Anil Kumar, Dudyala, and Vadlamani Ravi. "Predicting credit card customer churn in banks using data mining." International Journal of Data Analysis Techniques and Strategies 1.1 (2008): 4-28.

[2]Chuanqi Wang, Ruiqi Li, Peng Wang, Zonghai Chen,"Partition cost-sensitive CART based on customer value for Telecom customer Churn Prediction, Control Conference (CCC), September 2017.

[3]Vafeiadis, Thanasis, et al. "A comparison of machine learning techniques for customer churn prediction." Simulation Modelling Practice and Theory 55 (2015): 1-9

[4]Xie, Yaya, et al. "Customer churn prediction using improved balanced random forests." Expert Systems with Applications 36.3 (2009): 5445-5449.

[5]Jain, Himani, Garima Yadav, and R. Manoov. "Churn Prediction and Retention in Banking, Telecom and IT Sectors Using Machine Learning Techniques." Advances in Machine Learning and Computational Intelligence. Springer, Singapore 137-156.

[6]Ho, Siu Cheung, et al. "A machine learning approach for predicting bank customer behavior in the banking industry." Machine Learning and Cognitive Science Applications in Cyber Security. IGI Global, 2019. 57-83.

[7]Santharam, Akshara, and Siva Bala Krishnan. "Survey on Customer Churn Prediction Techniques." International Research Journal of Engineering and Technology 5.11 (2018): 3.

[8]Mutanen, Teemu, Jussi Ahola, and Sami Nousiainen. "Customer churn prediction-a case study in retail banking." Proc. of ECML/PKDD Workshop on Practical Data Mining. 2006.

[9] Prasad, U. Devi, and S. Madhavi. "Prediction of churn behavior of bank customers using data mining tools." *Business Intelligence Journal* 5.1 (2012): 96-101.

Cryptographic Techniques

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Abstract: Over the decade, introduction of DOS, Cloud Computing, use of Internet, enhancement in the e-commerce sector and net banking have made it more demanding to design and implement more secure and uncrackable cryptographic techniques to ensure that security does not become the weakest link. The encryption techniques thereby have held importance on the network to carry out secure message transmission between the sender and the receiver. The paper has provided a brief description of two commonly used symmetric key encryption techniques namely DES and AES. A comparative analysis of the two techniques has also being covered in the paper.

Key words: Uncrackable, Secure, Encryption, Symmetric, Cryptographic.

Introduction

In order to protect data over a network, we follow various encryption protocol which can be broadly classified as symmetric key and asymmetric key encryption protocols. In symmetric key cryptography, there is a single private key used for both encrypting and decrypting process.[1] Sender and receiver needs to agree upon a common private key. Private key needs to be shared by both sender and receiver. Private key needs to be shared over the network. In asymmetric key cryptography, data is encrypted using public key and decrypted using private key. Though asymmetric key cryptography is more secure, symmetric key cryptographic technique is widely used due to its fast computation speed for large data. Block and Stream ciphers are two categories of symmetric key cryptography based on input.[2] Block cipher takes block of plaintext as input and encrypts it. Stream cipher takes 1 byte of plaintext at a time and converts it into cipher text. Search for more and more secure encrypting technique with less complexity is carried out to design and implement them in order to ensure secure communication and transfer of data. The main problem of symmetric key cryptography is secure transmission of private key over the network, which is a vital issue.

The Data Encryption Standard (DES)

DES was jointly developed in 1974 by IBM and US Government designed to ensure secure transfer of message over a network for everyone. It was designed for hardware component and was thus slow with software. It is a type of block cipher which was originally developed by Fiestel. Classical ciphers used substitution and transposition as the basic working principle to encrypt data. DES makes use of both the   above.
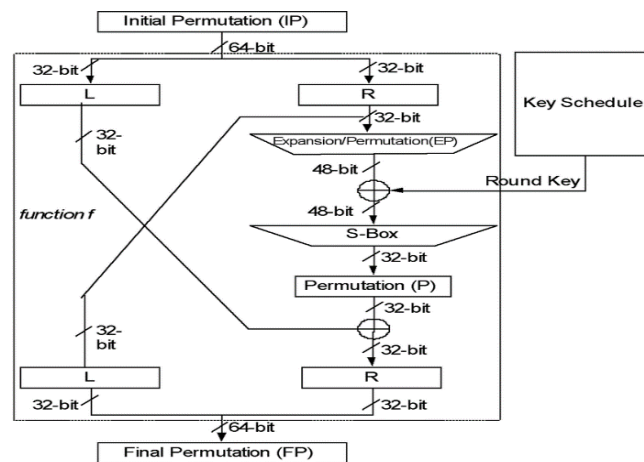

Figure 1. Fiestel Structure of DES

Working of DES

Being a block cipher, DES encrypts and decrypts data in block of 64 bits using 56 bits key, which was originally proposed to be of same length as plaintext data block. The block cipher received as output also comprises of 64 bits. Initially, 64 bits plaintext is shuffled according to the Initial Permutation Table. The permuted 64 bits are then divided into two left half block L of 32 bits and right half block R of next 32 bits.

Table 1. Initial Permutation [4]

The Initial Permutation: IP							
58	50	42	34	26	18	10	2
60	52	44	36	28	20	12	4
62	54	46	38	30	22	14	6
64	56	48	40	32	24	16	8
57	49	41	33	25	17	9	1
59	51	43	35	27	19	11	3
61	53	45	37	29	21	13	5
63	55	47	39	31	23	15	7

From 64 bits long key, every 8th bit is removed to form 56 bits key. Permutation is applied according to PC-1 Table to produce permuted key of 56 bits. Left shift operation is performed. In this method, every bit is shifted to its left except first bit which takes last bit place in the key. Permutation is again applied to produce 48 bits permuted key using PC-2 which is applied again and again to produce 16 subkeys.

Table 2. PC-1 [5]

pc-1						
49	42	35	28	21	14	7
0	50	43	36	29	22	15
8	1	51	44	37	30	23
16	9	2	52	45	38	31
55	48	41	34	27	20	13
6	54	47	40	33	26	19
12	5	53	46	39	32	25
18	11	4	24	17	10	3

Table 3. PC-2 [5]

PERMUTED CHOICE 2 (PC-2)					
14	17	11	24	1	5
3	28	15	6	21	10
23	19	12	4	26	8
16	7	27	20	13	2
41	52	31	37	47	55
30	40	51	45	33	48
44	49	39	56	34	53
46	42	50	36	29	32

R obtained after Initial Permutation is expanded to produce 48 bits block which is then XORed with the subkey obtained for that particular round after PC-2. The result is again 48 bits block which is passed as an input to the S-box (Substitution box). There are $S_1, S_2, S_3 \ldots S_8$ in S-box.[6] Each takes 6 bits of data and operates to produce 4 bits result. In each S box, first and last bits represents the row number and middle 4 bits represents the column number. In the S-box Table we find the value by checking the interaction of row and column and then convert it into binary form to get 4 bits data. We get 32 bits data as output from S-box.[7] Permutation is performed and the result is XORed with left half L to produce 32 bits. Initial right half R forms the left half L for the next round and the result of XOR performed on permutation and left half L forms the right half R for the next round.[8] This process is repeated. There are total of 16 such rounds. The output of the last round is finally applied to Inverse Permutation Table. The output obtained is a 64 bits cipher text.

Table 4: Inverse Permutation Table [9]

57	49	41	33	25	17	9
1	58	50	42	34	26	18
10	2	59	51	43	35	27
19	11	3	60	52	44	36
63	55	47	39	31	23	15
7	62	54	46	38	30	22
14	6	61	53	45	37	29
21	13	5	28	20	21	4

Need For Advanced Encryption Standard (AES)
Diffie and Hellman outlined that brute force was possible to crack DES. A special-purpose machine was devised to decrypt message. The machine was capable of searching 88 billion keys per second and cost was as low as $250,000.[10] Electronic Frontier Foundation (EFF) announced on July 1998, that DES is insecure because it is cracked.[11] This gave rise to the search for a newer and better encryption algorithm. As a result, AES was designed for secure data transfer in order to maintain its integrity, confidentiality and authority.[12]

Working of AES
AES algorithm comprises of 10 rounds only but the initial data block is double the length of DES input. The key also consists of variable length specified independently.[13] AES does not use fiestel structure as DES. There are 4 stages which are applied in each 9 rounds.[14] These stages are- substitution bytes, mix columns, shift rows and add round key. The last round makes use of 3 stages only, eliminating mix column stage.[15]
Initially, in add round key stage, XOR operation is performed on plaintext and key.[16] The result is 16 bytes which are arranged in square matrix of 4*4. First four bytes form first column and so on. S-box is used to map each and every individual byte to a new byte obtained by checking the interaction of row and column.[17] Shift row stage requires shifting of bytes. No change is performed on first row. Left shift of 1,2 and 3 bytes are done.
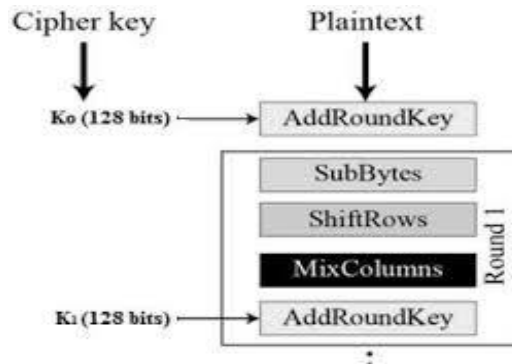
Figure 2: Structure of Round of AES [18]

On second, third and fourth row respectively. The key is XORed with the output in add round key of next round. These stages are repeated for total of 10 rounds.

Comparison between DES and AES

Table 1. Comparison [19]

Basis of Comparison	DES	AES
Year of development	1977	2000
Number of rounds	16	10
Length of key	56 bits	128, 192 or 256 bits
Security issues	Cracked and hence insecure	More secured
Length of block	64 bits	128 bits

309

Conclusion

Symmetric key cryptography provides security as well as authentication. The two prominent symmetric key encryption techniques are AES and DES. The usefulness of both the encrypting algorithm lies in the fact that AES is more secured as compared to DES whereas DES is very helpful in evaluating the symmetric key encryption techniques. Attacker attempts to breach the network in order to exploit other or steal some valuable information. As the area of application is expanding with advancement in technology, attackers are finding new techniques to crack already existing algorithm. Better algorithms are being designed with time but the root of their design lies in these two prominent algorithms.

References

[1] "Data encryption standard (DES)", (April 1997) National Bureau of Standards (U.S.), Federal Information Processing Standards Publication 46, National Technical Information Service, Springfield, VA.

[2] G. Singh and Supriya, (April 2013) "A study of encryption algorithms (RSA DES 3DES and AES) for information security", *International Journal of Computer Applications*, vol. 67, pp. 33-38.

[3] P. S. Mukesh, M. S. Pandya and S. Pathak, (2013) "Enhancing AES algorithm with arithmetic coding", *2013 International Conference on Green Computing Communication and Conservation of Energy (ICGCE)*, pp. 83-86.

[4] P. Mahajan and A. Sachdeva, (2013) "A study of Encryption algorithms AES DES and RSA for security", *Global Journal of Computer Science and Technology*, vol. 13, pp. 14-22

[5] B. Padmavathi and S. R. Kumari, (April 2013)"A Survey on Performance Analysis of DES AES and RSA Algorithm along with LSB Substitution", *International Journal of Science and Research (IJSR)*, vol. 2, pp. 170-174.

[6] Z. Musliyana, T. Y. Arif and R. Munadi, (October 2015) "Security Enhancement of Advanced Encryption Standard (AES) using Time-Based Dynamic Key Generation", *ARPN Journal of Engineering and Applied Sciences*, vol. 10, pp. 8347-8350.

[7] J. Juremi, R. Mahmod and S. Sulaiman, (2012) "A proposal for improving AES S-box with rotation and key-dependent", *International conference on Cyber Security Cyber Warfare and Digital Forensic (CyberSec)*, pp. 38-42.

[8] A. Janadi and D. A. Tarah, (2008) "AES immunity Enhancement against algebraic attacks by using dynamic S-Boxes", *3rd International Conference on Information and Communication Technologies: From Theory to Applications (ICTTA)*, pp. 1-6.

[9] S. Sahmoud, W. Elmasry and S. Abudalfa, (January 2013)"Enhancement the Security of AES Against Modern Attacks by Using Variable Key Block Cipher", *International Arab Journal of e-Technology*, vol. 3, pp. 17-26.

[10] V. Kaul, B. Nemade and V. Bharadi, (2016) "Next Generation Encryption Using Security Enhancement Algorithms for End to End Data Transmission in 3G/4G Networks", *Procedia Computer Science*, vol. 79, pp. 1051-1059.

[11] H. Alanazi, B. B. Zaidan, A.A. Zaidan, H.A. Jalab, M. Shabbir and Y. Ai-Nabhani, (March 2010) "New comparative study between DES 3DES and AES within nine factors", *Journal of Computing*, vol. 2, pp. 152-157.

[12] A. Alabaichi and A. I. Salih, (2015) "Enhance security of advance encryption standard algorithm based on key-dependent S-box", *2015 Fifth International Conference on Digital Information Processing and Communications (ICDIPC)*, pp. 44-53.

[13] K. Lala, A. Kumar and A. Kumar, (2012) "Enhanced throughput AES encryption", *IJECSE*, vol. 1, pp. 2132-2137.

[14] J. Daemen, and V. Rijmen, (November 2010) "The First 10 Years of Advanced Encryption," IEEE Security and Privacy, vol. 8, pp. 72-74.

[15] A. Fahmy, M. Shaarawy, K. El-Hadad, G. Salama, and K. Hassanain, (2005) "A Proposal For A Key-Dependent AES," 3rd International Conference: Sciences of Electronic, Technologies of Information and Telecommunications. Tunisia: SETIT.

[16] R. Zhang, L. Zhen, (2008) "A Block Cipher using key-dependent S-box and PBox," ISIE'2008 2008 IEEE International Symposium on Industrial Electronics, pp. 1463-1468.

[17] R. Churchhouse, "Codes and Ciphers: Julius Caesar the Enigma and the internet", (2002), Cambridge University Press.

[18] N. Ferguson, R. Schroeppel, and D. Whiting, (2001) "A simple algebraic representation of Rijndael," Selected Areas in Cryptography, pp. 103-111.

[19] E.T. Oladipupo, O.A. Alade, "An Approach to Improve Data Security using Modified XOR Encryption Algorithm", (2014), International Journal of Core Research In Communication Engineering, Volume No. 1, Issue No. 2.

Track 4

Advances in Electrical and Electronics Engineering

Synthesis of Graphene Oxide by Modified Hummers Method

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Abstract: In recent years, graphene oxide (GO) has been explored for its usefulness in various fields and applications because of its remarkable electronic, thermal and mechanical properties. To synthesize GO using conventional method at very low cost and environmental friendly is a huge challenge because it involves hazardous and harmful chemicals. In this research paper, authors presents an outline and discussion of GO produced by Modified Hummers Method. The variation in interlayer spacing by XRD of GO is 8.69 A^0 indicates formation of GO.

Keywords: Graphene Oxide; XRD; Raman Spectroscopy

Introduction

Graphene and its derivatives have attracted tremendous attraction to researchers due to their various potential applications in various fields and their excellent thermal, mechanical, optical and electrical properties. Various number of methods are reported in the literature for graphene oxide and its derivative's synthesis, such as micro-mechanical exfoliation [1], chemical reduction of graphene oxide (GO), and chemical vapour deposition (CVD)[2-4]. The CVD and micro-mechanical exfoliation produce graphene of high quality with demanding properties but are not suitable for mass production of graphene oxide because of high cost and poor yield. In this study, GO is synthesized by Modified Hummers Method and systematically analysis of the interlayer distance or spacing between the layers is done.

Methodology

To prepare GO, graphite (5 g), $NaNO_3$ (2.5 g) were mixed in concentrated sulfuric acid (108 ml), which should be cooled and ortho-phosphoric acid (12 ml) added under stirring in ice bath for 10 minutes. $KMnO_4$ (15 g) was added step by step to the above mixture with continuous stirring and cooling so that the temperature of the above prepared mixture was maintained below 5°C [5]. The reaction solution was then stirred again at 40°C for about 30 minutes to form a thick paste. After that, 160 ml of de–ionized water added to the above formed paste, followed by continuously stirring at 90°C for about 90 minutes. Later, additional 200 ml water was added to stop the oxidation reaction. Sequentially, 15 ml of 30% H_2O_2 was added in above solution in small steps to remove the excess amount of $KMnO_4$. Hence, appearance of yellow color indicates the fully removal of $KMnO_4$.

After that, the above solution was washed with 10% HCl to remove sulfate ions [6]. After that, it was again washed and filtered about ten times with de-ionized water to obtain graphene oxide. Fig 1 illustrate the Modified Hummer's Method to prepare GO from flaked graphite powder.

Results and Discussion

The **XRD** pattern for GO in fig 2 (a.) exhibit a sharp and strong peak at 2θ=10.44° corresponding to the (002) plane. This indicates the formation of highly oxidized GO. Interlayer spacing of GO (8.69Å) was greater than graphite (3.36Å) [7]. Interlayer spacing of GO within the layers becomes very large because of the various oxygen–containing functional groups formation such as epoxy, carboxyl and hydroxyl in between the graphite layers [8]. The other less intense peak in XRD of GO might be attribute to trace MnO_2 and most probably due to the defects in the GO system.

In the **Raman** spectrum of GO in fig 2 (b.), the G band was broadened and shifted slightly to 1592.42 cm^{-1}. It might be happened due to the presence of isolated double bonds which mostly resonate at higher frequencies. The intensity of the D band at 1351.38 cm^{-1} increases considerably and the 2D line disappeared [9]. The larger intensity and line width of D band as compared to G band indicates more disorder due to defects arising from strong treatment with chemicals.
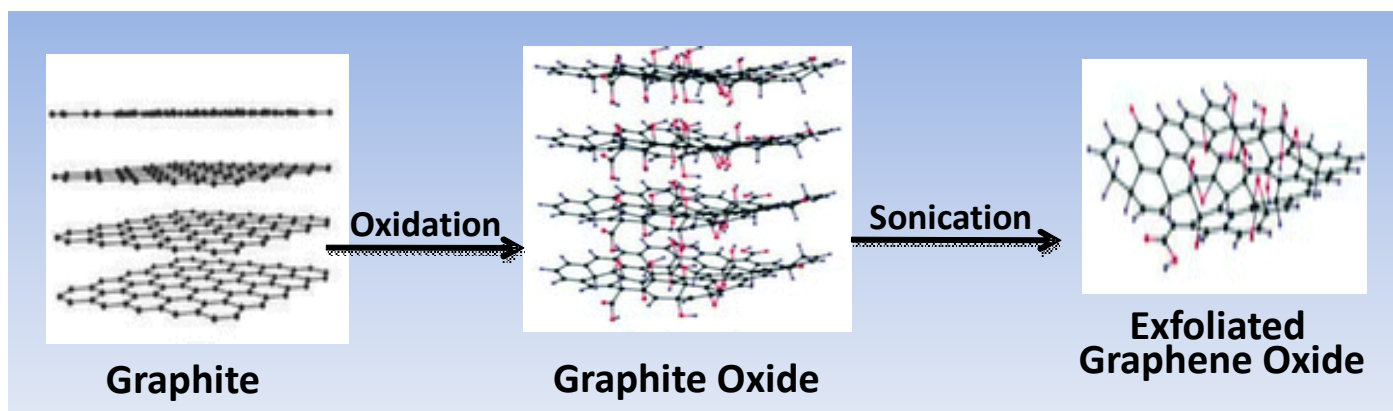
Figure 1. Represent Modified Hummers Method to prepare GO from flaked graphite powder.

Conclusions

XRD and Raman results confirms the formation of GO by modified Hummers Method. Increased interlayer spacing (8.69 A^0) between graphite layers from XRD result shows good oxidation of graphite. Observed lower Id/Ig ratio from the Raman spectrum reveals fewer defects in the GO.Graphene oxide is interesting for a broad scope to scientific community for its widespread applications in emerging research areas of interest like energy sector and biomedicinebecause of various oxygen containing functional groups like epoxy, hydroxyl, carboxyl and carbonyl, and various disordered/defects caused during chemical functionalization. The GO is also a useful platform for the fabrication of functionalized graphene that can potentially discuss improved mechanical, thermal and electronic properties etc.
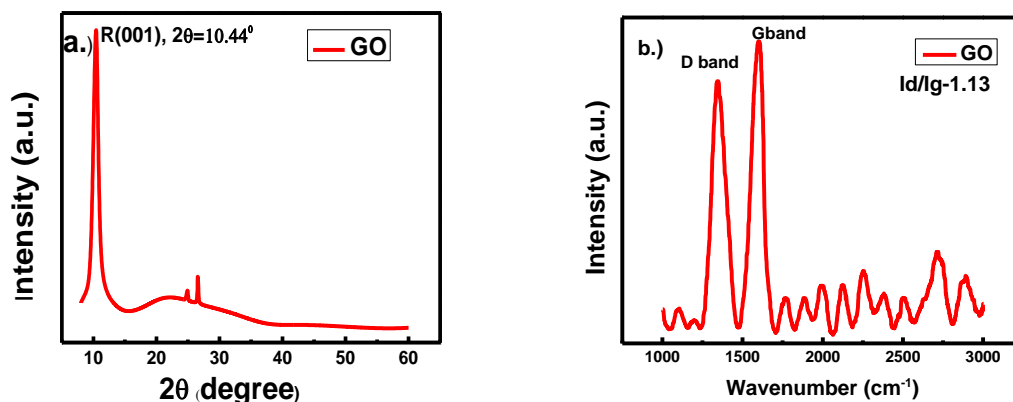
Figure 2. XRD,andb.)Raman spectra of GO

References

[1] K.S. Novoselov, A.K. Geim, S.V. Morozov, D. Jiang, Y. Zhang, S.V. Dubonos, I. V. Grigorieva, A.A. Firsov, *Science 306 (2004) 666–669.*

[2]A. Reina, X.T. Jia, J. Ho, D. Nezich, H.B. Son, V. Bulovic, M.S. Dresselhaus, J. Kong, *Nano Lett. 9 (2009) 30.*

[3]K.S. Kim, Y. Zhao, H. Jang, S.Y. Lee, J.M. Kim, K.S. Kim, J.H. Ahn, P. Kim, J.Y. Choi, B.H. Hong, *Nature 457 (2009) 706.*

[4]X.S. Li, W.W. Cai, J.H. An, S. Kim, J. Nah, D.X. Yang, R. Piner, A. Velamakanni, I. Jung, E. Tutuc, S.K. Banerjee,

313

L. Colombo, R.S. Ruoff, *Science 324 (2009) 1312.*

[5]X. Chao, Y. Ru–sheng, W. Xin, *Carbon, 71 (2014)345.*

[6]B.D. Cullity, Elements of X–ray diffraction*, 2nd Ed. Addison–Wesley(1978).*

[7] X. Hui Yau, F.Wah Low, C. SeongKhe, C. Wei Lai, S. KiongTiong, N. Amin, An investigation of the stirring duration effect on synthesized graphene oxide for dye senstized solar cell, PLoS ONE 15(2), (2020).
[8]X. Tong, H. Wang, G. Wang, L. Wan, Z. Ren, J Bai, *Journal of Solid State Chemistry, 184 (2011) 982*
[9] X. He, S. Zhang, H. Pan, J. Chen and J. Xu, Horizontally Aggregation of Monolayer Reduced Graphene Oxide Under Deep UV irradiation in Solution, Nanoscale Reasearch Letters, 14:117, (2019).

Petri Net Toolbox Efficacies for Specification and Evaluation of Communication Protocols

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Abstract: Petri Net have myriad efficacies in design and development of various types of system. Among various software tools available for analyzing PN models, Petri Net Toolbox software is used for Petri Nets under MATLAB. This toolbox can deal with untimed, transition-timed, place-timed, stochastic and generalized stochastic Petri Nets. The user-friendly graphical interface of toolbox allows analysis such as incidence matrix, coverability tree, structural properties (such as boundedness, conservativeness, repetitiveness and consistency), behavioral properties, time dependent performance indices. Utilization of toolbox enhanced after integration with MATLAB in the area of discrete event systems. This toolbox can be used in many domains of engineering to demonstrate its value as an educational aid through examples. This paper presents the introduction to Petri Net toolbox and its efficacies to study various properties of a communication protocol to illustrate the effectiveness and usefulness.

Keywords: Petri Net Toolbox, MATLAB, Properties of Petri Nets.

Introduction

The design and development of a system involves accessing system requirements, description of service, performance evaluation and implementation of software capabilities. Earlier this development process was carried out on textual documents, graphical description and analysis. These informal methods lacked any scientific background and provided no means for to analyse correctness of the designed system. Even for fault diagnosis, the cumbersome process has to be repeated. Informal methods were not good enough to design and develop a reliable system[1].

With advancement in research, now design and implementation can be achieved with mathematical techniques. Such methods are called formal methods and are theoretical foundation for software tools and techniques. Mathematical methods are strong but rigorous to develop and this brings into picture the graphic based formal methods like Petri Net for design and performance evaluation of a system[2]–[6]. Petri Net has found application in almost all fields of science and engineering and is a reliable method for system designing. Communication system is one area where the contributions made by Petri Net are noteworthy[7]–[9].

A Petri Net (PN), first introduced by Carl Adam Petri in 1939, is a formal modeling language having mathematical background for description and analysis of discrete event systems like communication systems. A PN is a form of directed graph consisting of places and transitions. Places represent states of a system and are specified by circles while transitions represents events that may occur are denoted by bars[10].

A Petri Net is also known as place/transition or P/T net consists of not only places and transitions but also arcs that run between place and transition or transition and place. Input places are places from which an arc runs while output places are places to which an arc runs into. Tokens also play an important part in execution of Petri Nets and each place may or may not be marked with discrete number of tokens. The occurrence of an event is represented by firing of transitions only if it is enabled i.e. sufficient number of tokens are present in input places. Also, when an event occurs, or we can say that when a transition fires it consumes tokens from input places and produce tokens at output places as per the weight of associated arcs. The process of Petri Net can be well understood from Figure 1 [11], [12].

PN Toolbox

There are many software tools for analysis and simulation of PN models but The Petri Net Toolbox (PN Toolbox) is a software tool for simulation, analysis and design of discrete event systems, based on Petri net (PN) models[13]–[15]. This software is embedded in the MATLAB environment and its usage requires the MATLAB version 6.1 or higher. The usability of MATLAB has made its use easier for researchers. The capabilities of this toolbox can be well understood by the fact that this toolbox makes it possible to use infinite capacity places because of inbuilt function Inf returning representation for positive infinity.

The existing version of PN Toolbox accepts five different types of PN models viz. untimed, transition timed, place timed, stochastic and generalized stochastic. In case of stochastic cases, appropriate distribution functions can be used. This toolbox contains an easy to use GUI and can be used not only to draw the models but also to simulate, analyze and design a PN based system. The main analysis and evaluations that can be achieved can be described as:

315

- The incidence matrix can be automatically built from topology of net.

- The behavioral properties such as liveness, boundedness etc. can be studied by analyzing coverability tree which is automatically built.

- The structural properties can also be explored.

- P-Invariants and T-Invariants can be calculated.

Before Firing   **Firing**   **After Firing**
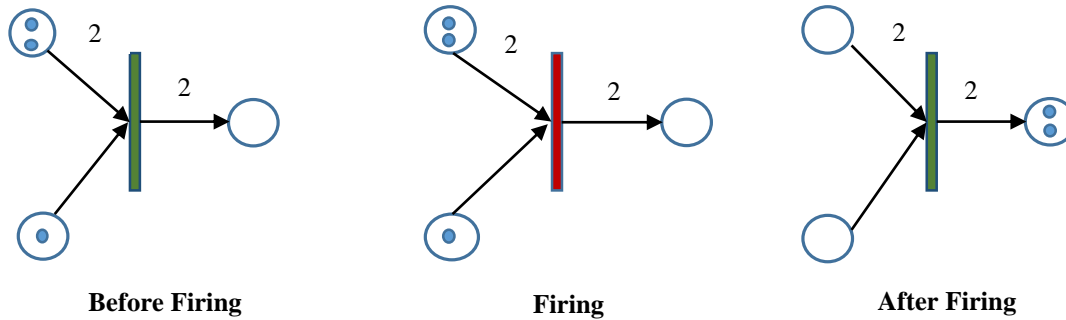
Figure 1. PN Process

Communication Protocol Analysis

Communication protocols is the area where petri nets have been actively used for representation of essential features of a system. The properties of petri nets are used for criterion for correctness of communication protocols.

In this paper we have discussed how PN is used for evaluation of a communication protocol [10] shown in Figure 2. This system represents a communication protocol between two systems for information exchange. Figure 3 represents the designed model in PN Toolbox.
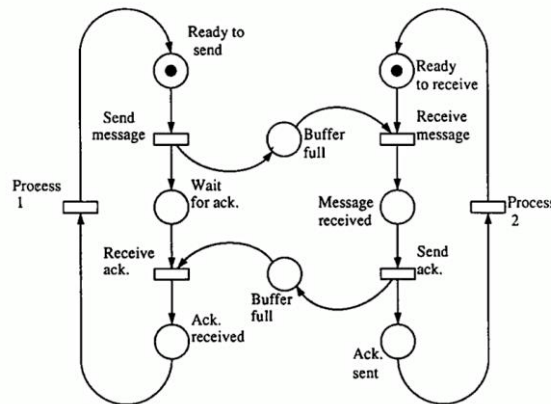
Figure 2. Communication Protocol Representing Information Exchange Between Two Processes[10]
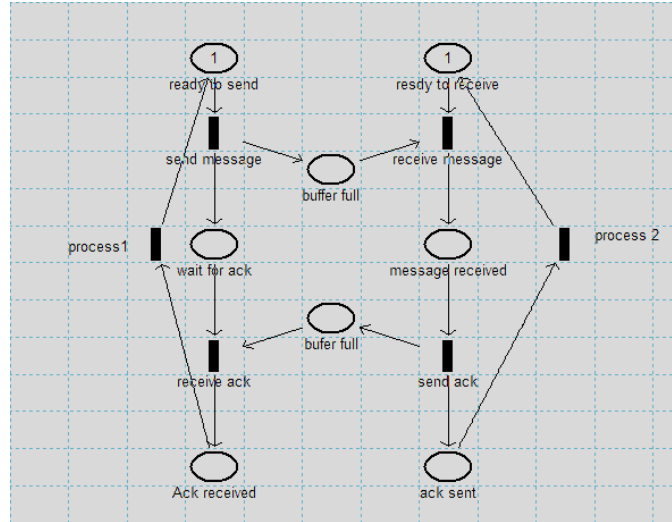
Figure 3. PN Toolbox Representation

The topology of this net can be evaluated as shown in Figure 4. It represents the subclass to which the developed model belongs i.e. the type of PN developed.
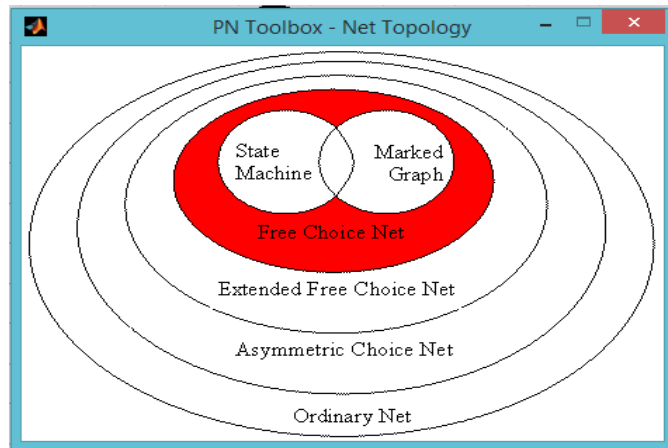
Figure 4. PN Topology

We can easily calculate the P-Invariants and T-Invariants as shown below in Figure 5 and Figure 6. These invariants can be used for mathematical analysis of the developed system.
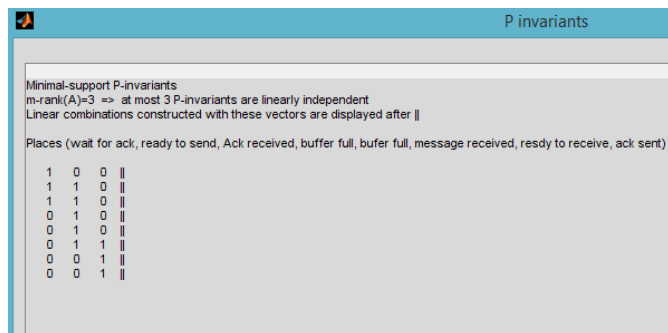
Figure 5. PN P Invariants

317
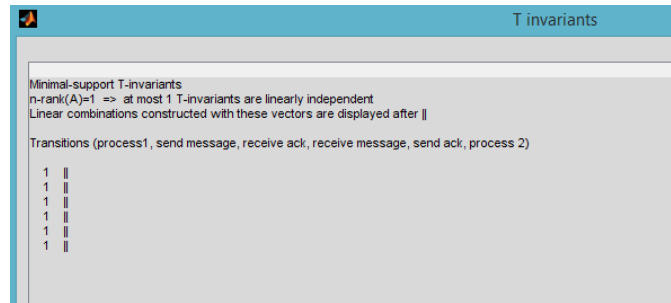
Figure 6. PN T Invariants

The coverability tree can also be drawn as shown in Figure 7. The coverability tree can be further used for evaluation of structural properties of PN model[16].
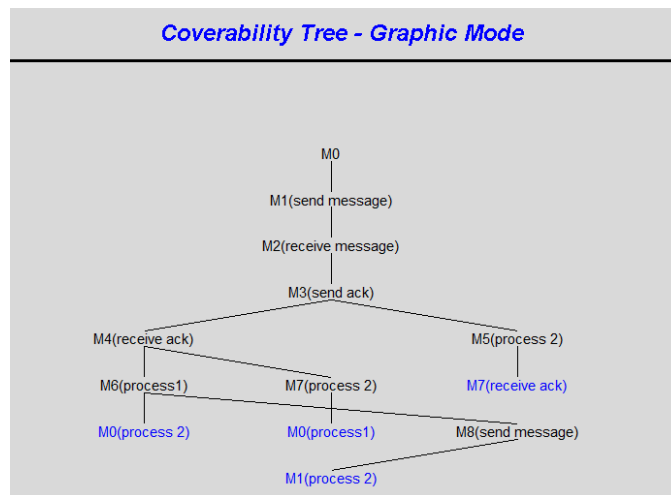
Figure 7. PN Coverability Tree

The net is live i.e. all the transitions can be fired at least once as shown in Figure 8. This shows that all states in this system are significant. The structural properties like conservativeness, consistency etc. of the net can also be studied.
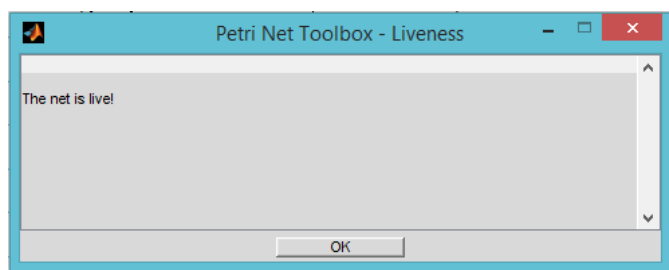
Figure 8. PN Liveness

Conclusion

The PN theory has been used during last decade for technical scenarios and various engineering areas specially in communication protocols and PN Toolbox is efficient for design and analysis of PN models.

The property analysis of communication protocol is presented, and it has been seen that the developed model representing a communication protocol for information exchange between two processes is deadlock free and valid. All the defined states are significant as the model is live. The coverability tree and Invariants are successfully calculated for further mathematical analysis. The PN Toolbox is efficient for design and analysis of a system.

318

References

[1]   F. Babich and L. Deotto, "Formal Methods for Specification and Analysis of Communication Protocols," *IEEE Commun. Surv. Tutorials*, vol. 4, no. 1, pp. 2–20, 2002.

[2]   H. Kaid, A. M. El-tamimi, E. A. Nasr, and A. Al-Ahmari, "Applications of Petri nets Based Models in Manufacturing Systems : A Review," in *Proc. of International Conference on Operations Excellence and Service Engineering Orlando, Florida, USA*, 2015, no. 1, pp. 516–528.

[3]   K. Q. Zhou and A. M. Zain, "Fuzzy Petri nets and industrial applications: a review," *Artif. Intell. Rev.*, vol. 45, no. 4, pp. 405–446, 2016.

[4]   Z. Tafa, G. Dimic, and V. M. Milutinovic, "A survey of Military Applications of Wireless Sensor Networks," in *Mediterranean Conference on Embedded Computing*, 2012, no. January.

[5]   I. Ituen and G.-H. Sohn, "The Environmental Applications of Wireless Sensor Networks," *Int. J. Contents*, vol. 3, no. 4, pp. 1–7, 2007.

[6]   D. E. G. Dr. S.R.BOSELIN PRABHU, M.PRADEEP, "Military Applications of Wireless Sensor Network," *A Multidiscip. J. Sci. Res. Educ.*, vol. 2, no. 12, pp. 164–168, 2016.

[7]   V. Prakash, S. Dahiya, S. Kumawat, and P. Singh, "Design of 4 × 4 Butler Matrix and Its Process Modeling Using Petri Nets for Phase Array Systems," vol. 103, no. June, pp. 137–153, 2020.

[8]   S. Dahiya, S. Kumawat, and P. Singh, "A petri net based approach for modelling of resource shared distributed wireless sensor networks," *Int. J. Sci. Technol. Res.*, vol. 9, no. 1, pp. 113–119, 2020.

[9]   S. Dahiya, S. Kumawat, P. Singh, and K. K. Sekhon, "Modeling and Analysis of Communication Subsystem design Process for Wireless Sensor Networks based on Petri Net," *Int. J. Recent Technol. Eng.*, vol. 8, no. 4, pp. 10124–10128, 2019.

[10]   T. Murata, "Petri Nets: Properties, Analysis and Appl k a t ions TADAO MURATA, FELLOW, IEEE Invited Paper," vol. 77, no. 4, pp. 541–580, 1989.

[11]   S. Dahiya, S. Kumawat, and P. Singh, "Petri net based modeling and property analysis of distributed discrete event system," *Int. J. Innov. Technol. Explor. Eng.*, vol. 8, no. 12, pp. 3887–3891, 2019.

[12]   S. Dahiya and K. Kumar, "PN Toolbox Efficacies for Analysis of Data Computation Model," vol. 8, no. 6, pp. 2186–2190, 2020.

[13]   M. Matcovschi and C. Mahulea, "Modeling, Simulating amd Analysis of Petri Nets inMatlab," in *Proc. of International Conference on Control Systems and Computer Science*, 2003.

[14]   M. Matcovschi, C. Mahulea, and O. Pastravanu, "EXPLORING STRUCTURAL PROPERTIES OF PETRI NETS IN MATLAB," in *Proc. of International Symposium on Automatic Control and Computer Science*, 2001.

[15]   M. Matcovschi, C. Mahulea, and O. Pastravanu, "Petri net toolbox for MATLAB," in *Proc. of IEEE Mediterranean Conference Control and Automation*, 2003.

[16]   S. Wang, M. Zhou, Z. Li, and C. Y. Wang, "A new modified reachability tree approach and its applications to unbounded petri nets," *IEEE Trans. Syst. Man, Cybern. Part ASystems Humans*, vol. 43, no. 4, pp. 932–940, 2013.

Sound Recognition through Device Control Systems

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Abstract: This research paper highlights the growth in technology and how it can be used for the betterment of human lives. We live in an era where our voice plays a very important role. The very voice that we possess can be used as a tool to activate devices at home as speech is a favourable and one of the easiest modes of communication for us humans. The appliances thus respond to the voice accessing it and then responds to it after[4] comparing sets of pre-recorded commands already stored in the system. The voice recognition system is very convenient to use. This is because of the inbuilt voice recognition module of the LabVIEW software which can be trained in words (or with our voice) which the user requires the module or the appliance to recognise. If the given 2 signals turn out to be the same, then the module/appliance turns on. For example: if we utter 'switch on the light' the light would be switched on. The voice could be modulated by an individual by the high of low-pitched voice frequency. This technology would be very useful to older people or the differently abled so that they[5] can use appliances in a very flexible way. The appliance responds through "beeps" or "visual" signals and thus expresses to the owner that it has understood the command. This paper thus specifies the use of such integrated sound technology highlighting its advantages and disadvantages.

Keywords: Betterment, Favourable, Inbuilt, LabVIEW, Pitched, Beeps, Integrated.

Introduction: Home automation is a rapidly growing industry that can change the way people approach their day to day lives. It on one side focuses on people who love to live in luxury and on the other side it also targets people [1]who are older or differently abled. It is a helpful and useful tool for the disabled. For say, if the attender or the caretaker of a disabled person is not available it would really be difficult for him/her to move and turn on/off any appliance, manually. The Sound Operated Device Control System (SODCS) would bring about a big change in such people's lives. Frequent variations and improvements are being brought to this technology so that it can be used anywhere anytime. Therefore, time and space are not a constraint.

Technology continues to evolve in our everyday life more closely and highlights the vision of what Sci-Fi of the 60s envisaged of how the future would look like. Self-driving cars? Handheld computers? Call them smartphones. Alarms and **cameras that are voice activated**? Of course, we have those! Thanks to home automation and smart technology, our life cannot be made more convenient.

Does it require fitting all these security products with microphones? **Does sound activation improve the performance** of a camera, or can other features — like motion detection — do the job just as well? The sound devices and microphones have evolved to such perfection that it even captures the breath of the person who is delivering the speech.

LabVIEW is a very versatile application creating a highly productive environment which uses virtual instruments to connect the various problems by providing suitable solutions. In the LabVIEW function block a real time audio signal is acquired using a microphone. The inbuilt voice recognition module recognizes the input signal of the user then interprets and builds on these messages. In LabVIEW, the Average recognition accuracy turns out to be 67%. Thus, technology helps to improvise the way of life, rather it improves the quality of living itself.

The Voice Recognition Technique - An Overview

Modern technology has improved quite drastically. One such technique is the voice recognition technique in which an individual is made to speak a few phrases which are recorded and then these phrases are converted into electrical signals which are transformed into a binary code or machine language (0s and 1s) to which a certain definition is given. This concept is what we in our day to day lives have termed as voice recognition or speech recognition. Our voices are the focus here because most of the time we naturally depend on our voices to relay the thoughts circulated in our brains to others in our immediate environment. The user would probably gain the greatest feeling of immersion and would feel very secure to use his or her voice as the most common mode of communication. Initially a sound is given to the signal analyser which analyses the signal and moves it forward to the acoustic model and after that the processed data is given at the output.
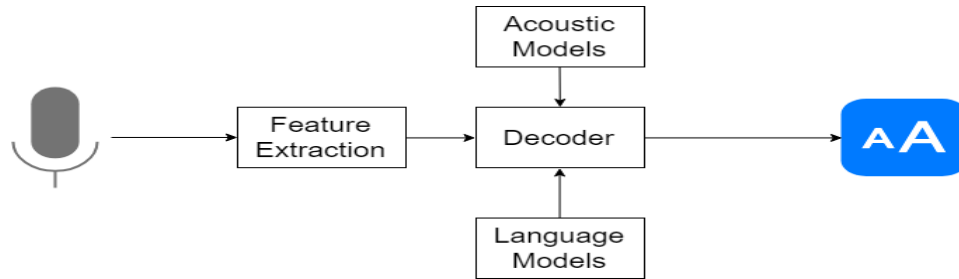
Figure 1. Flowchart for a voice operated system(diagrammatic).

The voice capturing Device: It consists of a microphone or any other device through which our voice can[6] be retrieved, here the conversion takes place as it converts the sound wave signals to electrical signals and an Analog to Digital Converter is used to sample and digitize the analog signals which have been taken to obtain a discrete data that the computer can understand.

The Processor: It processes the raw speech signal like the frequency domain conversion, all the fuzz, distortion and hum are removed which could have been taken along with input and the original data is preserved.

The Pre-processed Signals: A pre-processed voice which has already been stored in the memory is used to carry out the further task of voice or speech recognition.

Reference Speech patterns: The database or the system consists of predefined speech patterns or templates which are already stored in the memory, these are used as the reference for matching.

The Pattern match algorithm: The unknown pre-processed voice signal is compared with the reference voice pattern stored in the database to determine if the actual words or the pattern of pattern of speech match with the previously recorded signal.

Applications of Sound Operated Device Control System:
Apart from basic home appliances the Sound Operated Device Control System is already in use in many other fields in Science.
1) Voice modulation can capture the voice of eminent personalities of yesteryears and can bring to life a speech which might not have a verbatim recording.
2) It can be used to cut across language barriers by a person directly conveying a speech in the local dialect even without knowing a foreign language. For example, a person who only knows English can still [2]communicate in Japanese or any other language without losing his voice modulation or expression. Hence, the message conveyed can easily be grasped by the hearer. Hence, this is a Sound Operated Device Control System.
3) In meetings conducted by the United Nations/high level international gatherings there is direct translation of the speaker to the native mother tongue of the hearer or participants. So, this cuts across language barriers. Hence, saving time and human efforts.
4) It is already being used in fields like biometrics. The voice recognition biometrics uses our voice patterns[7] to create unique voice identification based on various physical and behavioural properties such as vocal tract, mouth and nasal passages and accent etc. Thus, helping in identification and recognition of voice of an individual.
5) In forensic sciences voice stress analysers are used on an accused to figure out whether a person is lying or not by using lie detectors. This helps in criminal investigations. This enhances that technology could be used to prove that justice could be brought about to the afflicted/ inflicted person through Sound Operated Device Control systems.

Advantages of Sound Operated Device Control System

1) Ability to use voice recognition remotely: One of the biggest advantages offered by voice verification [3]technology is the ability to use it anywhere at any point. Many other types of biometrics systems are not suitable for us to use at any time as they can be quite inefficient or time consuming if the conditions are not

321

apt. The retina biometrics or the iris biometrics would be quite time consuming to use and could end up damaging our eyes which is not the case with our voices and speech patterns.

2) One of the most important advantages of voice recognition technology is that it can be easily used over the phone or other speaking devices, hence increasing the usefulness of this technology to many big offices and companies. The way in which it can be used so remotely makes it a way better option in biometrics compared to the other forms and systems of biometrics.

3) Highly reliable: Another one of the most esteemed advantages of voice recognition is that this technology has a very high reliability rate. 10-20 years ago, the rate of reliability of the voice recognition technology was in reality very low. However, these cases and problems were deeply investigated and have turned out to be very successful today, thus the reason for this technology to have a very high reliability rate. The vocal prints of a person now can easily be used to identify any individual, even if their voice sounds a bit different due to illness or because of any other factor.

4) Minimally Intrusive: The advantages of the voice recognition technology is that it only requires a particular individual to speak or to offer just a vocal sample, which is quite minimally intrusive. Just because this technology has a very high approval rate among many consumers, it helps big businesses to keep their clients and customers happy with the service they are being provided with.

Though SODSC is quite helpful in many situations there are certain areas where some improvements are still desired.

Disadvantages of Sound Operated Device Control System:

1) Words need to be spoken one at a time as continuous words are not that feasible as the various signals would end up overlapping causing a muffled sound entering the input causing errors and increasing the system rejection rate.

2) A sound operated system is a system which is speaker dependent. If at all too many speakers end up speaking simultaneously it would result in an overlapping of the signals and cause delays and interruptions.

3) There is a limit on vocabulary size of a language as well. Languages which have quite a large vocabulary make it very difficult for the patterns to match compared to languages which have a small vocabulary, since chances of having words which are difficult to pronounce or enunciate are quite rare.

Conclusion

Though we are totally focussed on devices which can use our voices to get activated and work on their own, it is true there is still room for a lot of improvement and improvisation. Even a small improvement can bring about a big change. After all, we have come this far after each minor upgrade. Every machine has some flaws and would result in some minor errors or may end up giving an undesirable output. But even as technology grows the growth[8] of Sound Operated devices is inevitable. As technology grows, the path to near perfection becomes clearer. Gone are the days where we would watch Sci-Fi movies and wonder how the world would be a different place had these technologies been available. Soon enough there will come a time where these sound and voice operated devices would not just be available to all but become a reality and thereby a necessity. Not just in certain fields or for certain privileged people but would be accessible to everyone to be used in their daily walk of life.

References

1. Ankita Kosare , Chhaya.M. , Lumdevi.D., Minal.T. and Jitesh.S: Sound Operated Device Control System International Journal of Innovative Research and Advanced Studies (IJIRAS) Volume 4 Issue 3, March 2017.
2. David.E., Kieth.W. and Craig.P. : A Report on voice Biometrics An Introduction to Contact Centres, Biometrics, Published On: 22nd Apr 2015 Last modified: 20th Oct 2017
3. Harris.A. (2020): Report on the Advantages of using Voice Recognition Software. Tech 21 Century
4. Manoj.K.S., Rohit.K., Mantu.K.S. and Mousumi.P.: Controlling home appliances using Voice Command. International Journal of Modern trends in Engineering and Research; Scientific Jourrnal Impact Factor (SJIF) : 4.364.

5. Mark.S.H., Stuart.P.C., Phil.D.C., Roseli.D.G., Pam.E., Rebecca.P., Siddharth.S., and Peter.O.N., "A Voice-Input Voice-Output Communication Aid for People with Severe speech Impairment", IEEE Trans. Neural system and Rehabilitation engineering, vol. 21, no. 1, pp. 23-31, Jan 2013.

6. Noraphizah.A. and M.B.Othman: Voice control of appliances using Android. Publisher: Conference at Malang, Indonesia Institute of Electrical and Electronics Engineering. **IEEE *Xplore*:** 08 Jan 2015.

7. Rawlson.O.N : Speech and voice recognition white papers. Biometric Update Special Report May 2014.

8. Ronaldo.P., Ned.K. and John.S. An Analysis of the Implementation and Impact of Speech-Recognition Technology in the Healthcare Sector. Online Research Journal Perspectives in Health Information Management V.1:2004 > PMC2047322

A STUDY ON BRAIN TUMOR CLASSIFICATION TECHNIQUES

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Abstract: Brain tumors are the one of the leading causes of mortality these days. With the advancement in the Machine Learning approaches many tissues specific decision-based models have been developed to extract and classify lesion precisely and accurately, to assist neurologist in decision making and treatment planning. This paper presents the generalized classification model as well as compares state-of-the-art classification approaches.

Keywords: Brain tumor, classification, SVM, PCA-KNN, ANN, CNN, DNN, Alex Net, Image Net, GAN.

Introduction

Brain tumor is one of the deadliest diseases prevailing in the world today with severe morbidity and complications. This terminal disease requires early detection and classification for proper oncologic treatment. Depending upon the behavior and origin of the cells there are more than 150 types of intracranial and CNS tumors (Central nervous system) which WHO has categorized, from Grade I Benign tumors (least aggressive) to Grade IV malignant tumors (most aggressive). Glioma is the most frequently occurring brain tumor originating from the brain with highest incidence of death. The low-grade gliomas (LGGs) and high-grade gliomas (HGGs) are ranked (I-IV) depending on its aggressive and infiltrative characteristics. [1] The treatment of a brain tumor depends on the tumor size, its type, and its growth stage.

MRI is one of the frequently using imaging modality in health care industry as it offers non-invasive, reproducible, quantifiable measurement of tissue including anatomical, functional, and structural evidence. MRI does not use any ionizing radiations and provides various images using different tomography parameters with high tissue contrast [2, 3]. These high-resolution images are commonly being used by radiologist to examine any portion of the body. However, determination of disease based on visual inspection MRI is subjective, exhausting, and susceptible to errors. [4] Therefore informed decision-making support system is required for automatic disease identification and classification.

Now a days, health care data in form of Electronic health records (EHRs) are easily accessible to the healthcare professionals for data analytics and interpretation. It can be employed in preventive medicine by the primary care providers (PCP) to come up to conclusive evidence of pathology so as to dispense best quality care and treatment. However, investigation of medical data is demanding task because of its inherent heterogeneity, high dimensionality, partial and unbalance nature. Heterogeneity here means the data values are of different types (real, integer) with diverse ranges, image, and text types. Also, many diagnostic examinations do not perform all tests due to increase in cost leading to its incomplete dataset.

Furthermore, the data mining and analytic techniques should interpret the classification result and should be accepted by the experts in a health industry. In the recent times, it has been established that machine learning (ML) and deep learning (DL) based methods provides much improved accuracy than other approaches to solve a problem. This paper is talks about the solution to the unorganized dataset by using improved Computer aided diagnostic methods which incorporate robust feature extraction and classification such as PAPNET: a data processing package for cervical cancer detection via morphometric analysis of pap smears. [5]. Morphometric analysis of histopathological images providing molecular signature of tumor integrated with the MR image processing CAD approach is quickly evolving as a diagnosing mechanism in a variety of diseases [6], particularly true tumor computerized diagnostics.

Generalized Classification Approach

In Neuropathology, classification of brain tumors implies correctly locating and categorizing MR images to spot which kind of brain tumor the patient is bearing. The general steps involved in lesion segmentation and classification are clearly depicted in figure 1. 3D volume of MR data is pre-processed (noise removal, skull extraction, enhancement) and then applied to lesion segmentation and localization module which demarcates the abnormal tissue to the healthy tissue. Afterwards feature matrix is generated and the crucial attributes are selected from the feature space. Thereafter

the classifier is trained, tested, and validated. This network can then be used radiologist to take it as a confirmatory analysis tool during treatment.
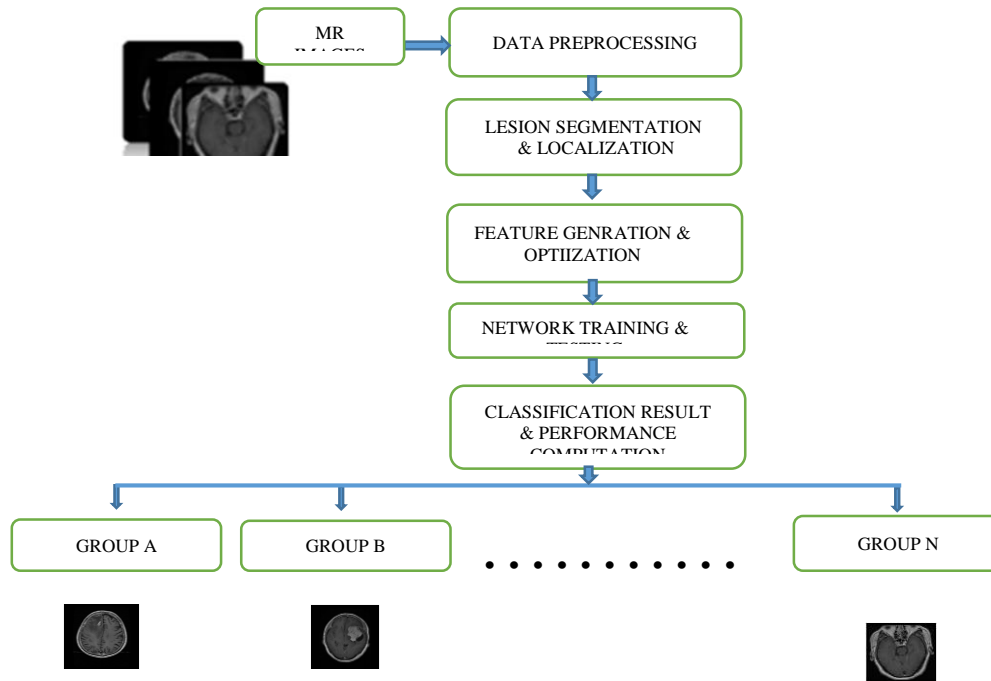

Figure 1. Generalized lesion segmentation and classification system

Related Literature

This section reviews about the data mining and the computationally clever machine learning approaches whose involvement in medical field has improved the disease diagnosis and treatment planning exponentially. Automatic learning and classification models have been developed for CT and MRI brain tumors. Supervised and unsupervised learning approaches were used widely for disease localization and classification. Authors used knowledge based supervised methods for instance conditional random fields, Support Vector Machine (SVM)[7], Random Forests [8], Expectation Maximization Algorithms [9], Genetic Algorithm (GA)[7], K- Nearest Neighbour (KNN) [10,11] as well as unsupervised approaches such as Self-Organizing Maps (SOM) [12] and Fuzzy c means clustering (FCM) [13] to categorize cancerous and normal tissues. FCM was popular in earlier days as it was computationally inexpensive method. Tumor voxels of 3D MR image were classified using discriminative random decision forests by Geremia et al. [14]. Kumar et al. suggested a model for multiclass brain tumor classification by utilizing principal component analysis - artificial neural network (PCA-ANN) [15, 16]. Z. A. Al-Saffar and T. Yildirim proposed automatic classification of brain gliomas using singular value decomposition. The best features were gathered through MI-ASVD and used RNN along with LDI means clustering. [17]

Authors have used various existing classifiers like Back Propagation Neural Network (BPNN), Radial Basis Neural Network (RBNN), Adaptive Neuro Fuzzy Inference System (ANFIS), Support Vector Machines (SVM), Pointing Kernel Classifiers (PKC) to demarcate benign and malignant tumors. Tripathi et al. has reviewed various segmentation and classification techniques and proposed the classification model. This model uses minimum redundancy maximum relevance (mRmR) feature selection tool to optimize the number of extracted features and then categorized brain tumor using ANN scheme [18-19].

Machine Learning (ML) algorithms are the computationally efficient mathematical tools used in data mining and exploratory data analysis. Lately, deep learning had become popular and had endured extraordinary growth in the medical field. Deep learning classification has shown immense potential in solving tissue specific detection [20]. These decision models are capable of handling large data sets with high accuracy such as ImageNet [21] using images

325

more than 1 lakh. Similar deep learning convolutional techniques are Google InceptionNet [22], Alex Net [23], GAN[24,25] etc. Following table 2 summarizes the latest methods adopted for brain tumor classification.

Table 1. Comparative analysis of brain tumor classification approaches

Authors	Year	Method Used	Classes	Results
Sachdeva et al [16]	2013	Content based active contour (CBAC), Principle component analysis (PCA), Artificial neural network (ANN)	Multi-class	Overall accuracy: 91% for AS, GBM, MED, MEN, MET, NR type tumor classification
Kharrat et al [7]	2015	Genetic algorithm (GA), Support vector machine (SVM)	Two class	Overall Accuracy: 95.65 % for normal and abnormal brain MR image
Machhale et al [11]	2015	Support Vector Machine (SVM), K- Nearest Neighbour (KNN)	Two class	Overall Accuracy: 98 % for normal and abnormal brain MR image
Gupta et al [10]	2017	Random forest (RF), K nearest Neighbour (KNN), Linear support vector machine (Linear SVM)	Two class	Overall Accuracy: 88 % for normal and abnormal brain MR image
Tripathi et al [18]	2018	Minimum redundancy maximum relevance (MRMR), Artificial neural network (ANN)	Two class	Overall Accuracy: 96.5 % for normal and abnormal brain MR image
Saraswathi et al [8]	2019	Principle component analysis (PCA), Random Forest (RF)	Multi class	Overall Accuracy: 88.72 % for classification in brain MR images
Sultan et al [19]	2019	Deep Neural Network (DNN)	Multi class	Overall accuracy: 96.13% for meningioma, glioma, and pituitary tumor. 98.7 % for Grade II, Grade III, and Grade IV tumor classification.
Al-Saffar et al [16]	2020	Mutual Information- Accelerated Singular Value Decomposition (MI-ASVD), Residual Neural Network (RNN)	Multi class	Overall accuracy: 94.91 % for healthy, high-grade glioma, and low-grade glioma classification.
Chelghoum et al [20]	2020	Transfer Learning Using Convolutional Neural Network (CNN)	Multi class	Overall Accuracy: 96.56 % for 3 different categories of brain tumor in MR image
Badža et al [22]	2020	Convolutional Neural Network (CNN), ALEXNET	Multi class	Overall Accuracy: 96.56 % for 3 different types of brain tumor in MR image
Ge et al [24]	2020	pairwise Generative Adversarial Network (GAN)	Two class	Overall Accuracy: 88.2 % for categorizing glioma molecular subtypes: isocitrate dehydrogenase 1 (IDH1) mutation and IDH1 wild type.

Conclusion

Over the years many semi-automatic and automatic classification schemes are developed which uses hand crafted feature set as input to their classification models. These feature sets depend on the knowledge of the expert to estimate the most significant features vectors available. Many authors have developed various optimized feature generation approaches which perform very well with small data size. With the growing data size many computationally efficient techniques are available which outperformed the traditional one like Convolutional nets. This paper suggest the need of availing the benefits of these methods in medical diagnostics in a universal platform.

References

[1] Cha (2006). Update on brain tumor imaging: From anatomy to physiology. *Amer. J. Neuroradiol.*, 27(3), 475–487.

[2] Drevelegas A. (2002). *Imaging of Brain Tumors With Histological Correlations*. Berlin, Germany: Springer.

[3] Litjens G., Kooi T., Bejnordi B. E., Setio A. A. A., Ciompi F., Ghafoorian M., et al. (2017). A survey on deep learning in medical image analysis. *Med. Image Anal.*, 42,60-88.

[4] Zeljkovic V., Druzgalski C., Zhang Y., Zhu Z., Xu Z., Zhang D., and Mayorga P. (2014). Automatic brain tumor detection and segmentation in MR images. in Proc. *Pan Amer. Health Care Exchanges (PAHCE)*, Brasilia, Brazil, p. 1

[5] Mango L. J. (1994). Computer-assisted cervical cancer screening using neural networks. *Cancer Lett.*, 77 (2-3), 155–162.

[6] Chan K., Lee T.-W., Sample P. A., Goldbaum M. H., Weinreb R. N., and Sejnowski T. J. (2002). Comparison of machine learning and traditional classifiers in glaucoma diagnosis. *IEEE Trans. Biomed. Eng.*, 49(9), 963–974.

[7] Kharrat, A., Halima, M. B., & Ben Ayed, M. (2015). MRI brain tumor classification using Support Vector Machines and meta-heuristic method. *15th International Conference on Intelligent Systems Design and Applications (ISDA). doi:10.1109/isda.2015.7489271*

[8] Saraswathi V. and Gupta D. (2019). Classification of Brain Tumor using PCA-RF in MR Neurological Images. *11th International Conference on Communication Systems & Networks (COMSNETS),* Bengaluru, India, 440-443, *doi: 10.1109/COMSNETS.2019.8711010.*

[9] Abdulbaqi H. S., Jafri M. Z. M., Omar A. F., Mutter K. N., Abood L. K. Mustafa and I. S. B. (2015). Segmentation and estimation of brain tumor volume in computed tomography scan images using hidden Markov random field Expectation Maximization algorithm. *IEEE Student Conference on Research and Development (SCOReD)*, Kuala Lumpur, 55-60, *doi: 10.1109/SCORED.2015.7449396.*

[10] Gupta T., Gandhi T. K., Gupta R. K., and Panigrahi B. K. (2017). Classification of patients with tumor using MR FLAIR images. *Pattern Recognit. Lett.*, *doi: 10.1016/j.patrec.2017.10.037*

[11] Machhale K., Nandpuru H. B., Kapur V. and Kosta L. (2015). MRI brain cancer classification using hybrid classifier (SVM-KNN). *Proc. Int. Conf. Ind. Instrum. Control (ICIC)*, 60-65.

[12] Goswami S. and Bhaiya L. K. P. (2013). Brain tumor detection using unsupervised learning based neural network. *Proc. Int. Conf. Commun. Syst. Netw. Technol. (CSNT)*, 573-577.

[13] Xiao L., Qi H., Fan C. and Ai Z. (2020). Energy Noise Detection FCM for Breast Tumor Image Segmentation. in *IEEE Access*, 8, 62895-62904, *doi: 10.1109/ACCESS.2020.2984392.*

[14] Geremia E., Clatz, B. H. Menze, Konukoglu E., Criminisi A., and Ayache N. (2011). Spatial decision forests for MS lesion segmentation in multi-channel magnetic resonance images. *NeuroImage*, 57(2), 378–390.

[15] Kumar V., Sachdeva J., Gupta I., Khandelwal N., and Ahuja C. K. (2011). Classification of brain tumors using PCA-ANN. in Proc. *World Congr. Inf. Commun. Technol.*, Mumbai, India, 1079–1083.

[16] Sachdeva, J., Kumar, V., Gupta, I., Khandelwal, N., & Ahuja, C. K. (2013). Segmentation, Feature Extraction, and Multiclass Brain Tumor Classification. *Journal of Digital Imaging*, 26(6), 1141–1150. doi:10.1007/s10278-013-9600-0

[17] Al-Saffar Z. A. and Yildirim T. (2020). A Novel Approach to Improving Brain Image Classification Using Mutual Information-Accelerated Singular Value Decomposition. in *IEEE Access*, 8, 52575-52587, doi: 10.1109/ACCESS.2020.2980728.

[18] Tripathi S., Anand R.S. and Fernandez E. (2018). Segmentation of Brain Lesions in MR images", *International Conference on Recent Innovations in Electrical, Electronics & Communication Engineering - (ICRIEECE).*

[19] Tripathi S., Anand R.S. and Fernandez E. (2018). Classification of Normal and Abnormal Brain in MR Images. *International Journal of Emerging Technologies and Innovative Research*, 5(5), 610-614.

327

[20] Sultan H. H., Salem N. M. and Al-Atabany W. (2019). Multi-Classification of Brain Tumor Images Using Deep Neural Network. in *IEEE Access*, 7, 69215-69225, 2019, *doi: 10.1109/ACCESS.2019.2919122*.

[21] Chelghoum R, Ikhlef A, Hameurlaine A, Jacquir S (2020). Transfer Learning Using Convolutional Neural Network Architectures for Brain Tumor Classification from MRI Images. *Artificial Intelligence Applications and Innovations.* 583:189–200. *doi: 10.1007/978-3-030-49161-1_17. PMCID: PMC7256397.*

[22] Szegedy C. et al. (2015). Going deeper with convolutions," in Proc. *IEEE Conf. Comput. Vis. Pattern Recognit. (CVPR),* 1-9.

[23] Krizhevsky A., Sutskever I., and Hinton G. E. (2017). ImageNet classification with deep convolutional neural networks," *Commun. ACM*, 6(6), 84_90.

[24] Goodfellow I. J. et al. (2014). Generative adversarial nets," in Proc. *Neural Inf. Process. Syst.,* 2672_2680.

[25] Ge C., Gu I. Y., Jakola A. S. and Yang J. (2020). Enlarged Training Dataset by Pairwise GANs for Molecular-Based Brain Tumor Classification. *IEEE Access*, 8, 22560-22570, *doi: 10.1109/ACCESS.2020.2969805.*

Characterisation of an Alloy Steel Using Sem and Microindentation

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Abstract: Steel alloys remain key materials used in industry today, dominating the most industry since the 1920s. Steel has excellent corrosion resistance and mechanical properties even at elevated temperatures. Bulk stainless steels are produced by processes, which include smelting, hot rolling, followed by cold-swaging and annealing processes. From the past research work, suitability and material properties of stainless steel as a structural material is studied with reference to mechanical properties like stress-strain behavior, thermal resistance, corrosion resistance and cost. For material engineers, it is important to understand mechanical properties and their relationship to the distribution and microstructure of the phases. Mechanical testing plays an important role in evaluating fundamental properties of engineering materials as well as in developing new materials and in controlling the quality of materials. This paper presents hardness test and scanning electron microscopy (SEM) test of a stainless steel alloy sample to establish its microstructure and elemental composition.

Keywords: Charecterisation, alloy steel, scanning electron microscopy

Introduction

Since has been a main engineering material since 1920s, contributing by weight, 60.1 per cent of an average light vehicle [1]. It exhibits has excellent corrosion resistance, strength and creep properties even at elevated temperatures [2]. Bulk stainless steels are produced by smelting, hot-rolling, cold-swaging and annealing processes [3]. Materials stress-strain behaviour, thermal resistance, corrosion resistance and cost are important use factors [4]. These properties depend on their microstructures. Mechanical testing is fundamental in evaluating properties of engineering materials during their production and before use in design [4]. This paper presents hardness test and scanning electron microscopy (SEM) test of a stainless steel alloy of unknown specifications to establish its microstructure and elemental composition. It also seeks to establish its imperfections in the structure of the alloy and composition if such imperfections.

Literature review

Properties of steel

Although pure iron is too ductile, for structural applications [5]. In the form of steel, it is an alloy of iron and carbon and other elements, which influence phase changes resulting in slowing of the movement of those dislocations and enhanced mechanical properties [5] . Steel is relatively cheap compared to other alloys with high tensile strength, lending it for use in components, infrastructure, appliances and weapons among other things [6] . Typical steel alloys may contain up to 2.14% C of its weight and many other alloying elements, whose chemical and physical makeup in the final steel affect its mechanical properties [6]. The added elements may exist in the steel either as solute elements, or as precipitated phases. Carbon steel is a steel contain up to 0.4% copper, manganese 1.65 although no minimum is set for the elements chromium, cobalt, molybdenum, nickel, niobium, titanium, tungsten, vanadium or zirconium [7]. Stainless steels, which have added elements such as chromium, nickel, silicon, manganese, nitrogen and carbon and often molybdenum and aluminium [8]. They typically contain a minimum of 10.5% chromium content by mass notable for their corrosion resistance [8]. The difference between carbon and low-alloy steels, the proportional limit is assumed to be at least 70 % of the yield point, but for stainless steel the proportional limit ranges from approximately 36 % - 60 % of the yield strength [9].

Impact of alloying elements on properties of steel

The characteristic corrosion resistance of stainless steel is dependent on the chromium content and is enhanced by additions of molybdenum and nitrogen [5] [4]. Nickel is added, primarily, to ensure the mechanical properties and the correct microstructure of the steel [10]. Additions of molybdenum increase corrosion resistance in reducing acids and against pitting attack in chloride solutions [7] [5]. Alloying elements may be added to improve particular aspects of the stainless steel such as high temperature properties, enhanced strength or to facilitate particular processing routes

329

[5]. Generally, stainless steel structural members are more expensive than carbon steel [4].The composition of major alloying elements distinguishes between austenitic and duplex steels is compared below in Table 1 [10].

Table 1. Elemental composition of steel (Source: Graham Gedge et. al.(2008))

	Chromium	Nickel	Nitrogen	Molybdenum
Austenitic steel	16.5 - 17%	8 -12.5%	-	0.1 – 2.5
Duplex steels	>21%	>1.5 - 4.5	0.5	0-2.5

Hardness Testing
Hardness is an important property applied to solid material which measures its resistance to indentation or penetration by another material [11] or resistance to scratch [12]. Hardness testing involves the use of a loaded indenter, which is applied to the particular sample material, at a predetermined rate, then held in place for a set amount of time and unloaded from the sample at a set rate [11]. In principle, hardness is quantified as the ratio of the applied indenting load (P) to the indentation area (A). Mathematically shown as;

$$H = P/A \tag{1}$$

A is the projected contact area between the indenter and the specimen [11] .Thus, the projected contact area (A), Samples presented for testing vary in size from large to small and measurements may be required on a micro to a nanoscale [13]. The shape of the indenter is modelled after the diamond tipped Vickers shaped tip is common in micro-indentation testing [14]. Vickers hardness testing for micro-indentation, the contact area is the surface area of the tip-faces that are in contact with the sample [13]. Vickers hardness value can be expresses in MPa using the expression;

$$VH = 2P/d^2 \tag{2}$$

Where P is peak load in kgf and d is diameter of the impression in mm. hardness can be used to characterise the various phases present in a material as well as the bulk material [13].

Scanning electron microscopy (SEM)
Scanning electron microscopy (SEM) is an important technique, widely used throughout the scientific, industrial and technological communities [15] for imaging and topography [16]. Pioneered by Manfred von Ardenne in 1937, [17], it was commercialised by Sir Charles Oatley in the mid-1960s leading to the development of the first commercial instrument by Cambridge Scientific [18]. The principle of SEM is based on achieving high magnification by scanning a very small raster with a demagnified and finely focused electron beam [19]. The first and most widespread electron source in electron microscopy was the thermionic gun which used a tungsten filament bent into a V-shaped hairpin, with a tip radius of about100 mm. This tip spontaneously emits thermionic electrons when electrically heated to a temperature around 2700 K [16]. SEMs always have at least one detector, a secondary electron detector [20]. The specific capabilities of a SEM depend on which detectors it accommodates [17]. The schematic of an SEM is shown below in Figure 1 .
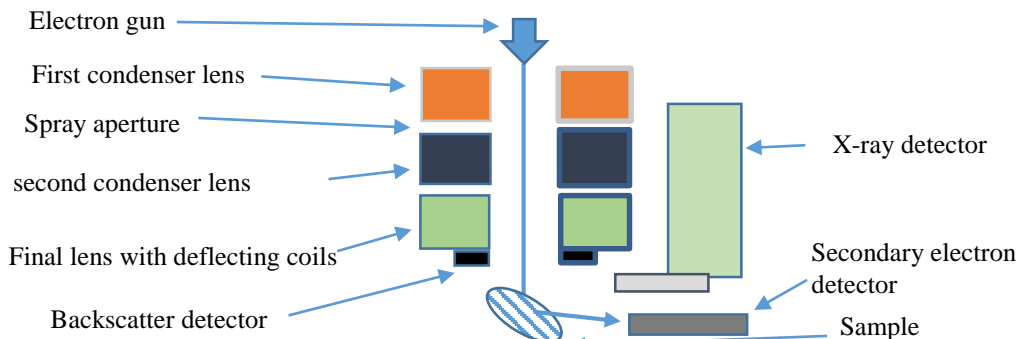
Figure 1. Schematic of scanning electron microscopy equipment

Electrons are generated from an electron gun and focussed on a specimen surface through lenses and aperture [18]. The beam passes through pairs of scanning coils or pairs of deflector plates in the electron column, typically in the final lens [18]. The electrons beam has energy of typically 0.1-30 keV with a diameter of 0.5 nm to 1µ [21]. The accelerated electrons in carry significant amounts of kinetic energy, and this energy is dissipated as a variety of signals

330

produced by electron-sample interactions when the incident electrons are decelerated in the solid sample [22, 15]. When the primary electron beam interacts with the sample, the electrons lose energy by repeated random scattering [20]. The electron beam is deflected in a magnetic field and performs a scanning movement in a raster pattern to capture the specimen surface [16]. A fine probe of electrons, generating various signals generated by the focused incident electron beam over a surface are collected to create an image [22, 21]. The information is deduced from the behaviour of the beam as it interacts with the sample material [23] . Where an electron beam impinges on a sample, electron scattering and photon- and X-ray-production develops in a volume (the electron interaction volume). Several of these interactions are used for imaging, semi-quantitative analysis and/or quantitation analysis [24]. SEM provides detailed high-resolution images of the sample by rastering a focussed electron beam across the surface and detecting secondary or backscattered electron signal [20]. An Energy Dispersive X-Ray Analyzer (EDX or EDA) provides elemental identification and quantitative compositional information [24, 21]. The electrons in the beam interact with the sample, producing various signals are then used to obtain information about the surface topography and composition [22, 15].

Sample preparation for SEM analysis, depends on the nature of the samples and the data required [25]. During sample preparation process, the sample's size, shape, state, and conductive properties prior to sample preparation are important [26]. The sample must fit into the SEM chamber, leaving room to prevent charge build-up on electrically insulating samples [25]. Some samples need to be coated to make them conductive while metals require no preparation due to their inherent conducticity [26]. However, non-metals need to be coated with a conductive material, carbon or often, a thin layer of gold, metal or alloy which is applied using sputter-coater [26, 27]. The choice of such conductive material depending on the data to be acquired during the analysis [27]. Carbon coating is most desirable if elemental analysis [27].

Experimental procedure
Sample preparation
Marble's Reagent is a metallographic etchant for etching austenitic stainless steels, nickel, and cobalt-based super alloys [28]. The etchant has 50ml H2O, 10g Cuso4 and 50 ml HCl and is used for general etching [29]. Immerse or swab the polished surface few seconds to a minute [28]. The etched sample was observed under a microscope and the micrograph captured. The etchant will darken austenitic grains, attack sigma phases, and show grain flow [28]. The dark areas in the micrograph shows the σ phase, which has is a tetragonal crystal structure, which usually precipitates at a temperature between 600°C and 1000°C [30].

Hardness Testing
Hardness measurements were taken on an Innovest Falcon 507 micro indenter. By observing the alloy under the microscope the microstructure, revealed dark and bright areas in the microstructure and a set of 10 hardness measurements was taken for each phase. Microhardness test HV/0.1, was taken on the sample. A dwell time of 10 seconds was used. The microstructures are shown below in Figure 5 below.

Results and discussion

Hardness testing of dark areas
Micrographs do not apparently present surface defects, except some longitudinal striations along their axis, produced by the manufacturing process. Micrographs of dark phases are shown below in Figure 2 and hardness measurements in Table 2.
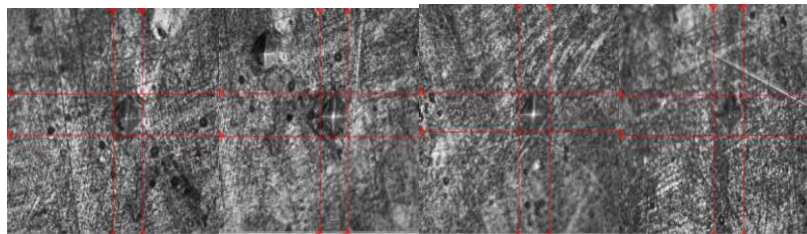

Figure 2. Micrographs showing dark microstructural phases

331

Table 2. Hardness values of ten dark positions

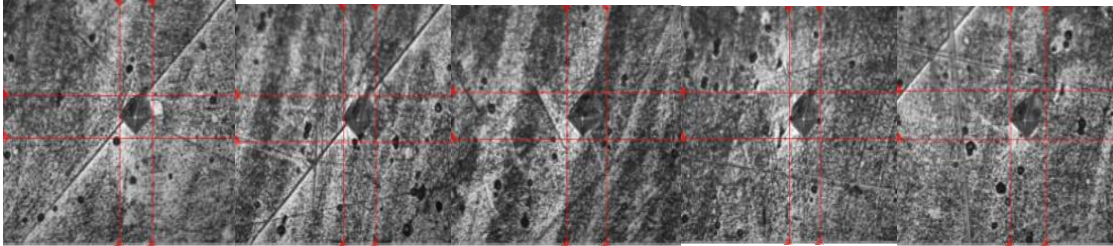| Indent	1	2	3	4	5	6	7	8	9	10
d_1 mm d_2 mm	0.0245 0.0236	0.0235 0.0246	0.0234 0.0259	0.0265 0.0260	0.0244 0.0229	0.0222 0.0250	0.0232 0.0241	0.0215 0.0244	0.0243 0.0252	0.0242 0.0242
HV / 01	320.9	319.8	304.2	269.3	331.4	332.6	330	351.6	304.9	306.5

Hardness test of bright areas

Figure 3. Micrographs showing dark microstructural phases

Table 1. Hardness values of ten bright positions

Indent	1	2	3	4	5	6	7	8	9	10
d_1 mm d_2 mm	0.0203 0.0243	0.0220 0.0255	0.0224 0.0288	0.0234 0.0291	0.0227 0.0259	0.0250 0.0248	0.0252 0.0282	0.0224 0.0233	0.0237 0.0257	0.0293 0.0278
HV / 01	372.3	329.1	282.9	269.1	313.9	300	260.1	355.1	303.6	227.3

Sample Scanning Electron Microscope analysis
The sample was tested using Oxford Instruments X50 series Scanning electron microscope with Electron Diffraction Spectroscopy (EDS) analysis. The polished specimen was mounted on a specimen stage in a vacuum chamber, positioned on the zero position on the stage and then scanned by the electron beam to expose the microstructure and elemental composition. The images were detected using the secondary electron detector. Two images were captured at magnification levels of x80 and X500 are shown below in Figure 4.
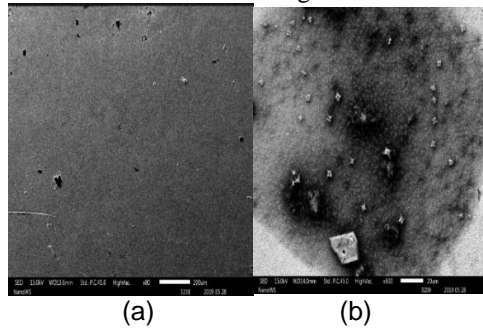
(a)   (b)
Figure 4. SEM sample image a (X 80) and b (X 500)

Specimen SEM micrograph shows that the alloy possess the same polygonal microstructure, similar to the cold-worked AISI 304L condition, with irregular austenite grains and dispersed carbide particles. EDS analysis of the alloy was shown below to establish composition of the bulk alloy and the dark inclusions. Results are shown below in Figure 5.

(a)   (b)   (c)   (e)   (f)   (g)
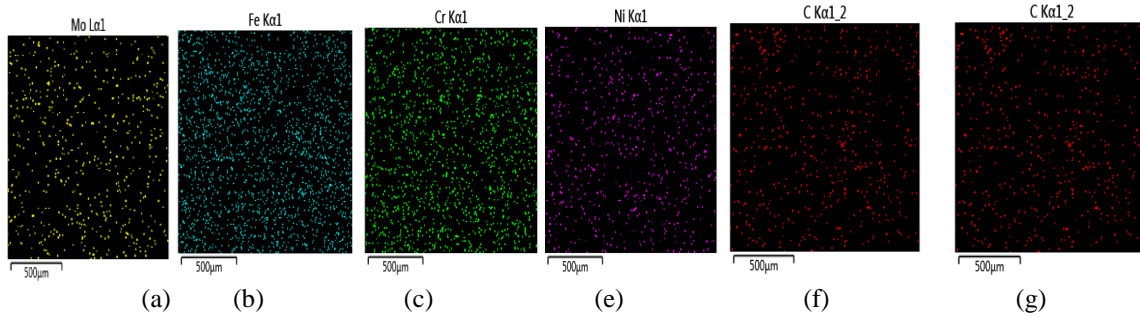
Figure 5. Elemental maps of (a) Mo (c) Iron (e) Cr (f) Ni (g) C

The composition of constituent elements in the bulk sample surface is shown below in Figure below.
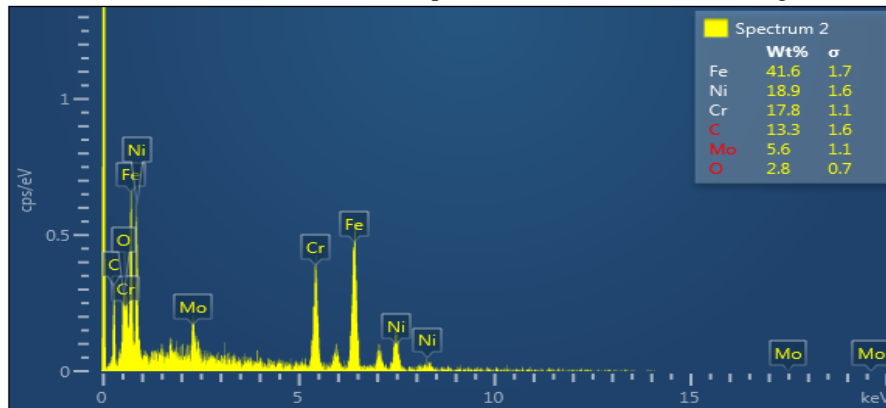
Figure 6 . Composition % by weight in the bulk sample.

Elemental analysis on the inclusions and precipitates
Elemental analysis was done on the inclusions and precipitates in the alloy to discern their composition The sample precipitate and its elemental maps is shown below in the Figure 7.
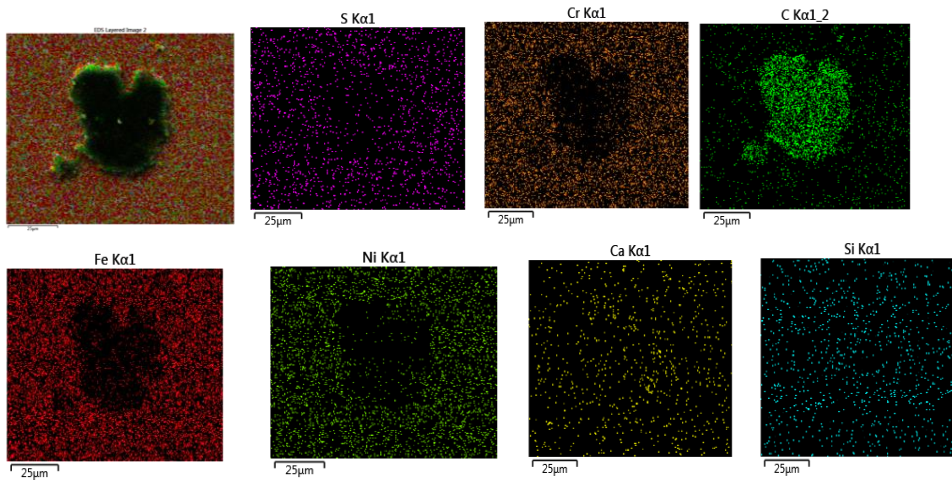
Figure 7. Micrograph of inclusion and elemental map of inclusions in structure showing Cr, C, Ni, Ni, S, Ca and S

Elemental analysis of the precipitate is shown below in Figure 8 showing its composition.

333
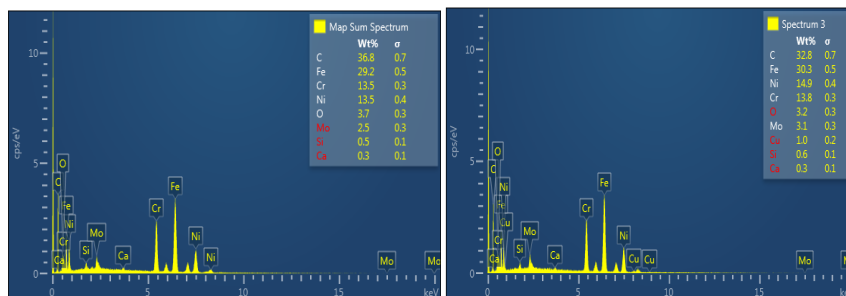
Figure 8. EDS analysis showing composition of elements in two EDS runs

Discussion

The test sample is a Chromium-Nickel austenitic alloy. Its Chromium content is abbot 17.3% while carbon content is about 13%. It does not present itself as a Type 304 stainless steel is a T 300 Series Stainless Steel austenitic. It has a minimum of 18% chromium and 8% nickel, combined with a maximum of 0.08% carbon. The material can be suited for higher temperature applications since they have higher thermal stability. The sample material is an austenitic steel and can operate well up to 800oC after which carbide precipitation occurs. Austenitic stainless steels, particularly AISI 304L, usually have excellent corrosion resistance, good weldability and formability, good resistance to hydrogen embrittlement, in addition to high ductility and toughness. However, they have relatively low yield strength in the annealed state [3]. These results in loss of toughness and make it more susceptible to intergranular corrosion. Once cooled to room temperature for maintenance equipment may suffer loss of room temperature toughness and subsequent embrittlement at room temperature [2]. Possible characteristics of this alloy include good forming and welding properties, corrosion/ oxidation resistance due to the chromium content, deep drawing quality, excellent toughness and ease of cleaning, ease of fabrication, beauty of appearance [31]. It can be applicable in manufacture and fabrication of tanks, appliances, heat exchangers and architectural panelling. However, due to its high carbon content it will require post weld heat treatment to reduce embrittlement, and loss of toughness. Austenitic Stainless steels are sensitised when exposed to elevated temperature range of 470-750°C causes carbide precipitations at grain boundaries [32]. Carbide precipitation can impair resistance to intergranular corrosion and reduces the tensile properties of these stainless steels, specifically strength and toughness [32]. There are various strengthening mechanisms for austenitic stainless steels, such as grain refining, transformation strengthening and work hardening, converting them in materials widely used in engineering applications, such as in the manufacturing, nuclear, chemical, oil and petrochemical, and food industries, as well as the medical industry for biomedical implants [3]. The addition of a strong ferrite stabilizer into the stainless steels (Cr, Si, or Mo) rapidly leads to the formation of the σ phase [33]. This means that the transformation from δ-ferrite to the σ phase can be accelerated when the Cr, Si, or Mo diffuse efficiently in δ-ferrite [30]. The σ phase has a morphology classified in four types; grain boundary precipitation, triple point precipitation, corner precipitation and cellular precipitation [30]. Grain boundary precipitation occurs at the δ/γ phase boundary, which is high in Cr [34]. Triple point precipitation occurs at the incoherent twin boundaries and the intragranular inclusions [35]. Corner precipitation occurs directly in corner δ-ferrite particles because the δ-ferrite is a high Cr content phase [30] while cellular precipitation involves the σ phase and secondary austenite, $(\sigma+\gamma 2)$ precipitate as laminar precipitation in the δ-ferrite particles. [33]. The microstructure also shows austenite and ferrite.

Conclusion

Hardness testing and SEM characterisation can assist in identifying the mechanical prosperities of alloys. Information on the microstructure can help predict mechanical behaviour and elemental analysis can predict chemical and metallurgical stability under chemical reagents and high temperature encountered in service. Before using a material in design, it may be necessary and important to test its properties. This particular sample did not exactly conform to the composition of alloy 304.

References

[1] B. Yirka, "New process allows for stronger, lighter, flexible steel," 2015. [Online]. Available: https://phys.org/news/2015-02-stronger-lighter-flexible steel.html?utm_source=TrendMD&utm_medium=cpc&utm_campaign=Phys.org_TrendMD_1. [Accessed 27 August 2018].

334

[2]   Nickel Development institute, High temperature charectecteristics of stainless steels: A designers' handbook series, No 9004, American iron and Steel Institute, 2000.

[3]   F. J. Baldenebro-Lopez, C. D. Gome-Esperaza, R. Corral-Higuera, S. P. Arredondo-Rea, M. J. Pellegrini-Cervantes, J. E. Ledezma-Sillas, R. Martinez-Sanchez and J. M. Herrera-Ramirez, "Influence of Size on the Microstructure and Mechanical Properties of an AISI 304L Stainless Steel—A Comparison between Bulk and Fibers," *Materials,* vol. 8, pp. 451-461, 2015.

[4]   M. Vaghani, S. A. Vasanwala and A. K. Desai, "Stainless Steel As A Structural Material: State Of Review," *Int. Journal of Engineering Research and Applications,* vol. 4, no. 3, pp. 657-662, 2014.

[5]   G. S. Brady, H. R. Clauser and V. A. J., Materials Handbook, 14th ed ed., New York, NY : McGraw-Hill., 1997.

[6]   https://en.wikipedia.org/wiki/Steel, "Steel," 2018. [Online]. Available: https://en.wikipedia.org/wiki/Steel. [Accessed 4 September 2018].

[7]   ASM Aerospace Specification Metals Inc, "AISI Type 304 Stainless Steel," 2018. [Online]. Available: http://asm.matweb.com/search/SpecificMaterial.asp?bassnum=mq304a. [Accessed 17 August 2018].

[8]   L. P. Karjalainen, T. Taulavuorl, M. Sellman and A. Kyrolainen, "Some Strengthening Methods for Austenitic Stainless Steels," *Materials Technology,* vol. 79, no. 6, pp. 404-412, 2008.

[9]   B. Young, "Experimental and numerical investigation of high strength stainless steel structures",," *Journal of Constructional Steel Research ,* vol. 64, pp. 1225-1230, 2008.

[10] G. Gedge, "Structural uses of stainless steel - buildings and civil engineering," *Journal of Constructional Steel Research,* vol. 64, pp. 1194-1198, 2008.

[11] D. L. Joslinal and W. C. Oliver, "A new method for analyzing data from continuous depth-sensing microindentation tests," *Journal of Material Research,* vol. 5, no. 1, pp. 124-126, 1990.

[12] M. Coughlin, "10 Material Properties Every Mechanical Design Engineer Should Know," 2016. [Online]. Available: https://www.engineeringclicks.com/10-material-properties/. [Accessed 10 June 2019].

[13] Nanomechanics, Inc, "Sample Preparation for Nanoindentation and Scratch testing," 2015. [Online]. Available: http://nanomechanicsinc.com/. [Accessed 22 March 2015].

[14] N. A. Sakharova, J. V. Fernandesa, J. M. Antunesa and M. C. Oliveira, "Comparison between Berkovich, Vickers and conical indentation tests:A three-dimensional numerical simulation study," *International Journal of Solids and Structures,* vol. 46, pp. 1095-1104, 2009.

[15] D. J. Stokes, Principles and Practice of Variable Pressure Environmental Scanning Electron Microscopy (VP-ESEM), Chichester: John Wiley & Sons. ISBN 978-0470758748., 2008.

[16] A. Bogner, P. H. Jouneau, G. Thollet, D. Basset and C. Gauthier, "A history of scanning electron microscopy developments: Towards ''wet-STEM'' imaging," *Micron,* vol. 38, pp. 390-401, 2007.

[17] Electron Microscope, "A biography of Manfred von Ardenne, the inventer of scanning electron microscope," 2012. [Online]. Available: http://www.leo-em.co.uk/a-biography-of-manfred-von-ardenne-the-inventor-of-scanning-electron-microscope.html. [Accessed 12 December 2018].

[18] D. McMullan, "Scanning electron microscopy "1928–1965"," *Scanning,* vol. 17, no. 3, p. 175–185, 2006.

[19] M. von Ardenne, "Das Elektronen-Rastermikroskop. Praktische Ausführung," *Zeitschrift für technische Physik (in German),* vol. 19, p. 407–416, 1938.

[20] G. I. Goldstein, D. E. Newbury, P. Echlin, D. C. Joy, C. Fiori and E. Lifshin, Scanning electron microscopy and x-ray microanalysis, New York: Plenum Press: ISBN 0-306-40768-X. , 1981.

[21] D. E. Newbury, J. R. Michael, N. W. Ritchie, J. Scott, D. C. Joy and J. I. Goldstein , Scanning Electron Microscopy and X-Ray Microanalysis, 4th ed., New York, USA: Springer, 2017.

[22] S. Swapp, "Scanning Electron Microscopy (SEM)," 2018. [Online]. Available: https://serc.carleton.edu/research_education/geochemsheets/techniques/SEM.html. [Accessed 10 November 2018].

[23] T. Kowoll, E. Müller, S. Fritsch-DecKER, S. Hettler, H. Stormer, C. Weiss and D. Gerthsen, "Contrast of Backscattered Electron SEM Images of Nanoparticles on Substrates with Complex Structure," *Scanning,* Vols. 2017, https://doi.org/10.1155/2017/4907457, pp. 1-12, 2017.

[24] D. Henry, "Electron-Sample Interactions," 2016. [Online]. Available: https://serc.carleton.edu/research_education/geochemsheets/electroninteractions.html. [Accessed 7 December 2018].

[25] A. Argast and C. Tennis, "A web resource for the study of alkali feldspars and perthitic textures using light microscopy, scanning electron microscopy and energy dispersive X-ray spectroscopy,," *Journal of Geoscience Education,* vol. 52, no. 3, pp. 213-217, 2004.

[26] S. Sadasivan, "Sample Preparation for Scanning Electron Microscopy," 2017. [Online]. Available: https://bitesizebio.com/34150/sample-preparation-scanning-electron-microscopy/. [Accessed 12 December 2018].

[27] Carleton College: Science Education Resource Centre, "Geochemical Instrumentation and Analysis: Scanning Electron Microscopy - Cathodoluminescence (SEM-CL)," 2018. [Online]. Available: https://serc.carleton.edu/research_education/geochemsheets/semcl.html. [Accessed 12 December 2018].

[28] ES Laboratory, "Marble's Reagent, 250 mL," 2019. [Online]. Available: https://www.etchantstore.com/Marbles-Reagent-250-mL-141.htm. [Accessed 4 July 2019].

[29] B. L. Bramfitt and A. O. Benscoter, "Common etchants for Irons and steels," *Advanced Material and Processes,* pp. https://www.asminternational.org/documents/10192/1756301/amp16006p042.pdf/f805348f-5422-4460-985f-36307cf4bbf7, June 2002.

[30] C.-C. Hsieh and W. Wu, "Overview of Intermetallic Sigma (σ) Phase Precipitation in Stainless Steels," *ISRN Metallurgy,* pp. 1-17. doi:10.5402/2012/732471, 2012.

[31] Lenntech, "Alloy 304," 2019. [Online]. Available: https://www.lenntech.com/stainless-steel-304.htm#ixzz6SH1tPEPV. [Accessed 25 April 2020].

[32] M. Nura, M. S. Dambatta, A. Ahmed and S. Auwal, "Effect of heat treatment temperature on mechanical properties of AISI 304 stainless Steel," *IJIRSET,* vol. 3, pp. 9516-9520, 2014.

[33] C. C. Hsieh, L. D. Lin and T. C. Chang, ""Microstructural evolution during the δ/σ/γ phase transformation of the SUS 309LSi stainless steel after aging under various nitrogen atmospheric ratios," *Materials Science and Engineering A,* vol. 475, no. 1-2, pp. 128-135, 2008.

[34] Y. S. Sato, H. Kokawa, K. Okamoto , S. Hirano and M. Inagaki, "Rapid formation of the sigma phase in 304 stainless steel during friction stir welding," *Scripta Materialia,* vol. 49, no. 12, p. 1175–1180, 1999.

[35] J. Barcik, "The kinetics of σ-phase precipitation in AISI 310 and AISI 316 steels," *Metallurgical Transactions,* vol. 14, no. 4, p. 635–641, 1983.

[36] Sandmeyer Steel Company, "Specification Sheet: Alloy 304/304L," 2019. [Online]. Available: https://www.sandmeyersteel.com/images/Alloy304-304L-APR2013.pdf. [Accessed 18 July 2019].

[37] J. Goodge, "Energy-Dispersive X-Ray Spectroscopy (EDS)," 2017. [Online]. Available: https://serc.carleton.edu/research_education/geochemsheets/eds.html. [Accessed 7 December 2018].

[38] K. F. J. Heinrich, "Electron probe microanalysis by specimen current measurement. In Castaing R, Deschamps P, Phillibet (eds), Proceedings 4th conference on X-ray optics and microanalysis," Paris, 1966.

[39] Wikipedia, "Scanning electron microscope," 2018. [Online]. Available: https://en.wikipedia.org/wiki/Scanning_electron_microscope. [Accessed 10 December 2018].

[40] S. J. Boggs and D. Krinsley, Application of Cathodoluminescence Imaging to the Study of Sedimentary Rocks, New York: Cambridge University Press, 2006.

[41] Avomeen, "SEM EDS Microscopy Analysis," 2018. [Online]. Available: https://www.avomeen.com/knowledge/methods/microscopy/. [Accessed 12 December 2018].

[42] EMCO, "VS 3004 hardness testing overview: Hardness Testing on metallic materials: Vickers EN ISO 6507," 2019. [Online]. Available: https://www. emcotest.com/index.php?. [Accessed 2019 June 2019].

[43] A. Bogner, P. H. Jouneau, G. Thollet, D. Basset and C. Gauthier, "A history of scanning electron microscopy developments: towards wet-STEM imaging," *Micron,* vol. 38, pp. 390-401, 2007.

Control Strategy for Back-To-Back VSC of DFIG in the Wind Power Generation for Smart Microgrids

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Abstract: This research paper proposes a control scheme for three-phase back-to-back (ac-dc-ac) Voltage Source Converter (VSC) of Doubly Fed Induction Generator (DFIG) in a wind power generation system for smart microgrids. This control strategy is developed to control the three-phase back-to-back (ac-dc-ac) converter of the DFIG, for providing desired output power as well as rated voltage, under the stand-alone as well as grid connected modes. The suggested control scheme has been implemented in the rotating *d-q* synchronous reference frame. The performance analysis of the wind power generation system with proposed control strategy have been tested in the MATLAB/Simulink environment.

Keywords: Smart Microgrid, Wind Power Generation, Three-Phase Back-to-Back Converter, Doubly Fed Induction Generator, and Power Quality.

Introduction

The electrical energy has been primarily generated using the conventional fossil fuels resources and nuclear power plants, which are limited resources. But the safety hazards have been attributed to generate the electrical power from nuclear and fossil fuels based power plants. The electricity demand is also continuously increasing. Due to having all these issues such as environmental aspects, global warming, continuous energy demand growth, and limited earth fuel resources, etc. it is a need to move towards green energy sources. Therefore, during last few years, the green energy sources i.e. renewable energy sources as well as non-renewable energy sources have been deployed and have witnessed for fast development. The small-hydro, biomass and biogas, solar, wind, microturbine, tidal, fuel cells, gas-turbine, geothermal, etc. are belonging to the green energy sources [1]-[4], with the range of 1kW to 10 MW. Among the several renewable power sources, the wind energy is a most promising option for future energy demand.

Due to uncertainty and intermittent nature of renewable resources, the direct connection of several renewable Distributed Generations (DGs) to the main grid would cause several issues like as stability and protection issues, more stress on electrical network, voltage and frequency variations, power quality, and reliability, etc. Because of all these issues and limited transmission capacity, the microgrid, which can be dc or ac, is a most promising solution for integration of various renewable as well as non-renewable DGs [1], [2]. Nowadays, wind power generation and solar photovoltaic systems are the main DGs components of smart microgrid.

Nowadays, the wind power generation system consisting of Double Fed Induction Generator (DFIG) is a most preferable system for variable speeds wind power generation because of their several advantages offered by them such as; 1) back-to-back Voltage Source Converter (VSC) controls reactive and active power, separately, 2) less back-to-back VSC cost because of its ratings is 25-30% of DFIG rated power, 3) better controllability, 4) improved power quality, 5) higher efficiency, and 6) reduced mechanical stresses [5]-[9].

In this research paper, a WPG system with the DFIG is considered. A control technique of three-phase back-to-back VSC of DFIG in the WPG system has been developed, under the stand-alone as well as grid connected modes. The proposed control strategy has been suggested into rotating *d-q* Synchronous Reference Frame (SRF), using the feed-for-ward and feed-back loop signals. The simulation tests for the developed control scheme are conducted in the MATLAB/Simulink environment.

Wind Power Generation System with DFIG for Smart Microgrids

An architecture of a WPG system with the DFIG consisting of back-to-back VSC is represented in Fig. 1. The back-to-back (ac-dc-ac) VSC is consisting two main converters; 1) Rotor Side Converter (RSC) and 2) Customer Side Converter (CSC) or Stator Side Converter (SSC) or Grid Side Converter (GSC). The RSC has been used for controlling the stator flux, maximum power point tracking, and providing the reactive power to the generator of the WPG system by rotor circuit. The CSC has been aimed for maintaining the real output power of the WPG system, and establishing almost constant dc link voltage of three-phase back-to-back VSC. The WPG system with DFIG can work in stand-alone as well as grid-connected mode. This WPG system with the DFIG is being widely used for smart microgrids (both ac and dc). The WPG system generates ac power supply. Therefore, in case of ac microgrid, the WPG system is integrated to the ac microgrid directly or through the transformer, as represented in Fig. 2(a). However, in case of dc microgrid, the WPG is

337

interconnected to the dc microgrid by using the three-phase voltage source rectifier, as represented in Fig. 2(b). In the ac microgrid, as represented in Fig. 2(a), ac generation based DGs are integrated to the ac microgrid through transformers, while dc generation based DGs are integrated to the ac microgrid by using the three-phase voltage source inverter. The Energy Storage System (ESS) has been interconnected to the ac microgrid by using three-phase bidirectional VSC, and dc loads have been interconnected to the ac microgrid by using the rectifiers. In the dc microgrid, as represented in Fig. 2(b), ac generation based DGs are interconnected to the dc microgrid by using the three-phase voltage source rectifiers, while dc generation based DGs have been interconnected to the dc microgrid by using the dc-dc boost converters. The ESS is interconnected to the dc microgrid through the bidirectional dc-dc converters. The ac and dc loads are integrated through the voltage source inverters and the dc-dc buck converters, respectively.
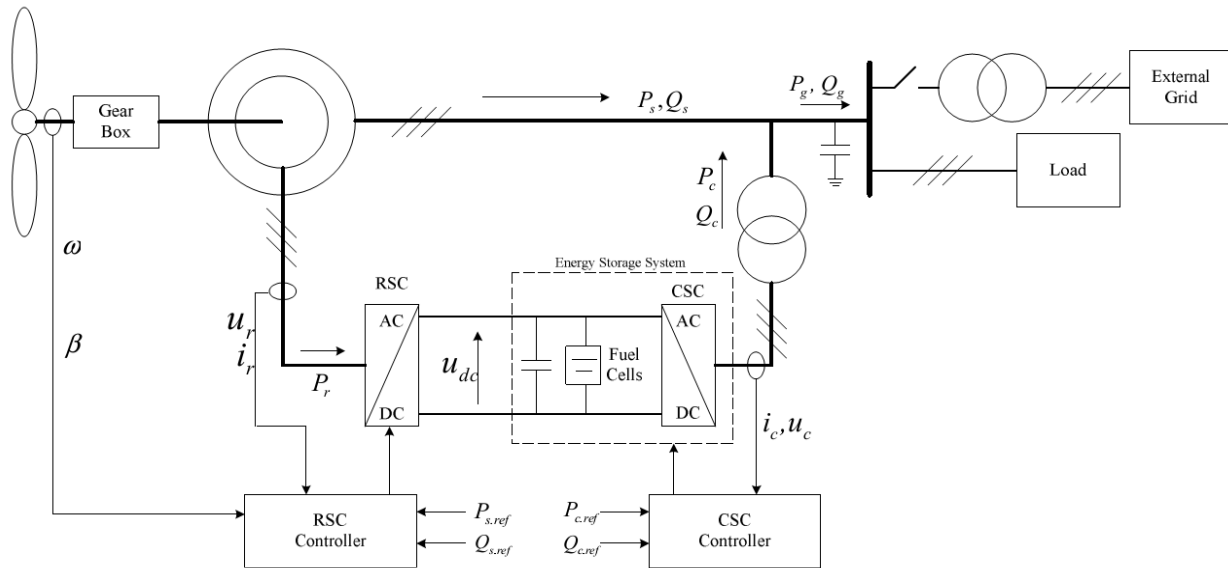
Figure. 1. Architecture of a wind power genration system with the DFIG consisting of back-to-back VSC.
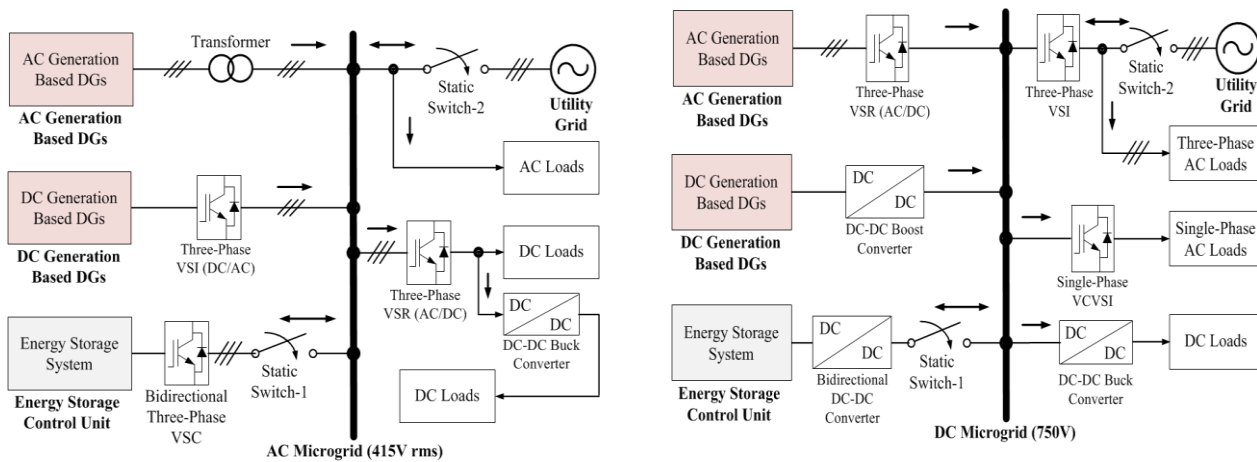
Figure 2 (a). Smart ac microgrid for interconnection of several DGs.   **Figure 2** (b). Smart dc microgrid for interconnection of   several DGs.

Modelling of Wind System with DFIG

The kinetic energy of the wind can be converted into the electrical energy by using the WPG system. The mechanical power (P_m) drawn from the wind can be expressed [1]. [4], [6], [7], [11], by equation (1).

$$P_m = 0.5C(\lambda,\theta)\rho_{air}A_b v_{wind}^3 \quad (1)$$

where, ρ_{air} is air density, A_b is swept area of rotor blades, v_{wind} is wind speed, and C is aerodynamic efficiency of the WPG system which is depending on tip-speed ratio λ ($= \omega_t *R_b /v_{wind}$) and pitch angle θ, ω_t is electrical speed which

depends on mechanical speed.

The output power generated by the WPG system is given as;

$$P_{WPG} = P\left(\frac{v_{wind} - v_{wind,cut\text{-}in}}{v_{wind,rated} - v_{wind,cut\text{-}in}}\right) \quad ; v_{wind,rated} > v_{wind} > v_{wind,cut\text{-}in} \quad (2)$$

$$\left.\begin{array}{ll} P_{WPG} = P & ; v_{wind,cut\text{-}off} \geq v_{wind} \geq v_{wind,rated} \\ P_{WPG} = 0 & ; v_{wind,cut\text{-}off} < v_{wind} \ \& \ v_{wind,cut\text{-}in} \geq v_{wind} \end{array}\right\} \quad (3)$$

where, P_{WPG} is the output power of WPG, P is rated capacity of the WPG, $v_{wind,cut\text{-}off}$ is cut-off wind speed, and $v_{wind,cut\text{-}in}$ is the cut-in wind speed.

The mathematical equations of the DFIG for both rotor and stator voltages can be given in *d-q* SRF [1], [6], [11] as;

$$\left.\begin{array}{ll} u_{s,d} = \dfrac{d\varphi_{s,d}}{dt} - \omega_s\varphi_{s,q} - r_s i_{s,d} & \& \quad u_{s,q} = \dfrac{d\varphi_{s,q}}{dt} + \omega_s\varphi_{s,d} - r_s i_{s,q} \\[3mm] u_{r,d} = \dfrac{d\varphi_{r,d}}{dt} - (\omega_s - \omega_r)\varphi_{r,q} - r_r i_{r,d} & \& \quad u_{r,q} = +\dfrac{d\varphi_{r,q}}{dt} + (\omega_s - \omega_r)\varphi_{r,d} - r_r i_{r,q} \end{array}\right\} \quad (4)$$

where, $u_{r,d}$ and $u_{r,q}$ are d & q- components of rotor voltage, $u_{s,d}$ and $u_{s,q}$ are d & q- components of stator voltage, $i_{r,d}$ and $i_{r,q}$ are d & q- components of rotor current, $i_{s,d}$ and $i_{s,q}$ are d & q- components of stator current, $\varphi_{r,d}$ and $\varphi_{r,q}$ are d & q components of rotor flux linkages, respectively, $\varphi_{s,d}$ and $\varphi_{s,q}$ are d & q components of stator flux linkages, respectively, ω_r and ω_s are electrical frequencies of rotor and stator, respectively, r_r and r_s are the resistance of rotor windings and stator windings, respectively.

Control Strategy for Three-Phase Back-to-Back VSC of DFIG in WPG System

A control strategy of 3-phase back-to-back (ac-dc-ac) VSC of DFIG in the WPG system for both stand-alone and grid-connected mode, is suggested, as represented in Fig. 3. In this control strategy, the RSC and CSC/SSC are controlled by separate controllers independently, without interfering to each other. Thus, the controlling of RSC does not depend on the CSC/SSC controllers or vice-verse. The proposed control technique is implemented in to d-q SRF, using the feed-forward and feed-back loop signals. Initially, the three-phase currents and voltages of both sides converters are to be measured, and then voltages/currents have been changed from 3-phase (abc) reference frame in to 2-phase (α-β) reference frame. After this, currents/voltages have been changed from 2-phase (α-β) reference frame in to 2-phase rotating d-q synchronous reference frames. Then, the d-q voltage components are controlled using the controllers, which will provide the reference signals for current controllers. By using these reference currents signals, the d-q current components have been controlled using the controllers. These controllers provide the controlled reference signals for pulse width modulation generation, which provide controlled gate signals for generating required output power and voltage. The WPG system comprising the DFIG along with the developed controlled strategy is being widely used for the smart microgrids.

The objectives the CSC/SSC are to maintain rated frequency, rated voltage, reduce harmonics, and retain the stator currents. However, the RSC is aimed to track maximum power point, control the stator flux, eliminate its inherent poorly damped oscillations, and operate WPG system at unity power factor.

Simulation Results

The performance analysis of the WPG system comprising the DFIG, along with the suggested controllers, has been conducted in the MATLAB/Simulink environment, for presenting its robustness. The ratings of the WPG system consisting the DFIG, considered for simulation purpose are shown in Table-1.

In this simulation analysis, the intermittent nature of wind (i.e. variable wind speed) has been considered for output power generation through the WPG system using the DFIG. The variable wind speeds are as 11.2, 2.4, 14, 1.1, 4.5, 16.3, 13, 5.7, 10.5, 10, 16.6, 14, and 9.5 m/s, as represented in Fig. 4. The cut in wind speed, rated wind speed, and cut-off wind speed for the WPG system are considered as 4 m/s, 12 m/s, and 25 m/s, respectively. The output power generations by the WPG system with the variation of wind speeds (as per Fig. 4) are available as 540kW, 0, 600kW, 0, 36kW, 600kW, 128kW, 490kW, 454kW, 600kW, and 414kW, respectively, as shown in third curve of Fig. 5. The variation of output power generation with variable wind speeds is as per equations (2) and (3). With this the proposed control strategy, the output power generation is maintained constant even during variable wind speed. Three-phase
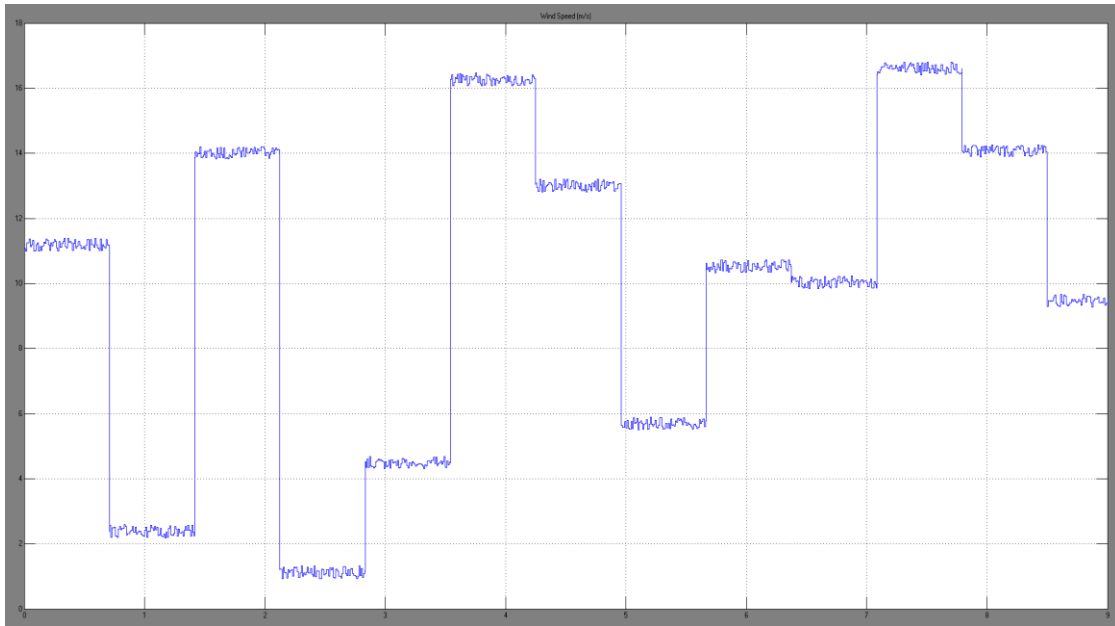
output voltage of the WPG system has also been established constant at its rated value during the whole operation, as represented in first curve of Fig. 5. The stator output current has also been maintained with the wind speed variations, as represented in second curve of Fig. 5. The fourth curve of Fig. 5 is showing that the reactive power has been managed independent and maintained constant during the whole operation of WPG. The voltage of dc link of the back-to-back (ac-dc-ac) VSC of the DFIG is also established constant at its rated value (1200V DC), during the whole operation, as shown in last curve of Fig. 5.

Thus, it has been observed that the simulation results are providing the satisfactory and desired output of the WPG system comprising DFIG using the suggested controllers.

Figure 3. Proposed control technique of three-phase back-to-back (ac-dc-ac) VSC of DFIG in the WPG system.

Conclusion

A WPG system along with the DFIG consisting of three-phase back-to-back (ac-dc-ac) VSC is suggested for smart microgrids (both dc and ac), because of their several advantages offered by the DFIG. A control strategy of three-phase back-to-back (ac-dc-ac) VSC of the DFIG for WPG system has also been developed under stand-alone and grid connected mode. The presented control strategy is suggested into rotating d-q SRF, using feed-forward and feed-back loop signals. The developed control strategy has been maintained desired output power, constant rated output voltage, tracking of maximum power at all time, and constant dc link voltage, even during intermittent nature of wind speed. Thus, the simulation results are providing the satisfactory performance of the WPG system consisting DFIG, along with the developed control strategy, under the variable wind speeds.

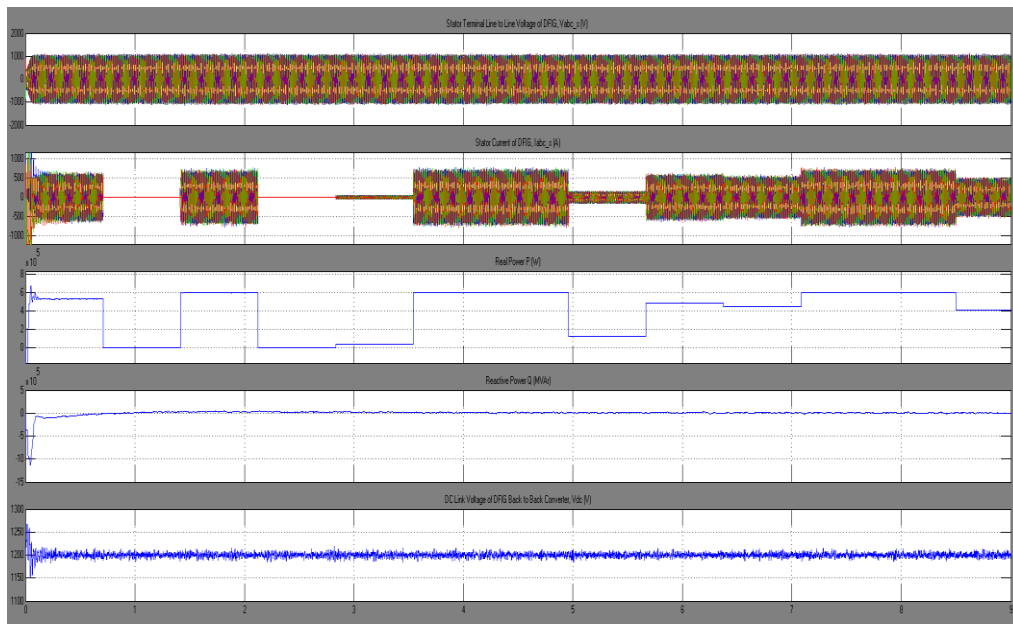**Figure 4**. Available variable wind speed for wind power generation

Figure 5. Stator output 3-phase voltage of DFIG, 3-phase output current of DFIG, output power generation as per with variable wind speed, reactive power, and dc voltage of dc link of the back-to-back VSC of the DFIG in the WPG system.

341

Table 1. Parameters of Wind Power Generation System [4].

Parameters of WPG System	Values
Wind Turbine:	
Rated power capacity, P (kW)	600
Rotor diameter, D_b (m)	52
Swept area, A (m^2)	2124
DFIG:	
Rated output power, P_{rated} (kVA)	660
Rated voltage (line to line), V_{rated} (V)	690
Nominal frequency, f_n (Hz)	50
Number of poles, p	4
Stator to rotor turns ratio, n	0.3806
Stator resistance/phase, r_s (pu)	0.0093
Stator leakage reactance/phase, X_{ls} (pu)	0.0416
Rotor resistance/phase, r_r (pu)	0.0553
Rotor leakage reactance/phase, X_{lr} (pu)	0.484
Mutual reactance, X_m (pu)	3.21

References

[1] Kumar, M., Singh, S. N., & Srivastava, S. C. (2012, July). Design and control of smart DC microgrid for integration of renewable energy sources. *In Proc. IEEE Power Energy Soc. Gen. Meeting*, San Diego, CA, USA, (pp. 1–7).

[2] Kumar, M., Singh, S. N., & Srivastava, S. C. (2015). Control strategies of a dc microgrid for grid connected and islanded operations. *IEEE Trans. Smart Grid*, *6(4)*, 1588 – 1601.

[3] Jha, R.R., Srivastava, S.C., and Kumar, M. (2017). Development of control schemes for a cluster of PV-integrated houses in islanded mode. *IET Renew. Power Gener.*, *11(7)*, 903 – 911.

[4] Kumar, M., Singh, S. N., Srivastava, S. C., & Ramamoorty, M. (2015). Development of a control strategy for interconnection of islanded direct current microgrids. *IET Renew. Power Gener., 9(3)*, 284 – 296.

[5] Xiang, D., Ran, Li , Jim, R., Bumby, Tavner, P. J., & Yang, S. (2006). Coordinated control of an HVDC link and doubly fed induction generators in a large offshore wind farm," *IEEE Trans. Power Del., 21(1)*, 463 – 471.

[6] Vieira, J.P.A., Nunes, M.V.A., Bezerra, U.H., & Nascimento, A.C. D. (2009). Designing optimal controllers for doubly fed induction generators using a genetic algorithm. *IET Gener., Trans. & Distri.*, *3(5)*, 472 – 484.

[7] Babu, B.C., & Mohanty, K.B. (2010). Doubly-fed induction generator for variable speed wind energy conversion systems-modeling & simulation. *International Journal of Computer and Electrical Engineering*, *2(1)*, 141 – 147.

[8] Koa, H. S., Yoon, G. G., Kyung, N. H., & Hong, W. P. (2008). Modeling and control of DFIG-based variable-speed wind-turbine. *Journal of Electric Power Systems Research (Elsevier Journal), 78(1)*, 1841–1849.

[9] Bhuiyan, F. A., & Yazdani, A. (2009). Multimode control of a DFIG-based wind-power unit for remote applications. *IEEE Trans. Power Del., 24(4)*, 2079 – 2089.

[10] Goel, P. K., Singh, B., Murthy, S.S., & Kishore, N. (2010, Dec). Modeling and control of autonomous wind nergy conversion system with doubly fed induction generator. *In Proc. IEEE Inter. Conf. on Power Electronics, Drives and Energy Systems*, New Delhi, India, (pp. 1-8).

[11] Rashed, M., Ghanem, A.E,. Sayes, A.E., & Mansy, III. (2009). Control strategy for an isolated dfig based micro-grid with integrated super- capacitors. *The Online Journal on Electronics and Electrical Engineering (OJEEE), 1(2)*, 81 – 88.

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343

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