GIT-Journal of Engineering and Technology

About Gandhinagar Institute of Technology

Gandhinagar Institute of Technology was established by Platinum Foundation Trust in December 2006. The Institute is affiliated to Gujarat Technological University and approved by AICTE New Delhi. It is situated near Village "Moti Bhoyan" and 24 km away from Ahmedabad city.

The Trust is registered under Public Trust Act at Ahmedabad, Gujarat. The members of the trust are involved in the social activities and are also promoting the technical interest of the state and country by contributing to the technical institution development.

The vision of the institute is to develop young engineers with active and creative minds. It stresses total development of the students: spiritual, moral, intellectual, social, emotional and physical. The Institute aims to be a leading centre for research and engineering study, pursuing knowledge in both fundamental and applied area, and collaborating closely with business and industry in promoting technological innovation and economic development. The institute has team of dynamic and dedicated professors, working hard for overall development of students, so that they get ready for any kind of challenges in their life.

It offers U.G Program in Mechanical Engineering, Computer Engineering, Information Technology, Electronics & Communication Engineering, Electrical Engineering and Civil Engineering. It also offers P.G in Mechanical Engineering with specialization in Thermal Engineering and CAD / CAM and P.G in Software Engineering in Computer Engineering. It also offers MBA Program with specialization in Marketing, Finance, Human Resource, and Information Systems. Gandhinagar Institute of Technology is trying to nurture the intellectual growth of its students and serve humanity through creation, application and dissemination of knowledge relevant to technology and become one of the premier Engineering and Management Institutes and achieve the highest order of excellence in teaching.

Our students are innovative and have excellent acceptability to latest trends and technologies of present time. Our students have also participated in various technical activities as well as sports activities and have achieved various prices at State level and National level. GIT campus is always a buzz with a plethora of activities and has become a dynamic venue where brilliant minds converge and share their vast reserves of knowledge and skills.

We have two annual publications, a National level research journal "GIT-Journal of Engineering and Technology (ISSN 2249–6157)" and "GIT-A Song of Technocrat" (college Annual magazine) and one quarterly publication "GIT-Newsletter". This enhances the documentation culture of the institute. This would definitely create an impact in the minds of readers, by way of providing larger visibility and dimension to the campus. Gandhinagar Institute of Technology proudly celebrated its fifteen years of excellence in Education, but more importantly, taking time to reflect on the past, learn in the moment, and plan for what comes next.

Message from the Director

"The whole of science is nothing more than a refinement of everyday thinking." – Albert Einstein

Gandhinagar Institute of Technology started its journey in 2006. The institute started with a vision to develop young engineers with active and creative minds, a sense of understanding and sympathy for others and the courage to act on their beliefs and to treat every student as an individual, to recognize his / her potential and to ensure that he/she receives the best preparation to help one meets his /her career ambitions and goals. GIT is proud to have dynamic and dedicated professors, State of art Laboratory, Wi-Fi enabled campus, Seminar halls, Cafeteria, Open Air Theatre, Amphi Theatre and Centrally air conditioned 3 star rated Resource Centre of Indian Institutes of Technology, Bombay. GIT has a huge lush green campus. A rich library, a tasty canteen, an active sports ground, a soothing Amphi theatre and a spacious open-air theatre makes our institute more vibrant and unique.

The Institute aims to provide a better platform for academic teaching, expert lectures, seminars, interactive sessions, combining all to give the best learning environment. It also provides the students to showcase their involvement outside the classroom by indulging them into various social activities and connects them culturally, socially as well as mentally with the system. The institute with all its glorious achievements and scholastic pursuits created an ideal position for itself in Gujarat. It provides quality education in a highly disciplined environment along with the character building of the students. It gives better opportunities to the students to excel themselves towards the betterment of the society. GIT not only gives exposure to academics but also gives importance to overall development of the students and has inserted interpersonal, leadership as well as managerial skills in our students.

It gives me immense pleasure that the Fourteenth Regular and Special Edition of our National Journal "GIT-Journal of Engineering and Technology" are being published with ISSN 2249 – 6157 for the fourteenth successive year. The annual journal contains peer reviewed technical research papers submitted by the researchers from all domains of engineering and technology. An enormous amount of work has gone into the development of this journal and I believe you will see that effort reflected in this edition and in the impact it will have on the field. I take this opportunity to thank the esteemed members of Editorial board and Reviewers for being a part of our family. I am sure, with their advice and support; the journal will

achieve new milestones in future also. As you examine the board's makeup you will see a remarkable breadth of disciplines, experiences, and backgrounds. Without the guidance, support, and feedback of the board, it would have been impossible to offer the selections you will find in these volumes. We received manuscripts for the regular edition from IIT Palakkad Kerala, Dr.Thakorbhai Patel Girls Commerce College Baroda, Shree Govind Guru University Godhra etc. We congratulate and thank all the research scholars for their contribution. I firmly believe that this current issue Volume-14 will turn out to be Reader's delight. GIT-Journal of Engineering and Technology is **Google Scholar Indexed** and we are also in process of indexing like DOAJ, ResearchGate etc.

We are also happy to share that we have come up with a special edition in the form of post publication of "International Conference on Recent Progress in Material Science and Mechanical Engineering" held at Metallurgical Department, Government Engineering College, Patan and sponsored by GUJCOST. The publication highlights some of the latest developments in the areas of material science and other related areas. I feel privileged to make this publication a part of our successive edition. I am thankful to Dr S.P. Dave, Dr H.S. Patel, Dr I.B. Dave, Dr H.N. Panchal and the organizing team to select GIT-JET as a post publication of research performed by the researchers. I also thank all the contributors for their contribution in this special edition.

We are happy to welcome the researcher to contribute in this open access peer reviewed engineering and management journal for the betterment of the society. As the publication gives a broader way of development to academicians and researcher, we wish to have more collaboration with reputed institute and industries and research organisations across the world.

GIT has been moving towards a huge growth of achivements and progress throughout the span of 15 years and still the journey is continued. In 2020-21, the idea came up with the establishment of **"State Private University".** Expansion of horizons was the necessity of the present era and looking into the same and the need of the hour, it came up with a new version to embody the spirit of excellence in teaching, research, innovation and creative activities and thus, the institute is in the transformation phase of **"Gandhinagar Univesity".**

I am very much thankful to team GIT JET Coordinator for giving proper form to JET Regular and Special Edition. I congratulate the JET committee who have worked determinedly to conceptualize and compile this publication.

In the end, I give my hearty thanks to the backbone of the institute, our trustees and congratulate all the faculty members, students and parents for their kind support throughout these 15 years and wish to pray that our institution will reach the peak of success, recognition, and glory in near future.

Happy Reading!!!

Dr H N Shah
Chief Editor- GIT JET
Director - GIT

Editorial Board

Coordinator & Co-Coordinator of Journal of Engineering & Technology

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Parasitic Striplines for Mutual Coupling Reduction between Dual Polarized Phased Array Antenna Elements

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Abstract

In this paper, a simulation-based method has been used to demonstrate reduction in mutual coupling between phased array elements of a dual-polarization phased array antenna. The antenna element used in this phased array has been designed as dual layer antenna to operate at 2.8 GHz and has been simulated in high-frequency structure simulator (HFSS). The two layers have two microstrip square patches and the top patch acts as a parasitic microstrip antenna. The mutual coupling reduction is achieved by two microstrip lines printed on a substrate over the antenna elements. For the design analysis of mutual coupling and its reduction two of the antenna elements are placed adjacent to each other. The simulated results indicate that the mutual coupling is suppressed by 4-6 dB without affecting the cross-polarization levels.

Keywords: Mutual Coupling reduction; Dual-polarized antenna;

Nomenclature

EBG   Electromagnetic Band Gap
DGS   Defected Ground Structures

λ Wavelength of operating frequency
ϕ Azimuth angle
θ Elevation angle

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1.   Introduction

Dual polarization phased array radars operating in S-band are widely used in retrieving weather information accurately. However, these radars are constrained in the scan angle range. This limit is because of the scan blindness at wide scan angles from broadside direction [1]. The scan blindness is affected by mutual coupling between antenna which is characterized by scattering parameter between various ports. This in turn is related to active reflection coefficient of mth element, (Γ_m) that is a function of scan angle and mutual coupling between elements as in equation (1)

$$\Gamma_m(\theta_0) = \sum_{n=1}^{N} S_{mn}e^{-j(n-m)u} \tag{1}$$

Where S_{mn} is the scattering parameter between m and n ports (represents coupling), $u = kd\ sin\ sin\ \Box$, d is the inter-element spacing. This results in degradation of performance including impedance mismatch, limited scan range, scan angle misalignment, etc. Mutual coupling is because of surface waves, near field and space wave coupling between elements of an antenna array. Depending on various factors, one of these causes of coupling will dominate the others. These factors include but are not limited to, ground plane size, thickness and type of substrate material and the types of modes excited by the patch antenna and the grounded dielectric slab [2]. If a very thick dielectric slab with high permittivity has the antenna printed on it, the main cause of coupling becomes surface waves when substrate thickness, h/λ_0 satisfies equation (2)

$$\frac{h}{\lambda_0} \geq \frac{3}{2\pi\sqrt{\varepsilon_r}}, \tag{2}$$

where h is the thickness of substrate, λ_0 is the wavelength and ε_r is the relative permittivity [3]. These waves propagate through the grounded dielectric slab and once reaching the edge of the slab they diffract. When an antenna is placed in the near field of another antenna near field coupling becomes the major cause. This effect is particularly dominant when a substrate of very low permittivity is used to print the antenna on. The radiation characteristics of the antenna can be severely degraded under such

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conditions. In very thin grounded substrates although the surface wave phenomenon is only weakly excited, space wave coupling can dominate especially when antennas are in close proximity. Space wave coupling has a dominant electric field component that is normal to the grounded slab.

Many solutions have been proposed to reduce mutual coupling between antenna elements that are fed by coaxial cables at microwave frequencies. These include electromagnetic band gap structures (EBG) which acts as band gap for the surface wave propagation [4] [5]. EBG structures are difficult to implement and make the antennas very expensive and are not cost effective. In addition, defected ground structures (DGS) that are special structures in the ground plane which help in reducing mutual coupling between elements [6] [7]. On the other hand, DGS structures tend to impact cross-polarization level (which is unacceptable) in dual-polarization antennas that are aperture fed antennas. Different metamaterial structures are being proposed to obtain reduction in mutual coupling. These metamaterial structures are complicated to implement and are difficult to characterize. As a result of the above-mentioned limitations aperture fed dual polarization antenna mutual coupling reduction has not been studied in detail. This paper explores the reduction in mutual coupling between antenna elements that are impacted by surface wave coupling by using parasitic microstrips. These microstrips are placed on top of the substrate above the antenna element and the position of the parasitic element with respect to the antenna element is optimized to reduce mutual coupling, achieve the required reflection coefficient and not impact the cross-polarization between dual-polarizations. Section 2 describes the proposed antenna structure in detail with the details of the proposed structure to reduce mutual coupling. Section 3 has the simulation results comparing mutual coupling in antenna arrays with and without micro-striplines. Conclusions are discussed in Section 4.

2.   Proposed Antenna Structure

2.1   Design of a single element

A dual polarized antenna is designed and simulated that operates in the frequency range of 2.66 to 3.1 GHz and uses aperture coupled feeding technique. This antenna has 3 substrates of which two have radiating square patches (top patch length = 28.5 mm and bottom patch length = 25.5 mm) with their substrates (dielectric constant = 2.55) stacked one over another as shown in Figure 1(a). There is a ground plane beneath the middle substrate with two dumbbell shaped slots. The slots correspond to horizontal and vertical polarizations are arranged perpendicular to each other to ensure required isolation between them. Below this, there is the feed substrate (dielectric constant=4.1) with microstrip feedlines at the bottom as in Figure 1(b).
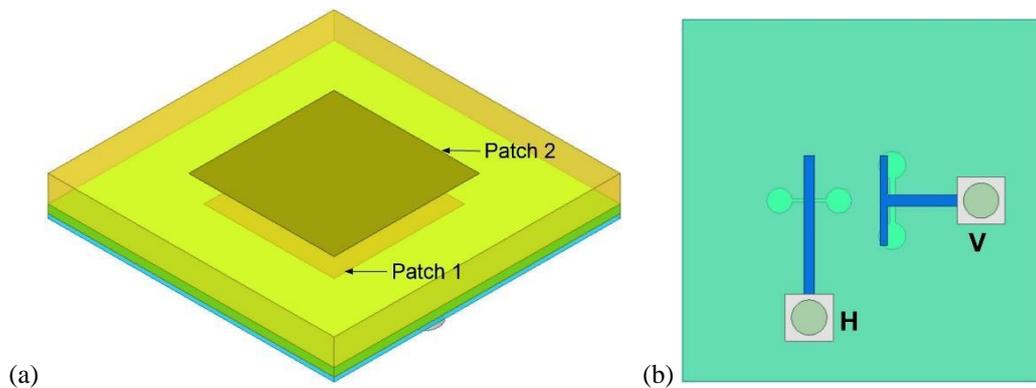
Fig. 1. Antenna Structure for (a) Isometric view and (b) Bottom view.

The two layer antenna element achieves bandwidth of 400 MHz. The dumbbell shaped aperture coupled feeding technique is used here to obtain lower cross-polarization level [8] [9] [10]. The S-parameter plot of the single element is shown in Figure 2 showing that the reflection coefficients, S(HH) and S(VV), for both the ports are below -14 dB in the required frequency range. Isolation between two ports, S(HV), is below -48 dB in the desired frequency range. Radiation patterns for the two polarizations of the single antenna element is shown in Figure 3. Cross-polarization level at broad side direction is 53 dB and 50 dB below main lobe for H and V polarizations, respectively.

	H-Pol	V-Pol
Gain	4.67 dB	4.68 dB
Cross-Pol level at θ=0º	53.80 dB	50.44 dB
Bandwidth	2.66 to 3.08 GHz	

Table. 1. Specifications of the antenna element.
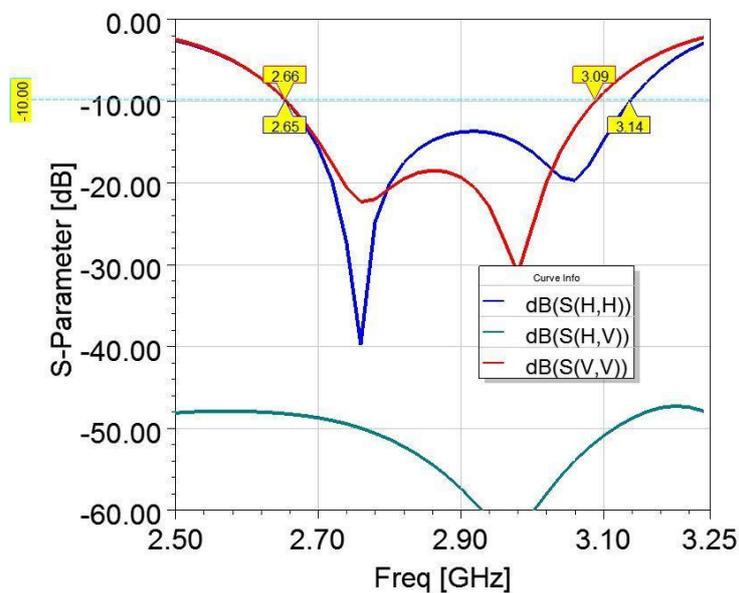
Fig. 2. S-Parameter plot for single antenna
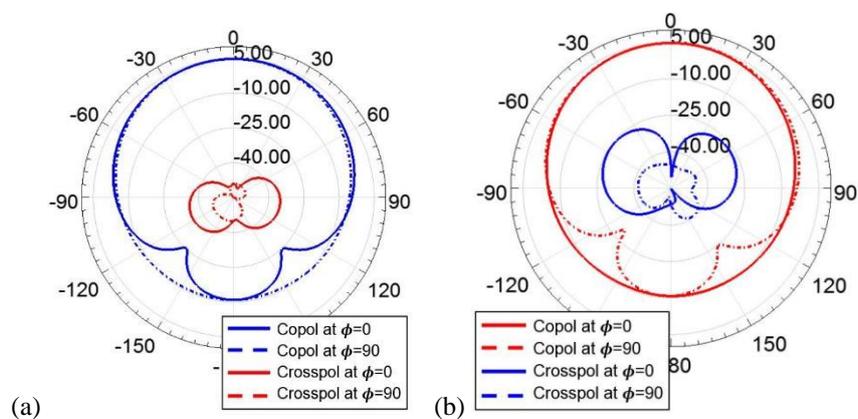
Fig. 3. Radiation Pattern for (a) H-Polarization and (b) V-Polarization.

A 1X2 array of the elements is designed with an inter-element spacing of 0.5λ and is shown in Figure 4 (a). The simulations results in Figure 4 (b) show that mutual coupling between the elements is -19 to -24 dB for H and V polarizations. This mutual coupling is due to surface wave as is already proven by the theory and equations in Section 1.
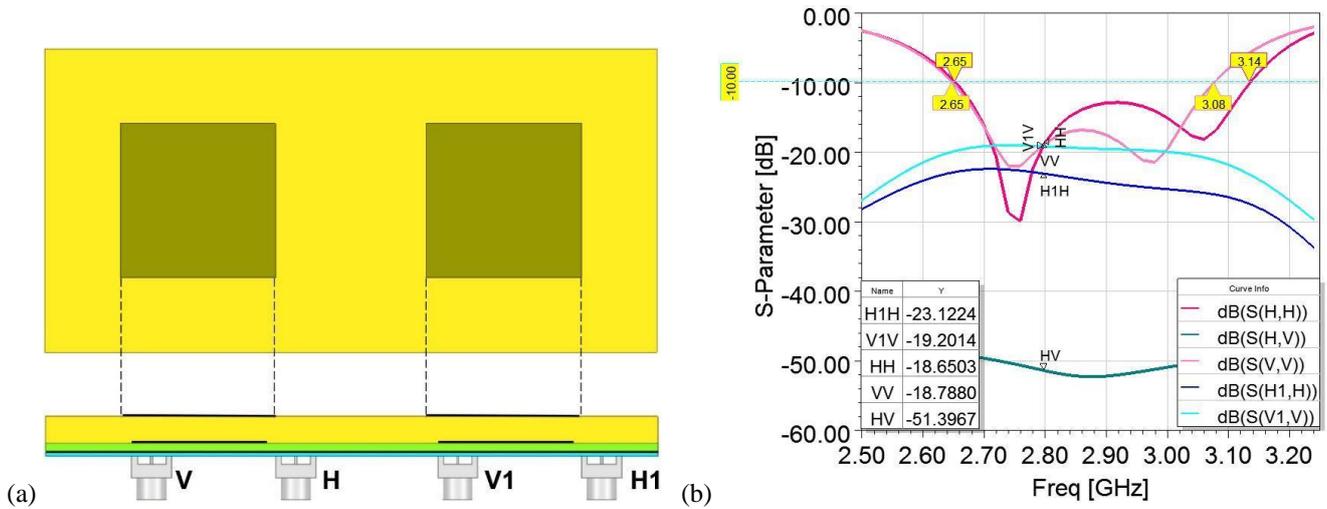
Fig. 4. (a) Top and side view of normal 2X1 array and (b) its S-Parameter plot.

2.2 Mutual Coupling Reduction

The mutual coupling reduction technique uses another substrate of dielectric constant 2.55 at the top of the antenna array. Above the substrate two microstrip lines are etched on the top of this substrate. Top and side view of the antenna structure is shown in Figure 5a. This extra microstrip and substrate combination acts as a band stop filter and reduces the level of mutual coupling between elements due to surface wave in the frequency range of 2.6 to 3.1 GHz. The optimized values for thickness of the top layer are 0.5mm and length and width of the microstrip lines are 52.8 mm and 3.8mm respectively. Distance between the parasitic lines is taken to be 7.48mm.
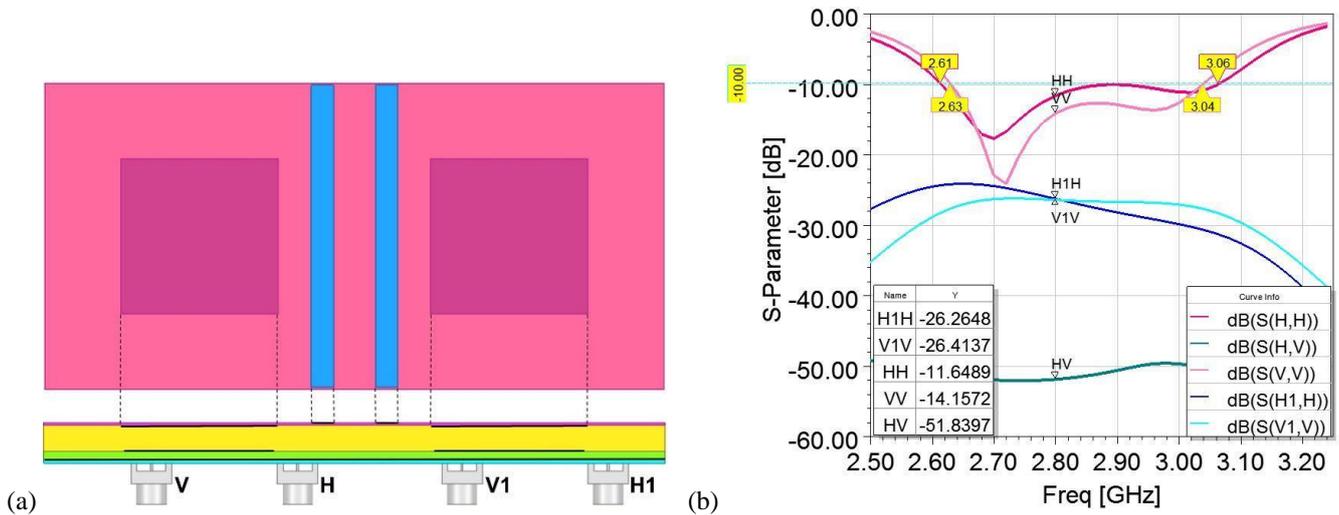
Fig. 5. (a) Top and side view of 2X1 array with striplines and (b) its S-Parameter plot.

3.   Simulation Results

The simulated S-parameter values for 2X1 antenna array with strip lines above are shown in Figure 5 (b). Total bandwidth remained 430 MHz before and after adding micro-striplines. The mutual coupling is suppressed by adding two microstrips to -26.2 dB and -26.4 dB for H and V ports. Thus, mutual coupling suppression of 3-7 dB is achieved. The two micro-striplines above dielectric does

the function of a band reject filter in the working frequency region [11]. Thus, it stops the surface waves and other near field radiations causing mutual coupling. Mutual coupling reduction is also analyzed using surface current at various layers of the antenna element. Figure 6a and 6b show that the current on the adjacent patch when first H-port is excited for antenna array with and without striplines, respectively. The surface current induced in the adjacent element (without suppression) is approximately 1-2 A/m which reduces to almost 0 A/m (with suppression). Similarly, Figure 6c and 6d show the mutual coupling reduction when V-port of single element is excited. The surface current induced is 3-5 A/m (without coupling suppression) which is again reduced to approximately 1 A/m (after coupling reduction). It is clear that current in the unexcited element due to mutual coupling has been reduced with the use of parasitic striplines for both polarizations.

Table 2. Comparison of the properties of 2X1 array without and with parasitic striplines.

	Without parasitic striplines		With parasitic striplines	
	H-Pol	*V-Pol*	*H-Pol*	*V-Pol*
Gain	7.81 dB	7.67 dB	7.74 dB	7.33 dB
Cross-Pol level at θ=0º	54.28 dB	49.62 dB	60.10 dB	48.56 dB
Bandwidth	2.65 – 3.08 GHz		2.63 – 3.05 GHz	
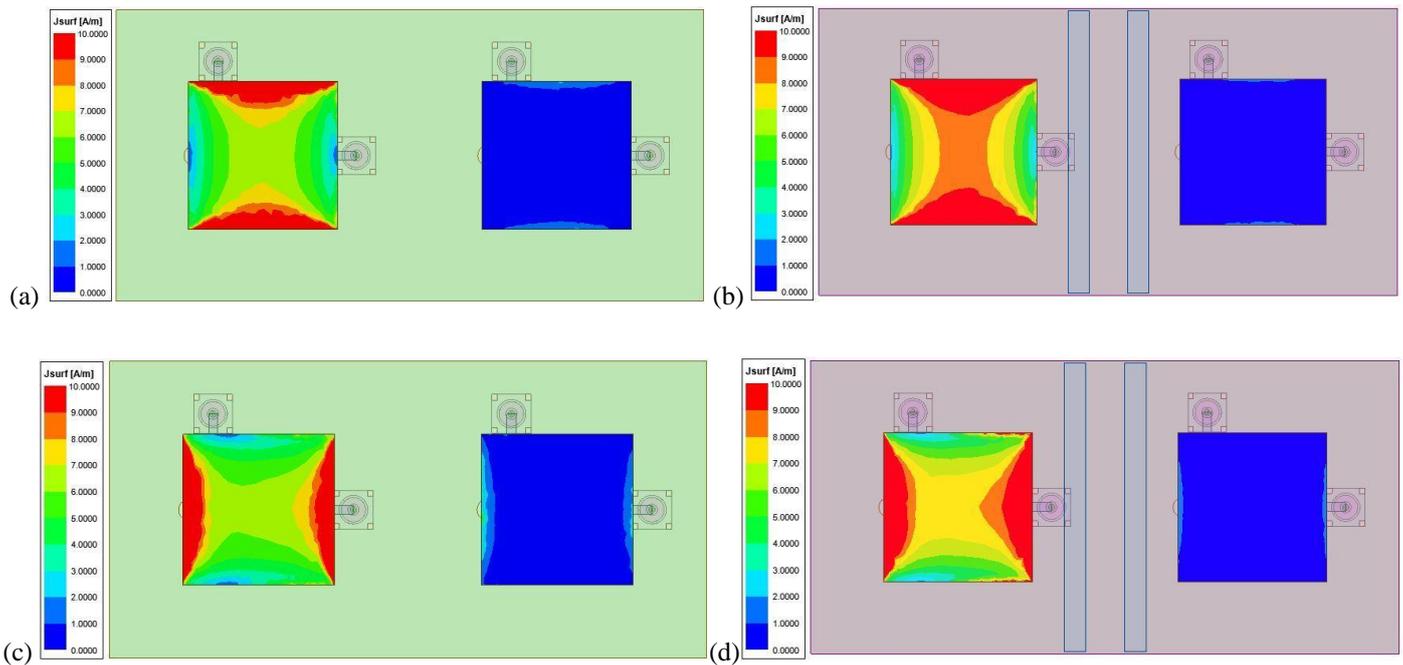
Fig. 6. Surface current plots (a) Normal 1X2 array and (b) 1X2 array with micro-striplines when H-port is excited (c) Normal 1X2 array and (d) 1X2 array with micro-striplines when V-port is excited.

Radiation patterns for the array with and without the striplines are shown in Figure 7. It can be seen that the cross-polarization level remains same for both H and V polarization before and after placing the parasitic micro-striplines. Cross-polarization levels are 54 dB and 49 dB below the main lobe for H and V polarizations, respectively. Similarly, the beamwidth and pattern does not change with the introduction of the striplines.
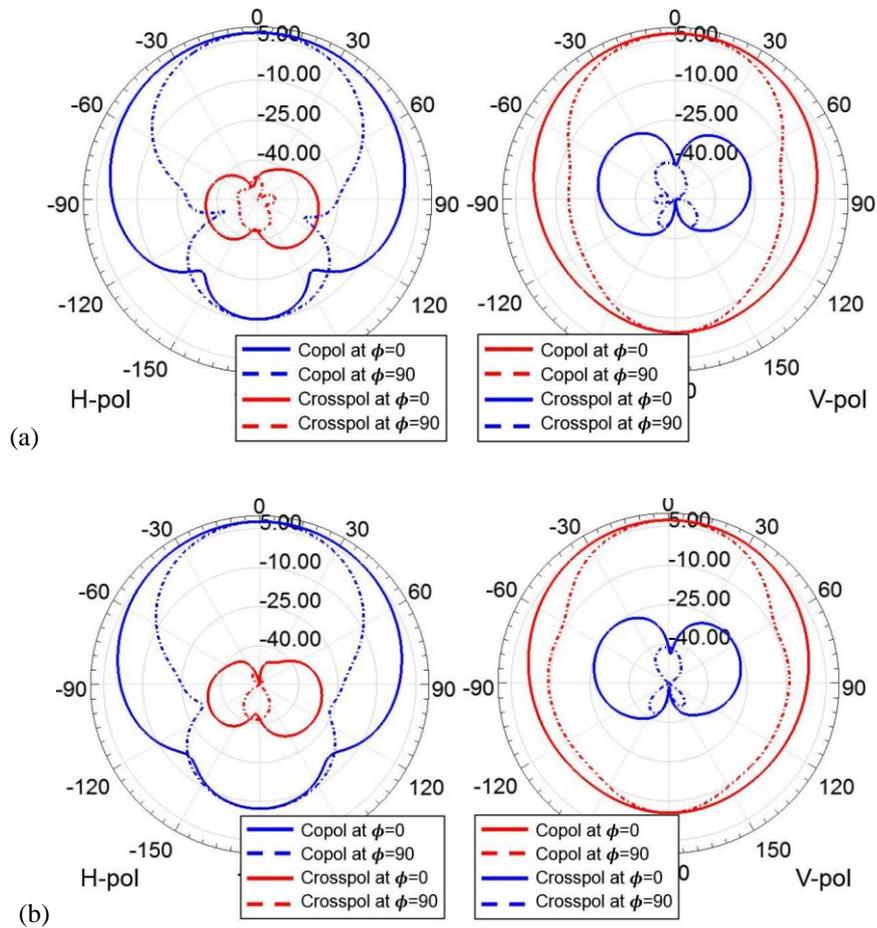
Fig. 7. Radiation patterns for 1X2 array (a) without striplines and (b) with striplines.

4.   Conclusion

The paper proposes a technique to reduce mutual coupling for a dual polarization antenna array at an operating frequency of 2.6 to 3.04 GHz. The two micro-striplines inserted between the adjacent elements above a dielectric suppresses coupling in the operating frequency range. The designed structure resulted in increased isolation between adjacent elements from -19 dB to -26 dB for V-port and -23 dB to -26 dB for H-port. Other parameters like bandwidth and cross-polarization level remained same.

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Acknowledgement

Challenges in Conventional Micro Drilling Processes - A Review

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Abstract

With the increasing demand of miniaturized merchandise with size in microns in industries like physics, aerospace, medication and cars, the need for small drilling with diameter in microns is inflated. To satisfy the demand, a variety of various small drilling techniques are developed. There has been, however, no report that explains, compares and contrasts all of those standard micro drilling techniques and points out its challenges. This study examines the newest standard micro drilling ways and techniques, categorizes them into completely different teams, highlights recent developments and new trends, and depicts the long run necessities within the field of small drilling. Standard small drilling techniques employed in trendy age applications are classified. Standard small drilling makes use of drill bits of various configurations like twist, spade, D-shaped, single flute, compound drill and coated small drill. Comparative study of standard small drilling techniques is bestowed here to point out the potential and flexibility of assorted small drilling ways. and necessary challenges moon-faced·

Keywords: Conventional micro drilling,micro drilling manufacturing techniques

1.   Introduction

 Nanotechnology has been growing apace over recent years and is already having an excellent impact on the event of recent materials and merchandise. The most varieties of the ultra-precision technologies serving to thrust the event area unit preciseness engineering, micro-engineering (MST/MEMS/ MOEMS), nanoscience and engineering, and that we powerfully advocate that they be considered a continuum; they're extremely dependent disciplines and technologies. Specifically, informing the producing business the requirement for the small-/meso-sized parts and their increased performance within the crucial areas of engineering drive the producing business to provide components with micro-options, together with micro-holes of size but zero to 5 mm. Micro-holes area unit utilized in fuel injection system nozzles, filters, flow measurement devices, inkjet printers, small cannulas, computer circuit boards (PCB) and cooling channels in rotary engine blades. Properties like light-weight weight, high specific stiffness, sensible damping and better fatigue life create the carbon composite a higher variety among most of the engineering materials.

Drilling is a basic requirement in each and every type of industry. The efficiency of the drill bit depends on various parameters. Various researchers have worked on different parameters like geometry and material of drill bit there is no work done on the current challenges faced in micro drilling. In this paper all the offered standard conventional drilling processes are reviewed. It'll initially offer a written account description of conventional drill history then justify the elemental ideas of small drilling, geometrical attributes of a small drill, advancements in materials used for small drilling, and therefore the producing techniques of the foremost commercially accessible twist kind small drill. The review then surveys progressive small drilling techniques and methods; classifies them into completely different groups; highlights recent advancements and current new trends; illustrates future necessities, and sets out the prevailing shortcomings and provides recommendations to beat these. Typical conventional drilling makes use of drill bits of various configurations like twist, spade, D-shaped, single flute, compound drill and coated small drill. An in depth compare table is enclosed to match the options of the various techniques together with their blessings and downsides.

2.   Background and Fundamentals of Micro drilling

 2.1 History

One of the most commonly used machining techniques, drilling has been used since ancient times. According to the observation it is that 25% of manufacturing time is involved in the drilling process. Approximately 250 million drill bits are used annually in the U.S. industry alone which shows the importance of the drilling in itself. Needs for micro drilling were first realized in the 1940s.Microdrilling technology is the frontier in the 21th century due to high demand of miniaturized products. But the roots of the

techniques and processes as well as the manufacturing of drill bits were observed in middle of 19th century. In countries like Korea, Japan and China there had been biggest interest in miniature drilling due demand in   PCB manufacturing in printing companies. High tech drilling development started to minimize burring sound from mikes in late 80's. And this was the time miniature drills (under 3mm) development started to cope with large quantity production for Printed circuit board. Since then, the automatic drilling work started with the introduction of CNC machines. With increase in microscopic and miniature drilling, the demand for more precise manufacturing of the drill bits increased. Today it is possible to manufacture the drill bits to make hole with diameters in microns. [2]

2.2 Types of micro drilling processes

Classifying at broad end, types of micro drilling processes can be divided in two parts. 1. Conventional, 2. Non-conventional

1.Conventional processes: This process refers to micro-drilling where a drill bit is mounted on the spindle and rotates at high speed, goes through the workpiece and makes the micro hole. There are various types of micro drills depending on their shape and configuration can be seen below. All the types   are discussed in detail in this paper further. Conventional micro drilling processes: 1. Twist type 2. Spade 3. D-shaped 4. Single flute 5. Compound tool micro drilling 6 Coated micro drill

2.Non-conventional micro drilling: Non- conventional micro drilling process on the other hand are the newly developed processes comparatively and are also used in industries at huge scale in many modern applications. The non-conventional micro drilling processes involves various means of electrical, chemical, mechanical, thermal operation and/or a combination of these processes. Non-Conventional micro drilling processes: 1. Laser, 2. Electrical Discharge Machining (EDM), 3. Electrochemical Machining (ECM), 4. Spark Assisted Chemical Engraving (SACE), 5 Electron beam, 6. Ultrasonic Vibration.

2.3 Core concepts for micro drilling processes

2.3.1. Function and Basic Geometry of microdrill

Drilling can basically be defined as a process for making holes in any component and as the component becomes smaller and smaller the size of hole is decreased and can eventually go in micron range hence it is called micro drilling or miniature drilling. The required diameter of the hole plays an important role defining micro drilling. There is no specific definition of micro drilling due to the observed ambiguity among different opinions of the researchers but based on the study the hole can be termed as micro drilled hole if it's diameter is equal to or below 1mm.
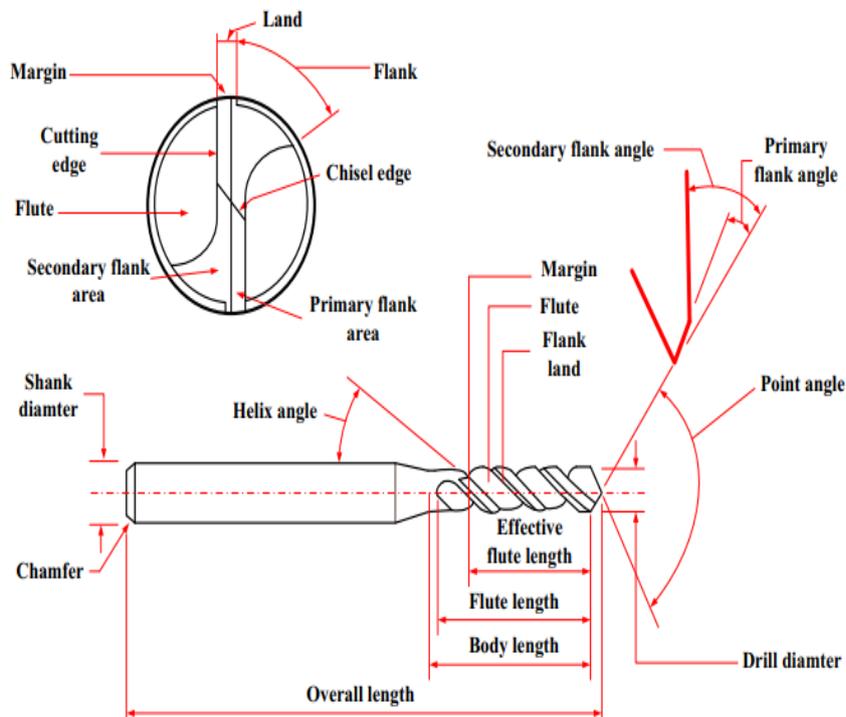

Fig. 1. Basic Geometry of micro drill[6]

Working at such miniaturized level it is observed that life of these drill bits are quite unpredictable. Due to the relatively great load compared to its strength it is observed that the drill bit breaks before it wears out. Even a slight change in geometrical parameters can result in catastrophic destruction of drill bits hence the geometrical parameters play an important role for satisfactory performance of drill. The effect of geometry and shape of the micro drill were observed by various researchers[11].

As visible from the top of the figure the land is that the space that remained once groove. Drill bits area unit essentially margin eased by reducing the number of land that generates friction at hole wall initializing the warmth generation. Hence, margin is outlined as the number of land that is still in grips with hole-wall at the time of drilling. The broader the margin, the larger the friction area and thus the larger the drilling temperature, inflicting higher extents of heat-related a little perforation quality faults. The consequence of accelerating land and net is a smaller amount within the flute space. Little flute area infers shorter amounts of obtainable space to require away drilling chips, that after will increase drilling temperature further. Another key issue is flute length that is measured by the depth of the trained hole. Flute length is, in fact, a determinative issue for the activity of the stiffness of rigidity. Higher rigidity that comes with shorter flute length, offers perforation operation with additional stability and increased tool life. Point angle determines the sharpness of the small drill, and is additionally a vital issue, significantly because it plays a major role within the starting of the small drilling. It's effects on thrust force, torque, and leading edge, that eventually determines the dimensions of the chips created. It's found that with the correct purpose angle, the thrust force is decreased, and position error is avoided. The optimum purpose angle of the small drill is found that time angles that time 130◦ have higher performance in terms of upper tool life. The toolmakers like Associate in Nursing angle of 90◦ for soft materials, on the opposite hand for more durable material it ranges from 120◦ to 130. Another necessary issue that greatly influences the performance of small perforation is the angle. The foremost unremarkably used angle. Therefore, a careful style is predominant to avoid breakage and attain higher performance.

2.3.2 Material used for manufacturing micro drills

Availability of metals and alloys as material for macro scale drilling is in immense range, but the choices for material for microdrill are still restricted. Commercially available micro drill materials includes : 1.Tungsten carbides (WC) 2. High speed steel (HSS) 3.Cermet 4.Polycrystalline diamond (PCD). From the above material tungsten carbide(WC) and high speed steel(HSS) are the most commonly used material due to their low cost [1].

2.3.2.1 Carbides

Cemented inorganic compound tools, conjointly called arduous metal tools square measure created by a combination of fine-grained metallic element inorganic compound with atomic number 27 at heat and pressure. Small proportions of metallic elements, atomic number 22 or V carbides may also be mixed. Carbides that confer with alloys, created with the assistance of metallurgy strategies square measure the optimum selection for a drill material. Atomic number 27 cobalt (Co) is often intercalary as a binding element within to vary from 6–15% by mass. Due to the sumptuous material properties, metallic element inorganic compound is extensively utilized. Metallic element inorganic compound is or so double stiffer than steel, with a Young's modulus within to vary from 530–700 standard. It has a high purpose freezing point temperature} freezing point ◦C (∼5200 ◦F) and a boiling point of ∼6000 ◦C (∼10,830 ◦F). WC is a particularly arduous material, ranking concerning nine on scale of measurement. It's glorious wear resistance, higher rigidity (2–3 times over steel), terribly low constant of thermal growth, and higher rupture strength. Owing to these superior mechanical and thermal properties, WC small drills offer higher cutting force (2–3 times over that of high speed steel), increased point and dimensional accuracy, improved surface end and exaggerated production rate (4–12 times faster)[7,8].

2.3.2.2. High speed steel.

Beside WC, the second most well-liked material by manufacturer for small drill is HSS attributable to its improved tool life and reduced value. HSS is largely a high-content carbon steels containing a high proportion of alloy parts like metallic element (Mo), atomic number 74 (W), V (V) Cr (Cr) and cobalt(Co). This may increase the hardness of the tool material and can permit the small drill to last longer at hot temperature. There are a large type of HSS allotted names by Yankee Iron and Steel Institute(AISI), however few of them are used for creating small drills. M1, and money supply and M7 are principally used for cutting materials like steel, aluminium and brass. The side metal in M35 and M42 creates higher thermal properties than regular HSS, making it a much better choice for cutting more durable materials [17]. HSS created by metallurgy (known as HSSPM), offers a high wear resistance, high toughness, and hardness. There's a recent trend towards creating super high speed steel, termed as HSS-E. The metallurgy created HSS-E-PM steel, containing metal alloy, provides an awfully undiversified structure that features a direct positive result on the systematically high durableness of the small preciseness drills. In future HSS-E-PM are often an honest alternative for producing small drills, however a lot of analysis is required to seek out the most effective thanks to acquire the specified properties.

3. Conventional Micro Drilling processes

Today it is possible to manufacture a micro drill bit of diameter equal or smaller than a sieving thread .Spade type micro drills with diameter of 2.5 is manufactured by using ultra precision abrasive techniques by National Jet Co.. It is also reported by Nisshin Seisakusho Tools making a twist type micro drill of d = 10 micrometre as shown in figure.
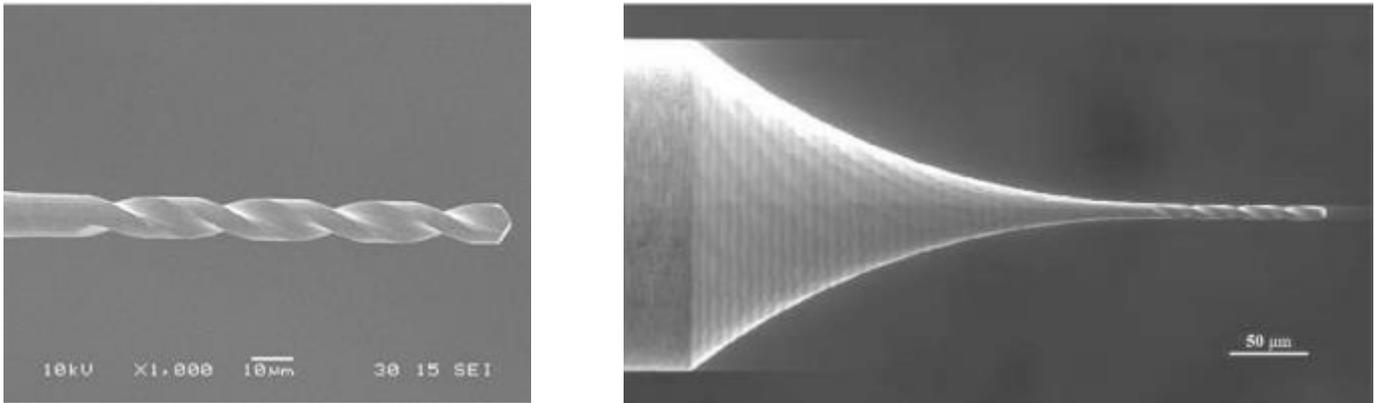
Fig. 2. [(a),(b)] Ultra small twist micro drill, d = 10 micro meter, standard l = 10d, made of WC[33]

3.1 Manufacturing process of micro drill bet

It is very difficult to understand the manufacturing process of micro drill bits due to dearth of content available. Hence step by step process for manufacturing is represented here.
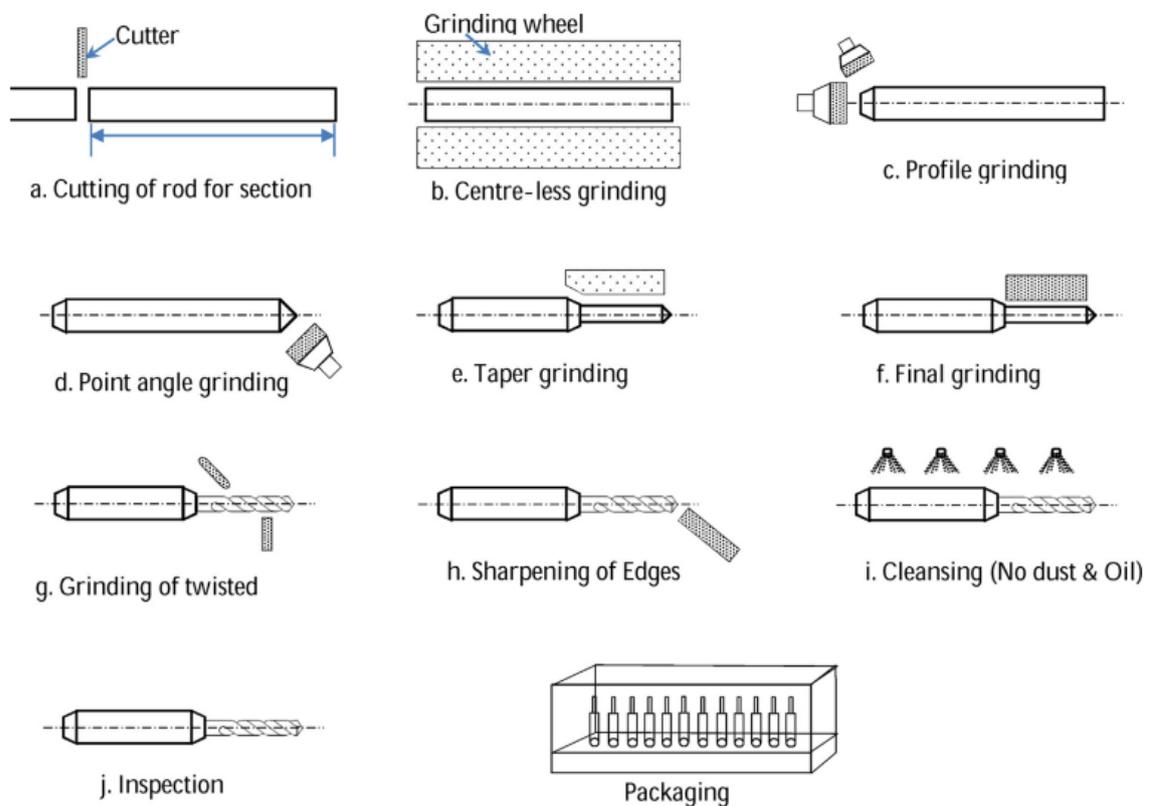
Fig. 3. Manufacturing process of twist type micro drill bit[1]

3.2 Twist type micro drilling

Multiple varieties of small drill bits square measure offered within the market as mentioned in classification among that twist sort drill bits square measure the foremost common one. In terms of application, this sort of small drill has the best proportion of market demand. However, because of its involved options it's counselled to require precise care whereas producing it. The benefits offered by twist kind of small drills embody high production rate, availability within the market and higher dimensional accuracy.
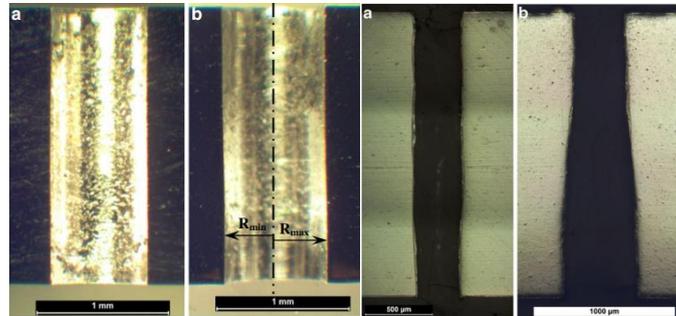
Fig. 4. Micro holes in Inconel 718 material[18]

3.3 Spade type micro drill

The tiniest quite small drill is that spade kind. Once the diameter of the trained hole is a smaller amount than ten micro meters, the twist kind small drill is no longer capable of acting the task because of the problem of such tiny kind twist small drill. Spade kind small drills area unit employed in that case the' their cutting ability is a lot more restricted than twist kind. the opposite drawback is the absence of associate degree termination. The top of the littlest small drills consists of an innovative, that is termed the chisel edge, fashioned by 2 primary intersecting planes of small drill. The overall pure mathematics of spade kind small drill is given in Fig. 5 below.
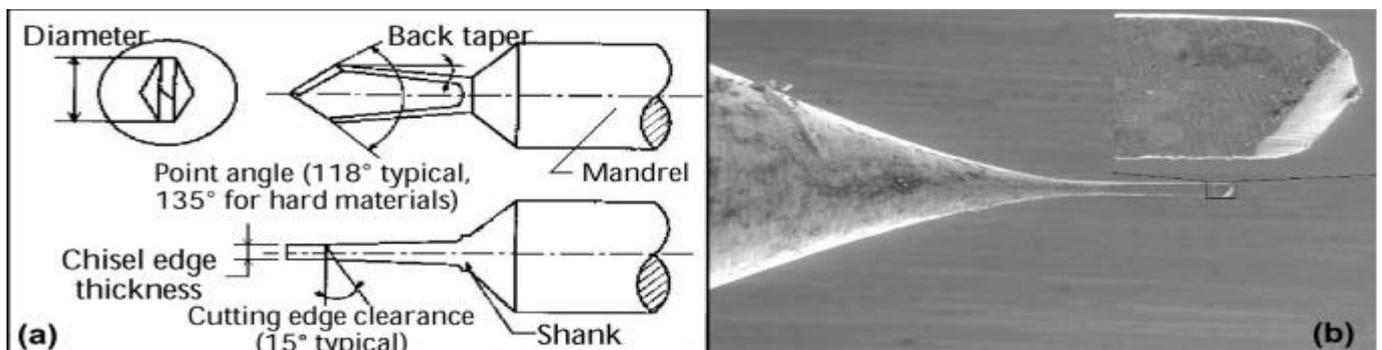
Fig. 5. Spade type micro drill(a) General geometry (b) Cutting part[32]

3.4 D-shaped micro drilling

 D-shaped micro drilling is also known as half round micro drill. Typically D-shaped micro drills are used for micro perforation of less than 50 micro meters in diameter. The geometry of the D-shaped micro drill is presented in Fig. 6[31].
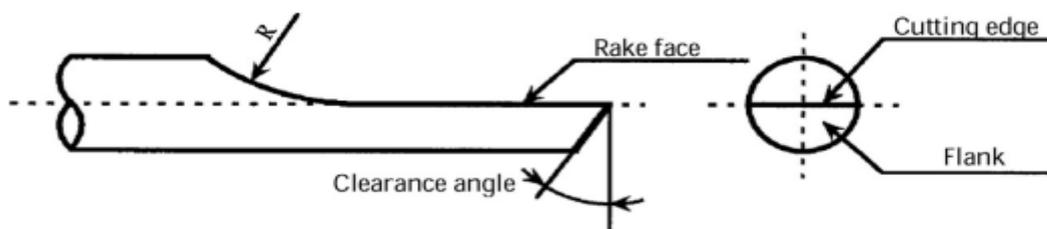
Fig. 6. D-shaped micro drilling[32]

The contour is semi-cylindrical with one straight flute. The advantages of this type of micro drill include manufacturing simplicity and smaller diameter, however, their cutting performance is limited by poor chips removal .Egashira et al. [2] fabricated a D-shaped micro drill of 17 m in diameter by means of a micro-EDM machine equipped with Wire Electro Discharge Grinding (WEDG). With the help of this microdrill they were able to machine a micro hole on the silicon board..

3.5 Single Flute Micro Drilling

Conventional small drills with 2 spiral flutes, greatly reduces the rigidity of the small drill and so limits the anti-breakage ability of the bit. To unravel this downside, one flute small drill is meant. Another vital blessing of single flute small drill embraces reduced heat generation thanks to little (virtually 0.5 compared to twist type) contact space between chips and hole walls, easy chip disposal, high ratio attainment, shrivelled rate of breakage and high point accuracy. In spite of providing such smart options, there are some limitations in addition. Since in single flute small drills, there's only 1 flute equivalent to one innovative space, that is often 0.5 compared to twist sort, the cutting speed is not up to that of twist kind of small drills when put next with a similar spindle speed and feed rate. The matter typically encountered by single flute small drill is the negative rake angle at the points of cutting on lips adjacent to the small drill axis. This negative rake angle makes the drill tip blunter, inflicting magnified cutting force in addition as friction force and elevated temperature [28,29,30]. The geometrical attribute of one flute micro drill is conferred in figure below.
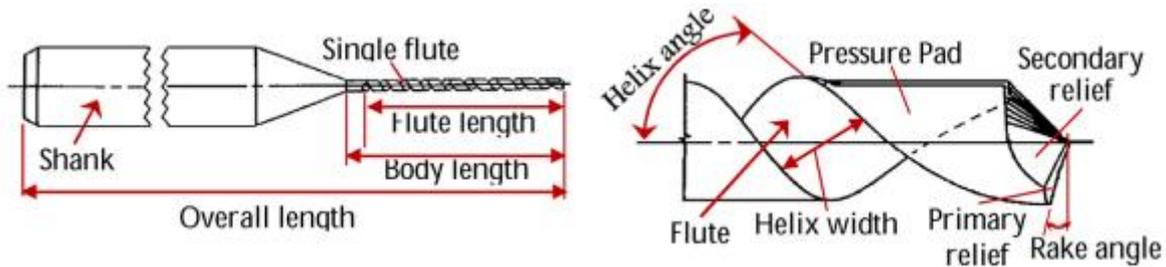
Fig. 7. Single flute micro drilling[28]

3.6 Compound micro drill

Standard micro drills sometimes machine a miniature hole with small burrs round the hole. These burrs cause appreciable issues. to get rid of these burrs, a deburring operation is sometimes performed when machining the holes, however, this causes different issues. The deburring tool should be in AN correct position, fitting precisely within the small hole, and this can be terribly troublesome to realize. It additionally consumes additional value and time. Therefore, combining these 2 tasks along – small drilling and deburring, by one tool is incredibly advantageous. the concept is bestowed in Fig. 8. it's noteworthy that the technique is applicable for the case of through holes. For no-through holes the deburring half cannot reach the opposite finish of the holes and so cannot perform the deburring operation.
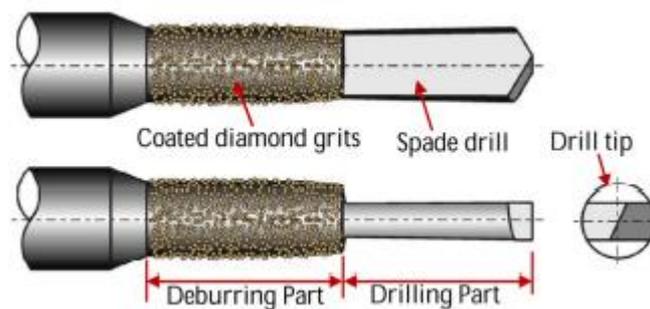
Fig. 8. Compound micro drill bit[4]

3.7 Coated Drill bits

In order to enhance the performance of the small drill, varied researchers have worked on the coating treatment of small drills. an appropriate surface engineering technique is adopted for depositing the coating material with the required properties on the surface of the small drill cutting half. Typically an awfully skinny layer of zero.002-0.015 milli meter coating of tougher material is deposited on the surface [1]. This coating layer will considerably improve the surface properties of small drills by enhancing hardness, lubrication ability, heat and wear resistance. Common materials that square measure employed in the coating of small

drills embody diamonds (e.g. diamond like carbon (DLC), small crystalline diamond (MCD), fine grade diamond (FGD), nano-crystalline diamond (NCD), B doped diamond (BDD)), atomic number 40 (e.g. Zr-Ti-N, Zr-C-H, Zr-C:H:Nx), metallic element (e.g Cr2N, Cr2WCN), Carbon (C:Wx%), atomic number 22 (e.g Ti, TiN, TiCN), and metallic element (e.g. AlN, Al2O3) [24-27]. These coating materials square measure applied in mono/multi-layers by means that of many ways as mentioned in Table one below

Table 1. Micro drill coating techniques.

SN	Coating techniques	Acronym	Common coating materials	Coating temp
1	Physical vapor deposition	PVD	TiN, TiCN, TiAlN, TiZrN, CrN	300–600°
2	Chemical vapor deposition	CVD	Diamond, Al2 O3 , TiCN	900–1100°
3	Medium-temperature chemical vapor deposition	MTCVD	TiCN	750–900°
4	Unbalanced magnetron	UBM	a-C:W×%, TiN, AlN	Room–200°
5	Closed-field unbalanced magnetron sputtering ion plating system	CFUBM	Zr-C:N×%, Zr-Ti-N	Room–300°
6	Physical vapor deposition-electron cyclotron resonance-chemical vapor deposition	PVD-ECRCVD	Ti, TiN, TiCN, DLC	300–600°
7	Hot filament chemical vapor deposition	HFCVD	NCD, BDD, MCD FGD	750–950°
8	Atomic Layer Deposition	ALD	Al2 O3	Room–400°
9	Coaxial excited microwave plasma system	CEMP	DLC	600–800°
10	Filtered cathodic vacuum arc	FCVA	Ta-C	Room temp.

4. Limitation and challenges during micro drilling processes

Because of the massive load compared to the mechanical strength, small drill bits often break down before they wear out. A small drill is loaded with a torsion, feed force, and radial metallic element force at the time of machining. Improper association of those forces may cause torsional deflection and elongation of the cutting part; compression and angular deflection; buckling and bending deflection and end in the failure of the drill. Several researchers had done a certain assessment of mechanical properties of small drills to cut back the prospect of breakage [22,23] but the improvement processes square measure time intensely. Once a small drill breaks within the work, it's not solely troublesome to require out the drill however conjointly the work is wasted. Therefore, dynamically the small ram down advance is crucial so as to continue the assembly and eliminate such demurrage. To grasp the precise time of adjusting, however, is incredibly troublesome. variety of various techniques and approaches square measure reported to observance the drilling operation or the condition of bit, that embrace observance of drilling torques, machine-vision power-assisted drilling condition scrutiny, optical scrutiny of drill purpose defects, and optical device scrutiny of outer diameter run out [18–21], however the techniques mentioned cannot solve the matter of huge portion of application field in industries. The study of factors related to drill bit is very important.

4.1 Important factor

Frequent tool breakage and quality of small holes are the foremost mentioned problems in standard small drilling views. Since the dimension is within a range of microns, the drill cannot give adequate mechanical strength to face up to the cutting force. This is often why small drills break down long before they wear out. Additionally, precise hole quality necessities are typically terribly crucial depending on the kind of application. Variety of researchers have tried to work out the explanations for tool breakage, ways to enhance the tool life and forestall tool breakage, and improve the outlet quality. The key factors about tool life and hole quality, that came out from their investigation will be summarized as follows: 1. Formation of chips, 2. Burr formation, 3. Cutting edge radius, 4. Tool point angle.

1.Formation of chips

Since drilling may be a method of fabric removal, chip elimination is one of the foremost vital factors that has to be taken under consideration. Notably within the case of small deep drilling, chips don't seem to be simple to get rid of, and sometimes encountered

ECM within the flutes, that produces extra stress and warmth, and eventually causes breakage of small drill. Tool failure that happens because of improper chip removal may be classified into 3 main classes,

1) Mechanical impact : Mechanical impact is caused by slippery action between cutting edges and piece of work surface. Throughout slippery, grains that square measure up-to-date become debilitated at their grain boundaries and ultimately result in premature failure.

2) Thermal impact : Once the chips square measure packed within the outlet, it generates heat, inflicting the leading edge to be softened at higher temperature, deforming the form and ultimately resulting in tool breakage.

3) Adhesion impact ; The third supply is adhesion usually termed as built-up-edge (BUE). BUE is the accumulation of a piece of work material over the leading edge of the drill. During this state of affairs the chip is adhered to the drilling bit and changes the pure mathematics of the tool.

In this state of affairs the chip is adhered to the drilling bit and changes the pure mathematics of the tool. This reduces leading edge space, sharpness of the tool, shrinks chip removal house and generates high friction, stress and warmth and eventually ends up in tool failure. Chips that fashioned throughout small drilling square measure created in several shapes as portrayed in Fig.9 [1]. Typically it's in medium form throughout entrance, and shorter within the middle, and longer at the exit. It's rumoured that chips with long frizzly shapes tend to stick within the gap of flute that avert fluid from going within to decrease temperature and perform lubrication at the tip of drill. Shorter chips square measure a lot of susceptible to jam the house of flutes and manufacture a lot of stress and warmth eventually shorten tool life. Medium size chips square measure relatively higher for small drilling, although more investigations square measure needed to optimize the adjustment to supply good form of chip further as chip removal rate.
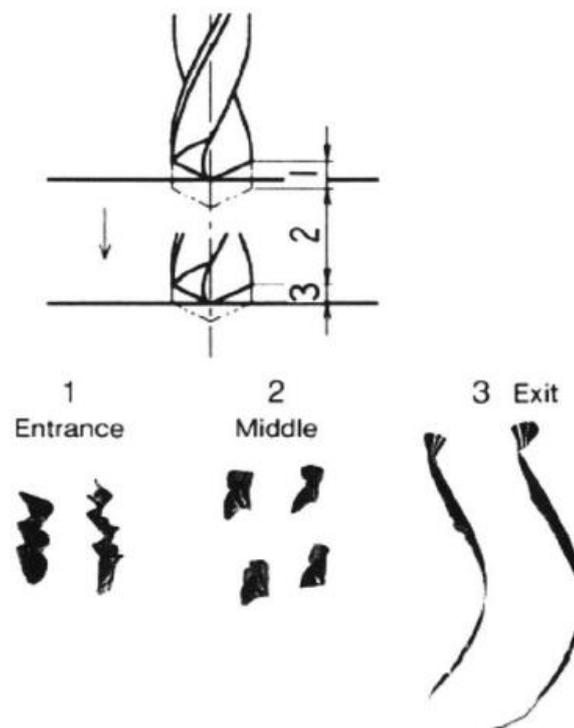
Fig. 9. stages of chip formation[1]

2. Burr Formation

Another development, like chip formation as mentioned within the previous section, is the formation of burrs at entry and/or exit of a small hole. Formation of burrs at entrance is caused by lateral extrusion action and at exit by rubbing the margins of the drill . within the small drilling method, however, the most concern is exit burr thanks to bulk volume and bigger size than that at the entry facet. Formation of burrs generate many issues for product quality and accuracy, produce hazards in handling of machine elements, and might negatively interfere with the assembly method. Deburring could be a tough, time overwhelming and overpriced operation, and in some cases, thanks to half fragility and edge tolerance, deburring of small holes isn't potential. Additionally, sharp burrs have

a big risk of safe handling as they'll cause lacerations to fingers or hands. Sometimes, burrs will are available in loose forms and might cause injury to the merchandise. Therefore, burr reduction or elimination is incredibly necessary in drilling. Understanding the development of burr formation and its dominant parameters are essential for predicting and reducing burr formation[18,19].
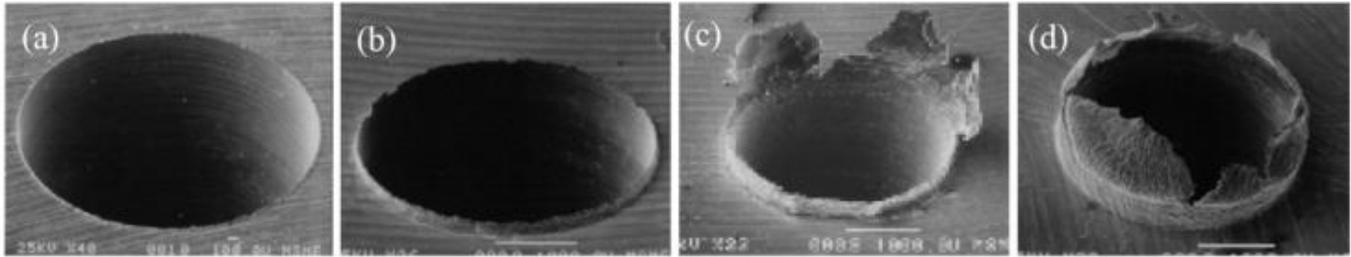
Fig. 10. Types of burrs in micro drilling (a) virtually burr free (b) uniform burr, (c) transient burr, (d) crown burr[18]

3. Cutting edge radius

The innovative radius plays a big role within the performance of a small drill and therefore the quality of small holes. It's been ascertained that the reduction in cutting edges, caused by abrasive wear, ends up in chip and obstructive small drill and eventually ends up in failure thanks to fracture propagation [15]. Aramchareon et al. [16] reportable that a rise in innovative radius causes size result and may well influence cutting forces, chip formation, chip thickness and therefore the quality of wall surface end. Nair [17] has examined the result of an innovative five hundred m diameter WC small drill. Fig. 20(a) and (c) show the sharp innovation of the new drill, innovative once 118 small holes and unhealthy quality of hole by forming burr severally. The author terminated the innovative radius hyperbolic with the increment of cutting speed and feed rate. This increase in innovative radius hampered the dimensional accuracy and surface integrity of the small hole as proved by SEM micrograph shown in Fig. 20(c). Excessive wear 358 M. Hasan et al. / Journal of producing Processes twenty-nine (2017) 343–375 Table a pair of Comparison of the capabilities of standard small drilling techniques. Twist Spade D-shaped single Compound
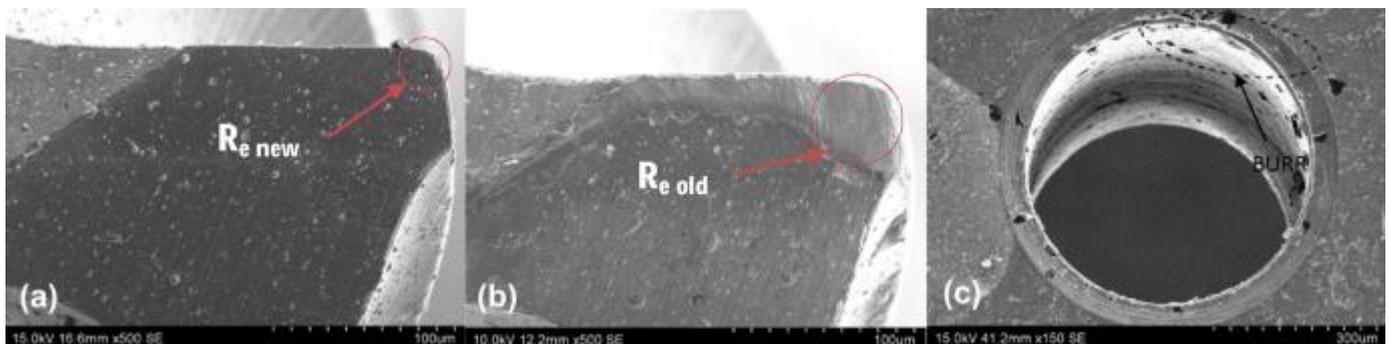
Fig. 11. Cutting edge radius of 0.5 mm micro drills before and after drilling of 118 holes (a) new drill, (b) drill after 118 holes, (c) burr formation [14]

4.Tool point angle

Tool point angle plays a significant role at the commencement of the drilling process. Researchers as well as manufacturers have conducted numerous studies to find out the optimized tool point angle. Wong et al. [13] figured out that by decreasing point angle, thrust force that generated during drilling can be minimized and position error can be escaped. Researchers had conducted several experiment to study the optimized point angle of micro drill and found that point angle B (120∘) and C (130∘) have better performance in terms of higher tool life.

5. Conclusion and Recommendations

In this work, the leading edge technologies used for micro drilling in a very wide selection of various applications are listed and reviewed and challenges are pointed out . The techniques square measure classified into 2 broad classes, standard and non-conventional. The traditional methodology is to use a small drilling of various shapes and geometric configurations. Their square measures six varieties of standard small drilling. These squares measure twist, spade, D-shaped, single flute, compound, and coated small drill. Of those six sorts, the twist kind small drill is the preferred one. The careful producing steps of twist small drill square

measure represented during this study. The key recommendations which will be drawn from this study square measure summarized as follows.

• because of size effects, the behaviour of standard small drills is completely different from that of macro drills, as small drilling parameters (such as form and pure mathematics of the small drill, tool purpose angle, angle, chip formation and removal, impact of fluid used, beginning hole or spot drilling, and favourable cutting conditions i.e. spindle speed and feed rate) got to be terribly fastidious designed. Obtaining aid from today's advanced simulation software system to optimize these parameters is very counselled before producing it in order to avoid wasting time, effort and price

• Because the material of standard small drills plays a big role in their performance and sturdiness, selecting the proper material is incredibly necessary. Mistreatment of small grain and ultra-fine grain powder so as to offer small drills will provide glorious quality materials with superior hardness and wear resistance. Corresponding metallurgy also can be simulated by virtue of molecular dynamics or powder simulation [1,5].

• Standard small drills square measure fancied by means of Associate in Nursing abrasive grinding. This involves many producing steps, requiring an exact wheel and machine, intense higher labour value and longer time. Developing Associate in Nursing innovative direct small forming methodology, by virtue of that, small drills of any sorts might be created in a very direct powder solidification-extrusion forming methodology while not the usage of a wheel, would be ready to save each value and time.

• Standard small drills square measure sometimes made from atomic number 74 inorganic compound and high speed steel. WC, above all, is the preferred one because of its superior mechanical properties for example high hardness, higher wear resistance, and better temperature. The matter of WC, however, is that it's brittle and infrequently causes breakage of a tool. A composite small drill of outer material WC to produce adequate hardness and wear resistance, and a high strength steel inner material to produce strength for withstanding the breakage, may considerably improve the tool life and therefore save a substantial quantity of value

• Spade kind small drills are terribly promising within the case of small drilling of a diameter but ten micro meter. This is often primarily because of producing simplicity. This implies that any investigation into this sort of small drilling has nice potential [4].

• D-shaped small drills square measure necessary in some exactitude applications. However, producing ultra-small D-shaped small drills still remains a challenge. Sometimes they're fancied by EDM. Development of a grinding set-up for creating such small D-shaped small drill, even higher manufacturing them by an instantaneous forming methodology might be a stimulating space of analysis, by avoiding the high-ticket arrangement for EDM [2].

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A Comparative Reconnaissance Review on IoT Application Layer

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Abstract

Over billions of 'things' got connected to the internet for the past few years. Devices are connected and pass the data. To provide effective communication between devices, the application protocol of IoT is selected. By connecting to IoT gateway, IoT devices share the sensor data. These data are passed through the network and it creates traffic. To reduce internet traffic, the appropriate protocol is selected which also improves reliability. The goal of the Internet of things (IoT) is to ensure effective communication between different objects. For providing services the application layer is responsible and provides a set of protocols for message passing at the application level. This survey shows different protocols that are used in IoT, to affirm a reliable communication between objects and things.

Keywords: IoT, Application layer, Protocol, MQTT, COAP, XMPP, AMQP.

1. Introduction

Billions of devices nowadays are interconnected and communicate to receive or send data. This is done by different protocols of the application layer in the Internet of Things (IoT). The evolvement of IoT shows that it is not a simple network of computers, but a network of various devices [1]. According to survey, in 2010, Devices connected to IoT has surpassed the number of total human population on earth [2]. With IoT, objects are connected and become smart. This is used in different fields like smart home, smart agriculture, smart healthcare, etc. Here objects work smart by transferring data [3,4]. IoT supports a large range of applications with contravention requirements and components [5]. The basic IoT smart grid consists of 3 layers: perception layer, network layer, and application layer [6].

Out of 3 layers of IoT Application layer is what the user will interact with. The application layer provides specific services to users through analysis and processing data [7]. The application layer interacts directly with the end-user which consists of applications each with its own application layer protocols.

The first section, the introduction gives an overview of IoT and its application layer protocols. The second section describes the application layer protocols and its architecture: Message queue telemetry transport (MQTT), Constrained Application Protocol (CoAP), Extensible Messaging and Presence Protocol (XMPP), and Advanced Message Queuing Protocol (AMQP). The third section gives the comparison of IoT application layer protocols and is finally concluded in the last section.

2. IoT Application Layer Protocols

IoT leads to various innovations of frameworks that detect and react without human interactions, when the fire is detected it sends the instant alert message to registered users [8]. Through the Application layer user interacts. The application layer is the interface between end devices and the networks. It provides high-quality services to meet users' requirements.

2.1. MQTT

The MQTT is a publish/subscribe model. Publisher and subscriber can switch roles depending on requirements and objectives. MQTT is suited for a constrained environment like low power, limited memory, and limited bandwidth as clients do not have to request updates [9]. It is suited for IoT applications and runs over TCP/IP [10,11]. MQTT protocol is simple and does not need high CPU and memory usage, it is a lightweight protocol. Fig.1 shows MQTT Architecture where there is an MQTT broker who works as middleware to producers and subscribers. Furthermore, MQTT does not require a request on message update which saves battery life and bandwidth [12]. MQTT is very much useful in communicating with low-power devices [13].

MQTT ensures reliability by providing the option of three QoS levels:

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QoS0: (At most once) it sends messages only once. The publisher sends data to the broker, in response it doesn't wait for an acknowledgment (ACK) from the broker. If the data sent by the publisher is not received by the broker, it is lost as there are no retransmissions in this QoS

QoS1: (At least once) to avoid the earlier problem of data, the publisher waits for ACK (APUBACK) from the broker. If the ACK is not received after a predefined time interval, data is retransmitted. This profile achieves reliability but increases the overhead.

QoS2: (Exactly once) in this, the publisher sends data to the broker and wait for Publish Receive (PUBREC) message back. It discards the reference to published data and Publishes Released (PUBREL) to the broker when PUBREC is received [14]. The same procedure is followed by the broker. When both publisher and broker perform their tasks, it ensures successful message delivery.
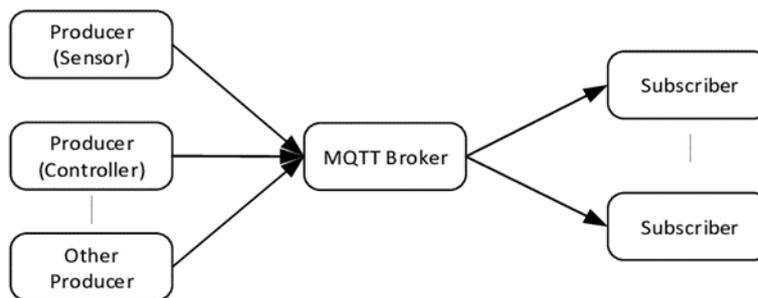
Fig. 1. MQTT Architecture [15]

2.2 COAP

The COAP is a synchronous request/response application layer protocol. Which aims to target constrained-recourse devices. The reason for bad packet delivery and high overhead is the constrained environment. CoAP was designed by the Internet Engineering Task Force (IETF). IETF is highly interested in the machine-to-machine (m2m) applications and the automation of systems to lower overhead, increase packet delivery, and make tasks simple, by using a simple interface with HTTP. To support a large number of users and provide a better performance, Publish /subscribe architecture is used [16]. Fig. 2 shows COAP Architecture. COAP incurs lower message size and overhead comparatively [17].

Following are two layers of COAP:

1) Messaging layer: The first layer, messaging layer aims to achieve reliability based on UDP [8].

2) Request/Response layer: The request/response layer aims to act the interactions and communication [8].

Types of massages in CoAP are:

A. Conformable Message: This type of message guarantees reliable communication by using the acknowledgment method; when a message arrives at its destination it returns an acknowledgment or reset message.

B. Non-conformable: Here there is no need for an acknowledgment message.

C. Acknowledgment Message: This message indicates that a conformable message has arrived.

D. Reset Message: Reset message shows that message was received (confirmable message or non-confirmable message), but due to some reason it was not executed properly. The main reason for this is when the receiving node has rebooted and has forgotten some state that would be required to interpret the message [18].

E. Piggybacked Response: As soon as the message of acknowledgment is received, the Receiver responds directly to it.

F. Separate Response: Here, receiver will respond in separate message to acknowledgement message.

CoAP is simple and consumes less CPU and memory. On the other hand, though, it is known for its high latency, bad packet delivery, and its inability to be used on complex data types [19].
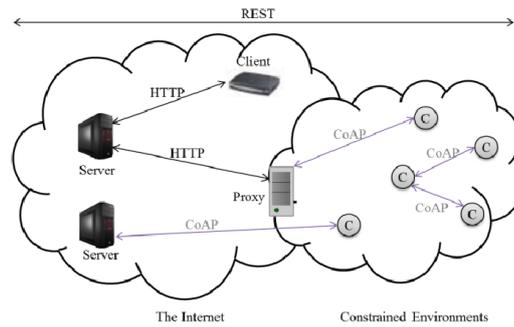
Fig. 2. COAP Architecture [20]

2.3 XMPP

The Extensible Messaging and Presence Protocol (XMPP) was designed for chatting and message exchanging. It is a well-proven protocol that has been used widely all over the Internet. As this protocol is older compared to other protocols, it does not provide the required services for latest data applications. For this reason, last year, Google stopped supporting the XMPP standard due to the lack of worldwide support.

XMPP runs over TCP which provides publish/subscribe and also request/response messaging systems. Publish subscribe is asynchronous whereas request response is synchronous. It is designed for near real-time communications and thus, it supports a small message footprint and low latency message exchange [21]. Fig. 3 shows XMPP Architecture. XMPP is extensible and allows the specification of XMPP Extension Protocols (XEP) by which its functionality is increased. It is also believed that XMPP is one of the best protocols for new era of cloud computing [22].

XMPP protocol uses XML for text communications, this may cause network traffic overhead, but it could be solved by compressing XML using EXI [23].
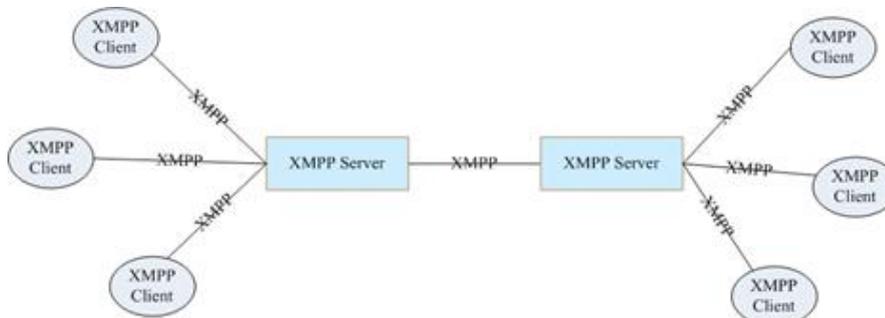
Fig. 3. XMPP Architecture [24]

2.4 AMQP

AMQP is a publish/subscribe model, depending on a coherent and authentic messaging queue [8]. The use of this approach makes the AMQP protocol easy to use and manage [25]. Applications that belongs to the AMQP protocol can exchange message from one to another. AMQP protocol focuses on achieving high reliability, security, and performance [26]. Because of its wide range of services related to messaging AMQP is the preferred choice for business [27].

There are two components of publish/subscribe approach of AMQP, that is Exchange queue and message queue,

1) The exchange queue is responsible for message routing.

2) The message queue keeps storing messages until they are sent to the receiver.

Publish/subscribe approach of AMQP consists of two components: There is a specific process with a set of rules to exchange messages between exchange components and message queues [14]. Fig.4 AMQP architecture which shows broker working between Publishers and Subscribers where they can publish/subscribe data.

AMQP protocol is Interoperable, highly extendable in different platforms and environments with good ability which can also support industrial applications. In addition, AMQP also offers more aspects considering security [28].
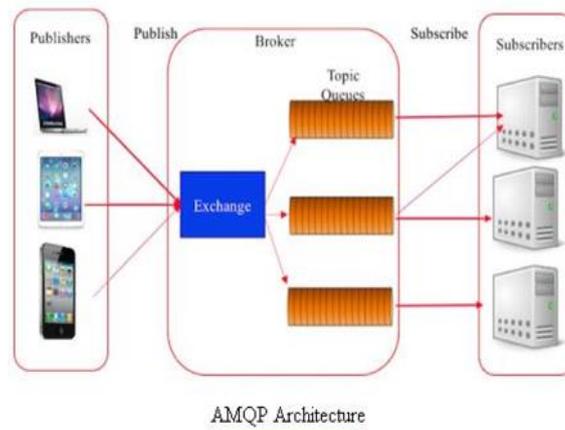
Fig. 4. AMQP Architecture [29]

Table 1. Application of Protocols

Protocols	Application name	Current version	Link	Released year
MQTT	Facebook Messanger	347.0.0.8.115 (299411680)	https://www.facebook.com/messenger/	August 9, 2011
COAP	Smart energy grid	Release 4.0	https://www.nist.gov/el/smart-grid	2007
XMPP	Firebase Cloud Messaging	CLI v9.12.1.	https://firebase.google.com/docs/cloud-messaging	October 21, 2014
AMQP	RabbitMQ	3.9.13	https://www.rabbitmq.com/	July 1, 2007

3. Comparison of IoT protocols

Table 2. Comparison of Protocols

Protocols	Types of Services provided	Architecture	Security	Header Size	Encoding Format
MQTT	TCP	Publish/Subscribe	TLS/SSL	2 bytes	Binary
COAP	UDP	Request/Response	DTLS	4 bytes	Binary
XMPP	TCP	Request/Response Publish/Subscribe	TLS/SSL	Very large with no limits (varies on data size)	XML
AMQP	TCP	Publish/Subscribe	TLS/SSL	8 bytes	Binary

4. Conclusion

This paper briefly discusses different protocols of the application layer. This comparison helps the researcher to select protocols based on the requirements. The main objective of this paper was to analyze the types of services, architecture, and security provided by each protocol. Further work can be carried out by implementing all these protocols which can give a more accurate idea of selecting protocol based on the requirements. We can also aim to implement a server that use multiple protocols and can provide the best result in terms of overall performance.

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Study of Materials and Process Parameters of 3D Printing

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Abstract

Now-a-days, most of the technology are the computer based system. i.e., making an object can be easier in CAD/CAM. Here, there is one technology for making complicated objects is 3D Printing. 3D Printing brings two fundamental innovations: the manipulation of object within the digital format and also the manufacturing of recent shapes by addition of material [Digital + Additive Manufacturing]. 3D Printing is an enabling technology that encourages and drives innovation with unprecedented design freedom while being a tool-less process that reduces prohibitive cost and lead times. The material available for 3D Printing have come a long way since the early days of the technology. Currently, a wide variety of different material types are available like, plastic, nylon, Polyamide, Thermoplastics (e.g. PLA, ABS), Eutectic metals, Edible materials, metal alloy, Thermoplastic Powder, Plaster, Liquid resin, Metal foils, ASA, PVA etc. This paper highlights the materials and process parameters of 3D printing technology.

Keywords: Additive Manufacturing, CAD, CAM, ABS, PLA, PEEK.

1. Introduction

Manufacturing is that the creation or production of fantastic with the assistance of kit, labor, machine, tools and chemical or biological processing or formulation. It is the essence of secondary sector of the economy. The term may ask to range of human activity from handcrafted to technology, but its most typically applied to industrial design, within which raw materials from the first sector are transformed into finished goods on an outsized scale. Such goods could even be sold to other manufacturers for the production of other more complex products (such as aircraft, household appliances, furniture or automobile).

Additive manufacturing, also referred to as 3D printing, rapid prototyping or freeform fabrication, is 'the process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies' such as machining. The use of Additive Manufacturing (AM) with metal powders is a new and growing industry sector with many of its leading companies based in Europe. It became an acceptable process to produce complex metal net shape parts, and not only prototypes, as before.
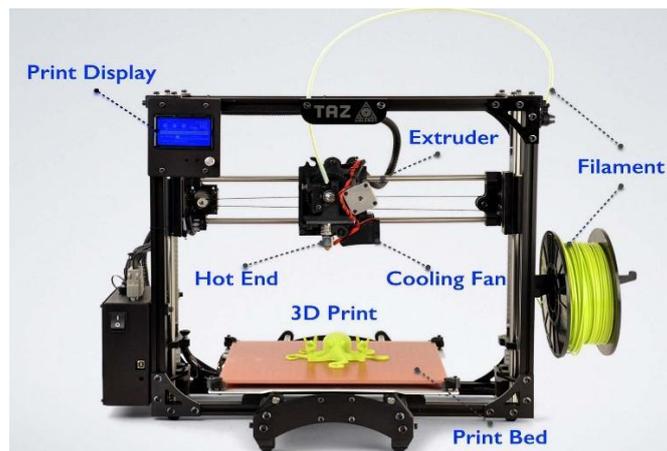
Fig. 1. 3D Printer.

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Additive manufacturing uses data computer-aided-design (CAD) software or 3D object scanners to direct hardware to deposit material, layer-by-layer, in precise geometric shape. As its name implies, additive manufacturing adds material to create an object. In contrast, when you create an object by traditional means, it is often necessary to remove material through milling, machining, carving, shaping.

3D printing encompasses many styles of technologies and materials as 3D printing is being used in almost all industries you could think of. It's important to see it as a cluster of diverse industries with a myriad of various applications. Examples: consumer products (eyewear, footwear, design, furniture), industrial products (manufacturing tools, prototypes, functional end-use parts), dental products, prosthetics, architectural scale models, reconstructing fossils, replicating ancient artefacts etc.

Fig. 2. 3D Printing Technique Basic Steps.

There are several types of 3D Printing, which include:
1. Stereo-lithography (SLA)
2. Selective Laser Sintering (SLS)
3. Fused Deposition Modeling (FDM)
4. Digital Light Process (DLP)
5. Multi Jet Fusion (MJF)
6. PolyJet
7. Direct Metal Laser Sintering (DMLS)
8. Electron Beam Melting (EBM)

Selecting the proper 3D printing process for your application requires an understanding of each process' strengths and weaknesses and mapping those attributes to your product development needs. Let's first discuss how 3D Printing fits within the product development cycle and so take a glance at common types of 3D printing technologies and the advantages of each.

1.1 Stereo-lithography

Vat photo polymerization may be a category of additive manufacturing (AM) processes light-activated polymerization. Stereo-lithography, the first AM process to be patented and commercialized, is a vat photo polymerization technique. Also referred to as stereo-lithography apparatus, optical photo-solidification, or resin printing. Photo polymerization processes make use of liquid, radiation-curable resins, or photopolymers, as their primary materials. Most photopolymers react to radiation within the ultraviolet (UV) range of wavelengths, but some light systems are used furthermore. Upon irradiation, these materials undergo a chemical process to become solid. This reaction is named photo polymerization, and is usually complex, involving many chemical participants.
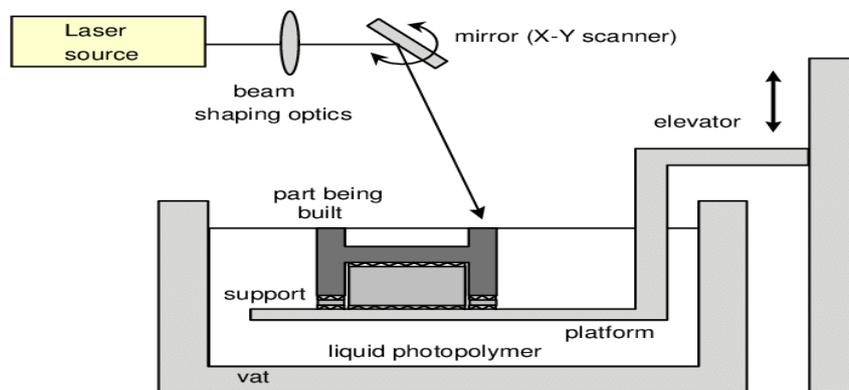
Fig. 3. Stereo-lithography.

Principle: SLA may be a laser based rapid prototyping process which builds parts directly from CAD by curing or hardening a photosensitive resin with a relatively low power laser. Stereo-lithography (STL) is a process for fabricating a solid plastic part out of a photosensitive liquid polymer using a directed laser beam to solidify the polymer. Part fabrication is accomplished as a series of layers, in which one layer is added onto the previous layer to gradually build the required three-dimensional geometry.

1.2 Selective Laser Sintering

Selective laser sintering could be a rapid prototyping process that builds medals from wide variety of materials using an additive fabrication method Selective laser sintering was developed by University of Texas Austin in 1987. The build media for selective laser sintering comes in powder form which is fused together by a powerful carbon dioxide laser to form the final product.
Principle: selective laser sintering relies on the principle that powder of thermoplastic material, metal, composite or ceramics is sintered layer by layer, under the heat generated by CO_2 laser to form the part.

1.3 Fused Deposition Modelling (FDM)

Fused Deposition Modelling (FDM) is a common desktop 3D printing technology for plastic parts. An FDM printer functions by extruding a plastic filament layer-by-layer onto the build platform. It's a cost-effective and quick method for producing physical models. There are some instances when FDM can be used for functional testing but the technology is limited due to parts having relatively rough surface finishes and lacking strength.
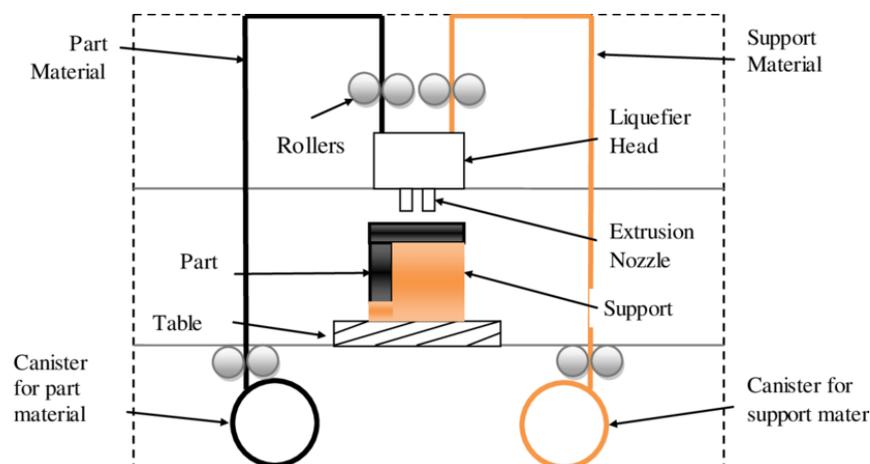
Fig. 4. Fused Deposition Modelling (FDM).

2. Literature Review and Research Gap

By performing various experimental investigation on polymer material, the work done on the material properties like tensile test in the standard size by ASTM D638-03 Specimen. And performance of doing experiment on various polymer material to identify properties of material by changing various process parameters [3]. To changing different parameters like Raster angle, infill density, Layer thickness found different ratio of tensile strength.

2.1 Material

3D printing materials are available in a good array of forms. Most consumer 3D printed products are made of thermoplastics. Designers and engineers prefer creating functional prototypes from 3D printing materials that have the identical or similar material properties as what's employed in creating the finished product. Plastics are the foremost widely adopted 3D printed material – and it comes in filament, resin, granule, and powder forms. Most thermoplastic 3D printing materials may be employed in home 3D printing technology and professional applications moreover. There are several variable printable materials like PLA, ABS, PVA, NYLON, HDPE, PEEK, RESIN, CARBONFIBRE, NYLON, INCOLE etc.

2.2 Printing Process Parameter

AM consists of the many technologies that create physical parts by the successive addition of materials. Various disciplines like architecture, medicine, engineering, education, and entertainment use AM technologies. To avoid confusion that may hamper

communication among different disciplines, this section defines the assorted process parameters supported on ASTM International standards.

1) Raster angle, sometimes called raster orientation, is that the direction of the deposited layers with relevance to the build platform. It always ranges from 0 to 90 [2]. The deposited filaments exiting the 3D printer nozzle form raster's (extrusions) that may be constructed using various angles to fill the inside of the part being manufactured.

2) Layer thickness is that height of every deposited layer within the 3D printed product. A product's height is that the sum of the thicknesses of the stacked layers extruded from the nozzle tip [1]. It depends on the nozzle tip diameter and therefore the filament material.

3) Infill percentage, sometimes called infill density, describes the solidity of the invisible inner structure of a printed part. In other words, it describes the infill volume, which plays an important role in a printed part's strength and mass. Usually, it ranges between 20% and 100%. Infill percentage is taken into account one in all leading parameters that significantly affect the part's mechanical properties [2].

4) Printing speed is that the nozzle's horizontal speed on the build platform during extrusion and deposition. It determines the overall printing time. It depends on the printing technique (stereo-lithography (SLA), selective laser sintering (SLS), and FDM) and also the filament material used. Typically, it ranges from 15 to 90 mm/s. The printing speed influences the material's spread and forming dimension quite all other FDM process parameters [2]. High printing speeds cause to over-extrusion on part edges and reduces extrusion width which winds up in poor dimensional accuracy as additional layers are added before previous layers have completely solidified.

5) Extrusion temperature is defined because the heating temperature for a filament material within the nozzle section during the extrusion process. It varies reckoning on the thermoplastic material type and therefore the printing speed.

3. Material Analysis

3.1 For ABS (Acrylonitrile Butadiene Styrene): Static Tensile Test

In order to determine the mechanical parameters of the tested materials the specimens were printed and extended In static tensile test according the PN-EN ISO 527-1/2012 and PN-EN ISO 527-2/1998 norms.
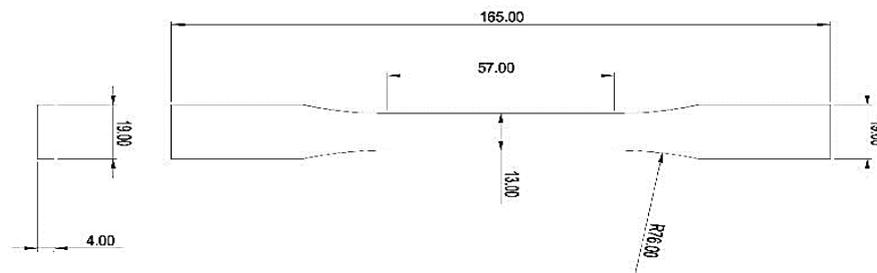
Fig. 5. Material Specimen.

Table 1. Dimensions of Material Sample.

Dimension	Unit
L1	60∓0.5 mm
L2	106-120 mm
L3	≥ 150 mm
B1	10∓0.2 mm
B2	20∓0.2 mm
H	4∓0.2 mm
L0	50∓0.5 mm
L	115∓1 mm
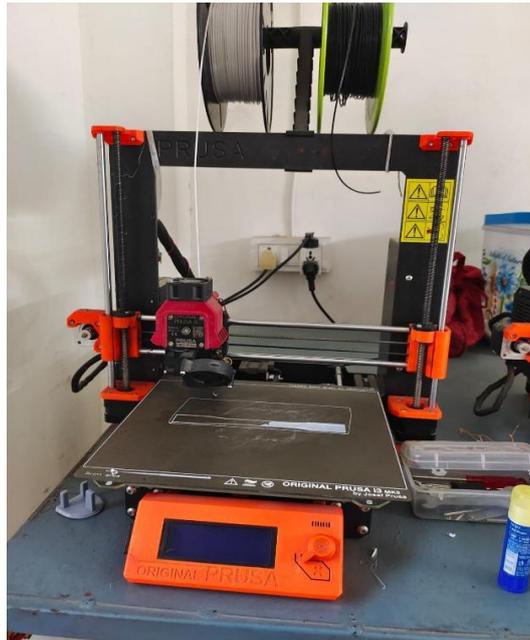
Fig. 6. Printing Material Specimen.

The research was done on standard size specimen (ASTM D638-03) and it was administrated on UTM (Universal testing machine). Machine is provided good sensor 16 md about range of 1000kN load capacity. Program is made for data acquisition. So as to work out the utmost force and values of Young's modulus for the studied materials, orientation and fulfilling, a 3-specimens were examined for a selected configuration. This work presents a comparison of two reasonably materials available on the market. The primary tested material was ABS by Solver and also the second was material named ABS B601 **[1]**. Specimens were printed within the same settings, where *20* means the peak of the paths (0,2 mm), *100* is for chamber temperature (100°), X, Y or Z means the axes orientation and # means the printing fulfilling. The 3D printer default fulfill value is 4. Authors distributed out the research also for value 1 of fulfil.
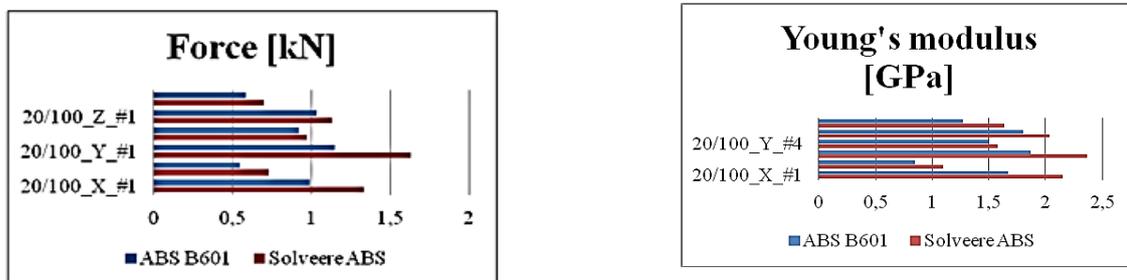
Fig. 7. Maximum strength obtained for the sample and Young's modules obtained for the Sample.

Fig. 8. Specimen Scrap.

The using of 3D printing technology for plastic materials enable rapid prototyping. It reduces the new construction testing time. Reducing the ratio of print fulfil, the printed object stiffness is increasing. Per presented equations, modification in stiffness matrix and mass matrix has a sway on obtained modes. Conducted modal analysis shows that the increasing of tested material

stiffness values increase the mods value range [4]. Strength tests shows that ABS by Solve ere material has higher Young's modulus value than the ABS B601 material. Modal analysis enables to avoid the hazardous vibration values of object still in design stage of construction. It's useful gizmo to diagnostic an object construction state.

3.2 For Polylactic Acid (PLA)

Many experiments on PLA material suggest that the last word strength heavily depends on the raster angle the implications of raster angle on the mechanical properties of PLA parts reduced using FDM. The assorted layer thicknesses were 0.1 and 0.2 mm, and three samples of each layer thickness were tested **[4]**. Three distinct infill patterns were used, and thus the experimental results indicate that layer thickness significantly influenced all three pattern's load capacities. A unique mechanical model of assorted mechanical properties that will accurately predict the strength and Young's modulus of FDM PLA. The experimental data show an identical effect of layer thickness on strength while varying the raster angles.
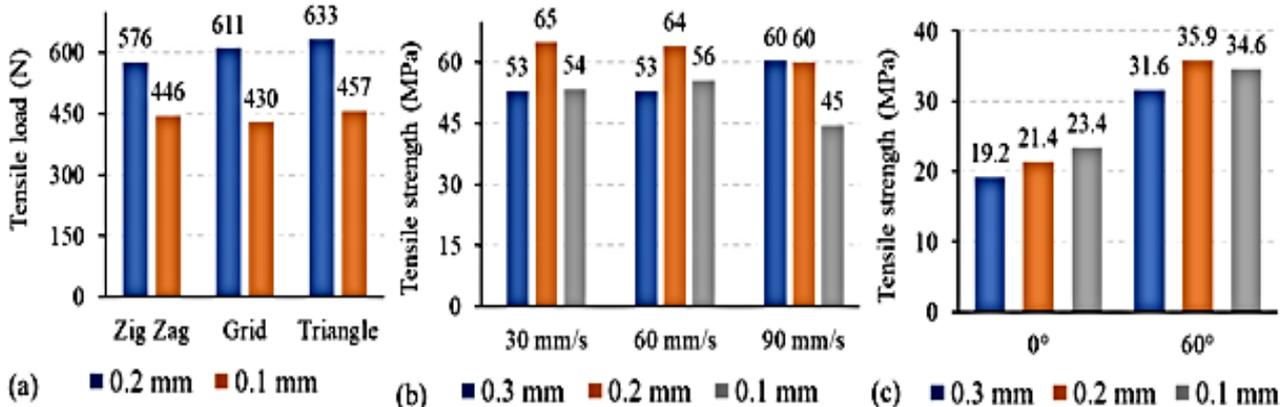
Fig. 9. (i) Influence of raster angle on PLA (a) tensile strength, (b) Young's modulus, and (c) % elongation and PLA strength sensitivity to layer thickness (mm) with different infill patterns.
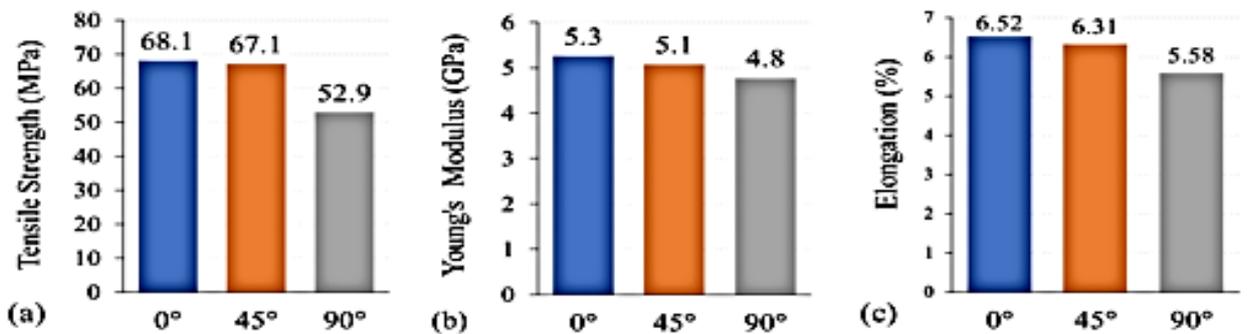
Fig. 9 (ii) Influence of raster angle on PLA (a) tensile strength, (b) Young's modulus, and (c) % elongation and PLA strength sensitivity to layer thickness (mm) with different infill patterns.
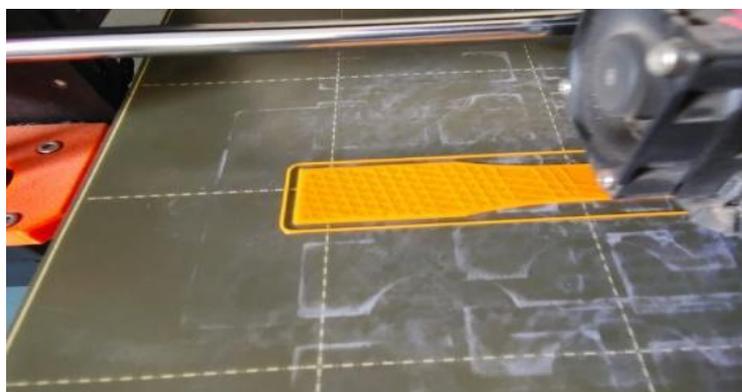
Fig. 10. Printing PLA Specimen.

The effects of varied manufacturing parameters on the mechanical behaviours of PLA parts fabricated via FDM methods. The study

concluded that increasing the infill percentage from 20% to 50% improved the UTS by 27%, yield stress by 21%, Young's modulus by 34% and elongation at break by 30% **[4]**. They also concluded that infill percentage influences these characteristics over layer height and build orientation. The increasing the PLA infill percentage from 25% to 75% could enhance the last word durability, yield strength and modulus of elasticity. Different printing speeds have a giant influence on the material's spread and forming dimension. In small parts, high printing speed results in material deformations thanks to new layers being placed on top of layers that haven't yet fully solidified. Consequently, the load of the new layer deforms the previous layer **[4]**. The study shows that different printing speeds (70, 80, 90, 100, and 110 mm/s) don't change Young's modulus by quite 20%. Additionally, higher printing speeds affect how the filament melts and causes poor layer-to-layer adhesion, which ends in lower strength. Additionally, examined the influence of various printing speeds (30, 40, and 50 mm/min) on the PLA's compressive strength.
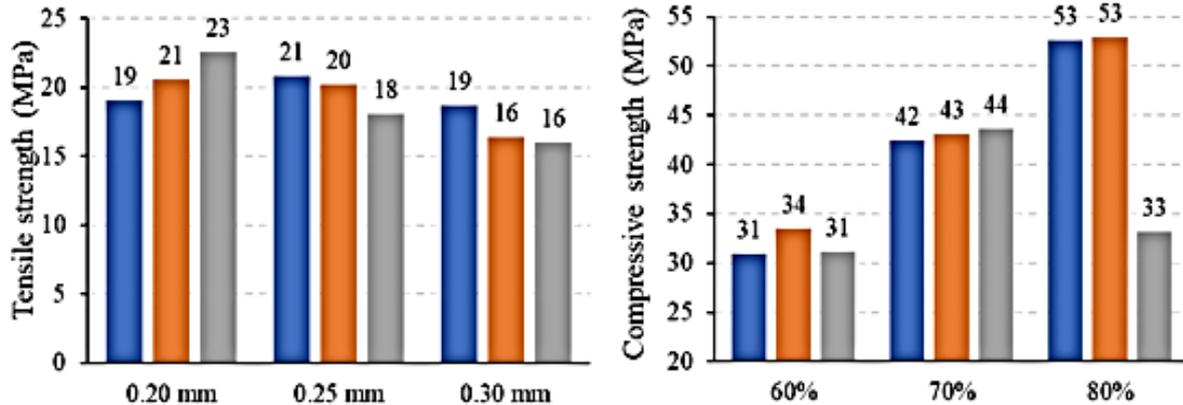
Fig. 11. (a) PLA tensile strength sensitivity to printing speed with different layer thicknesses (in mm) and (b) Compressive strength sensitivity to printing speed with different infill percentages.

Table 2. Process parameters range used for PLA.

PROCESS PARAMETER	RANGE SELECTED	LOW	MIDDLE	HIGH
Raster angle	0°–90°	0°	45°	90°
Layer thickness	0.1–0.3 mm	0.1 mm	0.2 mm	0.3 mm
Infill density	20-100%	20%	50%	100%
Printing speed	35-65 mm/s	35 mm/s	50 mm/s	65 mm/s
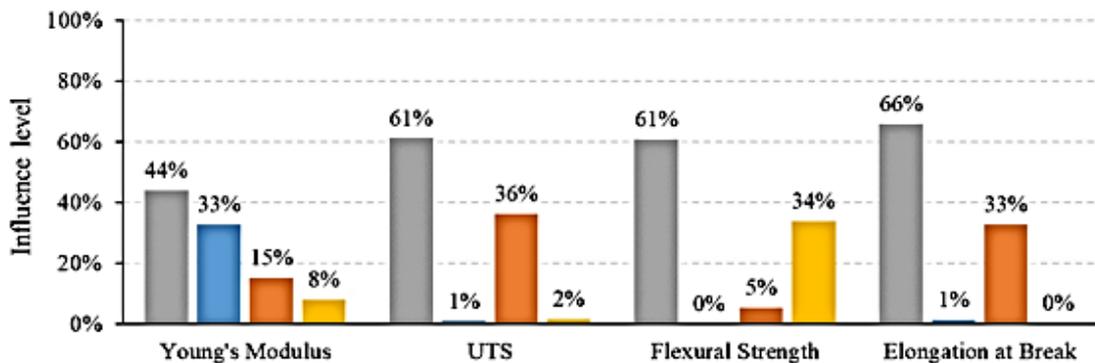
Fig. 12. Process Parameter's relative influence on PLA Mechanical Properties.

3.3 Polyether Ether Ketone (PEEK)

PEEK is a thermoplastic biomaterial that has superior thermal resistance, good dimensional stability, superior creep resistance, and excellent mechanical properties. It is used in compressor seals, aerospace components, and bearings as well as to support bone healing in human bodies. The size of printed specimen has selected of ISO527-02 standardized specimen. The dimensions are

mentioned as below:
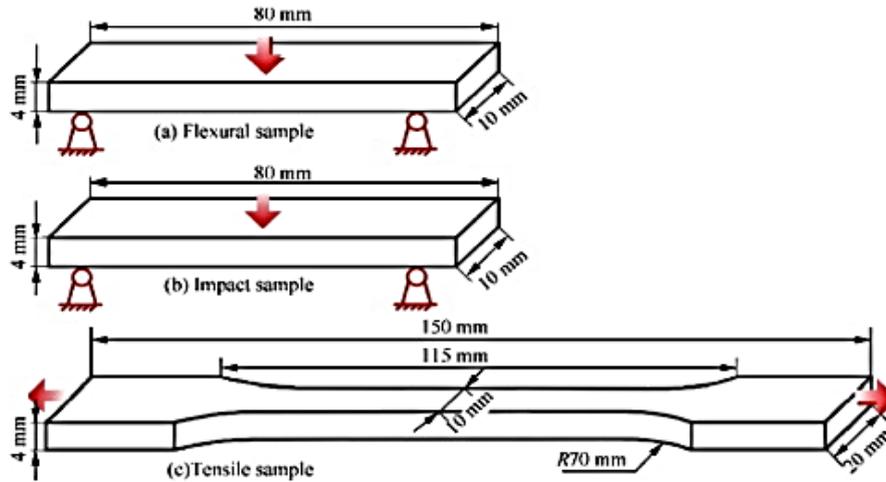
Fig. 13. Dimensions and load case of FDM-3D Printed Samples.

Effects of extruder temperature on mechanical properties including lastingness, flexural strength and impact strength of FDM-3D printed PEEK, CF/PEEK and GF/PEEK parts are illustrated that the extruder temperature can be from 360°C to 400°C, the lastingness and flexural strength of PEEK, CF/PEEK moreover as GF/PEEK increase. However, the impact property of fibre reinforced PEEK composites isn't obviously littered with nozzle temperature.
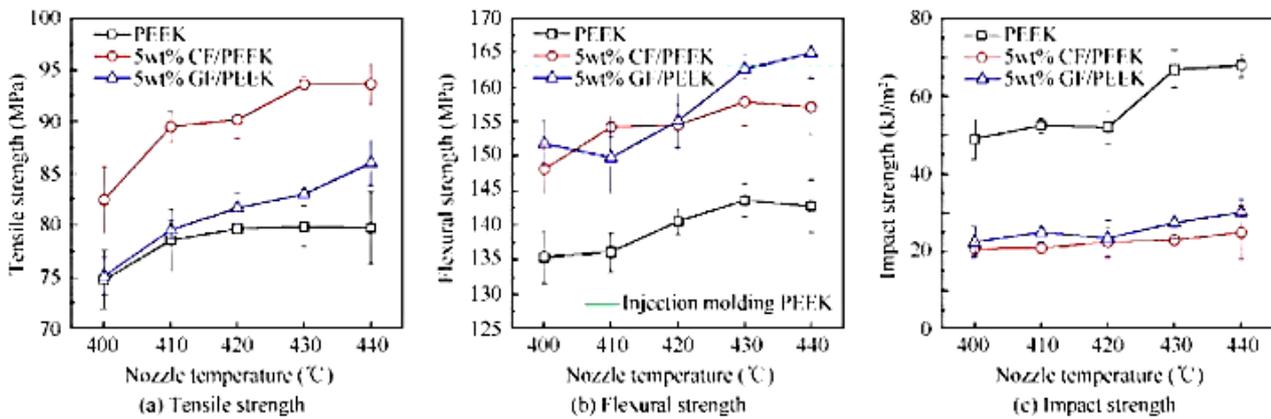
Fig. 14. Effects of Nozzle Temperature on Mechanical Properties.

The effect of platform temperature on the mechanical properties of FDM-3D printed PEEK, CF/PEEK and GF/PEEK parts. It will be seen that the influence regularity of the platform temperature on the mechanical properties is essentially according to that of the nozzle temperature: the tensile properties and flexural properties enhance because the platform temperature rising. When the platform temperature rises from 240 °C to 280 °C, the strength of CF/PEEK increases by most obviously to fifteen, and GF/PEEK has the largest improvement approximately 10% within the flexural strength.
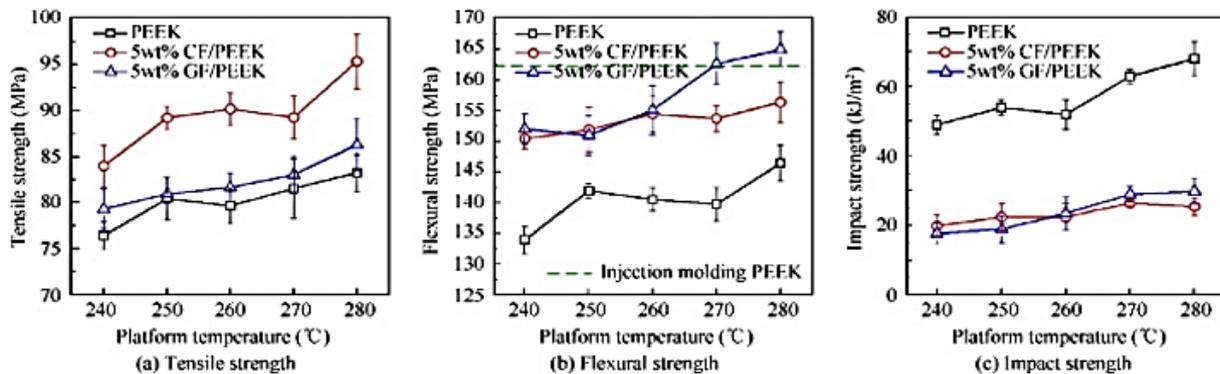
Fig. 15. Effects of Platform Temperature on Mechanical Properties.

While printing the PEEK material thing need to focus is that Control the temperature, Maintain clean nozzle, Keep the PEEK filament dry, Build platform material and Controlling the speed of print.

The effects of FDM-3D printing parameters on tensile properties, flexural properties and impact properties of printed PEEK, CF/PEEK and GF/PEEK samples were explored. So as to analyze the explanations of materials failure, the tensile fractured surfaces were observed by scanning electron microscope **[6]**.

Conclusion

The conclusions are given as follows:

The lastingness and flexural strength of CF/PEEK and GF/PEEK grow with the increase of nozzle temperature and platform temperature, respectively. However, the impact performance of fiber reinforced PEEK composites isn't obviously influenced by temperature. Extruder temperature of 440 °C and platform temperature of 280 °C lead to the largest comprehensive mechanical properties of printed CF/PEEK and GF/PEEK. Higher nozzle temperature makes better melting fluidity and formability of printed materials.
Increasing printing speed and layer thickness has negative effect on all mechanical properties of printed fiber reinforced PEEK composites. The results show that the printing speed and layer thickness are the crucial printing parameters affected the impact strength. The optimal mechanical properties are achieved when the printing speed and layer thickness are 5 mm/s and 0.1 mm respectively.

Result

By doing the various analysis of the specimen by changing the various parameter we find the different changes in the tensile strength, compatibility and the hardness of material occurs, durability as well as using taguchi method for optimization can help in to control material reduction in process. In addition, performing such research we can find out that the result shows the difference by changing some parameters so using this material in various application like aerospace industries, manufacturing in plastic polymers and different sectors of engineering to get better outcome. In future work we'll work on different specimen by using two different material at the same time.

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O&M Practices and Efficiency Improvements of AFBC Boiler

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Abstract

Energy crisis is one of the vital issues for the developing countries. The population growth and rapid industrialization increases the requirement of the energy sources increases. As per the current scenario, more than 399 thermal power plant are established with 2,34,000 MW generation capacity. The current study represents the energy escaping from the boiler and performance improvement of the AFBC Boiler. The boiler efficiency can be improved by increasing the number of tubes in the economizer, changing the insulation, by changing the fire nozzle angle etc. which enhances the thermal performance of the boiler. The current study focusses on the efficiency improvement of the AFBC boiler by increasing the number of tubes in the economizer. The result shows the thermal performance improvement of the AFBC boiler.

Keywords: Tools to improve boiler efficiency; Efficiency Improvement; Modification in Boiler; AFBC Boiler

Nomenclature	
ISO	International Organisation for Standards
RCA	Root Cause Analysis
KPI	Key Performance Indicator
QC	Quality Control
O&M	Operation & Maintenance
OHSMS	Occupational Health Safety Management System
AFBC	Atmospheric Fluidised Bed Combustion
VFD	Variable Frequency Drive
ID	Induced Draft
FD	Forced Draft
PA	Primary Air
MTBF	Mean Time Between Failure
MTTR	Mean Time to Repair
CLIT	Cleaning, Lubrication, Inspection & Tightening

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1. Introduction

Electrotherm (India) Limited is ISO 9001:2015, ISO 14001:2015, OHSMS 45001:2018 & ISO 50001:2018 certified company, Electrotherm (India) Limited is going through an operation excellence activity like Kaizen, Gemba Walk, RCA, 7 QC Tools, KPI, since January-2015 and started getting fruits from very first day.

Even through there is no Linear relationship between boiler load and efficiency, boiler efficiency is very poor both at low load and overload conditions. Efficiency is good at 80-90% loading. Efficiency of boiler depends on design of that boiler, and it should be experimentally determined at what load the boiler efficiency is maximum.

Fig. 1. Layout of the thermal power plant.

2. Methodology to Improve Boiler Efficiency:

In order to improve the efficiency of the boiler and to set the best O&M processes in Electrotherm (Captive Power Center) we have established the following methods:

2.1 Manage Boiler Loads:

Even if there is no direct linear relationship between boiler load and efficiency, boiler efficiency is worse for low loading and overload condition. Good performance at 80-90% upload. The efficiency of a boiler depends on

the construction of a particular boiler and should be determined by testing how much load is operating on the boiler.

2.2 Measure and Manage:

"What we cannot measure properly, we cannot manage properly"

Measure feed water flow, steam flow, fuel flow, pressure and temperature of gas, water and steam in several locations. Measure oxygen in the stack, compare all parameters with design values and identify the problem.

2.3 Monitor and Manage:

Monitor all the parameters mentioned in point (2) and record all the parameters periodically and compare the design parameters. Lower the gap between the design and the performance parameters for a specific load. Monitor specific steam production, special fuel consumption and daily temperature.

2.4 Boiler Tune-up:

Positive configurations using accurate testing equipment can detect and control excessive air, smoking, uncontrolled fuel loss, fire contact and high temperatures. Usually, 3% of the oxygen in the stack shows good tuning. Both high and low levels of oxygen in the stem result in low functioning, and low levels of oxygen in the starch also mean unhealthy and incomplete burns. Electrotherm (I) Ltd. monitors O2 Eco Outlet and continuous monitoring of gas stamp parameters by installing an online gas analyzer.

2.5 Combustion Control:

The total amount of air should be provided to be flammable and that should be automatically controlled by DCS control.

2.6 Low Excess Air Burner:

If the boiler burns gas or oil, then a low-temperature air heater should be used for high efficiency.

2.7 Additives:

Fuel additives help to improve the combustion of all types of boilers, and tests may be performed to determine the appropriate amount of additives to reduce fuel consumption by at least 2%. Electrotherm (India) Limited Uses petrol addiction to increase combustion efficiency.

2.8 Economizer & Air Preheater:

If the boiler is not fitted with an economizer and air preheater, consult an expert to replace the same so that it works more efficiently and saves fuel.

2.9 Soot Blower:

Soot is an excellent insulator, which can slow down heat to a large extent, so soot fuels are used to keep heat exchangers clean and to keep stack temperatures high and efficient. A spray gun or sonic soot blower / sonic horn operator can be used. Sonic Horn is advanced in terms of cost / initial performance, boiler safety and

efficiency. Every 40 ° F a drop in stack temperature saves 1% fuel. Electrotherm (India) Limited Use a sonic horn to keep the heat transfer area clean.

2.10 Blow Down Heat Recovery:

Blow down water temperature depends on pressure inside the boiler, and it contains a lot of energy that can go wasted if it is not put back to work either in the boiler or somewhere else. About 15% of ground water is heated to low pressure, so it is a good source of low pressure and can be used in a deaerator or water heater. This steam can be found in the flash tank and all the heat in the heat exchanger, and the subsequent heating of the water can be used in other applications as part of water conservation measures. Flash steam used in deer to heat Feed Water in Electrotherm (India) Limited.

2.11 Automatic Blow Down Control:

When the temperature is high, high energy explodes uncontrolled water, energy is wasted by dumping excess water in the boiler at a time, which should be replaced by cold cosmetic water. Lack of control can cause the soluble solids and concentrations of silica to rise, creating internal scales that will lead to tube failure, turbine insertion and reduced efficiency. Auto-down controls eliminate these problems and save water, chemicals and energy [1].

2.12 Vent Condensers:

Wherever steam is released into the atmosphere, a respirator can be used to capture this high energy level.

2.13 Increasing Cycles of Concentration of Boiler Water:

Cycles of concentration is the ratio of impurities being maintained in the boiler water to the impurity level of the boiler feed water. A higher cycle of concentration reduces blow down percentage and that improves boiler efficiency. Make sure that you are maintaining correct blow down percentage and cycle of concentration as per design. This is a tricky subject as too high a cycle of concentration may lead to scaling [1].

2.14 Solar Augmentation for Water Heating:

Rule of thumb is that every 10°C rise in feed water temperature increases boiler efficiency by 1%. Makeup feed water is a good candidate for solar augmentation.

2.15 Steam Trap:

Steam traps can waste a lot of energy if they do not work. Even when it works properly, steam traps do not work well, considering the loss of flash. Flash steam can also be detected by a dynamic pumping unit. Significant savings can be achieved with a proper steam trap repair program.

2.16 Condensate Recovery:

By not returning the condensate we release

    i.   Heat

    ii.   Water

iii.   Chemicals

A steam pump, also called a pressure pump, can be used to replace condensate and light steam.

2.17 Insulation:

Uninsulated hot surfaces are the source of lost energy as well as being a safety hazard. Insulation of bare steam piping is a quick payback item.

2.18 Steam Compression:

If you have low waste pressure and need a high pressure system somewhere far away from the distribution system, then system pressure may help. Screw compressor and steam educator sets developed for steam pressure driven by an electric or main engine type [1].

2.19 Steam Driven Pump and Blowers:

Electric-powered pumps and blowers are usually installed because they are lightweight and require minimal adjustment; however, if the cost of electricity is taken into account, steam-powered app can be very economical. If there is space to use the full volume of steam from a steam-powered machine, then a similar situation exists, where the rejected heat can be used to improve the efficiency of the entire cycle. Steam-powered equipment is especially popular when demand for electricity is very high.

2.20 Cogeneration:

Given the high cost of electricity, it is very expensive to use the mixing industry to supply steam while generating electricity. You can be independent of the grid and improve plant performance by avoiding grid failure.

2.21 Variable Frequency Drive or Adjustable Speed Drives:

Adjustable Speed drive is a proven energy saving method where pumps and fans operate at higher speeds than required for a specific load, The power used varies depending on the speed cube. Significant savings can be achieved by reducing the speed of rotating machinery. Rule 6: If the speed of the pump or the pump is reduced by half, there will be an 88% reduction in power consumption [1].

2.22 Soft Fine Brick in Combustion Chamber:

Light weight firebrick or ceramic fiber material should be considered for combustion chamber. This material heats up faster, taking the combustion zone through its cold smoky period more quickly. This should be considered for low use boilers.

2.23 Sizing of Coal:

Coal balancing is very important for heating and efficiency. Although different types of coal-fired boilers have different charcoal sizes, the atmospheric fluidized bed combustion (AFBC) boiler with a size of 6 mm is perfect. Excessive fines (over 30%) greatly reduce fire efficiency. Too many penalties help the formation of clinker.

Coal of large size reduces the efficiency of combustion and creates the problem of clinker formation. "Install VFD in a coal crusher to reduce coal mines and energy consumption"

2.24 Moisture in Coal or Fuel:

Heavy rains impede the availability of coal and increase moisture in coal. Every 10% increase in humidity in coal reduces the efficiency of boiler by 1% and creates other problems such as system congestion and generation.

2.25 Ash Conveying:

Care must be taken to ensure that the ash from the boiler is transported to the cell properly. There should be a level change in the hopper and alarm system. If the transmission system fails and there is no alarm, then there is a chance that the hoppers will be filled with ashes, and this will eventually pollute the economy or air heaters and reduce the efficiency of the boiler significantly.

2.26 Intermittent Ignition devices:

It does not make sense to keep the flames burning in a boiler when the heat is not needed, it wastes energy. Especially with gas-fired equipment, there are many small boilers with continuous driver flames. 24 hours a day, year after year, these tiny flames can use a lot of heat on BTUs. Occasional igniting technology has been proven to be reliable and safe, so these old-fashioned driving lights should be replaced with fittings. Occasional sewing devices are reliable certified machines. They are designed to regenerate in most boilers and furnaces and are inexpensive. Their payment period is shorter [2].

2.27 Use Flue Gas as Source of Carbon Dioxide:

In some location flue gas, with its high CO2 content, has been used as a source of CO2 for various purposes. This is a novel way to use a waste stream. There need to be a market for the CO2 and the boiler would be a reliable source.

2.28 Turbulators:

Turbulators are a very effective way to reduce stack temperature and increase the efficiency of fire tube boilers. In a hot tub boiler the hot gases must pass through a series of small tubes where the heat is supplied to the side walls causing the gases to slow down and slow down, forming layers of cold gas near the heat exchange. This condition prevents good heat transfer, so turbulators are used to break this protective film [2].

2.29 Heat Re-claimer:

It is heat exchanger installed in the stack with its own pump and regulating valves and is basically an additional heat exchange surface for the heating unit. The flue gas temperature can be controlled by regulating the flow of water through the heat re-claimer. Many of the older boilers have high stack temperature and high excess air levels, making this option very attractive.

2.30 Control Exhaust Draft Conditions:

In many cases the size of the stacks and exhaust systems is exaggerated, allowing unlimited drawings and often excessive misalignment to occur. Larger exhaust systems provide less resistance to different conditions for stacking and cause excess air to be pumped into the heater and facilitates the unlimited escape of large volumes of gases that emit high temperatures. Years ago, the gaps were cut in the stack with the molten metal inserted, but this option was unsatisfactory. A modern adjustable design, a special air-cooled barrier, is designed to show the best results. Install VFD in ID, FD and PA fan to control drafts and remove excess refractory from water wall to reduce ESP Inlet temperatures for Electrotherm (India) Limited boilers [2].

2.31 Autonomous maintenance:

Electrotherm (I) Ltd. we established best practices in maintenance of Critical auxiliaries of power plant. Started monitoring minor and major stoppage by using MTTR and MTBF Tools and improve MTBF and reduce MTTR by applying CLIT Schedule in Every equipment. Trained Operators to do minor maintenance activity and eliminate major breakdown by identifying and solving small variation in machine like, temp. Vibration, noise, leakages etc. (Condition Monitoring) CLIT Schedule of Boiler feed water pump [3].

Efficiency of boiler depends on flue gas outlet temperature so decreasing the flue gas outlet temperature, heat loss decreases. When the temperature decreased by 10°C, the efficiency improved of the boiler by 1%. If the excesses air supplied is very large amount, then the ignition temperature required for combustion of coal is decrease which effect the combustion efficiency of coal is reduced and due to these losses in boiler is maximized & formation of carbon monoxide is increase. Overall plant efficiency is depending on Combustion control optimization Flue gas heat recovery Soot blowing optimization. If Hydrogen % in fuel increases than it will lead to increase in loss due to H_2 in fuel & boiler efficiency will decrease. If there is increasing in the feed water temperature up to 6°C the boiler efficiency will increase up to 1%.

3. Conclusion

In the current study, various parameters were analyzed for the boiler efficiency improvement. The flue gas temperature, excess air supply and the hydrogen percentage in the fuel are the critical parameters for the boiler efficiency. The feed water temperature was enhanced by 1% when the feed water temperature enhanced by around 6°C. The overall efficiency improvement in the Boiler efficiency up to 81.45% in F.Y 2020-21 was observed in comparison to F.Y 2019-20 of 77.65% by accompanying the suggested changes.

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Application of an Improved Ant Colony Optimization on Generalized Traveling Salesman Problem

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Abstract

This paper presents ant colony system (ACS), a distributed algorithm that is applied to the generalized traveling salesman problem (GTSP). It gives a unique optimized implementation technique to lower the processing expenses engaged with routing of ants with inside the traditional ACO, and additionally the overall performance of the ACO via way of means of utilizing person range technique. Results display the velocity and meeting of the ACO may be advanced significantly, and the effects are pleasant in some event of GTSP. To attempt now no longer to stable in close by minima, an alternate interplay and a community searching through method are likewise added into this technique. Mathematical effects display that the proposed method can control the GTSP troubles truly well, and the created alternate interplay and close by hunt technique are powerful.

Keywords: Ant Colony Optimization, Generalized Traveling Salesman Problem (GTSP).

1. Introduction

The generalized traveling salesman problem (GTSP) is an augmentation of the notable traveling salesman problem. GTSP is a very important combinatorial optimization problem and is known to be NP hard. In the GTSP, the set of nodes is divided into clusters; the objective is to find a minimum-cost tour passing through one node from each cluster. Many applications of the GTSP exist in many fields. But researches still did not pay enough attention to GTSP specific local search and mostly use simple TSP heuristics with basic adaptations for GTSP [1]. Dorige presented the Ant Colony Optimization (ACO) in 1991[2], some strategies such as positive feedback and hidden parallel were proposed. By using positive feedback strategy, the ACO have the better result through parallel pheromone exchanging between ants. And by using hidden parallel strategy, jumping into the optimal solution can be prevented and the ACO is also very ancient. The researches and applications on ACO algorithm have made great progresses in the past years. Many scholars presented some efficient methods to solve these problems [3]. However, it still has some basic problems that have only been partially solved, such as searching time is too long and it may easily jump into local optimal solution. A big variety of publications had been dedicated to observe the TSP problem, together with some of its versions. The generalized TSP (GTSP) is a completely easy but sensible extension of TSP. In the GTSP problem, the set of nodes is the union of m clusters, which may also or may not be intersected. Every viable answer of GTSP, known as a g-excursion, is a closed path that consists of at the least one node from each cluster, and the objective is to discover an excursion with the minimum price. In a special case of GTSP, called E-GTSP, each cluster is visited exactly once [4]. The improvements of the ant colony algorithm are presented, provided the algorithm. Some simulation results are also provided.

The Ant Colony System

The Ant Colony System is evolved in step with the statement that actual ants are able to locating the shortest direction from a meals supply to the nest without the use of visible cues. To illustrate how the ''actual'' ant colony searches for the shortest direction; an instance from might be delivered for higher comprehension. In Fig. 1(a), assume A is the meals supply and E is the nest. The aim of the ants is to convey the meals again to their nest. Obviously, the shorter paths have gain as compared with the longer ones. Suppose that at time t = zero there are 30 ants at factor B (and 30 at factor D). And at this second there may be no pheromone path on any segments. So the ants randomly pick their direction with equal probability. Therefore, at the common 15 ants from every node will pass towards H and 15 towards C (Fig. 1(b)). At t = 1 the 30 new ants that come to B from A discover a path of depth, 15 at the direction that ends in H, laid through the 15 ants that went that manner from B, and a path of depth 30 at the direction to C, received because the sum of the path laid through the 15 ants that went that manner from B and through the 15 ants that reached B coming from D through C (Fig. 1(c)). The opportunity of selecting a course is consequently biased, in order

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that the predicted quantity of ants going closer to C could be double of these going closer to H: 20 as opposed to 10, respectively. The identical is proper for the brand new 30 ants in D which come from E. This manner keeps till all the ants will in the end select the shortest course [5].

Given an n-town TSP with distances Dij, the synthetic ants are disbursed to those n towns randomly. Each ant will select the subsequent to go to consistent with the pheromone path remained at the paths simply as cited within side the above example. However, there are foremost variations among synthetic ants and actual ants: (1) the synthetic ants have ''memory''; they could don't forget the towns they have got visited and consequently they could now no longer pick the ones towns again. (2) The synthetic ants aren't completely ''blind''; they recognize the distances among towns and like to select the close by towns from their positions [6]. Therefore, the opportunity that town j is chosen via way of means of ant okay to be visited after town i may be written as follows:
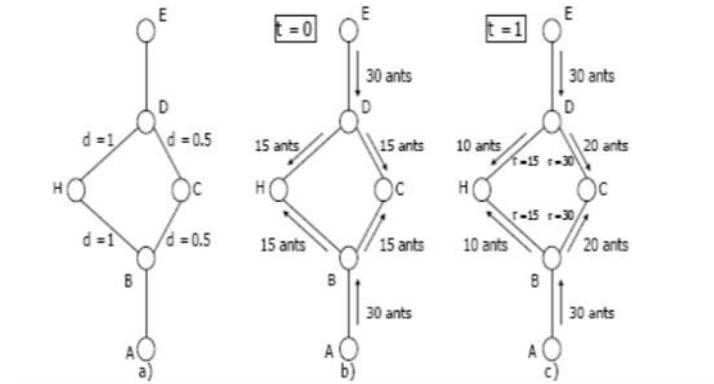
Fig. 1

Fig. 1. An instance with artificial ants. (a) The preliminary graph with distances. (b) At time t = zero there may be no path at the graph edges; therefore, ants pick whether or not to show proper or left with same chance. (c) At time t = 1 path is more potent on shorter edges, which might be therefore, within side the average, desired via way of means of ants.

$$p_{ij}^k = \begin{cases} \dfrac{[\tau_{ij}]^\alpha \cdot [\eta_{ij}]^\beta}{\sum_{s \in allowed_k}[\tau_{is}]^\alpha \cdot [\eta_{is}]^\beta} & j \in allowed_k \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

In which Sij is the depth of pheromone path among towns i and j, a the parameter to modify the effect of Sij, Gij the visibility of metropolis j from metropolis i, that is constantly set as 1/Dij (Dij is the space among metropolis i and j), b the parameter to modify the effect of Gij and allowed k the set of towns which have now no longer been visited yet, respectively. At the beginning, l ants are located to the n towns randomly [7]. Then every ant comes to a decision the subsequent metropolis to be visited consistent with the chance Pij okay given via way of means of Eq. (1). After n iterations of this process, each ant completes excursion. Obviously, the ants with shorter excursions need to depart greater pheromone than people with longer excursions. Therefore, the path degrees are up to date as on a excursion every ant leaves pheromone amount given via way of means of Q/Lk, in which Q is a consistent and Lk the period of its excursion, respectively. On the alternative hand, the pheromone will evaporate because the time is going via way of means of. Then the updating rule of Sij can be written as follows:

$$\tau_{ij}(t+1) = \rho \cdot \tau_{ij}(t) + \Delta\tau_{ij} \tag{2}$$

$$\Delta\tau_{ij} = \sum_{k=1}^{l} \Delta\tau_{ij}^k \tag{3}$$

$$\Delta\tau_{ij}^k = \begin{cases} Q/L_k & \text{if ant } k \text{ travels on edge } (i,j) \\ 0 & \text{otherwise} \end{cases} \tag{4}$$

Where t is the new release counter, q e [0, 1] the parameter to alter the discount of Sij, DSij the entire growth of path stage on edge (i, j) and DSij okay the growth of path stage on edge (i, j) due to ant okay, respectively. After the pheromone path updating process, the subsequent new release t + 1 will start.

ACO for the GTSP

The GTSP is a variation of the well-known TSP in which the set of nodes is divided into clusters; the objective is to find a minimum-cost tour passing through one node from each cluster. In GTSP, we are given n cities into m groups and we are required to find a minimum length tour that includes exactly one city from each group. Generally, we can mostly use simple TSP heuristics with basic adaptations for GTSP, but these conversions lead to the increasing of dimensions of the instance [8]. We use ACO to solve the GTSP without converting the instance. First, we introduce the GTSP with the mathematic model [13]: Let G= (V, E, W) be a completely weighted graph, in which V= {v1, v2... vn} (n≥3), E= {eij | vi, vj€ V}, and W {wij ≥0 and wij =0, ¥i, j N (n)} ij € N(n)} are vertex set, edge set and cost set, respectively. The vertex set V is partitioned into m possibly intersecting groups V1, V2…, Vm with |V j|≥1 and V=Um ,Vj. The unique Hamiltonian cycle is needed to by skip via all the groups, however now no longer all the vertices. At present there are forms of GTSP [15]: (1) the cycle passes precisely one vertex in every organization and (2) the cycle passes at least one vertex in every organization. In this paper, we add the parameter allowed k in the algorithm. The parameter allowed k denotes the city in the group has not been visited by ant t. By using allowed k, the algorithm avoids visiting the cities in the same group.

$$\text{Allowedk} = \{x \mid x \, €V \text{ and } c \, €G, \, ¥G€ \text{ tabuk} \} \qquad (5)$$

2. Ant colony optimization method for GTSP

Extended ACO technique for GTSP

In GTSP problem, the n towns are divided into m groups.
Each organization must be visited through precisely one town.
Initialize
For t=1 to new release quantity do
For k=1 to l do
Repeat until ant k has finished a excursion
Select the city j to be visited subsequent With possibility pij given by Eq. (1)
Calculate Lk
Update the trail levels according to Eqs. (2-4).
End

Algorithm:
1. Initialize:

   Set time:=0 {time is time counter}

   For each edge (i, j) set a preliminary sij = c for trail density

   and Dsij = 0.

2. Set s:=0 {s is tour step counter}

   For k:=1 to l do

   Place ant k on a town randomly. Place the town in visite dk.

   Place the organization of the town in tabuk.

3. Repeat until s 6 m

   Set s:=s + 1

   For k:=1 to l do

   Choose the following town to be visited in keeping with the probability pij k given by Eq. (1).

   Move the ant k to the selected city.

   Insert the selected city in visited k.

   Insert the group of selected city in tabuk.

4. For k:=1 to l do

   Move the ant k from visitedk(n) to visitedk(1).

   Compute the excursion period Lk traveled by ant k.

   Update the shortest tour found.

   For every edge (i, j) do

   For k:=1 to l do

   Update the pheromone trail density sij according to Eqs. (2)–(4).

   time:=time + 1

5. If (time<TIME_MAX) then

6. Go to Step 2 and repeat till step 5.

   Else print the shortest tour.

   Stop

3. 2-OPT local search

nearby seek To accelerate the convergence, a nearby looking method called ''2-OPT Local seek" is utilized in the proposed method.
Algorithm of the mutation process.
1. Randomly pick out t, let $0<t<m$
2. Randomly select s, let $0<s<|XC(visited(t))|$
3. For i:=1 to m-1 do
4. Insert the node N(visited(t), s) after the ith
5. node, compute duration i L
6. Find the shortest shortest L
7. If (shortest L< L origin)
8. Update the tour with the shortest one End

The function of the manner can be taken into consideration as to delete the crossover of visiting lines. The 2-OPT neighborhood seek basically eliminates edges from the excursion, and reconnects the 2 paths created. There is best one manner to reconnect the 2 paths in order that we nevertheless have a legitimate excursion (Fig. 4). We do that best if the brand new excursion may be shorter. It manner that a crossover factor is deleted within side the unique excursion. The pseudo-code of the 2-OPT manner is proven and the schematic diagram is proven respectively [9-10].

4. Numerical simulation

To confirm the validity of our proposed methods, those times may be received from TSPLIB library [13] and have been at the beginning generated for trying out preferred TSP algorithms. To take a look at GTSP algorithms, Fischetti et al. [12] furnished a partition set of rules to transform the times utilized in TSP to the ones which can be utilized in GTSP. Because the partition set of rules can generate the equal effects at distinctive experiments furnished that the records order are the equal, the partition set of rules may be used to generate take a look at records for distinctive algorithms. In the experiments, fundamental prolonged ACO method, ACO taken into consideration institution impact, ACO taken into consideration institution impact plus mutation procedure, ACO taken into consideration institution impact plus 2-OPT and ACO taken into consideration institution impact plus each mutation procedure and 2-OPT have been all executed 5 times [11].

Algorithm of the 2-OPT process.

1. Initialize

2. Select For i:=1 to i<m-3 do

3. Take For j:=i+2 to j<m do

4. If (di,i+1+dj,j+1>dij+di+1,j+1)

5. For k:=0 to k<(j-i)/2 do

6. Exchange (xj-k , xi+k+1).

Fig. 2

5. Conclusion

Focused on the generalized travelling salesman problem, this paper extends the ant colony optimization technique from TSP to this field. To avoid locking into close by minima, a mutation technique is also delivered into this technique. Moreover, a close-by searching technique, namely, 2-OPT are seeking for is applied The paper affords a unique optimized enforcing technique that's designed to lessen the processing prices worried with routing of ants' with inside the ACO; second, the man or woman variant is delivered to the ACO, which allows the ants have one-of-a-kind course strategies. In this model, we alter the routing method of the ant who labored better; this is to beautify the effect of pheromones with inside the course of this ant. As a result, the first-rate of answers of ACO set of rules has additionally been enhanced.

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Modelling and Simulation of Unified Power Quality Conditioner (UPQC) for Mitigation of Power Quality Problems

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Abstract

A power quality problem is an occurrence manifested as a nonstandard voltage, current or frequency that results in a failure or a mal-operation of end use equipment. With shifting trend towards distributed and dispersed generation, the issue of power quality is taking new dimensions. The concept of custom power was introduced to distribution systems for improving the system performance. The aim therefore, in this work, is to identify the prominent concerns in the area and thereby to recommend measures that can enhance the quality of the power, keeping in mind their economic viability and technical consequences. The Unified power quality conditioner (UPQC) is an effective custom power device for the enhancement of power quality due to its quick response, high reliability and nominal cost. A Unified power quality conditioner is used to compensate distortion in source current. It is efficiently capable of protecting sensitive loads against the voltage variations or disturbances//. The MATLAB software is used to simulate the 415 Volt system comprising of Non-linear load which injects harmonics in supply current and the supply voltage is Non-ideal. The Developed system in MATLAB using SRF (Synchronous reference frame) method.

Keywords: Harmincs Distoration, Powe Quality, Unified power quality conditioner, DVR, SRF

Nomenclature

DVR - Dynamic Voltage Restorer
APF - Active Power Filter
THD - Total Harmonic Distortion
UPQC - Unified Power Quality Conditioner
SRF - Synchronous Reference Frame
PLL - Phase Locked Lo

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1. Introduction

Power Quality (PQ) has become an important issue to electricity consumers at all levels of usage. The PQ issue is defined as "Any power problem manifested in voltage, current, or frequency deviations that results in failure or mal operation of customer equipment." The development of power electronic based equipment has a significant impact on quality of electric power supply. The switch mode power supplies (SMPS), dimmers, current regulator, frequency converters, low power consumption lamps, arc welding machines, etc. are some out of the many vast applications of power electronics based devices. The operation of these loads/equipment generates harmonics and thus, pollutes the modern distribution system. The growing interest in the utilization of renewable energy resources for electric power generation is making the electric power distribution network more susceptible to power quality problems. In such conditions both electric utilities and end users of electric power are increasingly concerned about the quality of electric power.

Many efforts have been taken by utilities to fulfil consumer requirement; some consumers require a higher level of power quality than the level provided by modern electric networks. This implies that some measures must be taken so that higher levels of Power Quality can be obtained. Active power filters (APF) have been proposed as efficient tools for power quality improvement. Active power filters can be classified as series or shunt according to their system configuration. The series APF generally takes care of the voltage-based distortions, while shunt APF mitigates current based distortions. The combination of series and shunt

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active power filter is called the unified power-quality compensator (UPQC). UPQC mitigates the voltage and current based distortion simultaneously as well as independently. In this thesis the main focus is on UPQC .

The paper [6] presents the enhancement of power quality for a micro grid system at distribution level using Shunt active power filter. The main objective of this paper is to identify a suitable controller technique for obtaining a better compensation capability of shunt active power filter. The compensation capability of the device is mainly depends on the regulation of DC link capacitor voltage. Conventionally this voltage regulation is achieved by the closed loop operation of PI controller. To raise the performance of shunt active power filter, Unit Vector Template Generation (UVTG) has been proposed [7].

2. Unified Power Quality Conditioner (UPQC)

The Unified Power Quality Conditioner is a custom power device that is employed in the distribution system to mitigate the disturbances that affect the performance of sensitive and/or critical load. It is a type of hybrid APF and is the only versatile device which can mitigate several power quality problems related with voltage and current simultaneously therefore is multi functioning devices that compensate various voltage disturbances of the power supply, to correct voltage fluctuations and to prevent harmonic load current from entering the power system. Fig. 3.1 shows the system configuration of a single-phase UPQC[15]. Unified Power Quality Conditioner (UPQC) consists of two IGBT based Voltage Source Converters (VSC), one shunt and one series cascaded by a common DC bus. The shunt converter is connected in parallel to the load. It provides VAR support to the load and supply harmonic currents. Whenever the supply voltage undergoes sag then series converter injects suitable voltage with supply. Thus UPQC improves the power quality by preventing load current harmonics and by correcting the input power factor .
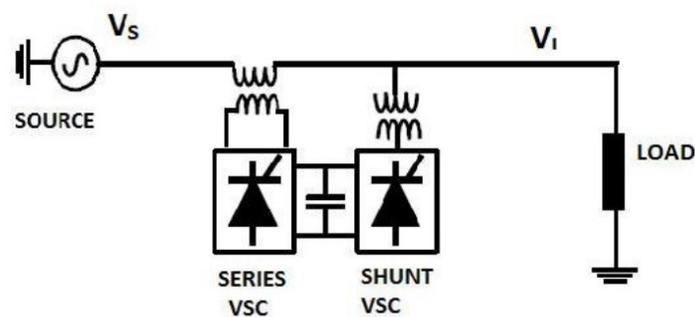
Fig.1. Block Diagram of UPQC

2.1 Series APF
In a transmission line series APF is generally connected in series. It is connected to the transmission line with the transformer. Series APF is a voltage source inverter connected in series with transmission line. It is used to compensate or mitigate the problems which comes due to voltage distortions and voltage unbalances. The series APF injects a compensating voltage so that load voltage will be perfectly balanced and regulated. Controlling of series inverter is done by PWM (pulse width modulation) techniques [14]. Here we used Hysteresis band PWM techniques as it implementation is easy. Also its response is fast. Its details are explained in subsequent sections.

2.2 Shunt APF
In a transmission line shunt APF is generally connected in parallel. Shunt APF is used to compensate for distortions & harmonics which are produced due to current. Due to non- linear load there are harmonics in load current, so to keep source current completely sinusoidal and distortion free, we uses Shunt APF[16]. Shunt APF injects compensating current so that the source current is completely sinusoidal and free from distortions. Controlling of Shunt APF is done by hysteresis band PWM techniques. In hysteresis band PWM techniques output current follows the reference and current and is within the fixed hysteresis band .

2.3 Synchronous Reference Frame (SRF) Technique
The series active filter based on SRF method can be used to solve the voltage related power quality problems such as, voltage sag, voltage swell and voltage harmonics. The SRF method is used in series active filter for generating reference voltage signal[17].

To implement the SRF method and for reference voltage calculation the phase locked loop (PLL) is used to generate the transformation angle (ωt) which presents the angular position of the reference frame. This transformation presents is known as

park transformation. Figure 3.10 Shows the Control block diagram of SRF theory for generating voltage reference signal in Series APF. The source voltages from a-b-c coordinates are transformed to d-q-0 coordinates. Then the d axis component is passed through low pass filter to obtain the reference source voltage in d-q coordinates. [13].
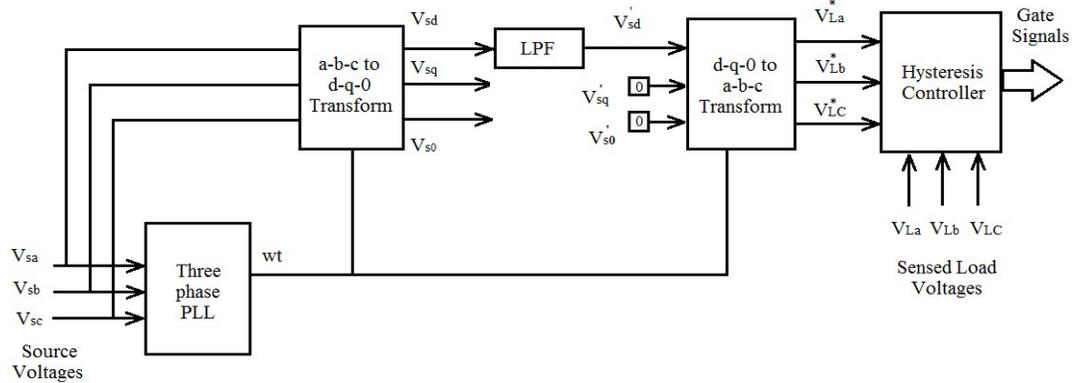
Fig. 2. Control Block Diagram of Series APF Using SRF

3. Simulation Results of Series APF with SRF

Series APF is used to mitigate all problems related to voltage unbalance and disturbance. It mitigate the voltage unbalance in source voltage i.e. voltage dip/rise so that the load voltage become perfectly balanced and regulated. Table-1 shows system parameters of series APF.

Table 1. System parameters used for series APF

Supply Voltage	415 V
Line Frequency	50 Hz
Line impedance	R = 0.01Ω & L = 0.01 mH
Load impedance	R = 50Ω & L = 1 mH
Series Transformer turns ratio	1:1
DC Voltage	415 V
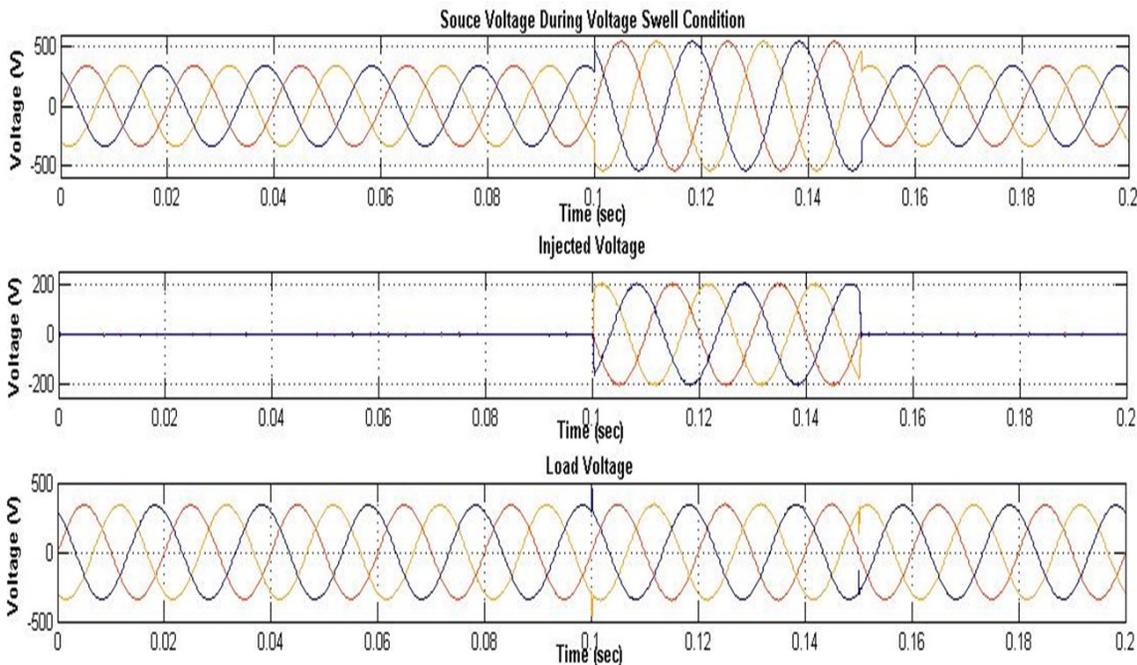
Fig.3. Voltage Waveforms of Series APF during Voltage swell

As given in Fig.3 it is the source voltage and load voltage during sag and swell condition with SRF theory. Sag time interval is 0.02 sec to 0.04 sec and swell time interval is 0.06 sec to 0.08 sec. The sag is due to voltage unbalance that may be caused due to faults and swell may be due to faults or capacitor switching. During the periods of voltage sag and voltage swell the voltage is injected in series with the line during 0.02 to 0.04 sec and 0.06 to 0.08 sec. In Fig.3 the load voltage of series APF during sag and swell is given. Due to operation of series APF the voltage sag from time interval 0.02 sec to 0.04 sec and voltage swell from 0.06 sec to 0.08 sec are removed and the load voltage becomes completely balanced. Now the voltage is completely balanced in whole interval of time.

2.4 Simulation Results of Shunt APF with SRF

Shunt APF is used to remove problems due to current harmonics. So it makes current drawn from source completely sinusoidal which is affected by load current harmonics. In Table-II system parameters of shunt APF are given

Table 2. System parameters of Shunt APF with SRF

Supply Voltage	415 V
Line Frequency	50 Hz
Source impedance	R = 0.01Ω & L = 0.01 mH
Load impedance	R = 50Ω & L = 1 mH
DC Link Voltage	800 V
DC Capacitor	2200 μF

As shown in fig.4.8 the waveform of load current of shunt APF is given and they are not sinusoidal due to presence of non-linear loads. This is non-linear waveform. They are Non-linear due to presence nonlinear loads like diode etc. Fig. 4.8 also shows source current of shunt APF with SRF. The source current waveform is sinusoidal after the operation of shunt APF.
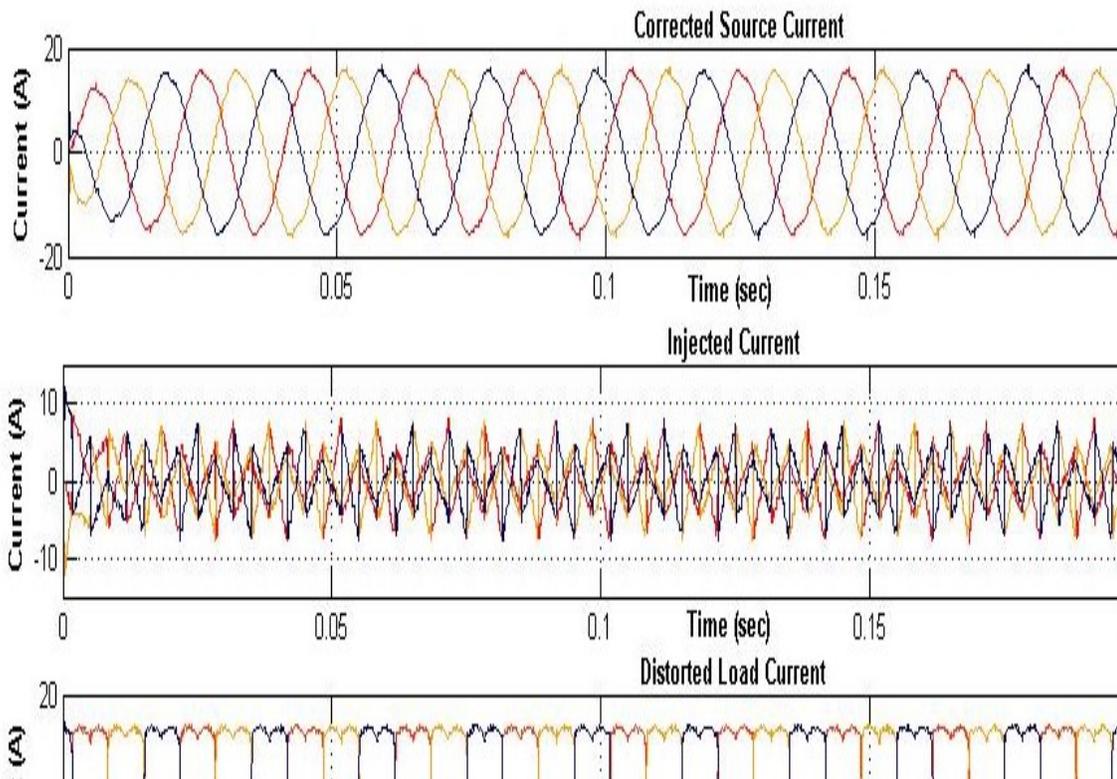
Fig. 3.1 Current Waveforms of Shunt APF during Only Nonlinear load connected

As shown in Fig.3.1 capacitor voltage is given. The shunt APF starts operating and PI controller compares the reference DC voltage and actual DC voltage of capacitor and always try to follow reference DC voltage which is 800 V.
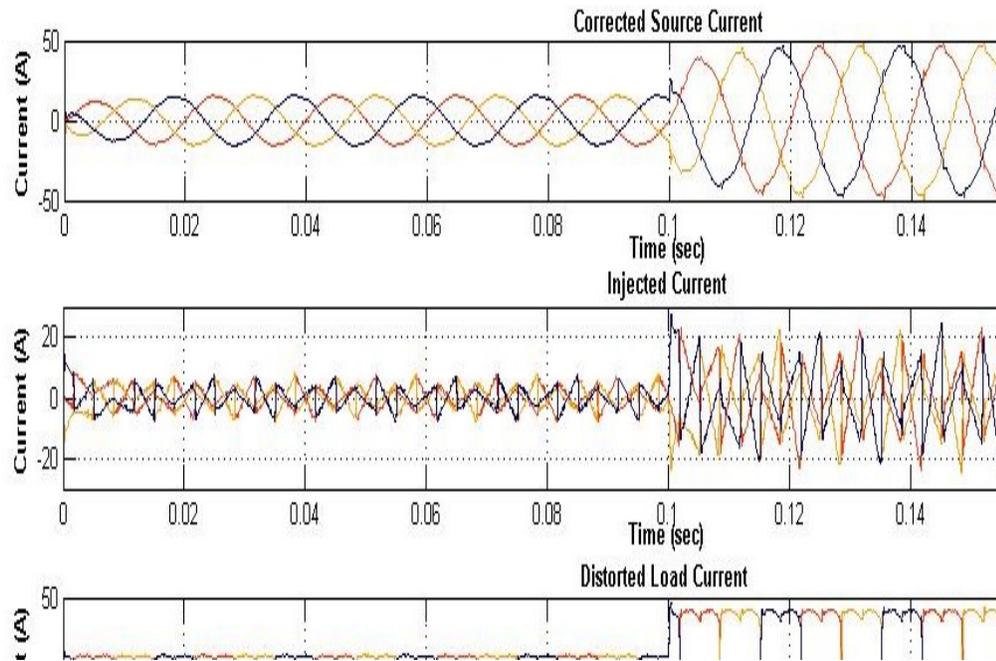
Fig. 3.2 Current Waveforms of Shunt APF during Only Nonlinear load connected
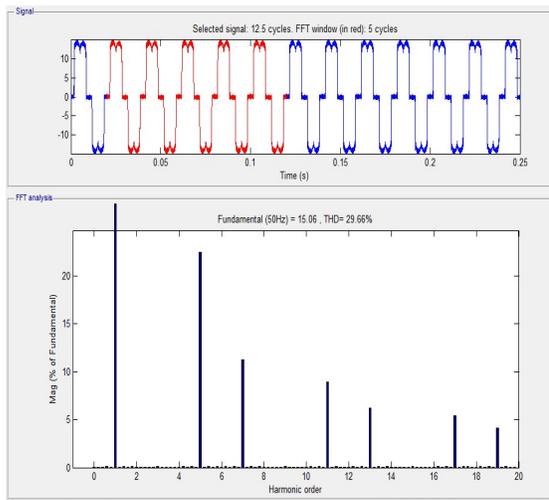
Fig. 3.3 THD of load current (A phase) using SRF   Fig. 3.4 THD of Source current (A phase) using SRF
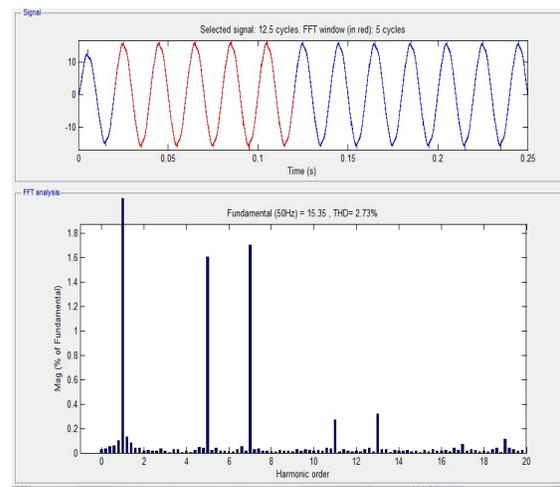
The % THD of load current of A phase was 30.53% and after operation of shunt APF the % THD of source current is reduced to 2.12 %. The % THD of load current of B phase was 30.57% and after operation of shunt APF the % THD of source current is reduced to 2.14 %. The % THD of load current of C phase was 30.53% and after operation of shunt APF the % THD of source current is reduced to 2.07 %.

4. Conclusion

Unified quality conditioner was studied and investigated in this paper for power quality improvement. UPQC is a type of advance hybrid filter which uses series APF for removal of voltage related problems like voltage sag and swell, fluctuation, imbalance and shunt APF for removal of harmonics in current harmonics.

Series APF model is developed using Synchronous reference frame (SRF) Theory and controlling techniques used are hysteresis voltage controller. The simulation is done and source voltage sag and swell are mitigated and load voltage is made completely balanced.

Shunt APF model is developed using Synchronous reference frame (SRF) Theory and control techniques used here is hysteresis current controller. The simulation is done and current harmonics are eliminated and current drawn from source is completely sinusoidal. The THD of source current is within the limit that is 5%.

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A Systematic Literature Review on Diagnosis of PCOS using Machine Learning Algorithms

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Abstract

The healthcare industry is very different from other industries. This industry is crucial and people expect the most important level of care and services. In terms of medical diagnostics by human specialists, it is very limited due to its subtlety, the complexity of the disease itself, and the variety that exists in all different interpretations. Machine Learning provides exciting and highly accurate solutions to medical diagnosis and is considered a critical alternative to future applications in the healthcare environment. The paper provides a review of the research done on diagnosis of diseases using different ML architectures and diagnosis of PCOS. Based on the review and its observation, research gaps are found.

Keywords: Medical Diagnosis, PCOS, Machine learning, Deep learning, CNN, Faster-RCNN .

1. Introduction

Diagnosis plays a significant role for not only patient care but research as well. If the diagnosis is accurate and timely, the patient has a better chance of getting a better health result because clinical decisions will be made to better understand the patient's health problem. Smart programs are increasingly being used in medicine and health care, but there is still a need for a robust and purposeful approach. Machine learning has shown great potential in targeting medical experts or patients. ML provides methods, techniques, and tools that can help solve diagnostic and predictive problems in a variety of medical fields.

It is argued that the successful implementation of ML methods could help the integration of computer-based programs into the healthcare environment that provide opportunities to assist and improve the work of medical professionals and ultimately improve the efficiency and quality of medical care. The Diagnosis can be made more accurate and the system can be more simplified with the help of Machine learning Algorithm like deep learning using Convolutional Neural Network (CNN) and Recurrent Neural Network (RNN).These methods can be widely used to model or simulate an intelligent system or process using annotated training data.

2. Background

- In terms of health care, A disease can be defined as a health condition that has a clearly defined reason behind it. A syndrome (from the Greek word meaning 'run together') however, may produce a number of symptoms without an identifiable cause. A syndrome refers to a group of symptoms, while a disease refers to an established condition.

- Medical conditions are often categorized as acute or chronic. Acute illnesses generally develop suddenly and last a short time, often only a few days or weeks. Chronic conditions develop slowly and may worsen over an extended period of time—months to years.

- One such type of illness is PCOS; it is a chronic disease with manifestations across the lifespan. Polycystic ovary syndrome (PCOS) is the most common endocrine disorder with a prevalence of 5~10 % among women with reproductive age and among them 70% remain undiagnosed. PCOS condition can be treated to some extent by controlled medication and bringing alterations in lifestyle.

- A polycystic ovary (PCO) can be characterized by twelve or more follicles with a diameter of 2-9 mm this causes the development of enlarged ovaries. PCOS affects both health and the quality of women's life. One place in particular, where machine learning has a widespread effect on the community is in the area of health care. In a growing industry of smart watches, fit bits, and devices that constantly gather a plethora of health data, the prevalence of using machine

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learning to analyze this data is gaining momentum. Machine learning has many applications in health care that involve diagnosis, image recognition, identification and prediction of data, etc.
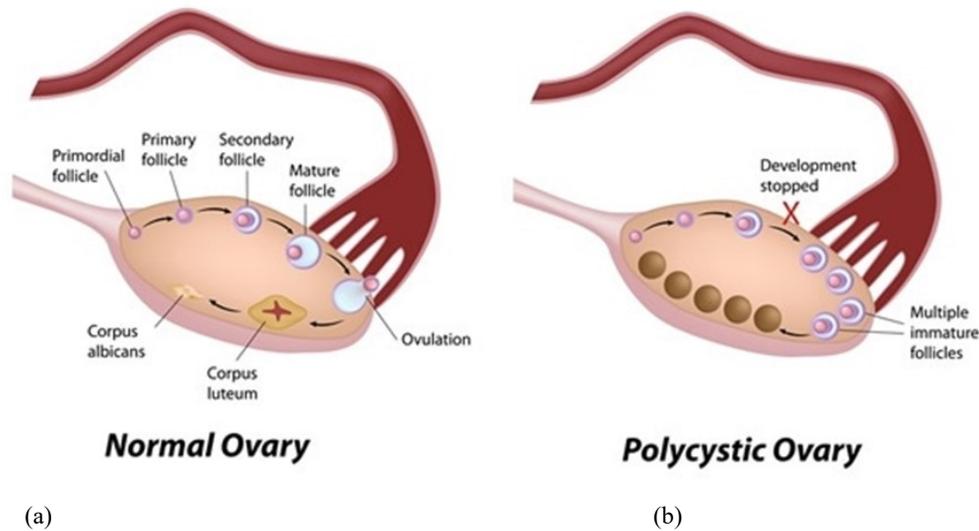
Fig. 1. Illustration of Ovaries for (a) Normal Ovary and (b) Polycystic Ovary

- The symptoms include cardiovascular diseases, infertility, type 2 diabetes, acne, baldness, hair loss, obesity, anxiety, depression, and stress. The early diagnosis and treatment can be used to control based on the symptoms and by the prevention of long-term problems. PCOS can be detected through ultrasound and sonography by a doctor by reckoning the number and size of follicles situated in the ovaries. However, this process takes a protracted interval, and needs good image quality and high accuracy to detect the presence of PCOS.
- Machine learning (ML) classification and feature selection algorithms have been used by researchers and clinicians for the prediction of diseases as a non-invasive method. PCOS datasets which consist of heterogeneous attributes related to biochemical, clinical, medical history, symptoms of the patients and ultrasound images are used to build predictive models.

3. Literature Review

3.1   *Medical diagnosis using Deep Learning*

- *Deep Learning in Medical Image Analysis by Lee Gobert, Fujita Hiroshi- 2020*

   The paper is divided into 3 parts. Part 1 explains issues and efforts needed to develop robust deep-learning-based CAD tools and integrate these tools into the clinical workflow. Also introduced medical image synthesis methods, mainly focusing on CNNs and GANs models. Part 2 compares the performance of deep learning algorithms for classification, Detection and segmentation on Images. Part 3 explains their proposed Computer-Aided Diagnosis system for Breast Lesion in Digital Mammogram based on deep learning detection, segmentation, and classification.

- *Deep and machine learning techniques for medical imaging-based breast cancer: A comprehensive review by Essam H. Houssein, Marwa M. Emam, Abdelmgeid A. Ali and Ponnuthurai Suganthan- Oct 2020*

   In this study, authors review the latest studies focused on the detection and classification of breast cancer. The review includes SVM, DT, Nearest Neighbor, Naive Bayesian Network, and ANN. It also focused on the Convolutional Neural Network and its Deep Learning architectures used to detect and classify breast cancer from different image modalities. This review provides a description of the medical imaging as well; Mammograms, Ultrasound, MRI.

3.2   *Diagnosis of PCOS using Machine Learning*

- An Efficient SMOTE Based Machine Learning classification for Prediction & Detection of PCOS by Pijush Dutta, Shobhandeb Paul and Madhurima Majumder – Nov 2021.

In this research a novel prediction model using Synthetic Minority Oversampling Technique (SMOTE) with five machine learning algorithms like Logistic Regression, Random Forest, Decision Tree Support vector machine and K-Nearest Neighbor (KNN) model which automates the PCOS detection in an early stage with higher degree of efficiency.In terms of execution time, SMOTE based Random Forest has taken remarkably less time with 0.10 seconds and both SMOTE based SVM & KNN has taken maximum area under ROC. The overall dataset contains 178 instances of the positive class (1) and 363 instances of the negative class (0). Unequal number of positive classes and negative classes within the dataset is one of the major causes of waning exactness of classification models.

- Diagnosis of Polycystic Ovary Syndrome Using Machine Learning Algorithms by Subrato Bharati, Prajoy Podder and M. Rubaiyat Hossain Mondal – June 2020.

  It can be seen that the ratio of Follicle-stimulating hormone (FSH) and Luteinizing hormone (LH) Indicated as the best ranking feature. It is shown in this paper that gradient boosting, random forest, logistic regression and RFLR exhibit good accuracy and recall values. RFLR has the best testing accuracy of 91.01%.

- Detection of Polycystic Ovarian Syndrome Using Follicle Recognition Technique by Rachana B, Priyanka T, Sahana K N, Supritha T R, Parameshachari B D, Sunitha R-July 2021.

  In this paper the approach taken to detect PCOS is using ultrasound images studying various features by combining segmentation, feature extraction and classification process. The various approaches for segmentation and classification were studied to enhance the past research to obtain a model with greater accuracy. For classification KNN method is used.

- Study and detection of PCOS related diseases using CNN by M Sumathi, P Chitra, R Sakthi Prabha and Srilatha K – Dec 2020.

  In this paper, CNN is used as an image classifier, by segmentation and feature extraction methods algorithm is capable of detecting cysts in the dataset. This process uses some input ultrasound images as train data and with their reference, it will classify test data in the dataset to know whether the ovary is affected and the parameters like area, solidity, extent, perimeter where exactly affected.

- Polycystic Ovarian Syndrome (PCOS) Classification and Feature Selection by Machine Learning Techniques by Satish C. R Nandipati, Chew XinYing and Khaw Khai Wah– Dec 2020.

  Radip Miner and Python are used to perform feature selection on various features like BMI: body mass index, hair growth and comparison between various algorithms like KNN, SVM, Random Forest, Naïve Bayes and Neural Network.The performances of each classifier and average performances show that RapidMiner can be used as an alternative machine learning tool. However, this cannot be a general rule since the performances depend on the nature of the dataset, sampling, and pre-processing steps.

3.3   *Comparison of Object detection algorithms*

- Some object detection algorithms are YOLO (You only look once), R-CNN, Fast R-CNN.
- YOLO is orders of magnitude faster (45 frames per second) than other object detection algorithms. The limitation of the YOLO algorithm is that it struggles with small objects within the image.
- R-CNN still takes a huge amount of time to train the network as one would have to classify 2000 region proposals per image.
- Both of the above algorithms (R-CNN & Fast R-CNN) use selective search to find out the region proposals. Selective search is a slow and time-consuming process affecting the performance of the network.
- Selective Search is a region proposal algorithm. It is based on computing hierarchical grouping of similar regions based on color, texture, size and shape compatibility.

R-CNN Test-Time Speed
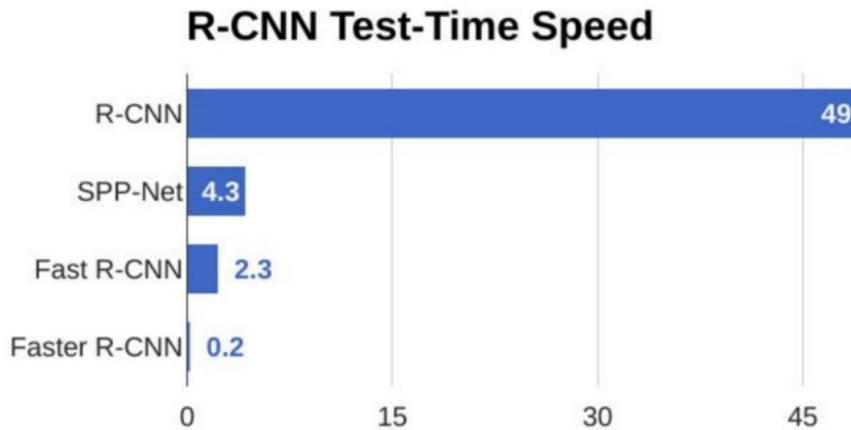
Fig. 2. Time speed graph of object detection algorithms

- Faster R-CNN is an object detection algorithm that eliminates the selective search algorithm and lets the network learn the region proposals.
- The image is provided as an input to a convolutional network which provides a convolutional feature map. Instead of using a selective search algorithm on the feature map to identify the region proposals, a separate network is used to predict the region proposals.
- The predicted region proposals are then reshaped using a RoI pooling layer which is then used to classify the image within the proposed region and predict the offset values for the bounding boxes.
- Faster R-CNN is much faster than its predecessors. Therefore, it can even be used for real-time object detection.

4. Observations

- CAD by the use of R-CNN showed high performance for detection.
- In image-based CADs by the use of CNN, classification of lung abnormalities was superior to feature-based CADx
- Analysis of types of images used for medical diagnosis.
- CNN used with a layer of faster R-CNN improved the accuracy in feature extraction.
- In term of execution time, SMOTE based Random Forest has taken remarkably less time with 0.10 seconds and both SMOTE based SVM & KNN has taken maximum area under ROC.
- Image processing before classification can improve the accuracy and performance of the model.
- The principle to detect PCOS is to find if the ovaries have a volume greater than or equal to 10 cm3, or having follicles around 10 or more in numbers with each 2-9 mm diameter.
- KNN provides accuracy as good as 97% but takes up a lot of computational time.
- Performance can be increased and time complexity can be reduced by an algorithm which combines image pre-processing and 'feature selection process' and only the selected features are trained.

5. Conclusion

- Repositories like kegal can be used to obtain a data set of medical images to train and test the model.
- Faster R-CNN has not been used yet for the diagnosis of PCOS.
- Deep learning models are faster than other models in the field of medical diagnosis.
- Other object detection algorithms can also be used for detection of cysts in ovaries such as YOLO, CNN , SPP-Net, R-CNN and fast R-CNN.
- Faster R-CNN eliminates many limitations of its contemporary object detection algorithms.
- Faster R-CNN has the tendency to detect smaller objects which will lead to more accurate and timely diagnosis of PCOS.

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Effect of Process Parameters in Fabrication of

10%SiC Reinforced Al 6061 MMC using Stir Casting Method

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Abstract

Metal matrix composites materials have wide range of applications due to high specific strength as well as good corrosion resistance. Metal Matrix Composites are the class of composite materials finding vast applications in automotive, aircraft, defence, sports and appliance industries. Such materials are fabricated by using different methods. Though these processes are not considered economical in the manufacturing of large structural components. Among all these methods, Stir casting appears to be very attractive as it is less costly and offers a wide range of material and processing condition options. In Stir casting, process parameters like stirring rate, stirring temperature, pouring temperature etc., are to be maintained for achieving improved behaviour and performance in the MMCs. In the present study, 10%SiC Reinforced Al 6061 metal matrix composites were fabricated by different processing temperatures with different holding time to understand the influence of process parameters on the distribution of particle in the matrix and some resultant mechanical properties.

Keywords: Metal matrix composites (MMC), Aluminium matrix composite (AMC), Reinforcement, particle distribution, Stir casting.

1. Introduction

Now-a-days, our life becomes comfortable with the development of various technologies due to accessibility of suitable materials. Composite is a combinations of materials differing in composition or form on a macro scale. Composite materials consist of synthetic fibres embedded within a matrix, a material that dispersed and is throughout bounded with the fibres. The most important benefits of composite over the conventional material are light weight, corrosion and fatigue resistance, high stiffness and strength. [1] There are three main types of composite matrix materials: Ceramic matrix composites (CMCs), Metal matrix composites (MMCs) and Polymer matrix composites (PMCs). All engineering materials can be used as matrix for the production of MMCs. Aluminium, magnesium, titanium and their alloys are the most commonly used matrix materials in the production of MMCs due to their lightness, high temperature resistance and ductility. Materials like SiC, SiO_2, Al_2O_3, B_4C and MgO are generally preferred as reinforcement elements. These can be used as long fibers, short whiskers or particles in either an irregular or spherical shape. The properties of the resulting composites are generally controlled by three critical components: Matrix, Reinforcement and Interface. AlSiCp composite material used on inside edge of body panel of automobiles, on the ceiling of automobiles for weight ratio management. Table.1 shows the composition of MMC with metal matrix & reinforcement material.

In order to achieve the optimum properties of the metal matrix composite, the distribution of the reinforcement materials in the matrix alloy must be uniform, and the wettability of bonding between these two substances should be optimized. The chemical reaction between reinforcement materials and the matrix alloy and porosity must be avoided or minimised. A sufficient bond is achieved only when good wetting of the reinforcement by the matrix is obtained, and this is dependent on the surface properties of the two phases. It is believed that a strong interface permits transfer and distribution of load from the matrix to the reinforcement, resulting in an increase in elastic modulus and strength. Fracture in discontinuously reinforced composites can result mainly from de-bonding of particles from the matrix [10].

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Table 1. Composition of MMC with Metal Matrix & Reinforcement Material.

Name of the MMC	Matrix Metal	Reinforcement		
		1	2	3
Al/SiC/Al$_2$O$_3$	Al	SiC	Al$_2$O$_3$	
Al/SiC/TiB$_2$	Al	SiC	TiB$_2$	
Al6061/TiB$_2$/12p	Al6061	TiB$_2$	12p	
Al/SiC/B$_4$C	Al	SiC	B$_4$C	
Al6063/SiC/ Al$_2$O$_3$/Gr	Al6063	SiC	Al$_2$O$_3$	Gr
Al/B$_4$C	Al	B$_4$C		
Al7075- Al$_2$O$_3$	Al7075	Al$_2$O$_3$		
ZC63/ Mg Alloy/ Fly ash	ZC63Mg	Fly ash		
Mg/Y$_2$O$_3$	Mg	Y$_2$O$_3$		
Mg/Al/Si	Mg/Al	Si		
Mg/1.3CNT	Mg	1.3CNT		
Mg-Al-Sn-GNPs	Mg/Al	Sn	GNPs	
AA2219-TiB$_2$/ZrB$_2$	AA2219	TiB$_2$	ZrB$_2$	
Al217+9% B$_4$C	Al217	B$_4$C		
Al2017+9%B4C+3%Gr powder	Al217	B$_4$C	Gr	

After the development of mixing techniques, by which ceramic fibres or particles were dispersed in matrix metals, the research on evaluation of those composites became very active and many papers about it have been published. [11]. Stir casting is the cheapest and easiest and the applications like automotive and aeronautics involves manufacturing and utilization of large number of components, so the price should be low and the process should be easy and simple. Lot of researches is going on this area by varying different parameters. Stir casting of metal matrix composites suffers from several limitations like uneven distribution, low wettability and cluster formation. Designing and trying out inventive impeller geometry can overcome all these limitations. Hence, researches focused on designing, fabricating and testing different stirrers and feeders and utilizing them in stir casting for the manufacturing of different metal matrix composite material [12]. The most important challenge during fabrication of metal matrix composites (MMCs) by liquid phase processes are uniform mixing of reinforcement in the matrix without sinking, floats and wettability of ceramic particles in the base metal with less porosity and higher density. To overcome these challenges, adding nano particles by stirring with squeeze casting procedure was adopted. [15]

1.1. Objectives for MMC Development

The objective of metal matrix composite material development is to combine the desirable properties of metals and ceramics. The reinforcement takes the form of particles, whiskers, short fibers, or continuous fibers in the MMCs. The metal reinforcement have different objectives. The reinforcement of light metals opens up the possibility of use of these materials in areas where weight reduction is the first priority. [2] The development objectives for light metal composite materials are:

1. Increase in creep resistance at higher temperatures compared to that of conventional alloys,
2. Increase in yield strength and tensile strength at room temperature and above while maintaining the minimum ductility or rather toughness,
3. Increase in fatigue strength at high temperatures,
4. Improvement of thermal shock resistance,
5. Improvement of corrosion resistance,
6. Increase in Young's modulus,
7. Reduce density,

8.　Controlled thermal expansion coefficient.

1.2. Advantages & Applications of Composites

Composite materials have different properties like light weight, high strength, corrosion resistance, high-impact strength, design flexibility and dimensional stability. It finds huge application in aerospace, automotive, structural and marine industries include performance, economic and environmental benefits. [3] Light weight metal-matrix composites have been attracting growing interest and introduced into the most important applications in the automotive industry.

Aluminium matrix composite (AMC) is an attractive class of composite materials which possesses the material requirements for structural applications in the automotive industry. The major requirement of AMC in the auto industry is as a result of its mass reduction; improve wear resistance and material properties particularly high strength and stiffness. Aluminium based MMC has attracted by researchers due to its low density, high thermal conductivity, low melting point and the ability to be reinforced by a wide variety of reinforcement phases such as SiC, Al_2O_3, TiC, B_4C and fly ash. [23]

2. Literature Review

Aluminium A356 alloy with different weight fractions of (0, 5, 7.5, 10 and 12.5%) RHA and Fly ash reinforced hybrid composites were successfully fabricated by using double stir casting technique. [13] Mono and hybrid composites were successfully prepared with B_4C and Gr flakes/ Powder reinforcements respectively using stir casting method. [14] Among all these reinforcement phase, silicon carbide (SiC) is an ideal candidate because of its significant ability to enhance the strength and stiffness, modulus, thermal stability, and abrasive wear resistance of the aluminium matrix. Stir casting methods when used to make the $A356/Al_2O_3$ micro and nano composites [15] revealed that the nano composites exhibited better properties in terms of compressive strength, hardness with reduced porosity. It was concluded that a 700 rpm stirring speed with 15 min stirring time could produce a composite sample with the incorporation of most of the added particles distributed almost uniformly throughout the microstructure. [16] Aluminium-silicon carbide is a metal matrix composites material consisting of silicon carbide particles dispersed in a matrix of aluminum alloy. It combines the benefits of high thermal conductivity of metal and low coefficient of thermal expansion of ceramic. With its composite features, Al-SiC is an advanced packaging material for high technology thermal management. Al-SiC is compatible with a wide range of metallic and ceramic substrate and plating materials used in microelectronic packaging for aerospace, automotive, microwave applications. Al-SiC allows for a new packaging technology that can replace traditional W-Cu, Mo, BeO, Kovar, Mo-Cu, AlN, AlSi, Al_2O_3.
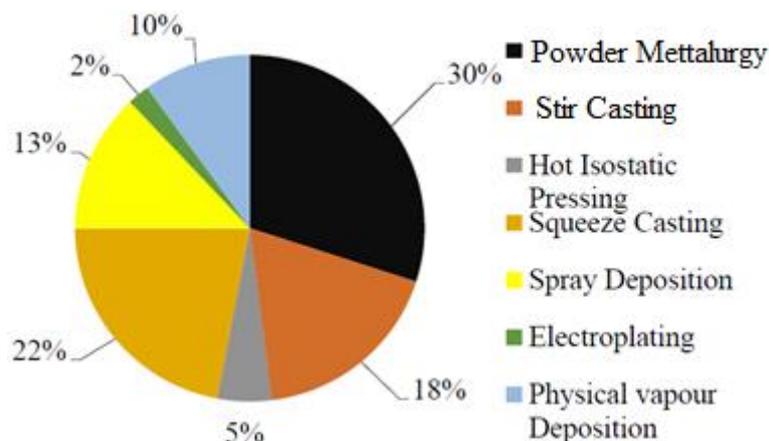

Fig.1. Researches on fabrication routes of MMCs in past decades. [19] [20]

2.1. Fabrication Methods

There are different fabrication methods available in manufacturing of the MMC materials. Fabrication methods can be divided into three types. These are solid phase processes, liquid phase process and semi-solid fabrication process. Solid

state processes are generally used to obtain the best mechanical properties in MMCs, particularly in discontinuous MMCs. According to the type of reinforcement, the fabrication techniques can vary considerably. The processes can be classified into five categories: (1) liquid-phase processes, (2) solid-liquid processes, (3) deposition techniques and (4) in situ processes. (5) two- phase (solid-liquid) processes.

Liquid phase fabrication of metal matrix composite involves incorporation of dispersed phase into a molten matrix metal, followed by its solidification. In order to provide high level of mechanical properties of the composite, good interfacial bonding (wetting) between the dispersed phase and the liquid matrix should be obtained. Wetting improvement may be achieved by coating the dispersed phase particles (fibers). Proper coating not only reduces interfacial energy, but also prevents chemical interaction between the dispersed phase and the matrix. The methods of liquid state fabrication of Metal Matrix Composites: Stir casting, Infiltration like gas pressure infiltration, Squeeze casting infiltration or Pressure die infiltration.

Stir casting method has a good potential in all-purpose applications as it is a low cost MMCs production method. To obtain a successful reinforcement process in the production of MMCs, the most important and effective criterion is the selection of the appropriate method and material. In order to provide good wettability between matrix and reinforcement particles, stir casting is the most common method used in the manufacturing field.

2.2. Stir Casting

Stir casting of metal matrix composites was found in 1968, when S. Ray introduced alumina particles into aluminium melt by stirring molten aluminum alloys containing the ceramic powders. It is a liquid state method of composite materials fabrication, in which a dispersed phase (ceramic particles, short fibers) is mixed with a molten matrix metal by means of mechanical stirring as shown in Fig. 1. There are different materials required for stir casting setup: Refractory bricks, crucible, blower, stirrer and charcoal. The stir casting methodology is relatively simple and low cost. It can be prepared by fairly conventional processing equipments by the use of stirring mechanism. [4] A refractory brick is a block of refractory ceramic material used in lining furnaces built to withstand high temperature and have low thermal conductivity. Crucible is the container in which the metal is melted and then poured into a mould to perform casting. The material of the mould should be a very good conductor of heat so that heat loss should be less. There are several materials available for this purpose like silicon-carbide, cast steel and graphite. The blower motor blows out high volume air for proper combustion of the fuel. By controlling the blower speed, the temperature in the furnace can be modified. A stirrer is required which can withstand the high temperature and doesn't affect the purity of the composite. Charcoal is a lightweight, black residue, consisting of carbon and any remaining ash, obtained by removing water and other volatile.

The liquid composite material is then cast by conventional casting methods and processed by conventional metal forming methods. [5] It has different benefits like simplicity, flexibility and applicability to large quantity production. It is also attractive because it allows a conventional metal processing route to be used and hence minimizes the final cost of the product. The cost of preparing composites material using a casting method is about one-third to half that of competitive methods, and for high volume production, it is projected that the cost will fall to one-tenth. In general, the solidification synthesis of metal matrix composites involves producing a melt of the selected matrix material followed by the introduction of a reinforcement material into the melt, obtaining a suitable dispersion. Stir casting is suitable for manufacturing composites with up to 30% volume fractions of reinforcement.

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The distribution of the particles in the molten matrix depends on the geometry of the mechanical stirrer, stirring parameters, placement of the mechanical stirrer in the melt, melting temperature, and the characteristics of the particles added. An interesting recent development in stir casting is a two-step mixing process. In this process, the matrix material is heated to above its liquids temperature so that the metal is totally melted. The melt is then cooled down to a temperature between the liquids and solidus points and kept in a semi-solid state. At this stage, the preheated particles are added and mixed. The slurry is again heated to a fully liquid state and mixed thoroughly. This two-step mixing process has been used in the fabrication of aluminum metal matrix composite. Among all the well-established metal matrix composite fabrication methods, stir casting is the most economical. For that reason, stir casting is currently the most popular commercial method of producing aluminum based composites.

Major researches have been found on study of quantitatively measures with the actual SiC concentration in Al. The objective of the study is the influence of stir casting process parameters such as processing temperature and holding time on the uniform distribution of particles and resulting mechanical properties.

2.3. Factors considered in preparation of metal matrix composites by stir casting method:

To achieve uniform distribution of the reinforcement material
In the stir casting process it is important that the reinforcement particles should be properly distributed in the molten matrix phase during casting. During this phase sometimes problem arises due to density difference between the reinforcement particles and the matrix alloy melt. It can be avoided by vortex method in stir casting process. In this method, after the matrix material is melted, it is stirred vigorously to form a vortex at the surface of the melt, and the reinforcement material is then introduced at the side of the vortex. The stirring is continued for a few minutes before the slurry is cast.

To achieve wettability between the two main substances
Wettability can be defined as the ability of a liquid to spread on a solid surface. Successful incorporation of solid ceramic particles into casting requires that the melt should wet the solid ceramic phase.

To minimize porosity in the cast metal matrix composite
In general, porosity arises from three causes: (a) gas entrapment during mixing, (b) hydrogen evolution, and (c) shrinkage during solidification. The process parameters of holding times, stirring speed, and the size and position of the impeller will influence the development of porosity, chemical reactions between the reinforcement material and the matrix alloy.

3. Selection of mixing technique

The method selected for incorporating particles and their mixing with the molten matrix play an important role in distributing the reinforcements. Although several techniques for introducing and mixing particles in the melt is known, a majority of those processes are found to be ineffective in dispersing nanometric particles, i.e. gas injection of particles introduces huge amount of gas into the melt without any significant incorporation of particles in the melt. Mechanical stirring often used for mixing, introduces floating impurities and oxide layers in the melt and excessive stirring can increase the gas content in the melt which increases porosity in the cast sample. Stirring speed and time, melt temperature, prevailing atmosphere over the melt, amount and nature of the particles to be introduced into the matrix are important factors which is required to be monitored and controlled precisely for effective incorporation of nanometric particles in the melt. [6]

3.1. Process Parameters

This liquid metallurgy technique is the most economical among all the available methods for metal matrix composite production, and allows very large sized components to be fabricated. Also the cost of preparing composites material using a casting method is about one-third to half that of competitive methods, and for high volume production, it is projected that the cost will fall to one-tenth. In preparing metal matrix composites by the stir casting method, there are several factors that need considerable attention, including the difficulty of achieving a uniform distribution of the reinforcement material; wettability between the two main substances; Porosity in the cast metal matrix composites; and Chemical reactions between the reinforcement material and the matrix alloy. Following parameters are taken into consideration during MMC fabrication by using stir casting method. It has been observed that melting and pouring conditions have directly or indirectly effect on mechanical properties of cast materials as hardness, percentage elongation, percentage reduction in diameter, toughness and so on. [7]

Stirrer Design: It is the important parameter in stir casting required for vortex formation. It contains blade in which blade angle and number of blades decides the flow pattern of the liquid metal. The stirrer is immersed till two third depth of molten metal. It is required for uniform distribution of reinforcement in liquid metal, perfect bonding as well as to avoid clustering.

Stirrer Speed: Stirring speed is an important parameter to promote binding between matrix and reinforcement i.e. wettability. The flow pattern of the molten metal is directly controlled by the stirring speed. Stirring speed decides vortex formation which is responsible for dispersion of particulates in liquid metal. [8]

Fig. 2 shows the bottom pouring type stir casting furnace.
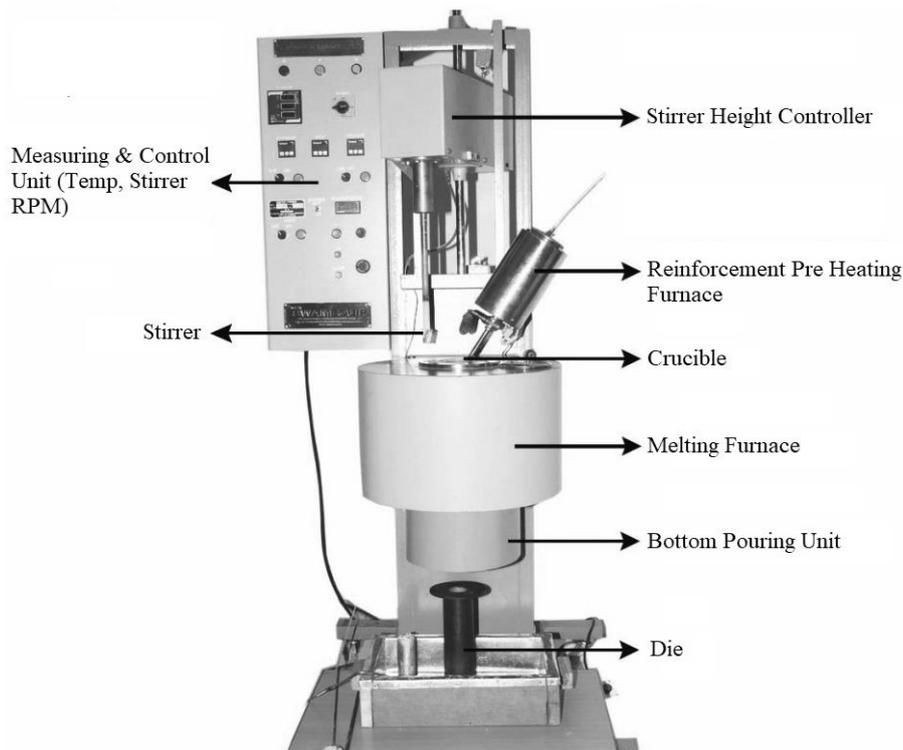
Fig. 2. Bottom Pouring Type Stir Casting Furnace.

Stirring Temperature: The viscosity of matrix material is mainly affected by the processing temperature. The viscosity of liquid is decreased by increasing processing temperature with increasing holding time for stirring which also promote binding between matrix and reinforcement. Good wettability is obtained by keeping temperature about 800°C.

Stirring Time: Stirring promotes uniform distribution of reinforcement partials and interface bond between matrix and reinforcement. Hence, stirring time plays an important role in stir casting. Less stirring leads to non-uniform distribution of particles and excess stirring forms clustering of particles at some places. [9]

Reinforcement feed rate: Non-uniform feed rate promotes clustering of particles at some places which causes the porosity defect and inclusion defect, so the feed rate of powder particles must be uniform to have a good quality of casting.

Pouring of melt: Pouring rate and pouring temperature contributes significantly in casting quality. Pouring rate of slurry must be uniform to avoid entrapping of gases. The distance between mould and crucible also plays an important role in quality of casting.

Pouring temperature: A major role is played by the pouring temperature on the mode of solidification and determines relation partly to the required structure type. Low temperature is associated with maximum grain refinement and equiaxed structure while higher temperature promotes columnar growth in many alloys. However, the range is limited in practical scenarios. To ensure satisfactory metal flow and freedom from collapse whilst avoiding coarse structures, the pouring temperature must be sufficiently high.

Mould temperature: Its principal signification lies in the degree of expansion of the die with preheating. The risk of tearing in casting is diminished by expansion. The mould temperature should neither be too low nor be too high, in non-ferrous casting. The mould should be at least 25 mm thick with the thickness increasing with size and weight of casting. The stir casting parameters which influence the microstructure and mechanical properties of AMCs are shown in Fig. 3.
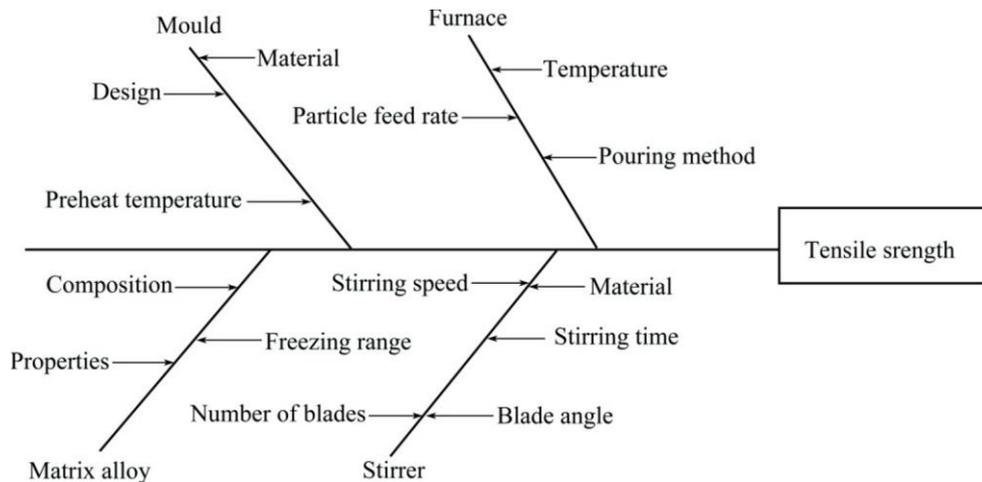
Fig. 3. Stir casting parameters influencing tensile strength of AMCs

3.2. Experimental procedure

The objective for the different mechanical properties and microstructure is to improve the quality of the composite material.

3.2.1 Selection of materials

Preliminary materials utilized for creating AlSiCp alloy composites incorporate SiC particulate matter and Al rod. SiC particulate matter has a normal molecule size of 10 μm and an immaculateness of 94.67 %. The Al (Al6061-T6) rod utilized as a part of this experiment. The chemical composition of Al6061 and SiCp is mentioned in Table 1 & 2 respectively.

Table 2. Chemical Composition of Al6061.

Elements	Mg	Cr	Si	Ti	Fe	Zn	Mn	Cu	Al
Wt %	0.07	0.08	1.08	0.01	0.25	0.01	0.018	0.015	Balance

Table 3. Chemical Composition of SiCp.

Elements	SiC	Fe	SiO_2	Si	C	Al	Ca	Mg
Wt %	96	0.2	0.8	0.5	0.6	0.2	0.65	1.05

3.2.2 Work-Piece Design

The Al6061 matrix composite reinforced with 10 wt% SiC was fabricated by stir casting process. Fig. 2 demonstrates the stir casting setup. The Al6061 composite was liquefied in a graphite crucible and it was placed inside a top loaded resistance furnace at different temperature level (700°C, 750°C, 800°C, 850°C, 900°C). Hardness of the Al-SiC composites increased with increasing wt.% of SiC particles, it is due to the presence of well bonded SiC particles in Aluminium matrix that are hard in nature which causes the movement of dislocations to hinder resulting in increased hardness of composite [22]. Since the SiC particulates are hard in nature thereby resulting in resistance to the applied load causing pinning effect or dislocations pileup and ultimately enhanced hardness. So, the amount of SiC was kept 10% to fabricate the Al6061 metal matrix composite. The four blade Stirrer was designed in order to produce the adequate homogenous particle distribution throughout the matrix material. Four blades stirrer setup is shown in Fig. 4.
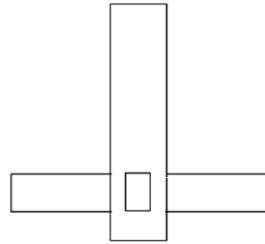
Fig. 4. Four blades Stirrer.

The axial and radial flows are provided to avoid different stagnant zones in the liquid melt by stirrer. Stirring of the mixture is carried out at different holding time (10, 20, and 30 minutes) to achieve homogeneity of particulates. Effect of the holding time helps in the Al-SiCp composites mainly two ways: to distribute the particles in the liquid, and to create perfect interface bond between reinforcement and matrix. The stainless steel stirrer blade was coated with zirconia to avoid the reaction between stainless steel and Al alloys at higher temperatures. The Argon gas was supplied into the near the crucible during the stirring to avoid the formation of oxide layer on the surface of matrix melt. The Stirring speed 450 rpm was maintained throughout work. The slurry of the composite accordingly prepared was poured the steel moulds. Fig. 5 demonstrates the prepared casting of the metal matrix composite.

Fig. 5. Prepared 10%SiC Reinforced Al 6061 MMC.

Table 4. Typical Properties of 10%SiC Reinforced Al 6061 MMC

Density, g/cm^3	2.95-3.00
Thermal Conductivity, W/m.k	170-200
Thermal Expansion Coefficient, E-6 k^{-1}	Tailor-made from 6.5 to 9.5
Electrical resistivity, $\mu\Omega$.cm	30-50
Bending strength, MPa	350-500
Elastic Modulus, GPa	200-230

3.2. 3. Advantages of Aluminium based MMC

The advantages of aluminium based metal matrix composites are [17] [18] [21]:

- High strength
- High stiffness
- Low density (weight)
- Improved properties at high temperatures
- Improved electrical conductivity
- Improved resistance to abrasion and wear
- Low thermal expansion coefficient
- Controlled heating of material
- Light weight
- Improved damping capabilities.

4. Results and Discussion

The effect of processing temperature is illustrated in Fig. 6 where the contact time between reinforcement and liquid Al metal with different temperature.
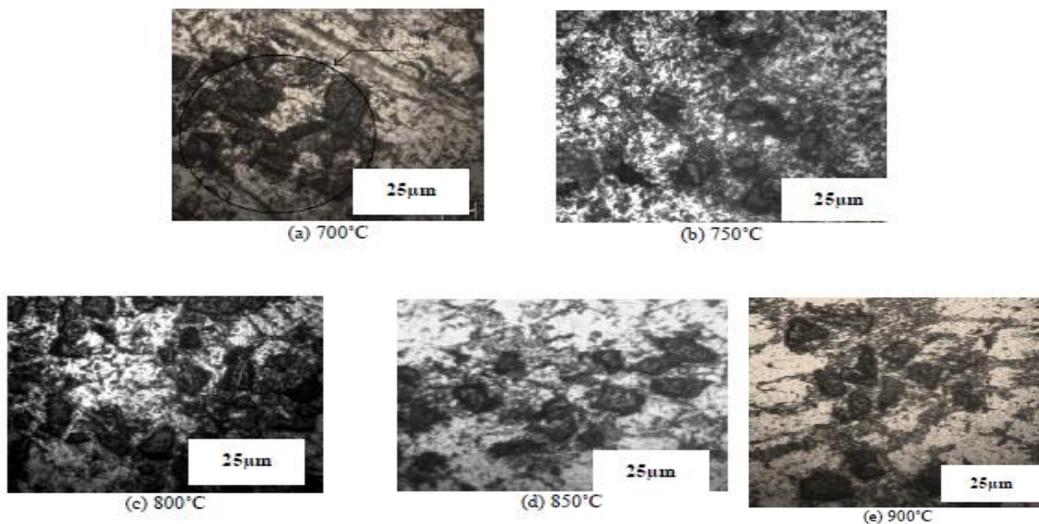
Fig 6. Optical image shows particles distribution at 20 minutes holding time.

Fig. 7 shows the variation in the ultimate tensile strength as a function of temperature is illustrated for Al-10% SiCp composites with different holding time. The ultimate strength of Al-10% SiCp composite has been increased and reached a maximum as the processing temperature changes from 700°C to 800°C, then began decrease with further increase of processing temperature from 800°C to 900°C. These composites exhibited different tensile behaviors. The overall strength of composite is influenced by distribution of particles in the matrix.
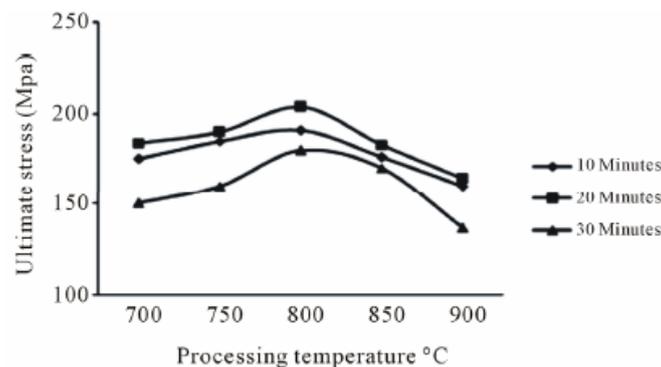
Fig. 7. Effect of processing parameters on tensile strength of Al/SiCp.

The Brinell hardness number was measured along length of the cast specimen at an interval of 1 cm. The low temperature with holding time hardness values at some places is minimum it close to harness values of Aluminium and some places is more. The high values is obtained from the places where the particles is accumulation more and lower hardness values is obtained from places where SiC particles where absent. The Fig. 8 shows the hardness number distributions along length of the cast specimens. The SiC particles added to the aluminium alloy matrix have a satisfactory effect in improving the hardness of the composites.
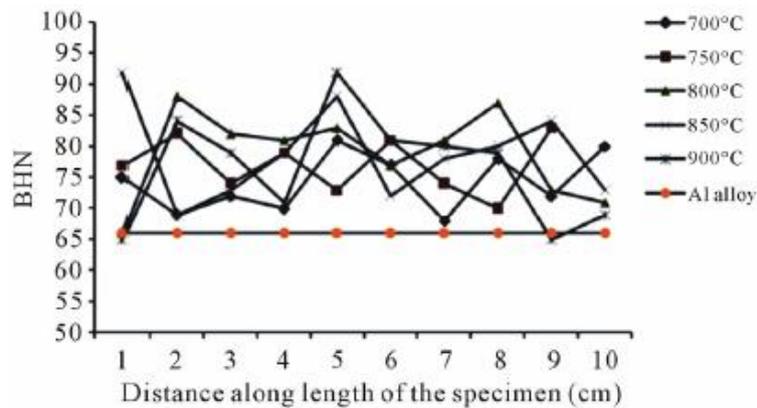
Fig. 8. Effect processing temperatures on Hardness of Al/SiCp.

5. Conclusion

In this research, aluminum as base matrix and SiC as reinforcement in 10% Wt was fabricated using stir casting method by different processing temperatures with different holding time. It is concluded from the microstructure analysis that the particles were distributed uniformly in the processing temperature 750°C and 800°C. The particles agglomerations were found in the processing temperature of 700°C, 850°C and 900°C due to the changes of viscosity in liquid Al matrix. The Ultimate strength of metal matrix composite de-creases with increasing holding time. It is revealed that holding time influences the viscosity of liquid metal, particles distribution and also induces some chemical reaction between matrix and reinforcement. The hardness values increases more or less linearly with increasing of processing temperatures from 750°C to 800°C at 20 minutes holding time.

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Implications of Using Social Media for Learning English as a Second Language:

An Action Research

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Abstract

The Success of any nation depends on the efficacy of its human resources. Humans are needed to be educated in all spheres for the same. The present education system should be up to date for making the growth of nation. Presently, technical education gives much priority to technical knowledge rather than focusing on language skills which is one of the most essential skills these days. It lessens the chances of the engineering students to get placements as they fail to express themselves in English language which is a need for the day. Thus, social media can be an effective tool which can help them to learn English as a second language. The objective of this study is to investigate implications of using social media in learning English as a second language for the first year engineering students of the proposed college in Gujarat as an action research. The students in the targeted college are coming mostly from the rural background and they are unable to express themselves in English language classrooms. To add to this situation, the students are more addicted to use social media in the present scenario. Keeping this in mind, a case study was conducted to know the ratio and its implications of using social media for learning English as a second language especially for the educational purpose.

Keywords: English as a second language, social media, engineering students, language skills

1. Introduction

The Success of any nation depends on the efficacy of its human resources. Humans are needed to be educated in all spheres for the same. The present education system should be up to date for making the growth of nation. Our society calls this 21st century as the "century of information" and social media plays a vital role in this world of information. Dewing (2010 , p.1) defined social media as follow: " The term social media refers to the wide range of internet-based and mobile services that allow users to participate in online exchanges, contribute user-created content, or join online communities".

Presently, technical education gives much priority to technical knowledge rather than focusing on language skills which is one of the most essential skills these days. The students are not used to the traditional methods of teaching for learning a language and thus social media can be an effective tool to learn English as a second language. As students are more addicted to social media these days, it can be the best effective tool for learning English language. The aim of the research is to involve them to use social media for giving their own views and suggestions regarding social media itself.

2. Objectives of the Action Research

- To encourage students' participation to use social platform.
- To inculcate technology-based learning in today's education.
- To combine language learning as well as socialization.
- To improve proficiency in learning English language.

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3. Sample of the Study

The subject of the research was first year engineering college of Gandhinagar Institute of technology, Gandhinagar, Gujarat. A total of 105 students voluntary participated in the survey. Out of those 80% were boys and 20% were girls who were selected as sample for the research. This was a group of students coming from various social, economic and cultural backgrounds. The students belonging to Mechanical, Civil, Computer, Information Technology, Electrical and Electronics and Communication participated in the survey.

4. Methodology and Procedure of the Research

The Questionnaire method is used by the researcher with an aim to find out the ratio and effectiveness of using the platform of social media in learning English as a second language. The study has been undertaken, keeping in mind, the random observation of use of social media in their daily life. Thus, it was a better idea to make the right use of this platform to learn English language. The study was conducted by using the social media platform where 18 questions including personal details were sent to the students through E-mail. The type of questions is asked to tick the appropriate answers. The replies were collected in return to get the responses from the students.

5. Observation of the Study

In Figure-1, it shows the use of technology in the learning process in the present scenario. Technology enhances the language learning by adding something new and innovative methods beyond the traditional methods of teaching. In the present era of globalization, language teaching in engineering colleges is a need of the hour and it is difficult for all the learners to make his own cup of tea of language learning. Thus, technology enables the learners to comprehend the tasks by doing activities which indirectly helps in gaining technical knowledge and using it in real life contexts. As they are used to more technological tools every day, it is the common belief of the engineering students to go for technology-based learning. According to the research done, 95.2% believes in technology-based education.
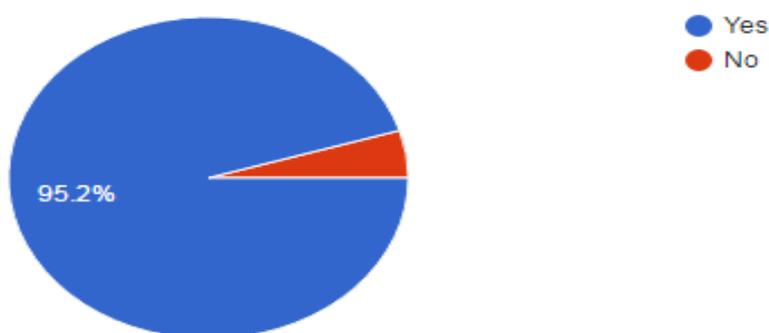
Fig.1. Percentage Distribution of technology-based learning in present scenario

In Fig.2, it shows the use of social media in the learning process. Social media plays a major role in teaching and learning a language. It helps to form a new teaching model these days. It helps the learners to be active users of technology. It creates a good platform of exchange between learners and teachers and makes a learner friendly classroom.76.2 percentage of the learners shows the major use of social media in the learning process.
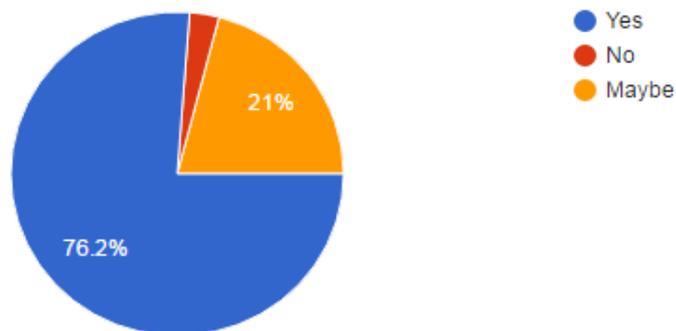
Fig.2. Percentage regarding the use of social media in the learning process.

In Fig. 3, it shows frequently used applications in the social platform. The applications like whatsapp, facebook, youtube, pinterest, twitter and blogs are mostly used by the young learners. These applications mostly help them to be in touch with the social world also. The figure suggests that whatsapp and youtube are the most commonly used application by the learners. Youtube consist of large number of educational videos about learning English. Facebook also serves as a successful networking site to motivate learners to share their ideas and thoughts that may sometimes be very difficult to express in a classroom setting. These will maximize their learning in listening, speaking, listening and writing skills. It serves as the best educational tool in language learning. At the same time, it depends on how one makes the best use of the online resources.
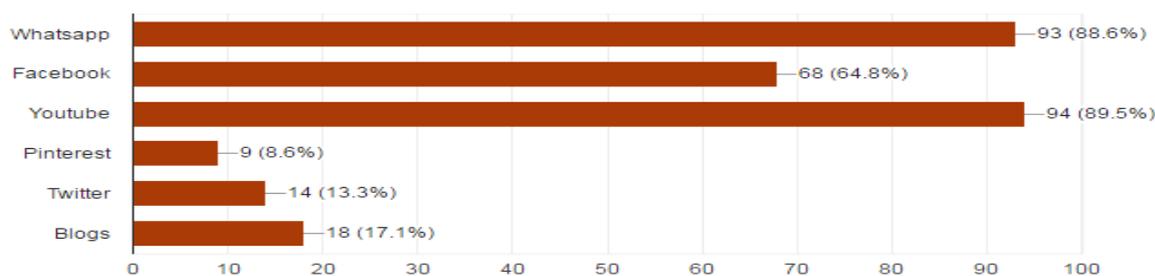
Fig.3. Percentage showing frequently used applications in social platform

In figure -4, it shows that social media plays a major role in improving proficiency in learning English. Sometimes, the learners get addicted to learn the English language and try to learn it as the medium of language is English in all the social media platforms. The figure shows that 68.6% of the learners believe that social media is helpful in learning English language. Thus, teachers should motivate students to indulge in social platforms and involve them to become more creative in language learning.
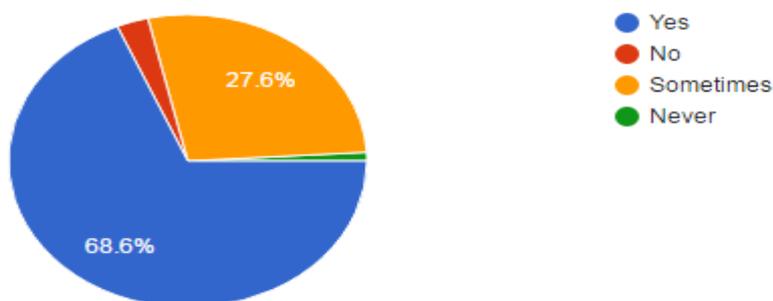
Fig.4. Percentage reflecting improvisation of proficiency in learning English

In figure -5, it shows that social media helps to learn lexical parts in English. Because of social media, words are moving very rapidly around the world within weeks and months. It's the age where the language is changing quickly and the technologies have developed and the mixture of both the language and technology gives rise to development of lexical knowledge as well as raise a chance for the learners to improve a specific area where they are interested in. Vocabulary development is the highly learned area which is helping students to learn at its most. It connects large number of learners as well as teachers which gives a scope to improve language skills. It also helps them to learn sentence structure, short phrases, unique coined terms, idioms and phrases, funny emojis and acronyms.
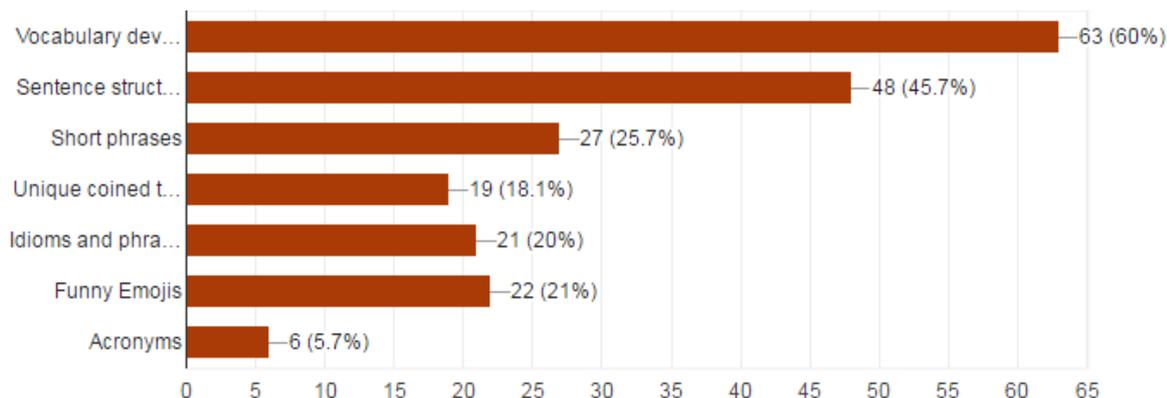
Fig.5. Percentage showing the role of social media to learn lexical parts in English

In figure -6, it shows the applicability of social media in the real life. The figure indicates that 88.6 % of students use social media websites in their daily life.11.4% of the students are not using social media. This ensures that the students are more used to digital platforms and they enjoy working with the online platforms. This also proves that they are more conscious about importance of social media on learning language skills.
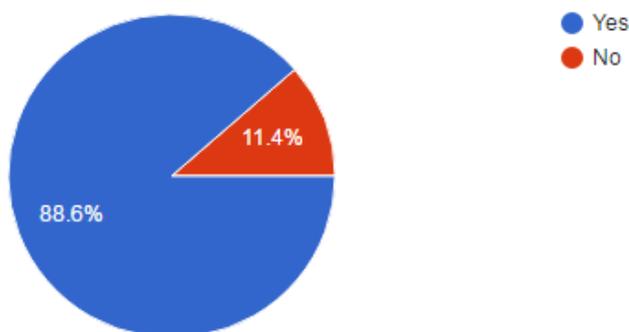
Fig.6. Percentage showing the role of social media regarding real life use.

In figure-7, 83.8% of students are in the view of recommending social media to other students. This result may come from their personal experiences by using social media in their routine work. Majority of the students believe that social media helps to improve language skills in one or the other ways. It gives a practical as well as live platform to the students to discuss and find out appropriate solutions regarding language learning.
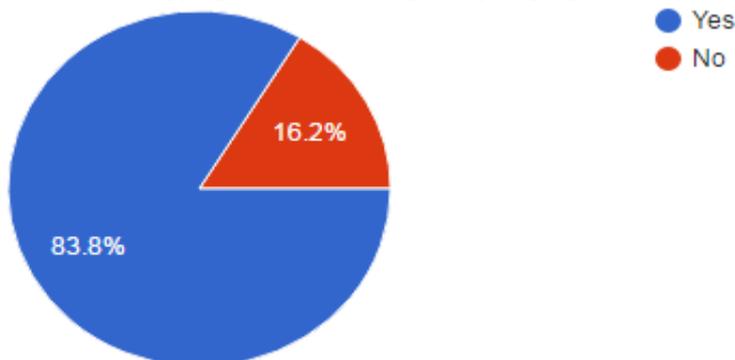
Fig.7. Percentage showing recommendation of using social media to other students for learning English

In figure-8, it shows that social media will create an enthusiastic and learner friendly classroom if implemented in the classrooms. It will make the students active and involve them in the real-life use. It will help the learners to engage them deeply and produce fruitful results.
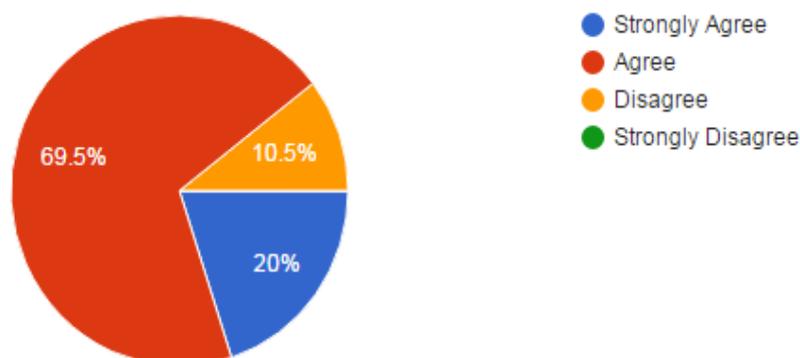
Fig.8. Percentage showing impact of social media for creating an enthusiastic and learner friendly classroom

6. Conclusion and Recommendations

To conclude, social media can be an additional tool which can help students to acquire language skills. In addition, it will make the learners conscious regarding the use of social media, if it is used for learning process. Social media also proves to create pleasant and attractive situation for obtaining better results. Though there are disadvantages of using social media, one must keep a watch on the track record of the learners regarding the same. The obtained results says that social media is really helpful and effective in improving language skills. It is also recommended that the teachers and learners have to be conscious about flawless use of the social media platform in teaching learning process.

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Reduced Latency Timing Model for Wireless Sensor Networks using Data Aggregation

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Abstract

Data aggregation schemes are widely used in wireless sensor networks (WSNs) to avoid redundant transmission of correlated data from tightly distributed sensor nodes. The life of the network will be longer, but it will be seriously affected by the increased data delivery time. The high end-to-end delay experienced by packets is unacceptable for delay-limited applications such as seismic activity monitoring and military field monitoring. This task proposes a new data aggregation timing model for node aggregation timeouts to reduce data delivery time.

Keywords: Wireless Sensor Networks, Data Aggregation, latency minimization, timing model, TOSSIM.

1. Introduction

Recent developments in the field of microelectromechanical systems (MEMS) have realized the dream of creating low-cost, small autonomous devices called wireless sensor nodes that can acquire, process, and transmit field data. Due to the low processing power of the node and limited communication capabilities, sensor nodes must be densely located at the monitoring site to cover the entire area and provide fault tolerance for node failures. Densely distributed nodes collect similar data, and there is a high correlation between these data. Communication costs are a major energy consumer in WSN, so it is not worth transferring similar information through many nodes. Much effort has been made to reduce the number of unwanted transmissions in sensor networks.

Data aggregation technology is gaining more attention in achieving power savings in WSNs. Data aggregation is a technique that combines data from various sensor nodes to eliminate redundant information and provide a rich, multidimensional view of the monitoring environment [1]. Many data aggregation protocols have been proposed in Ref. [24] to reduce power consumption. However, the data aggregation algorithm has the problem of longer data delivery times because the aggregator node has to wait for data from the child nodes. The longer the aggregator waits, the more data it collects from its children, which increases the aggregator's profits. As a result, the gain increases with increasing delay and vice versa. Therefore, there is a trade-off between energy and delay [5].

Wireless sensor networks are primarily used to send data wirelessly from the real world, so it is not worth sending information to the base station after the fact. There are many applications that require time-sensitive data delivery, and the challenge is developing data aggregation methods that guarantee delay requirements. If the aggregator node waits for a long time for data from all its children, it will take longer to deliver the data to the sink, causing the data in the current round to interfere with the data in the next round. The timing model defines how long the aggregator node waits for child data. The aggregation timeout should optimize the data aggregation so that the wait time is optimal for the data to be delivered to the sink within the specified time limit. Some of the works to reduce the delay while aggregating data are considered here.

The rest of the paper is organized as follows. In Section 2 the related work in this domain is outlined, in the Section 3 the proposed algorithm is explained, the protocol implementation is given in the section 4, in the Section 5, the performance of the algorithm is presented and the Section 6 gives the final conclusion of the work.

2. Related Work

The aggregation timeout is simply periodic, whether all nodes wait for a certain amount of time, hop by hop, the aggregator waits for a response from all children, or a cascade timeout, the timeout is It depends on the position in the data. Aggregation tree (DAT). Cascade timeout [6] allows the node to schedule a timeout based on its position in the DAT. The node times out after the child times out, allowing the node to collect information from all children. However, all nodes at a particular level are reported with the same timeout, regardless of the number of children. The advantage of this algorithm is that it does not require time

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synchronization or centralized control. Because the number of children in each tree is not taken into account, nodes with many children lose some of their child data, and nodes at the same level send data at about the same time, causing traffic congestion. In [7], the node timeout is dynamically determined based on the aggregate tree structure and the number of its children. If a node detects a missed deadline, it can increase the node's aggregation timeout. The update process is more complex and the sink's one-hop neighbor, the agent node, is more crowded because the data arrives at the agent node at about the same time.

Adaptive Time Control (ATC) [8] determines the node aggregation timeout based on the level of the sensor node in the data aggregation tree and the number of its children. Nodes with more children get more time, maximizing the opportunity to aggregate data from the children. Therefore, nodes at the same level get different aggregation timeouts. The authors argued that this algorithm offers higher data transfer rates and lower energy costs compared to cascade timeouts. IEEE modified in their simulation.

The 802.11 protocol is used as the media access protocol and does not take into account the node's sleep schedule. This affects energy consumption and delay calculations.[9] considers time-efficient data aggregation in clustered WSNs. The timeout is calculated for each subtree in the cluster based on packet transmission delays and cascading delays. Performance is compared for various modulation techniques that are a key component of packet transmission delay.

The above protocol is simulated by either the network simulator NS2 or a discrete simulator based on C ++. It also uses IEEE 802.11 as the channel access mechanism, with or without some changes. The performance of these protocols may be tested for the real time deployment of wireless sensor nodes. The wireless sensor nodes of our consideration are IRIS motes from Crossbow Technologies [10]. It is good practice to test the performance of any protocol using a simulator before it is implemented in the real world. The simulators like ns2 and other similar simulators do not reflect the real-world scenario properly. Therefore, we have chosen the WSN simulator TOSSIM to test the behavior of our proposed timing model. The TOSSIM simulator can simulate programs written in NesC, the native language of WSN-Mote IRIS, and can merge code into motes with minor changes. [11]

3. Timing Model

The goal of this work is to foster a convention, which conveys the information to the sink with in the cutoff time while adjusting the information collection strategies for diminishing the energy utilization. This convention assesses the break of every hub in the tree in a disseminated way, with the goal that the information created by every hub ought to be conveyed to the sink in short order. This work focuses on the objective stage as the remote sensor bit called IRIS. These bits use TinyOS working framework, which is one of the most broadly adjusted working frameworks for the asset compelled bit organization. The bits send the information to the sink utilizing the assortment tree, which is shaped and kept up with by the Collection Tree Protocol (CTP) [12]. The CTP convention involves the remote connection quality between the bits as the measurement to build the tree and it is a powerful tree. Assuming that the connection quality changes, the tree construction will likewise change. Thus, the collection break ought to be dynamic and refreshed as the tree structure changes.

In falling break, when an aggregator hub gets the solicitation from the sink, it works out its break in light of the level in the tree. The stunned break happens between the levels and time disarticulation between them is only a solitary jump delay. The hubs in a similar level are having same break and henceforth they attempt to get sufficiently close to the channel all the while. In this way, the transmission of the parcels by the hubs in a similar level will be conceded by the MAC and the parent break will happens before the youngster. Consequently, the aggregator hub will miss a portion of the bundles from its kids hubs and the accumulation gain diminishes. To work on the exhibition of the DAT, the aggregator's hub break should be relegated so that it could gather more data productively.

In our proposed calculation, every hub ascertains the underlying opportunity for information accumulation, which depends on the jump distance from the sink and the quantity of youngsters it has in its sub tree established from it. This underlying break will be different for every hub and it increments from the leaf hub to sink hub. The youngsters hubs break first, trailed by its parent and subsequently the information created by the kids hubs are gathered, handled and sent by its parent hub in staggered way. After the underlying staggered break, the hubs follow the proper break of length T, which is information age period. This guarantees that the information created by the hubs arrive at the sink before the following round starts. The Fig. 1 shows the break model of the proposed framework called Delay Efficient Aggregation Timing Model (DEATM).
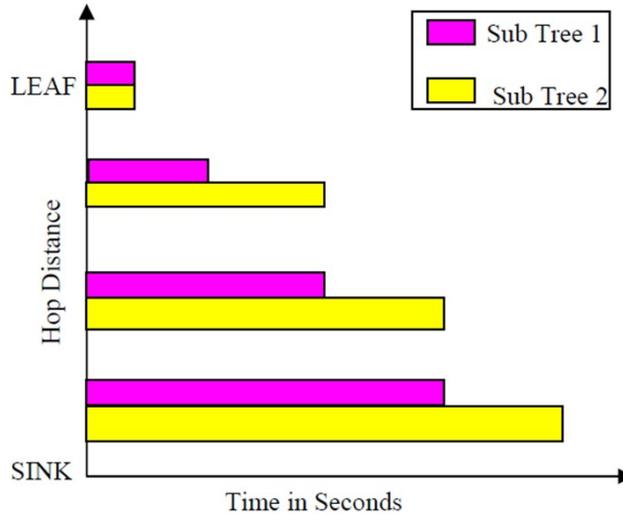
Fig. 1. Timing Model of DEATM

The Fig. 1 shows the initial outing of the nodes at different level from the sink in two different sub trees. Each color the figure shows the aggregation timer for the nodes within the same sub tree and therefore the figure shows two such a sub trees. The nodes within the same level are represented with different color and their initial outing will depend upon the entire number of youngsters within the sub tree during which it resides. The leaf nodes get the smallest amount waiting time and therefore the nodes almost the sink gets more staggering time. All the leaf nodes get an equivalent staggering time but the nodes within the same higher levels will get different stagger time. The leaf node's outing takes place early and therefore the outing of the nodes within the different levels increases because it approaches the sink. The nodes almost the sink get longer out and it's but the deadline T. The nodes within the same level will have different outing and hence the collision within the same level be avoided and it ensures that the info wave will reaches the sink through that sub tree with within the dead line.

3.1 Mathematical Model

The aggregator node I is A_i, and the leaf node j is L_j. For the aggregator node A_i, let N_i be the number of children nodes. i.e. N_i is the number of degrees (A_i). The cost of a path from any leaf node L_j to an aggregator node A_i is calculated as follows:

$$\text{Path\_cost}(L_j, A_i) = \sum_{A \in nk} \deg ree(A) \tag{1}$$

Where n is the set of aggregator nodes in the path from L_j to A_i. The maximum path cost from any leaf node to an aggregator node is P_i is the maximum path cost from leaf node to the aggregator.

$$P_i = \max \{\text{Path\_cost}(L_j, A_i)\} \; \forall j \tag{2}$$

The maximum path cost from any leaf node to sink is P_{sink} is the maximum path cost from leaf node to the aggregator.

$$P_{sink} = \max \{\text{Path\_cost}(L_j, sink)\} \; \forall i, j \tag{3}$$

The initial staggered time out is calculated as follows. Let T_i is the stagger time out for the aggregator node i, which is equal to

$$T_i = T_{ci} + T_{ai} \tag{4}$$

Where T_{ci} is the cascading time out which depends on the level in which the aggregator is in. This gives the initial timeout as in cascade time out for each node and it is same for all the nodes in the same level. The T_{ai} is the aggregation time out of the node, which depends on the number of children it has.

$$T_{ci} = 2 * [T - (T_{TD} * h)]$$

$$T_{ai} = (P_i / P_{sink}) * (T - T_{TD} * D) \tag{5}$$

Here, h denotes the hop distance of the node Ai, D is the depth of the tree, T is the data generation period or the dead line and T_{TD} is the one hop delay between the levels. It depends on the queuing delay, MAC delay, processing delay for aggregation function and the transmission delay. It is assumed to be 0.1 seconds as used in [8]. After introducing this initial delay into the aggregation timer, the aggregation timer is triggered every T seconds, allowing the collection of packets generated by all the nodes in the collection tree for that round.

3.2 Update Phase

The aggregation timer is updated whenever the topology changes or the aggregation gain drops due to time synchronization between the nodes. Beacon messages are exchanged regularly between nodes. When the topology changes, the routing engine broadcasts messages to neighbouring nodes so that all nodes in the network update the information. The aggregation timeout Tai is recalculated each time a beacon is received. If the new value and the previous timer value differ by more than the specified threshold Δ, the aggregate timer is reset. Also, the optimal number of responses for each aggregator node per round is Ni, which is the same as the number of child nodes. If the aggregator receives less than Ni, the timer value will increase by T_{TD}, and if it exceeds Ni, the timer value will decrease by T_{TD}.

4. Implementation

The standard CTP routing protocol sets up a data collection tree by exchanging beacon messages containing information about the parent and cumulative link quality to reach the sink. Each node sends a beacon message on a regular basis. The CTP beacon message is modified to carry additional information about the hop distance and Pi. The neighbour table is also modified to record neighbour hop distances and pi. Each aggregator node finds its own child in the parent field of the beacon message sent by its child. When a node receives a beacon message from a neighbouring node with the node ID as the parent, it increments the number of child fields in the neighbouring table. The aggregator node also uses the parent node's beacon information to detect the hop distance. Each aggregator node calculates the path cost for each subtree by adding the pi of the child node and the number of child nodes. The pi of a node is calculated by finding the maximum of all pi. This information is passed to the aggregator function that calculates the value of Ti. The first-time shift is reached and the data wave reaches the sink within the specified time.

Each node uses two timers. One is for data generation and the other is for aggregation. When the construction of the collection tree phase is complete, the node starts both timers. The data timer is triggered every T seconds. The initial timeout of the aggregation timer is calculated from the beacon message and the one-shot aggregation timer starts at the calculated time. When the data timer is triggered, the node reads the default sensor and keeps it in the buffer. When the aggregation timer is triggered for the first time, the aggregation timer restarts in T seconds, which is a periodic timer. When the periodic aggregation timer is triggered, the node aggregates packets from children with unique values and sends the aggregated packets to the top of the tree. The average of simple aggregate operators is used.

5. Simulation and Result

The proposed algorithm is simulated on a Linux platform using the TOSSIM simulator, a simulator for TinyOS 2.x developed by the University of California, Bellekelly, which can execute real TinyOS code without real particles. 100 nodes are evenly distributed over an area of 200-200m2. TOSSIM uses SNR-based simulation, and the simulator parameters are like simulating an indoor environment. The nodes are placed in a uniform topology, dividing the sensor fields into grids of the same size, and randomly placing the nodes on each grid. The standard MAC IEEE 802.15.4 is used for channel access and CTP using 4-bit link estimation as the data acquisition tree. The node generates traffic every 20 seconds.

The performance parameters to consider are aggregate gain, accuracy, and error rate. Aggregation gain is defined as a measure of the reduction in communication traffic due to aggregation related to a node's energy [13]. This is the ratio of traffic reduction by aggregation to total traffic without aggregation.

where t is the number of transmissions for all unaggregated nodes. In the absence of aggregation, the aggregator node must forward all packets from its children. Therefore, the value of t is calculated by adding the total number of transmissions and receptions by all nodes. ta is the total number of transmissions with aggregation and is equal to the number of packets sent by all nodes. Aggregate gain was chosen as one of the metrics for analysing the protocol because it is directly related to the energy consumption of the node.

The information is sent in one packet by an aggregator node, which receives and analyses Nr packets from its offspring. Without aggregation, the aggregator node is responsible for forwarding all packets, regardless of their content. As a result, a node's total number of transmissions is lowered by the factor Nr/ (Nr +1). The aggregation gain is the ratio of the number of transmissions reduced as a result of aggregating to the number of transmissions not reduced. If a node is waiting for an optimum time period, it could collect the information from all of its children, then the aggregation gain will be maximum. If the aggregator timeout is

shorter than the optimal timeout, the aggregator node was unable to collect information from some of its child nodes. Therefore, packets arriving after the deadline are discarded because they are not considered when finding the aggregate result. This reduces the accuracy of the aggregation process. Data accuracy is a measure of the amount of data used to extract information. It is defined as the number of readings received for the total number of packets generated on the network. The aggregated package contains the amount of child data used to find the aggregated value. Therefore, the sink can find the accuracy of the aggregation for a particular simulation time. The accuracy of the aggregation process depends on the number of packets received from its children, and then on the deadline requirements of the application and the node density of the network.

Another metric used to assess the protocol's efficiency is the miss ratio. It's calculated by dividing the number of packets that missed the deadline by the number of packets received. The packets of the current round arriving after the aggregation time out will be dropped in each data gathering round. For the duration of the simulation, each node will calculate the total number of packets dropped and the total number of packets received from its offspring. The miss ratio is calculated by adding the total number of packets dropped and received by all nodes. The number of hops, the number of nodes in the sub tree, and the node density in the surveillance field all influence these performance metrics.

The proposed algorithm is compared to simple hop-by-hop and cascade timeouts. For each simple hop, the node waits for a period of time to perform the aggregation, and for a cascading timeout, the staggered timeout is followed by a hop delay. Figures 2 through 7 show the results of the simulation test.
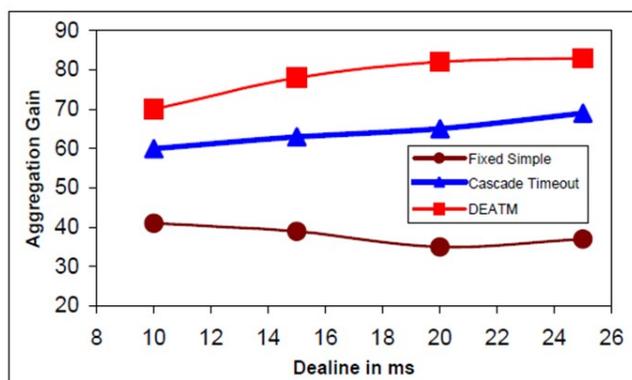
Fig. 2. Impact of Deadline on Aggregation Gain

The Fig. 2 indicates the aggregation benefit for the one-of-a-kind timing fashions as a feature of cut-off date. The nodes pattern the sensor and generate the records for each 20 seconds. This record is aggregated with the records acquired from its kids for the duration of the day trip duration and the aggregated packet is transmitted out while the aggregation timer fires. The records technology duration or cut-off date is numerous from 10 seconds to twenty-five seconds and the aggregation benefit is measured. The aggregation benefit will increase because the cut-off date will increase. If T is small, greater packets will omit the cut-off date because of small ready duration and improved records site visitors. As the cut-off date boom the records site visitors is decreased in addition to the nodes can be given greater possibilities to do the aggregation and therefore the benefit will increase. Our proposed set of rules offers higher aggregation benefit in comparison to cascade day trip seeing that in our method, the aggregator node's timeout consists of the wide variety of baby nodes and therefore it can gather greater records from its kids. In easy and cascade day trip, the nodes, that are very near the sink ought to ship the records with withinside the cut-off date and therefore the benefit is much less in comparison that of our proposed scheme.

The Fig. 3 suggests that the leave out ratio of the proposed set of rules could be very much less in comparison to different schemes due to the fact, every node waits suitable time to accumulate the statistics from all its youngsters and as a result the statistics reaches the sink with withinside the cut-off date. As cut-off date will increase, the leave out ratio decreases.

The fig. 4 suggests the statistics accuracy of the proposed set of rules as a characteristic of cut-off date. The accuracy of the proposed device is usually excessive due to the fact it can accumulate extra statistics from its youngsters in the cut-off date. Accuracy will increase with growth in cut-off date. In order to discover the effect of node density at the overall performance parameters, the simulation is carried out at some point of one hundred seconds and the range of nodes varies from 25 to one hundred. The place of the community is equal for all of the instances and as a result the density of the nodes withinside the sensor area varies.
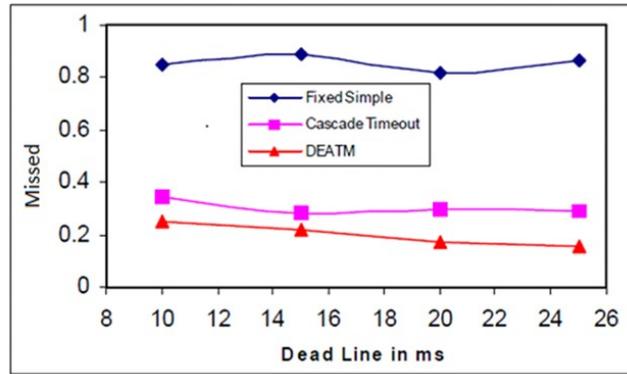
Fig. 3. Impact of Deadline on Miss Ratio
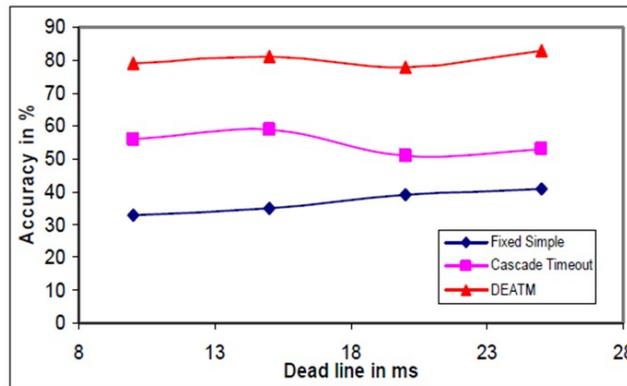
Fig. 4. Impact of Deadline on Accuracy

The Fig. 5 suggests dependency of aggregation advantage at the community length. As the community length will increase, the aggregator nodes should acquire greater packets from its kids and decrease the site visitors with the aid of using aggregation. Hence the advantage will increase because the wide variety of nodes will increase. This isn't linear because of the truth that the improved wide variety of nodes reasons collision and the kids' nodes must wait greater time to get the channel, which ends up in the lower in advantage.

The Fig. 6 suggests the effect of node density at the omit ratio. The omit ratio of the proposed scheme could be very much less as compared to the opposite schemes. Also, for the small node densities, the omit ratio does now no longer extrude a great deal for all of the schemes however the omit ratio will increase because the node density will increase. This is because of the truth that if the node density will increase, the wide variety of competition for a node to get entry to the channel will increase. This will growth the MAC deferring time and as a result the packets will omit the lifeless line and dropped with the aid of using the aggregators.
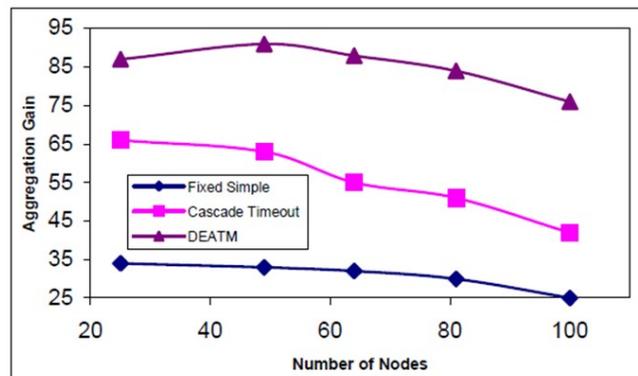
Fig. 5. Effect of Node density on Aggregation Gain
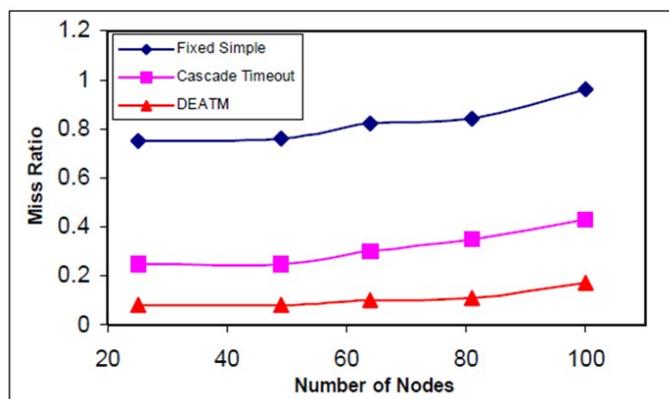
Fig. 6. Effect of Node density on Miss Ratio
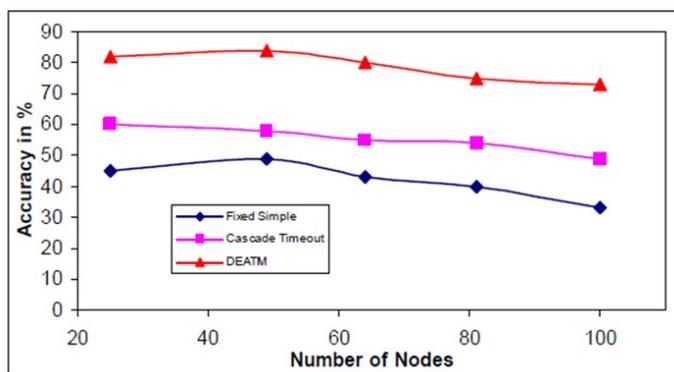
Fig. 7. Effect of Node density on Data Accuracy

The fig. 7 indicates the information accuracy of the proposed set of rules as a feature of community size. The accuracy of the proposed device is usually excessive and will increase with lower in community size. From those figures, our proposed set of rules can do higher than different algorithms even in excessive-density networks.

6. Conclusion and Future work

The proposed protocol offers extra aggregation benefit, which results in much less strength consumption, much less leave out ratio, which offers the statistics with withinside the stipulated time sure and the best statistics accuracy. Thus, our protocol can supply extra correct and clean facts to the sink in a strength green manner.

Also, our proposed set of rules is impartial of time synchronization and it doesn't want any centralized control. It additionally adjusts the time dynamically consistent with the extrade in topology or extrade in synchronization. This proposed set of rules offers extra aggregation benefit in comparison to that of cascading day out scheme and the statistics generated in a spherical is introduced to the sink withinside the equal spherical. Thus, the statistics freshness is maintained.

The benefit, leave out ratio and the accuracy of the protocol depend upon the cut-off date and the scale of the community. From our observations, for a given community size, a minimal cut-off date needs to be constant in order that the statistics may be introduced to the sink with withinside the cut-off date. The proposed paintings can be examined with the actual check mattress includes IRIS motes.

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Design Optimization of 3 Phase Induction Motor

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Abstract

The induction motor due to its overall good characteristics forms the most prevalent selection of industrial applications worldwide. To encounter the raising call of energy disaster, attempts have been made by either trapping energy from inexhaustible sources or by enhancing the operating efficiency of devices requiring bulk consumption of electric energy. Any remarkable augmentation in the operating efficiency of induction motor will, therefore, assist our endeavor at energy preservation. There is an essential selection into utilizing either a lower cost die cast or fabricated aluminum rotor versus the most extravagant copper bar rotor, while constructing a squirrel-cage induction motor. However, there are crucial benefits in electrical energy efficiency by using a copper in the rotor of motors. This paper depicts an optimal design tactic to optimize three-phase induction motor in assembling process. The optimally represented motor is equated with an existing motor having the same ratings.

Keywords: Efficiency, Optimization, Energy Saving, Pole Arc & Pole Pitch, Induction Motor etc

Nomenclature

B_{av}	Average Air-gap Flux Density (Wb/m^2)
ac	Ampere Conductor(ac/m)
P	Number of Pole
η	Efficiency
Ks	Stacking Factor
Kw	Winding Factor
m	Slot / pole / phase
Greek symbols	
α	Pole arc to Pole Pitch Ratio
Subscripts	
HP	Horse Power
KVA	Kilo Volt-Ampere

1. Introduction

There is a huge gap between demand and supply of electric power in India; this is leading us to focus on to use energy efficient conservation. Numerous attempts have been made to most efficiency from renewable energy souse and to increase efficiency of generation, transmission and utilization devices. Due to its simple and rousted construction three phase induction motor (IM) is the heart if the any industry [1][2]. Induction motors are considered to be the main workhorse and are used in very large number in a variety of applications which include sectors like office, home, farm and industry [3][4][5]. Any significant improvement in the operating efficiency of induction motor will, therefore, help our effort at energy conservation. This can be achieved by taking recourse to design optimization techniques [11].

In recent years digital computers are being widely used in all stages of electrical machine design namely analysis, synthesis and optimization. In the optimization phase of the problem the task is to get a design having minimum material cost, minimum weight or an optimum performance feature like maximum efficiency [3][4][10]. Until recently, the optimum design was chosen after comparing a number of feasible designs. The computer was used to make a detailed analysis of design and for obtaining a fairly large number of, alternate designs [4][12].

For this paper, to study design optimisation problem this paper is divided in two sections. In first half procedure will deal with the mathematical aspects, assumption and include the formulation, to create an algorithm to solve the design optimization problem [13]. And calculate main design parameter for few IM. In second half it will study the effect of change in variation of some key assumption like B_{av} and ac to its minimum and maximum theoretical values on the main design parameters on the IM.

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2. Flowchart for Design Optimization

The flow chart for design of three phase induction motor which is shown in Fig 1(a) and the flow chart for calculation of main dimension for IM is shown in Fig. 1(b) [1][2].
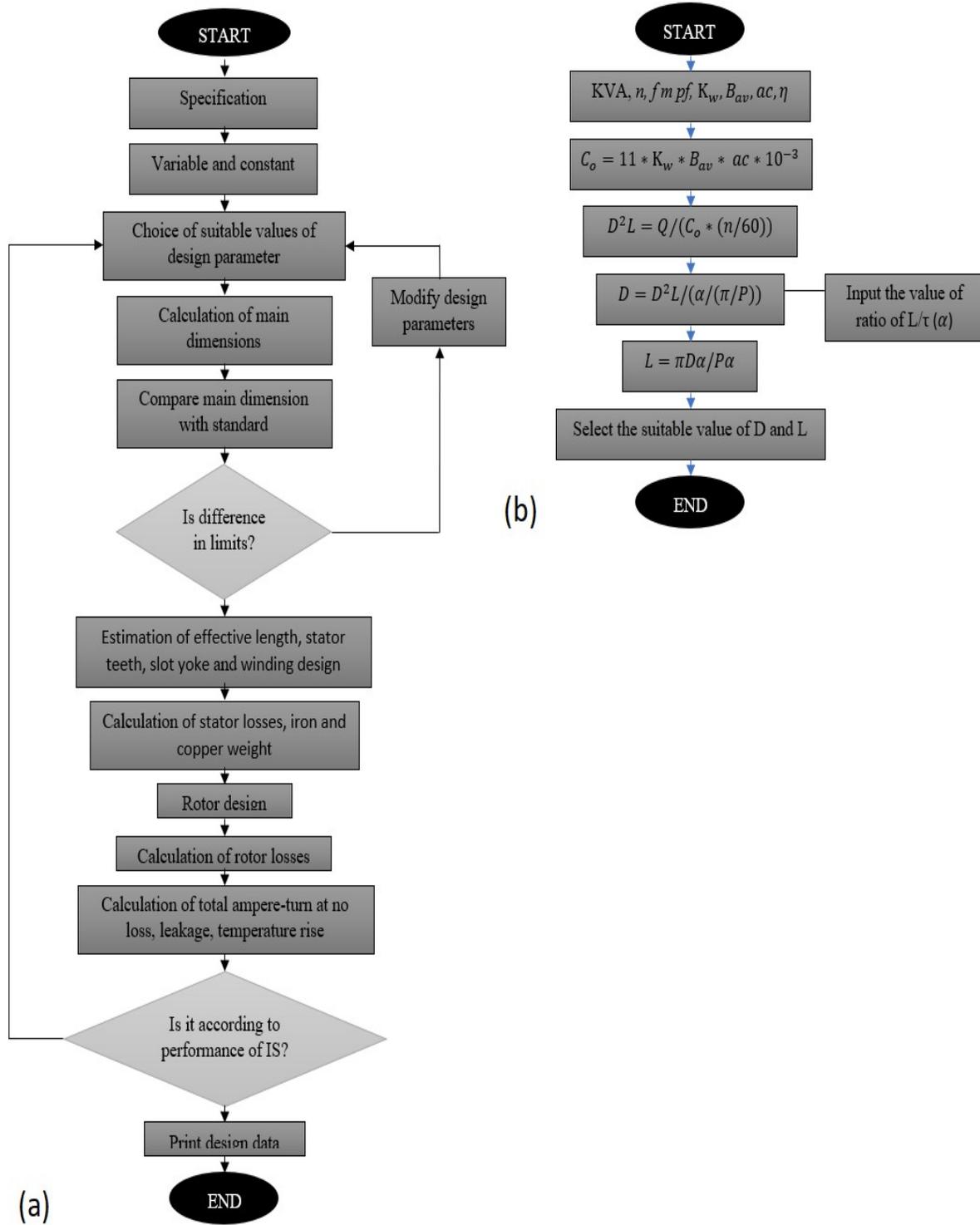
Fig. 1. Flowchart for (a) Overall design of three- phase IM (b) Main Diminution of IM [1]

3. Design of Induction Motor

The flow chart for design of three phase induction motor which is shown in Fig 1(a) and the flow chart for calculation of main dimension for IM is shown in Fig. 1(b) [1][2][12].

3.1 Design Optimization Problem

The design optimization problem of induction motor is formulated as a general nonlinear programming problem, as a follow:
Such that F(X) is optimum where X (x_1, x_2, x_3, x_4, x_5, x_6, ..., x_n) is the set of independent variables, which is representation of the electric and magnetic circuit of the machine. These parameters have considerable effect on the cost and performance of the motor. For this paper there are certain considering of few quantities for optimization problem which are given below:

1. Stator bore diameter (m) (x1)
2. Stator stack length (m) (x2)
3. Total number of stator conductor (x3)
4. Flux density in stator teeth (wb/m²) (x4)
5. Current in stator conductor (A) (x5)
6. End ring current (A) (x6)
7. Rotor bar current (A) (x7)

Other design parameter of machine can either find from above quantities or treated as fixed for any particular design based on application. The objective function to be maximized is F(X). The following constraints are imposed on the design optimization problem.

1. Max. stator/rotor tooth flux density ≤ 2.0
2. Full load slip ≤ 0.055
3. per unit maximum torque ≤ 1.0
4. Full load power factor ≥ 0.8
5. per unit starting torque ≤ 1.0
6. Full load efficiency ≥ 0.75
7. per unit starting current ≤ 6.5
8. Per unit no load current ≤ 0.5

3.2 Optimization using Algorithm

In this paper, to attend optimum results of squirrel cage induction motor, one has to considered three different power rating of induction motors as per IS, which are mentioned as below:

- 1HP Induction motor (η-0.77, pf-0.78)
- 3HP Induction motor (η-0.83, pf-0.78)
- 5HP Induction motor (η-0.85, pf-0.78)

The rating of this motor is taken from the IS 1599 and the main parameters, efficiency and power factor is also taken from this IS 1599 for 4 Pole IE 2 motors [5] [7][10]. In this process, to design the IM some initial assumption has to be made like B_{av}, ac, α and many more which are mentioned below:

V = 415 V	ac = 23,000 ac/m
P = 4	α = 1.75
M = 3	K_w = 0.955
B_{av} = 0.45 wb/m²	K_s = 0.9

By considering above assumption, the calculated basic design parameters for above motors as mentioned below here,

Table 1. Design Parameters for IM

	1 HP	3 HP	5 HP
X1 (m)	0.0693	0.0974	0.1146
X2 (m)	0.0952	0.1339	0.1275
X3	2909	1470	1063
X4 (wb/m²)	0.70	0.99	1.16
X5 (A)	1.73	4.81	7.83
X6 (A)	295.2	415.3	188.5
X7 (A)	132.4	186.3	219.2

4. Observation and Analysis

The value of B_{av} and ac is for any IM is varying according to the required performance, this also effect the manufacturing and running cost of the IM. Here the effect of B_{av} and ac on different parameter on different motor is shown.

4.1. Effect of Air-Gap Flux Density

- For 1 HP Motor:

Airgap Flux Density (wb/m^2)	Stator Bore Diameter (m)	Stator Stack length (m)	Current in Stator Conductor (Is) (A)	Stator Conductor Per Slot	Stator Turns Per Phase	Flux Density in Stator Teeth (wb/m^2)	End Ring Current (A)	Cu Losses in End Ring (W)
0.3	0.079	0.109	1.73	93	185.66	0.54	337.42	8.83
0.42	0.071	0.097	1.73	83	166	0.67	301.62	5.8
0.5	0.067	0.092	1.73	78	156.66	0.75	284.59	4.63
0.58	0.064	0.087	1.73	75	149	0.83	270.85	3.8
0.62	0.062	0.086	1.73	73	145.66	0.87	264.9	3.48
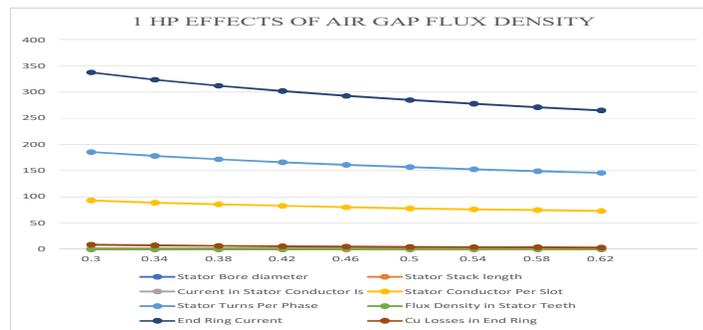
Fig 2. Effects of Air gap flux density on 1HP IM

- For 3 HP Motor:

Airgap Flux Density (wb/m^2)	Stator Bore Diameter (m)	Stator Stack length (m)	Current in Stator Conductor (Is) (A)	Stator Conductor Per Slot	Stator Turns Per Phase	Flux Density in Stator Teeth (wb/m^2)	End Ring Current (A)	Cu Losses in End Ring (W)
0.3	0.112	0.153	4.81	47	93.66	0.75	475.06	29.3
0.42	0.1	0.137	4.81	42	83.66	0.94	424.66	20.08
0.5	0.094	0.129	4.81	39	79	1.06	400.68	16.39
0.58	0.09	0.123	4.81	38	75.33	1.17	381.34	13.75
0.62	0.088	0.12	4.81	37	73.66	1.22	372.96	12.7
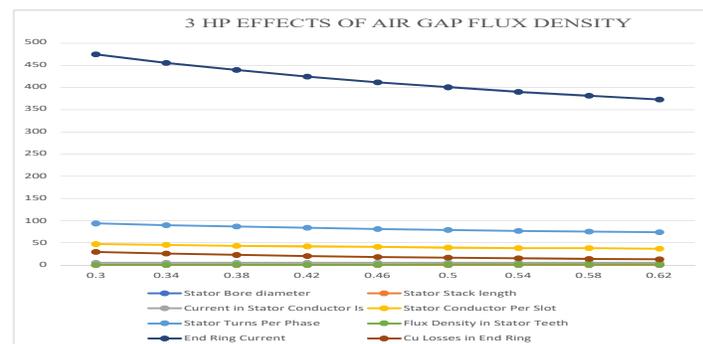
Fig. 3. Effects of Air gap flux density on 3HP IM

- For 5 HP Motor:

Airgap Flux Density (wb/m^2)	Stator Bore Diameter (m)	Stator Stack length (m)	Current in Stator Conductor (Is) (A)	Stator Conductor Per Slot	Stator Turns Per Phase	Flux Density in Stator Teeth (wb/m^2)	End Ring Current (A)	Cu Losses in End Ring (W)
0.3	0.13	0.179	7.65	34	68	0.89	558.15	50.77
0.42	0.116	0.16	7.65	30	60.66	1.11	498.93	34.87
0.5	0.11	0.151	7.65	29	57.33	1.25	470.76	28.62
0.58	0.105	0.144	7.65	27	54.33	1.38	448.04	24.16
0.62	0.102	0.14	7.65	27	53.33	1.44	438.19	22.38
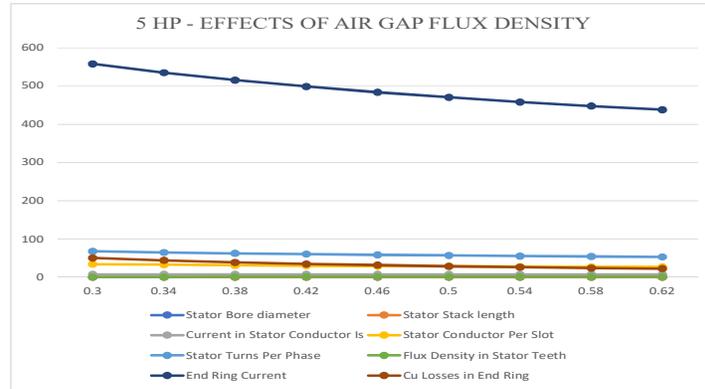
Fig. 4. Effects of Air gap flux density on 5HP IM

4.2 Effects of Ampere Conductor

- For 1 HP Motor:

Ampere Conductor (ac/m)	Stator Bore Diameter (m)	Stator Stack length (m)	Current in Stator Conductor (Is) (A)	Stator Conductor Per Slot	Stator Turns Per Phase	Flux Density in Stator Teeth (wb/m^2)	End Ring Current (A)	Cu Losses in End Ring (W)
5000	0.115	0.158	1.73	29	176	47.8	106.57	1.55
15000	0.08	0.11	1.73	61	366	99.44	221.67	3.86
25000	0.067	0.093	1.73	86	514	139.78	311.61	5.63
35000	0.06	0.083	1.73	107	644	174.93	389.97	7.03
45000	0.055	0.076	1.73	127	761	206.84	461.1	8.13
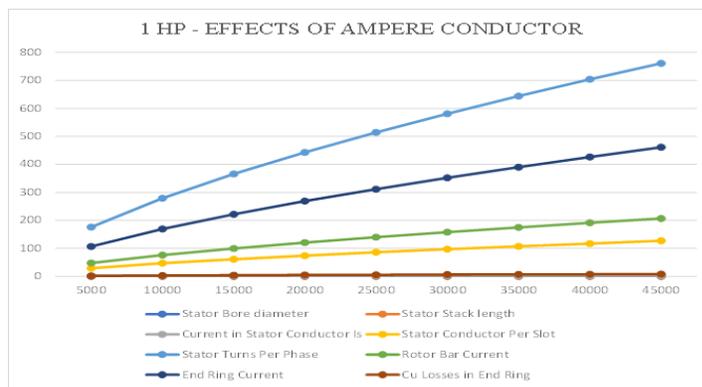
Fig 5. Effects of Ampere Conductor on 1HP IM

- For 3 HP Motor:

Ampere Conductor (ac/m)	Stator Bore Diameter (m)	Stator Stack length (m)	Current in Stator Conductor (Is) (A)	Stator Conductor Per Slot	Stator Turns Per Phase	Flux Density in Stator Teeth (wb/m^2)	End Ring Current (A)	Cu Losses in End Ring (W)
5000	0.162	0.223	4.81	15	89	67.3	150.04	4.82
15000	0.112	0.154	4.81	31	185	140	312.1	12.87
25000	0.095	0.13	4.81	43	259	196.8	438.72	19.86
35000	0.085	0.116	4.81	54	325	246.29	549.05	26.12
45000	0.078	0.107	4.81	64	384	291.21	649.19	31.79
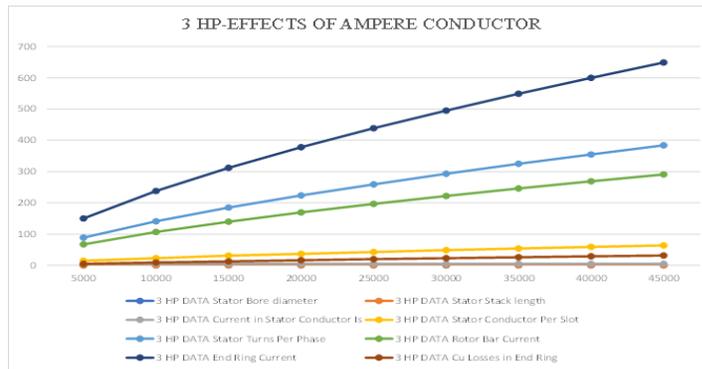
Fig 6. Effects of Ampere Conductor on 3HP IM

- For 5 HP Motor:

Ampere Conductor (ac/m)	Stator Bore Diameter (m)	Stator Stack length (m)	Current in Stator Conductor (Is) (A)	Stator Conductor Per Slot	Stator Turns Per Phase	Flux Density in Stator Teeth (wb/m^2)	End Ring Current (A)	Cu Losses in End Ring (W)
5000	0.189	0.26	7.65	11	64	79.08	176.28	8.1
15000	0.131	0.18	7.65	22	134	164.48	366.69	22.13
25000	0.111	0.152	7.65	31	188	231.22	515.46	34.67
35000	0.099	0.136	7.65	39	235	289.36	645.08	46.21
45000	0.091	0.125	7.65	46	278	342.14	762.74	56.94
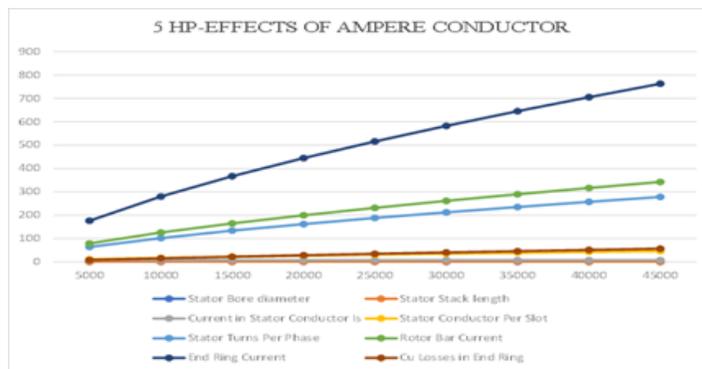
Fig. 7. Effects of Ampere Conductor on 5HP IM

These graphs depict that the effect of the B_{av} and ac has significant impact on the various factors like on bore of diameter, stack length of stator, number of conductor in stator, current in stator conductor and rotor bar, which has significant effect on cost and performance of motor.

5. Conclusion

With the help of such program, one can create a design sheet of any rating of induction motor. This has been done successfully achieved for 3 phase, 415 V, 50 Hz, 4 pole machines of 1 HP, 3 HP and 5 HP. In the process, It is also observe that the effect of varying the air gap flux density on different parts and rating of the motor for different power capacity. Similarly, effect can be observed by changing the ampere conductor in program. By investigating the behavior of the IM in this parameter, it will be easy for the manufacture to design induction motor which is better in terms of manufacturing cost and running cost. However, it is clear that this will indeed, make the optimized design more acceptable to the manufacturers and consumers.

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Deep Stacked CNN, A Deep Learning Approach for Driver Drowsiness Detection

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Abstract

Driver drowsiness is turn out to be one of the most common reasons for road accidents these days. To overcome this, with the help of advanced technologies like Computer Vision and Deep Learning a system can be designed which alerts the driver quickly if he encountered to be sleeping. Here in this work, a new framework is proposed using deep-stacked convolution Neural Networks to classify the real-time status of a driver into active or sleeping. Dlib and OpenCV libraries are used to extract the face and eye region of the driver from continuously captured real-time images of a driver. A Sigmoid activation function in the output layer of CNN Classifier is used to detect driver status. The proposed method is evaluated on a collected open-source dataset from Kaggle and real-time camera capture images. It has delivered an accuracy of 97.98% when compared to traditional CNN. The limitations of traditional CNN such as pose accuracy and different lightning conditions are overcome with the proposed Deep Stacked CNN model.

Keywords: Deep stacked CNN, Sigmoid Activation, Dlib, OpenCV

1. Introduction

In the modern era, living standards are very high and automobiles are a part of it. Automobiles are utilized as a means of transportation as it is comfortable and save time. Due to this, the amount of automobiles has surged significantly on the road. It is only natural that the number of road accidents also peaked. There are various reasons for a road accident but one of them is driver drowsiness. According to a survey conducted by the Times Of India (TOI), around 1.5 lakhs of accidents have a major reason for driver drowsiness [1]. We can only assume the damage caused due to driver drowsiness worldwide. Police personnel patrolling the highways revealed that most accidents are caused between 2 am to 5 am as drivers are sleep-deprived. Also, the most common age group is 18 years to 40 years who died in these accidents [2][3]. To prevent such accidents to endanger more lives a driver drowsiness alerting system is built. Such a system is a challenge at both the research level as well as at Industrial level.

To detect drowsiness, there are various approaches and signs to observe like the ability to keep eyes open, heart rate of the driver, yawning frequency, head forwarding, etc. but, on a large scale, these approaches are turn out less effective as the behavior of every person is different.

Far now, there are three most common measures for the detection of driver drowsiness as listed below.
- Physiological measures
- Behavioral measures
- Vehicle behavior

In physiological measures, various approaches like Electroencephalography (EEG), Electrocardiography (ECG), and Electrooculogram (EOG) are used to access the driver's conditions, but they turn out to be less practical and not accepted on a daily basis. In-Vehicle behavior, vehicle steering, and braking frequency are monitored but it is more sensitive to road conditions than drivers. In the proposed method, behavioral measures captured via camera and examined by deep-stacked CNN algorithm used which is easy to adapt and not affected by external road and vehicle conditions.

In this method, real-time images of the driver are captured via camera, the captured camera frames are then processed by dlib and OpenCV libraries which extract the eye region and give input to our CNN model. The model classifies the status of the driver and if it encounters the driver to be sleeping for a specified time frame then it will quickly sound an alerting warning alarm, resulting

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in the driver being alerted and suggested to take a rest or driver carefully. This method can prevent a lot of accidents from happening on the roads.

2. Related Works

Sukrit Mehta et all., has proposed an android-based Driver Drowsiness Detection system. By using the camera, the images of the driver have been captured and passed to a machine-learning algorithm to detect driver drowsiness. The proposed system was tested on a dataset and it showed an accuracy of 84% [4].

Dricare, a system demonstrated by Wanghua Deng1 Ruoxue Wu12 for Drowsiness Detection. The author has used MC-KCF to detect the facial area based on facial key points. Additionally, a method based on the moments of eyes was also introduced and because of this, his model has a high computational speed. It was observed from the experimental results that this model was capable of detecting at different lighting conditions [5].

Rukhsar Khan and Shruti Menon have suggested a drowsiness detection system. The authors have examined various criteria like the position of the head, facial detection, eye blinking moments, etc. The system was made to capture the real-time videos and the video was converted into image frames and each frame was given input to the algorithm for classification. Once the driver shows the sign of drowsiness, it sounds the alerting alarm to warn the driver. Additionally, in this approach, GPS tracking was installed in the cars, and vehicle movements were also captured [6].

C.M Sheela Rani et al and B.Mohana also have demonstrated a drowsiness detection system. In their approach, the authors had used classifier based on Haar in their research to detect the face and eye closure. The proposed model has delivered the accuracy of 85% on the test cases. It is observed that in better lighting condition environment the model performs better [7].

Shivani Sheth, V.V Ramalingam, and Aditya Singhal proposed a drowsiness detection approach. They have used Haar based classifier to recognize the face of the driver in their study. The eye aspect ratio was administered to detect the state of drowsiness of the driver. They have implemented this model on a raspberry pi computer attached with an alarming system. The warning alarming noise by alarming system will alert the driver, which alerts the driver and prevent any unwanted accidents [8].

3. Proposed Workflow of Model

1. Dlib's frontal face detector library is used to detect the face of the driver and also to extract the Region of Interest (ROI) from the detected face which will be given as input to OpenCV's CascadeClassifier for eye region detection.
2. With the help of OpenCV's Cascade Classifier the eye region of the driver's face (Fig. 4(a) & Fig. 5(a)) is extracted and given as input to the CNN model.
3. Two Convolution blocks having 3 and 2 convolution layers respectively are used to extract the features. A single MaxPooling2D layer is used after each block to reduce the dimensions of the feature maps.
4. Three fully connected layers follow convolution layers with ReLU activation at a decreasing rate of neurons (256,128,64) are used for classification. Also, a 30% dropout after each layer is used to avoid over fitting.
5. Sigmoid activation function at output layer plays the role of classifying images into sleepy or active status.
6. The system will monitor if, for a continuous specified time frame, the sleeping state encountered then a warning alarm will be triggered instantly to alert the driver.

4. The Data

For our research work, we have used the Drowsiness_dataset present on the Kaggle platform on this link. There are four classes present in the original dataset (Open Eyes, Closed Eyes, Yawning, or No-Yawning) [9]. However, for this project we have used only two classes (Open Eyes & Closed Eyes) as this projects' scope is to classify drowsiness based on driver's eyes only. So, for this approach the characteristics of the dataset are as follows:

- There is a total of 1452 images classified into two categories (726 images in each category).
- The dataset is distributed equally among both categories, so no need to balance it further.
- Categories (class labels): 'Open Eye' and 'Closed Eye'
- Labels are encoded into 0 and 1.0 for 'Open Eye' and 1 for 'Closed Eye'.

5. Eye Region Extraction

The CNN model does not require the whole image of the driver to detect his status, only the eye region is sufficient. The first step is to detect the face of the driver and for that dlib's frontal face detection library is used. In order to avoid false positives, we first detect the face Region of Interest (ROI), and then with the help of OpenCV, Haar Cascade Classifiers are used to extract the eye region of the driver which are given as the input to our classifier model.

6. Deep Learning Model

Convolution Neural Networks (CNNs) are used to detect the status of the driver into active and sleeping [10]. Generally, CNN required a fixed size input so data preprocessing is required. At first, all the images of the dataset are resized to (32,32,3) which is the standard input for our proposed model. Also, data augmentation is performed on the training data before passing it to the CNN model. The deep CNN model is comprised of various layers like convolution layers, activation layers, pooling layers, dense layers, and dropout layers. The Convolution layer is having kernels (filters) and each kernel has width, depth, and height. This layer produces the feature maps as a result of calculating the scalar product between the kernels and local regions of the image. CNN uses the pooling layers to reduce the dimensions and boost the calculation process. Our model use MaxPooling2D (with pool_size of 2) as a pooling layer which reduces the dimensions of the image by half. In Max pooling, for each region, the maximum value is selected and given as output. ReLU (Rectified Linear Units) is a non-linear function that will return the input unchanged if it is positive, else, zero for all non-negative inputs.

In this method, there are two Convolution blocks having 3 and 2 convolution layers followed by three totally connected dense layers are used. Images with the shape of (32,32,3) are passed as the input to the first convolution layer(conv2d) of the first convolution block. The first block comprises 3 convolution layers each having 32 filters of size 3x3(kernel size) and a non-linear activation function, ReLu. After the convolution layers, Max pooling over 2 x 2 cells with strides of 2 is placed in the architecture which reduces the dimensions in half. Conv2d requires 896 parameters. The output of conv2d is fed into the convolution layer-2(Conv2d_1) which requires 9248 parameters. Convolution layer-3(Conv2d_2) also requires 9248 parameters.At the end of the first convolution block, MaxPooling2D(max_pooling2d), a pooling layer is used which half the input dimensions. It gives an output dimension of (13x13) from an image of shape 26x26.

The second convolution block has 2 convolution layers followed by a Max Pooling layer. Both convolution layers have 32 filters with a kernel size of 3. Both layers (Conv2d_3 and Conv2d_4) requires 9248 parameters and has a ReLu activation function. At the end again a MaxPooling2d layer over 2 x 2 cells with strides of 2 is used which half the input dimension from 9x9 to 4x4. After the convolution blocks, before passing the output to the dense layers, a Flatten layer is used which transforms a multi-dimensional vector of shape (None,4,4,32) into a linear 1-dimensional vector of shape (,512). Here, three connected dense layers with ReLU activation functions and neurons at decreasing rates (256,128,64) are added. Between each dense layer, a dropout layer with 30% is placed to avoid overfitting.

In the end, the output layer having a sigmoid activation function is used to classify the status of images into active and sleeping states. The output layer has only 2 outputs, which turn out to be a binary classification problem so a sigmoid activation function is used. Also, we have set the losses to 'binary_crossentropy' as we have only 2 outputs to deal with. Adam optimizer with a default learning rate (0.0001) is used as it gives the best possible results. Overall, the proposed model has a total of 210,498 parameters with 210,498 trainable parameters and 0 non-trainable parameters.

The model architecture is shown in figure 1.

```
Layer (type)                 Output Shape              Param #
=================================================================
conv2d (Conv2D)              (None, 30, 30, 32)        896

conv2d_1 (Conv2D)            (None, 28, 28, 32)        9248

conv2d_2 (Conv2D)            (None, 26, 26, 32)        9248

max_pooling2d (MaxPooling2D  (None, 13, 13, 32)        0
)

conv2d_3 (Conv2D)            (None, 11, 11, 32)        9248

conv2d_4 (Conv2D)            (None, 9, 9, 32)          9248

max_pooling2d_1 (MaxPooling  (None, 4, 4, 32)          0
2D)

flatten (Flatten)           (None, 512)               0

dense (Dense)               (None, 256)               131328

dropout (Dropout)           (None, 256)               0

dense_1 (Dense)             (None, 128)               32896

dropout_1 (Dropout)         (None, 128)               0

dense_2 (Dense)             (None, 64)                8256

dropout_2 (Dropout)         (None, 64)                0

dense_3 (Dense)             (None, 2)                 130

=================================================================
Total params: 210,498
Trainable params: 210,498
Non-trainable params: 0
```

Fig. 1. Convolution Neural Network model architecture.

7. Testing

For testing purposes, we have tested this model on various types of datasets. For example, On the video, image dataset, and on real-time webcam. And in all these types we get accurate results. This model delivers a training accuracy of 98.78% and a validation accuracy of 97.98% when tested on the dataset. The alarm system is designed in such a way that if the driver is found in the sleeping status for more than a specified period of time then it will identify the driver as drowsy and sound the alerting alarm [11] to warn the driver and avoid any accident.

The confusion matrix is shown in figure 2. (0 represents open eye and 1 represents closed eye).

The training and validation losses and accuracies curves are shown in the figure 3.
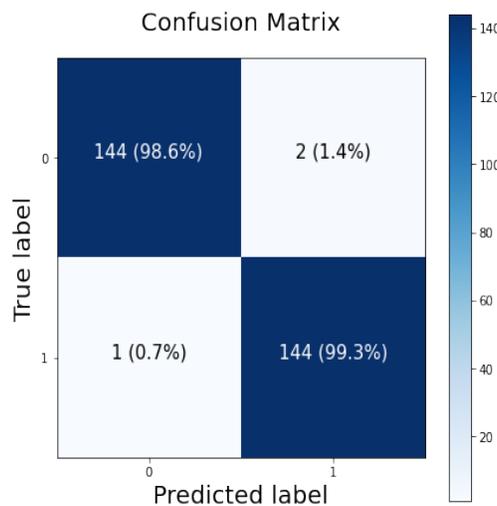
Fig.2. Confusion Matrix.
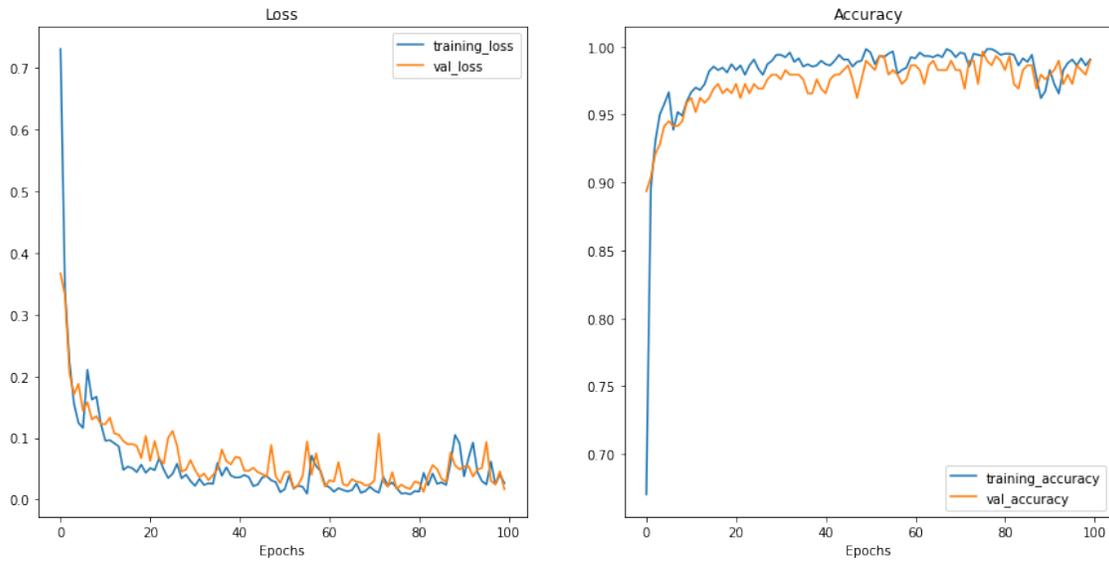
Fig.3. Losses and accuracies curves against no of epochs for training and validation data

Experimental Outcomes:
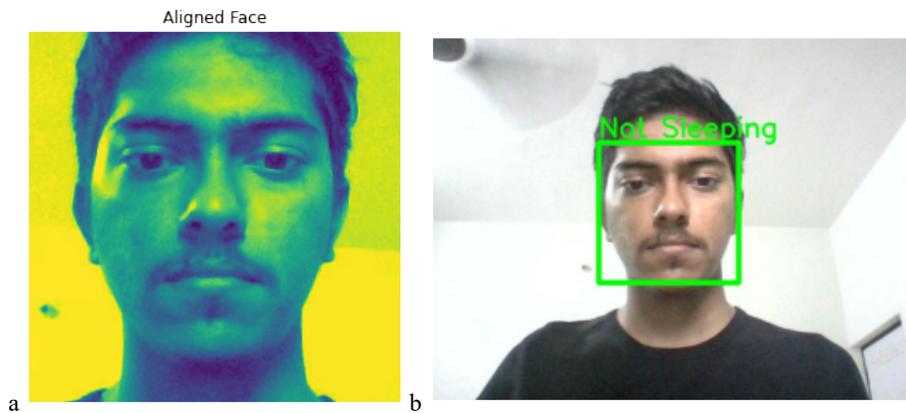
Fig.4. (a) shows the region of interest from the full image of driver and (b) shows the prediction of the driver's status (active status) by our classifier model.
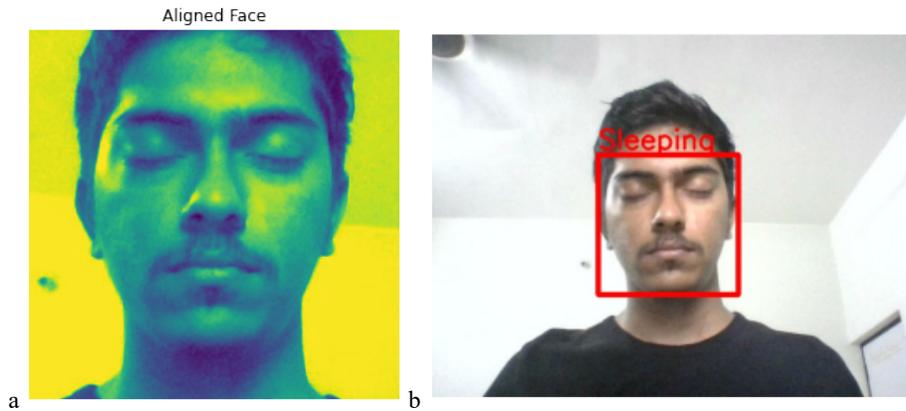
Fig. 5. (a) shows the region of interest from the full image of driver and (b) shows the prediction of the driver's status(Sleeping) by our classifier model.

8. Conclusion

Here, in this approach, a new method is proposed to detect the drowsiness of the driver. To accurately extract the eye region from the driver's face, dlib and OpenCV library are used. A deep-stacked CNN architecture is used to extract the features from the input images and the sigmoid activation function at the output layer is responsible to detect the current status of the drive. This method delivers an accuracy of 97.98%. The proposed method precisely detects the status of the driver into an active or sleeping state and alert with a warning alarm if the driver encounters to be sleeping for a certain period of time (adjustable as required). To further improve this model, we will focus on using transfer learning for more accurate performance.

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Experimental Approach to Measure Fuel Quantity in Automobile Vehicles

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Abstract

The recent times we are constantly hearing about petrol bunk frauds. Most of the petrol bunks today have manipulated the pumps such that it displays the amount as entered but the quantity of fuel filled in the customer's tank is much lesser than the displayed value. I.et the pumps are tampered for the benefit of the petrol bunks owner. This results in huge profits for the petrol bunks but at the same time the customers are cheated. All the vehicles in India consist of analog meters hence it is not possible to precisely know the amount of fuel currently in the vehicle and it is not possible to cross check the quantity of fuel filled in the petrol bunk. In this project we focus on creating a digital display of the exact amount of fuel filled in the vehicles tank and helps in cross checking the quantity of fuel filled at the petrol bunk.

Keywords - Fuel tank, Fuel flow Meter, Flow sensor, Digital fuel meter.

1. Introduction

In recent time petrol bunk scams are very common. today manipulate pumps such that it displays the amount as entered almost 80 percentage of the petrol bunks, but in reality, the quantity of fuel filled in the customer's tank is much lesser than the displayed value. Then the customers are being cheated. And petrol bunks are huge profit earning. That found out a proper solution indicating the accurate availability of fuel in the tank is a digital meter this meter calculating proper value of petrol bunks. Some issues to the existing level measurement techniques are identified and try to better alternat digital sensing technology has been suggested all description give below the paragraph and justified this issue.

Product name is fuel flow meter. Product is generally considered as one type of inspection device. Product is measure actual fuel quantity. This product in use flow rate sensor, Arduino UNO, digital display, Potentiometer, battery, etc. product is very simple attractive creative and helpful. This project domain is automobile industry. Product is fuel flow meter manufacturing is very easy. And use making this product material and part is easily available on market, so many advantages, low-cost product. We know that at the petrol pump give as lesser than petrol as we want. So we are going to make a product at an affordable price by which we can measure how many liters of petrol have been discharged in our tank.

2. Literature Survey

The following chapter discusses the literature survey done in fuel flow meter. The chapter further describes history, background and different types of flow meter.

Author S. R. Khan [1] has developed a Real Time Generator Fuel Level Meter Embedded with Ultrasound Sensor and Data Acquisition System. This project has an Ultrasound Sensor module, Liquid Crystal Display to show the updates, a micro-SD card for data acquisition and Real Time Clock to gave accurate time and date. The whole system has controlled by two PIC microcontrollers 18F4520.

V. Rahul [2] has worked on digital fuel indicator system. The author specifies the used of liquid pressure sensor which works on the principle of piezoelectric effect which has calibrated to the fuel tank. Calibration result of the liquid pressure sensor has linear than the Float level sensor and hence it can be used to measure level of the tanks.

P. Geetha [3] has published a paper on Design and Implementation of GSM Based Digital Fuel Meter and Fuel Theft Detection Using PIC Microcontroller PIC16F877A Microcontroller. LCD (16x2) has connected to Microcontroller to display the level of fuel. After ignition LCD will display current value of fuel level.

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G. Prath yusha [4] published a paper on Embedded Based Flow Control Using Fuzzy YF-S201 Hall Effect Water Flow Meter / Sensor. In this system, sensor placed in line with the water line and contains any simple level sensor. Sensor used to measure how much liquid has pumped through it. There has an integrated magnetic Hall Effect sensor that outputs an electrical pulse. The Hall Effect sensor has sealed that allows the sensor to stay safe and dry. The sensor comes with three wires: red (5-24VDC power), black (ground) and yellow (Hall Effect pulse output). By counting the pulse from the output of the sensor, user can easily calculate water flow.

3. Experimentation

The prototype contains the main body consisting of an external body, a flow meter sensor, an Arduino uno chipset and a digital display. A fluid is passed through the external body, which is connected to flow meter sensor. As the fluid flows through the sensor, it registers the flow of fluid. The registered data then forwarded to the Arduino uno chipset for programming, after programming the data will then be displayed on the digital display. This display shows how much fuel has been poured through the prototype/model. Non-corrosive materials, Arduino uno and 3D software have been used to prepare a prototype. The basic circuit diagram or actual circuit of the fuel flow meter is given in the fig 1 & 2.
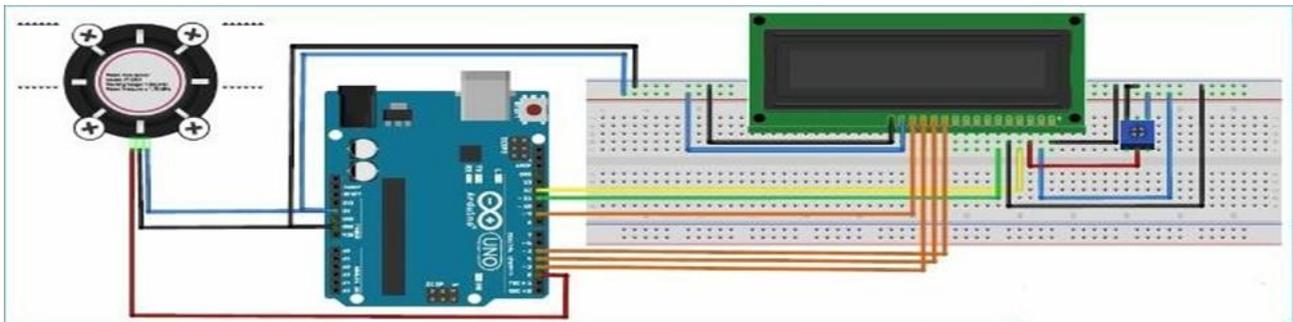
Fig. 1. Circuit Diagram of Fuel Flow Meter
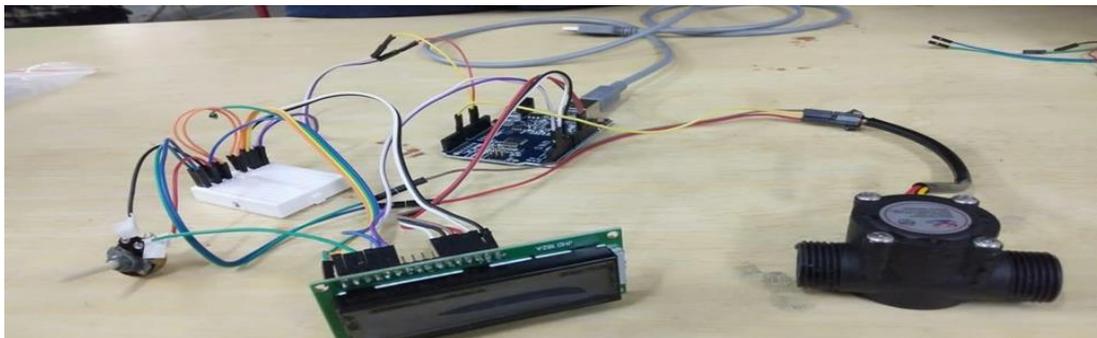
Fig. 2. Actual Circuit of Fuel Flow Meter

3.1 Components

1 Flow rate sensor
2 Arduino UNO
3 Digital display
4 Potentiometer
5 Battery
6 Body

3.1.1 Flow rate sensor

Accurate flow measurement is an essential step both in the terms of qualitative and economic points of view. Flow meters have proven excellent devices for measuring water flow, and now it is very easy to build a water management system using the renowned water flow sensor YF-S201. For example, you can make a robotic cocktail dispensing machine, and can use this sensor to accurately measure components like Soda, Water, etc.

The fig 3 show the YF-S201 1/2-inch Water Flow Sensor sits in line with the water line and contains a pinwheel sensor to measure how much water has moved through it. There is an integrated magnetic Hall-Effect sensor that outputs an electrical pulse

with every revolution. YF-S201 1/2-inch water flow sensor has only three wires and it can be easily interfaced between any microcontroller and Arduino board. It requires only +5V Vcc and gives pulse output, the sensor needs to be tightly fitted between water pipeline.

Specifications of 1/2 inch Water Flow Sensor - YF-S201: -

- • Model: YF-S201
- • Sensor Type: Hall effect
- • Working Voltage: 5 to 18V DC (min tested working voltage 4.5V)
- • Max current draw: 15mA @ 5V
- • Output Type: 5V TTL
- • Working Flow Rate: 1 to 30 Liters/Minute
- • Working Temperature range: -25 to +80℃
- • Working Humidity Range: 35%-80% RH
- • Accuracy: ±10%
- • Maximum water pressure: 2.0 MPa
- • Output duty cycle: 50% +-10%
- • Output rise time: 0.04us
- • Output fall time: 0.18us
- • Flow rate pulse characteristics: Frequency (Hz) = 7.5 * Flow rate (L/min).
- • Pulses per Liter: 450
- • Durability: minimum 300,000 cycles

Fig. 3. Flow Rate Sensor

3.1.2 Arduino UNO

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). The fig 4 Arduino UNO It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. You can tinker with your UNO without warring too much about doing something wrong, worst-case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and has been chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.
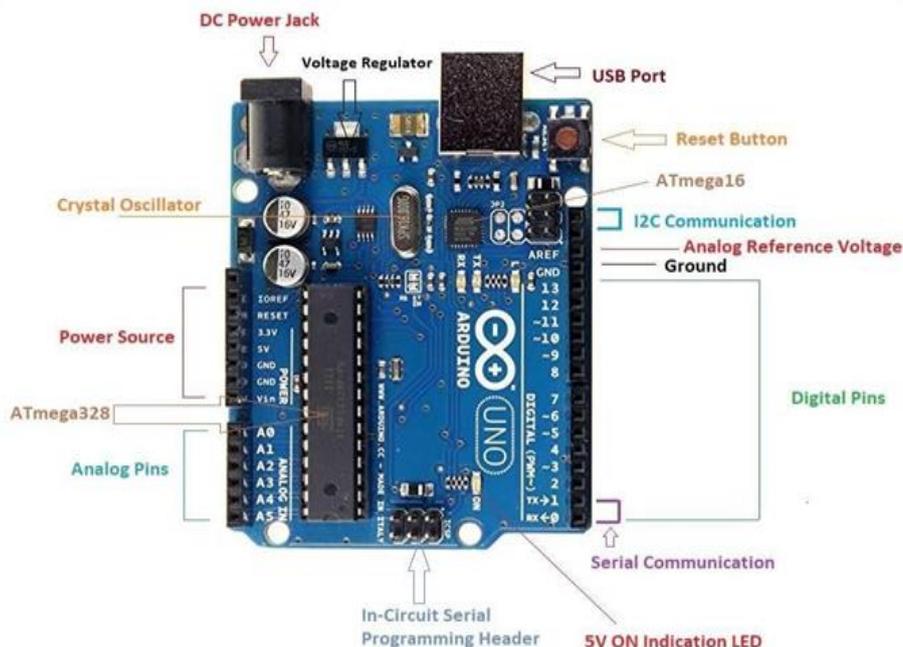
Fig. 4. Arduino UNO.

3.1.3 Digital display

The show in fig 5 LCD, we are using a high quality 16 characters by 2-line display module, with back lighting.

- 16 Characters x 2 Lines
- HD44780 Equivalent LCD
- Controller/driver Built-in
- 4-bit or 8-bit MPU Interface
- Standard Type
- Works with almost any microcontroller.

Fig. 5. Digital Display

3.1.4 Battery

This is general 9v Battery as show in fig 6 for all your project and application needs. Whether you need a new battery for your applications like a Flashlight, Portable Phone Charger, Wireless doorbell, Wireless audio transmitter-receiver systems or your kid's toys, etc. or even if you are looking for

A long-lasting, reliable option for your sensor devices like a smoke detector, everyone needs a good 9-volt battery every once in a while. It's also a great idea to keep extra 9-volt batteries around in case of an emergency. That's why we've found one of the best 9-volt battery available.

Fig. 6. Battery

3.1.5 Potentiometer

10k ohm Trim pot RM065 Package is a type of variable resistor, the show in fig 7 potentiometer it can be easily mounted on PCB and adjusted using screwdriver.

Fig. 7. Potentiometer

3.2 Programming

The explanation of the code is as follows.

We are using the header file of the LCD, which eases our interfacing the LCD with Arduino, and the pins 12,11,5,4,3,9 are allotted for data transfer between LCD and Arduino. The sensor's output pin is connected to pin 2 of Arduino UNO.

This function is an interrupt service routine, and this will be called whenever there is an interrupt signal at pin2 of Arduino UNO. For every interrupt signal, the count of the variable flow frequency will be increased by 1.

In the void setup, we tell the MCU that the pin 2 of the Arduino UNO is used as INPUT by giving command pinMode (pin, OUTPUT). By using attach Interrupt command, whenever there is a rise in the signal at pin 2, the flow function is called. This increases the count in the variable flow frequency by 1. The current time and cloopTime are used for the code to run in every 1 second.

If the function ensures that for every one second the code inside it runs. In this way, we can count the number of frequencies produces by the flow rate sensor per second. The flow rate pulse characteristics from the datasheet are given that frequency is 7.5 multiplied by flow rate. So, the flow rate is frequency / 7.5. After finding flow rate which is in liters/minute, divide it by 60 to convert it into liter/sec. This value is added to the vol variable for every one second

3.3 Prototype

Fig. 8. Fuel Flow Meter

4. Results & Discussion

With using the arrangement, we performed trials by pouring petrol through the device hence getting results as follows.

Table 1. Experimental results of fuel flow meter.

Sr No.	Fluid Type	Actual Quantity (Ltr)	Reading Quantity (Ltr)	Percentage Error (%)
1	Petrol	0.16	0.14	12.5
2	Petrol	0.50	0.44	12.5
3	Petrol	0.75	0.66	12.0
4	Petrol	1	0.88	12.0

After getting problems we tried to solve the issue and we firstly, used brass Pipe connector on both side of the fuel sensor, after performing trials we got the results but were not satisfactory, so then we used an arrangement of 2-3 pipes with different dimensions where the inlet pipe's diameter is maximum and outlet pipe's diameter is minimum and then again, we performed trials with getting better results and better accuracy.

5. Conclusion and Future scope

After completing, solution is figured out to overcome the problem and limitation in order to make our prototype run smoothly and successfully. Besides, students are able to have more understanding about the working of fuel flow meter. Furthermore, students

also have understood about the advantages and disadvantages of fuel flow meter. Product is fuel flow meter which performs very accurate and excellent.

As the project is new in country, there is a golden scope for this project. The project is helpful to other people to purchase it as per their requirement. Second strength of this project is its low production cost, this leads to allow to purchase it for their work. It is very simple to use. If any failure occurs in the part of this product, it can be changed as its construction is simple and not costly. Its maintenance cost is also very low. Hence, as we all have learned about the increase in the price of fossil fuel especially fuel used to run automobile vehicles, every drop of the fuel is very important for a common man considering the economic situation of every household. To ensure that we get the correct amount of fuel for the sum we paid, we introduce a product in form of our project that will tell how much quantity of fuel has actually gone in the vehicle. We are aware that these types of instruments are already available in the market but the problem with them is that they are very expensive and common public cannot afford them. So, the goal of our project is to provide common public a device which is accurate is very affordable and is easy to use.

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Parametric Influences in Hydro Mechanical Deep Drawing: A Review

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Abstract

Hydro-mechanical deep drawing (HMDD) is a new sheet metal forming technology originating from hydroforming technology to manufactured automobile parts, beverage cans and cookware of high strength and light weight. Various process and geometrical parameter influence the quality produced by hydro mechanical deep drawing. This paper is highlighting recent research work and results in HMDD. HMDD operations are executed to produce a high strength, low density and light weight. These requirements will rise the failure defects in the product. Parameters like Pre bulging pressure, Chamber Pressure, Coefficient of friction, Blank holder pressure, Drawing ratio, Punch speed and punch velocity, punch radius, die corner radius and springback affect HMDD. Understanding of process is required to produce product with minimum defects. This review paper has given the attention to collect latest progress, development and research work in the area of HMDD.

Keywords: Hydro-mechanical Deep Drawing, Pre bulging, Blank Holding Force, Friction, Drawing Ratio.

1. Introduction

Products made of sheet metals are all around us. They contain an extensive range of consumer and industrial products, such as beverage cans, metal desks, appliances, cookware, car bodies, trailers, and aircraft fuselages. Sheet metal is any metal that has a thickness in between 0.5 to 6 mm. In sheet-metal working, there is no need for additional machining as required for casting and forging works. It is the production of closed bottom cylindrical or rectangular containers from thin metal sheets. This process is sometimes called shell drawing, because one of the earliest applications of this process was the production of artillery shells and cartridge cases. When the ratio of depth of the product to its diameter (or the smallest dimension of its opening) is greater than 1, the process is known as deep drawing, whereas when the ratio is less than 1, it is considered as shallow drawing.

HMDD is a sheet metal forming technology creating from hydroforming technology. It consociates the features of both conventional deep-drawing process and hydroforming technology. The bottom of the sheet is supported with a bed of pressurized viscous fluid during forming process.
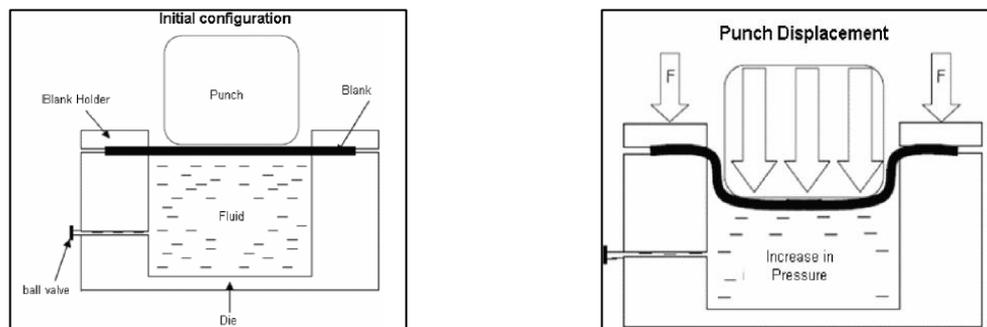
Fig 1. Hydro Mechanical Deep Drawing Process (a) Initial configuration (b) Punch Displacement

The punch deforms the sheet to its finishing shape by moving against a controlled pressurized fluid. The purpose is to form deep drawn cups without any kind of forming instability such as wrinkling, buckling, or bursting. The HMDD process comprises 2 steps: firstly, Pre-bulging step, in which blank is bulged by initial pressure and secondly drawing step with applied controlled pressure. In this step, a punch draws the blank into a chamber that has been filled by a controlled fluid medium (usually oil) as the female die. The fluid pressure used in the HMDD process mainly so that friction can be significantly reduced and so that clamping (or friction holding effect) between punch and blank can prevent the fracture of the blank at the punch corner, thus enabling the LDR value to be increased.

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There are many benefits of HMDD, over traditional metal forming processes, such as increased drawing ratio, forming of complex shapes, better surface quality, cost-effective parts and lower tool costs. The female die in the traditional; deep drawing process is replaced by a cavity filled with a fluid in the HMDD process. The final form of the part is determined by the punch. The usage of the fluid make possible to decrease the friction and to prevent metal-to-metal contact at the blank-die interface which improve the possibilities of obtaining a better geometry of the final products.

The factors affect the Hydro mechanical deep drawing process may be categorized into two categories. (1) Process parameters (2) Geometrical Parameters. Process parameters include pre bulging pressure, chamber pressure, coefficient of friction, blank holder force, drawing ratio. Geometrical parameters include Punch radius, die corner radius, clearance and springback.

2. Literature Review

The Hydro mechanical deep drawing has been a most important area of research for the forming of the sheet metals. The various parameter influencing the HMDD are
1.   Pre bulging pressure
2.   Chamber pressure
3.   Coefficient of friction,
4.   Blank holder force,
5.   Drawing ratio,
6.   Punch speed and punch velocity
7.   Punch radius,
8.   Die corner radius
9.   Clearance
10.   Springback

2.1 Pre Bulging Pressure
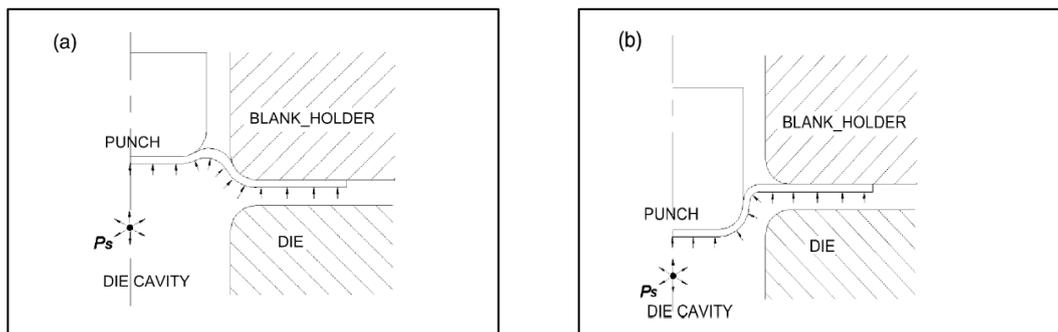
Fig 2. Pre-bulging methods (a) Plus pre-bulging method (PPB), (b) Minus pre-bulging method (MPB)

Pre-bulging height is the distance between the punch and blank before forming process. Pre bulging method incorporates 2 types (a) plus pre-bulging method (PPB) (b) Minus pre-bulging method (MPB). Pre bulging influence the uniformity of the product. Many process parameters such as the sheet thickness, the blank holder entrance radius, the die entrance radius, the clearance between the punch and the blank holder and the material properties of the sheet will impact the effects of pre-bulging. Generally, pre-bulging has two functions: building the pressure at the initial stage of forming, and pre-forming the sheet to interaction with the punch nose radius for stopping the fracture. The pre-bulging method has 2 parameters including pre-bulging pressure and pre-bulging height. F. Rahmani (2021) has investigated the effect of pre bulging pressure in HMDD process for square parts. HMDD for square parts was studied using FEA and Abaqus software has used for simulation. An experimental study has been also carried out to verify FEA result. Different simulations had carried out to conclude the influence of pre-bulging pressure on a maximum thinning by keeping fixed space between blank and punch. The blank can't reach to punch at lower pressure and it doesn't bulge and therefore the thinning increased. On the other hand, the blank is subjected to further extension at higher pre-bulging pressure. Minimum thinning is optimized by set a parameter of pre-bulging pressure Between 20 to 35 Bar. S. Yagohubi (2020) has presented an investigation on the effects of the process parameters of HMDD on manufacturing high-quality bimetallic spherical-conical cups. The bimetallic cup consists blank of aluminum and steel sheets. Two criterions has been selected to evaluate the effects on quality of the final product are thickness variation and thickness strain. The most substantial effect of the pre-bulge pressure was observed at the wall of the composite cup, where the separation of the layers was nearly prevented and, so the total thickness variation of the product was improved. The quality of the final product was improved by means of reduction of thinning with increasing the fluid pressure up to 15Mpa. Maximum thickness strain and thickness variation in the study were gained to be 57% and 68%, respectively, in comparison with the conventional deep drawing process. L. Lang (2003) has Investigation of the effect of pre-bulging for HMDD with uniform pressure on blank. The pre-bulging consist 2 factors: pre-bulging pressure and pre-bulging height. The pre-bulging

have greater impact on the initial forming stage as well as initial middle forming stage final formed cups but has no affect the final stage of forming cups. Around the punch nose the sheet will harden significantly by the bending and unbending effect, which will be very useful in stopping the occurrence of fracture. The pre-bulging height will be useful to prevent fracture here because of friction reduction between the blank and the punch. However, if using too-high pre-bulging height, fracture initiated due to heavy bending and unbending. At the starting of the forming stage, the pre bulging will affect the liquid pressure variation considerably.

2.2 Chamber Pressure

F. Rahmani (2021) submitted their work Thickness Distribution in HMDD Process for Square Parts. In this paper, different parameters like chamber pressure, bulging pressure and friction coefficient were investigated on thinning. Various simulations were carried out in different final chamber pressure to determine the effect of chamber pressure on the maximum of thinning. In all states, pre-bulging pressure (Pi) was considered 20 Bar. It can stated that from study, for 2 different LDR, the maximum of thinning increased at higher pressure, but wrinkling was decreased by increasing the chamber pressure in the flange zone. Wrinkling is generally shown in the flange area. Thinning was lower at the bottom side than the other areas and Thinning observed in the wall area is high. S. Yaghoubi (2020) has presented HMDD for manufacturing high-quality bimetallic spherical-conical cups and investigate on the effects of the process parameters on thickness distribution. Both the quality and uniformity of the final double-layer product was improved by optimizing a chamber pressure and by this study it has conclude that the optimize pressure is 15Mpa. Tensile stresses and the bending at the punch tip were uniformly distributed in HMMD comparison with conventional deep drawing so can say that the level of thinning was noticeably reduced. H. Ballikaya (2019) has studied the LDR in HMDD method in which die shape is angled. Taguchi experimental design method is used for investigating the effect of the different parameters on LDR. ANOVA which is a statistical formula used to analyze the data statically for evaluate the effect of different parameters on LDR. LDR increases with chamber pressure at some extent and after that it started decreasing. At 8MPa.The chamber pressure gave the optimum LDR When the chamber pressure was increased up to 8MPa, it was determined that the LDR increased up to 2.6 and decreased after this value.

2.3 Coefficient of Friction
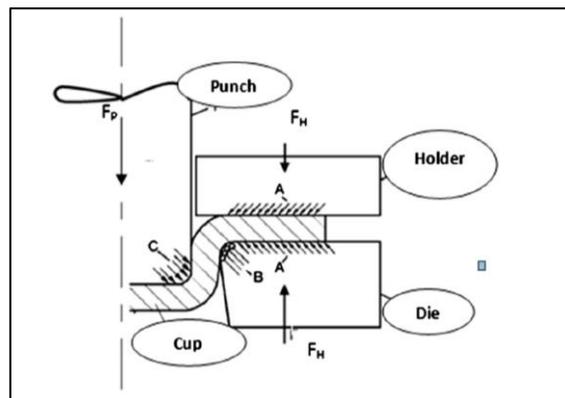
Fig. 3. Friction area when deep drawn a cup (A) Friction area between sheet metal blank and holder and sheet metal blank die; (B) friction area between sheet metal blank and the die radius and (C) friction area between sheet metal blank and punch edges; F_P - total drawing force; F_H, blank holder force.

The coefficient of friction, μ, is a measure of the amount of friction existing between two surfaces. A low value of coefficient of friction point out that the force required for sliding to take place is less than the force required when the coefficient of friction is high. K. There is generally 3 friction area considered when deep drawn a cup which shown in figure. A indicate a friction area between sheet metal blank and blank holder. B indicates friction area between sheet metal blank and the die radius and C indicates friction area between sheet metal blank and punch edges. The friction influences the energy which is desirable to deform a sheet material. Friction also affect the stresses and strains in the work piece material and, hence, the quality of the product. Therefore, it is important to control the friction between the tools and the work piece. Wiratchakul studied on Effect of Friction Coefficient in Hydro mechanical Deep Drawing Process on Part Quality for Parabolic Part. FE analysis has done by LS-DYNA program. AISI 1008 used in this work. This research examined the effect of friction coefficients: binder/blank ($\mu_{S\,(B/B)}$) and punch/blank ($\mu_{S\,(P/B)}$) on the wrinkle and thinning defect in the HMDD by FEM. Friction coefficients of $\mu_{S\,(B/B)}$ and $\mu_{S\,(P/B)}$ defined in range of 0.00-0.15 and 0.00-0.25, consequently. To analyze effect of friction coefficient on part quality for parabolic parts, least square regression method was selected to apply. Study indicates that thinning is affected by $\mu_{S\,(B/B)}$ and $\mu_{S\,(P/B)}$ and wrinkle is affected by $\mu_{S\,(B/B)}$ and interaction of $\mu_{S\,(P/B)}$ and $\mu_{S\,(B/B)}$. So, $\mu_{S\,(B/B)}$ is very crucial because it affect both of the wrinkle and thinning defect for the HMDD. Thus, it should be considered firstly. Form the analysis, the proper friction coefficient of $\mu_{S\,(B/B)} = 0.06$ is chosen to avoid wrinkles from occurring on the part. Then, the thinning quality can be improved by increment of $\mu_{S\,(P/B)}$. H. Zein (2014) presented Thinning and spring back prediction of sheet metal in the deep drawing process. The blank is made of MS. A FE model was developed for

the numerical simulation of the deep drawing process with help of ABAQUS software. For validation, the FE results has compared with experimental results. The developed model predicts the thinning, the thickness distribution and spring back of the blank which is affected by punch force, the blank holder force and the lubrication. The fluid lubricant with ($\mu_p = 0.25$), is more appropriate for the punch/blank interface to decrease the thinning and the springback in the cup. The fluid lubricant with ($\mu_h = 0.125$–0.2), is appropriate for the holder/blank. Interface, (μ_h) should be around 0.18 to reduction of thinning and the springback in the cup. The fluid lubricant with ($\mu_d = 0.125$–0.2), is appropriate for die/blank interface. (μ_d) is recommended to be about 0.16 to decrease the thinning and the max residual stresses within the cup wall. Wen-yu MA (2015) has investigated Effect of friction coefficient in deep drawing of AA6111 sheet at elevated temperatures. In this study, the effect of the friction coefficient ranging from 0 to 0.30 is evaluated. Results show that the friction coefficient and lubrication position considerably impact the minimum thickness, the thickness deviation and the failure mode of the formed parts. In terms of formability, the optimal value of friction coefficient determined in this study is 0.15. Thinning occurs near corner of the cup. The crack occurred at the center of cup bottom is the ductile fracture, while in ductile and brittle mixed fracture, the crack occurred near the cup corner. Q. Liu (2012) has investigated cushion conditions optimization for micro multi point sheet forming. The effect of material of cushion and friction coefficient on the sheet thickness distribution had investigated. Because of Good lubrication condition, Better thickness distribution and surface quality and can be obtained. It has found that friction influence the relative thickness distribution and surface quality in micro MPF. A lesser friction coefficient produces a superior surface quality and makes the thickness variation of the formed sheet higher. F. Vollertsen (2008) has studied Determination of size dependent friction functions in sheet metal forming w.r.t. the contact pressure distribution. In ABAQUS software, friction can be applied to realize size dependent FEA simulation. Applying the new friction features in ABAQUS, the virtual punch pressure vs. punch journey curves definite a higher settlement with the experimental curve. J.Hol (2015) investigated Multi-scale friction modeling for sheet metal forming with the boundary lubrication system. Outcomes display that friction coefficients range in space and time, and rely upon condition such as plastic strain and nominal contact pressure in sheet material. Friction model is confirmed through 2 small-scale forming processes, proving the improved predictive abilities of FE simulations. The slight growth in FE computation time, as compared to the use of a Coulomb primarily based totally friction version, demonstrates the efficiency of the proposed friction model. However, the outline of the material behavior itself will become increasingly. D. Karupannasamy(2012) has investigated Modelling blended lubrication for deep drawing processes. The coefficient of friction decreases because of hydrodynamic results and additionally will increase because of the have an effect on of stress. Further, the nominal pressure, stress and sliding velocity have been taken from FE simulation of a cup and used within side the mixed lubrication model to calculate the coefficient of friction. The coefficient of friction was shown for cup drawing at 3 distinctive drawing depths.

2.4 Blank Holder Force

Blank holder force (BHF) is important parameter in HMDD process and it influence wrinkle formation. In complex parts, Deep drawn cup can't manufactured by using constant BHF, so variable BHF is also used. The-Thanh Luyen (2021) has presented a deep drawing process using the graphical method and simulation as well as experimental study have been carried out. Firstly, Flow stress curve has evaluated by conducting experimental tests and for this uniaxial tensile specimens was used. Secondly, by using maximum force criterion (MMFC), the fracture point at plain strain, biaxial strain and biaxial tensile strain has calculated. After that, Forming limit curve (FLC) estimated with use of graphical method. Fracture height was determined by FEA and it compared with experiments. The study showed a good agreement between simulated and measured fracture height with a highest of 3.6 % deviation. BHF of 7.5 to 17.5kN is selected for study. The fracture height of the cylinder cup during process reduces by increasing BHF. There is no fracture at low BHF and BHF mostly occurs in the flange area because of insufficient compressive force. Also, there is no wrinkle on wall side. H. Ballikaya (2019) has investigated the LDR in die angled HMDD method. In this study, the experimental set-up of die angled HMDD was designed and established for conducting the tests. In the sub chamber of die, Hydro Oil Aw 46 was used as a forming fluid. The effects of the parameters on the LDR were numerically examined and compared experimentally using ANSYS packaged software. From this study, it can say that the optimum value of BHF parameter was 5882.72N and at this BHF LDR increases up to 2.6 and after that LDR decreases. H. Zein (2014) has developed experimental set up to calculate the Thinning and spring back prediction of the deep drawing process. A FE model was developed for the numerical simulation of the deep drawing process with help of ABAQUS. For validation, the FE results has compared with experimental results. The developed model predicts the thinning, the thickness distribution and spring back of the blank which is affected by punch force, the blank holder force and the lubrication. It has been shown from study that BHF increases over 0.5 tons, cup collapsed due to thinning. The strain over the punch face will greater at the high BHF. BHF also influences the springback percentage. With increasing the BHF up to 5 tons springback percentage is stable and after that value springback percentage increases. L. Lăzărescu (2015) has investigated Evaluation of thickness distribution and drawing force in the deep drawing process with variable blank holding force. The objective of this work was to examine the consequence of BHF on the wall thickness distribution and drawing force for cylindrical and square cups made from AA 6016-T4 aluminum alloy in deep drawing process. Drawing forces increases with blank holding forces. Drawing force is influenced by the amount of Blank holding force. The wall thinning in the punch shoulder part cannot be influenced by the constant or variable BHF considered in this study. The constant or variable BHF can't affect the wall thinning in the punch shoulder part. The thickening at the side wall of cups can be influenced by variable and constant BHF. Ultimately, it was shown that the increasing in BHF leads to a reduction of thickening of the side wall cups. S. Tommerup (2012) studied Experimental verification for adaptive blank holder pressure distribution of a deep drawing tool system. 8 different cavity

pressure schemes are applied during the punch stroke and its effects are documented by way of process data and 3D coordinate measurements of the formed parts establishing that both the thickness distribution and the geometric shape in the formed parts can be affected by the shimming system.

2.5 Drawing ratio

Deep drawability generally is expressed by the limiting drawing ratio (LDR) as LDR = Maximum blank diameter/punch diameter. LDR can limited by thickening at the flange. The flange portion is subjected to compressive load (circumferential) and tensile load (radial). Flange thickness increases due to circumferential load. Biaxial tensile loading at cylindrical portion affecting the thinning of sheet. And at the blank and tool interface affecting a fracture at the interface correspondingly. So thickening and thinning at flange portion and blank-tool interface correspondingly can controlled by BHF. S. Yaghoubi (2020) has an investigation on the effects of the process parameters of HMDD on bimetallic spherical-conical cups. This paper study analytically, numerically and experimentally study the HMDD process of bimetallic specimens. In this research work, double-layer blanks was used which consist 2 sheets, St13 and 1200 Al sheets The drawing depth, one of important parameters in various deep drawing processes, is defined in the present research work as: DD = H/d where H and d represent the final depth and the product diameter, respectively. The max. Thickness strain of the final product was determined for Al/St and St/Al layer sequences at various drawing depths to validate the results of the numerical simulations of the HMDD process. The HMDD operation was performed for 2 drawing depths of 0.40 and 0.55 with the purpose of investigate the effects of process parameters. With a maximum pressure of 30MPa at a drawing depth of 0.55, the experimental and numerical simulation has done for composite cups for sheet order of Al/St and St/Al layer. The workpiece was subjected to stretching and bending at the contact area with the punch tip. This condition could exaggerate the thinning at workpiece and contact area of the punch tip in comparison with the other areas of the spherical conical cup. The Thanh Luyen has studied on the deep drawing process for SPCC sheet using the graphical method. Simulation and experimental study has also carried out to investigate the effect of different parameters. Uniaxial tensile specimens is prepared and experimental tests were conducted to conclude the flow stress curves. In this study, ABAQUS software is used to analysis the deep drawing of cylindrical cup. A high drawing ratio ensures a constant contact area between blank holder and blank with the purpose of increase the capability of deformed sheet metals in the deep drawing. But, thinning and tearing take place with large drawing ratio. The calculation of the fracture points at plane strain, uniaxial tensile strain, and biaxial tensile strain was presented using the modified maximum force criterion (MMFC). The influence of drawing ratio on the fracture height is examined. Generally, the drawing ratio range is between 1.6 and 2.2 for most metals. A high drawing ratio is expected in the deep drawing process of sheet metals because a higher drawing ratio ensures a stable contact area between blank holder and blank with the intention of increase the ability of deformed sheet metals in the deep drawing. Though, large drawing ratio can cause unwarranted thinning and tearing of the metals. The drawing ratio is selected from 2.1 to 2.4 in this investigation. The punch corner radius and the blank holder force are set to 4 mm and 10kN respectively. It can be seen that with increasing drawing ratio, the fracture height gradually decreases. The deviation % of fracture height shows that the estimated and measured results are well matched with a max. Error of below 4%. I. Irthiea (2020) has investigated the Effect of process parameters on micro flexible deep drawing for SS304 cups utilizing floating ring. The floating ring is used to reduce minor wrinkles that normally occur at the flange, while the flexible die is used to complete the forming stroke. In this study, the consequence of choosing different initial sheet thickness, punch corner radius, drawing ratio and rubber height is investigate through simulations and experiments. This article presents a micro deep drawing in which consist of a floating ring (primary rigid die), and with a rubber pad (main flexible die) is engaged for forming cups. The function of the floating ring is to reduction of wrinkles that commonly occur at flange, while the flexible die is used to complete the forming stroke. For FEA, ABAQUS software is used. Several experiments are carried out using a special setup to validate the numerical results. The LDR obtained at the three scale factors adopted in this study are 2.63, at and $\lambda = 0.5$ and 1 where the blank diameters are 5.25 and 2.75 mm, respectively, and 2.5 at $\lambda = 2$ where the dia. is 10 mm. A Reddy has studied deep drawing of circular cups for calculate limiting drawing ratio and for that experimental study and simulation has carried out and compared both result. The AA6111 aluminum alloy of different sizes sheet blanks were drawn using optimum forming conditions which established through Taguchi experimental method. The LDR found for AA6111 was 1.8325 in this study. The critical diameter was found 146.6 mm in the study.

2.6 Punch Speed and Punch Velocity

Y. Dewang (2020) has studied effect of the velocity of the punch on Deformation Behaviour in Deep Drawing of Aluminum Alloy. The material is used for this investigation is AA-1100-O. FE simulation of the deep drawing was by the ABAQUS/6.14. With increase in punch velocity from 150 to 350 mm/s, Effective stress improved by nearly 56%. Equivalent plastic strain increased by 5 times on increase in punch velocity from 150 to 350 mm/s. At flange radii region (die corner) and at all velocities of punch, Von Mises stress and equivalent plastic strain found to be maximum. The wrinkling was found to be noticeable with rise in velocity of the punch after unloading of the punch. For prevention of wrinkling tendency, the punch velocity should be less than 200 mm/s. F. Vollertsen has investigated Analysis of velocity of punch in micro deep drawing. Using the material Al99.5 blank in thickness of 0.02 mm a LDR of 1.8 was selected for micro deep drawing independent from punch velocities from 1 to 100 mm/s. The allowable upper limit initial BHF increases with increasing velocity of punch. The permissible upper limit for initial BHF can be theoretically calculated. The calculation agrees well with the experimental process. The increment of the height of the process window is due to

the decrease of the coefficents of friction. The investigation in this work shows that the velocity dependent friction coefficients are Liable for the difference in process windows under different velocities of punch.

M. Jabbar (2021) has studied Numerical and Experimental of the Elastic Recovery by means of springback in Deep Drawing. 2 types of material, low carbon (AISI 1008) and galvanized steel sheets, of 110 mm dia circular blanks at 1.2 and 0.9 mm thickness are formed by process. Conical dies of 70°, 72°, and 74 were used to execute the experimental work and numerical calculation in which the punch velocities were 100, 150, and 200 mm/min. ABAQUS 6.14 was used for Numerical simulation. Increasing the velocity of punch causes an increase in the springback factor by around 0.002 to 0.003 and by 0.002 to 0.004. The numerical simulation results show same tendency and high agreement with experimental results with a maximum inconsistency of 4 percentage. M. Kardan (2017) has investigated Experimental and FE Results in Deep Drawing Process for Optimization of Punch Force and Thickness Distribution. By experimental investigation, the effects of 8 process parameters including punch velocity, lubrication conditions, die corner and punch radius, blank thickness, and Blank holder force on cylindrical deep drawing process have been studied, concurrently. Thickness distribution and punch force are considered as process outputs in this study. From the study, it is found that addition to blank thickness, die corner radius, punch radius and Blank Holder Force are correspondingly 3 main parameters which have uppermost influence on the punch force. It can be determined that initial blank thickness and die radius are 2 most significant parameters should be set up properly to accomplish the uniform thickness distribution and minimum punch force at the same time. Furthermore, uniformity of thickness distribution be increased the punch force will be decreased for higher die radius.

2.7 Punch Radius

The selection of punch nose radius is a crucial in the sheet metal forming process. The-Thanh Luyen (2021) has investigated the effect of Punch corner radius, drawing ratio and blank holder force on the fracture height of cylinder cup. A simulation and experimental study on the deep drawing for SPCC sheet by graphical Method. It has found that from simulation and experimental results, punch corner radius varying from between 4 mm to 8 mm affect the fracture height. The BHF is kept constant at 10kN. With the increasing punch corner radius, fracture height will increase. So small punch radius often results in a large drawing force for same cup height. This is due to increasing punch radius reduces the degree of bending deformation of the blank around the punch. SO using a punch with large corner radius, the metal flow in the die can smooth. When the detailed fracture height values and its deviation percentages between simulation and measured value with varying the punch corner radius, it shows a good agreement between simulation and experiment with below 3.67 % of the difference. H. Ballikaya (2019) has studied the effects of the parameters on LDR in die angled HMDD. The process were numerically examined and compared experimentally using ANSYS and for that Taguchi experimental design method is used, Also, ANOVA is used for the statically analysis of data in order to calculate the effect of various parameters such as punch radius, die radius and die angle. When the punch radius was increased up to 10 mm, it was witnessed that the LDR increased and after that the ratio decrease. The parameter of punch radius 10mm gave the best LDR and it is 2.6. H. Zein (2014) has studied Thinning and spring back prediction of sheet metal within the deep drawing. Thickness distribution and thinning of sheet metal blank within the deep drawing processes are influences by the geometry of punch. FE model is developed for the 3-D numerical simulation for deep drawing (Parametric Analysis) via ABAQUS/ with the anisotropic material property and simplify the boundary conditions. For validation finite element result compared with experimental results. Afterward The developed model predicts the spring back, the thickness distribution and thinning of the blank as tormented by the die design geometrical parameters and physical parameters. The blank is made of M.S. The material is demonstrated as an elastic–plastic material with isotropic elasticity by the Hill anisotropic yield criterion for the plasticity to term the anisotropic characteristics of the sheet metal. If a punch nose radius is less than 3 x blank thickness, the cup fails because of thinning, whilst for punch nose radius > 3t, thinning will fairly stable. The punch geometry influences the spring back of blank in the deep drawing. From this study it can be say that if a punch nose radius r_p > 6t, the cup have small values for the springback %, while for (r_p) < 4t, the spring back % is increasing. That's why the r_p is recommended to be > 4t. I. Irthiea (2020) has examined the Effect of process parameters on micro flexible deep drawing of SS 304 cups using floating ring: Simulation and experiments have also carried out to investigate the influence of punch corner radius, drawing ratio, initial sheet thickness, and rubber height on the thickness distribution in terms of max. Thickening, thinning and relatively large aspect ratio. System consist 2 dies: floating ring (primary die) and rubber pad (main flexible die). 3 size scales are selected to investigation. ABAQUS is used for finite element model and then number of experiments are carried out to verify the result. At every scale factor, forming processes are carried out using punches with several nose radius and blanks with different initial thicknesses. It is witnessed that using 50mm sheet thickness results in successful cups at λ = 0.5, 1, while wrinkled cups at λ = 2 for radius of 0.1 to 0.3 mm ranges are attained. The results showed that the possibility of failure by wrinkling increases as the scale factor increases for a particular range of punch nose radius.

2.8 Die corner radius

H. Ballikaya (2019) has investigate the effects of the several parameters on LDR in die angled HMDD. The process were numerically examined and compared experimentally using ANSYS and for that Taguchi experimental design method is used, Also, ANOVA is used for the statically analysis of data with the purpose of calculate the effect of various parameters such as die radius, punch radius, BHF, chamber pressure and die angle on the LDR. Up to 8mm die radius, it is witnessed that the LDR increased and

after that the LDR decrease. It was determined that the LDR increased up to 2.6 and then decrease. It was concluded that in this die angled HMDD, when optimum parameters were choose, the LDR increased up to 2.6 value.
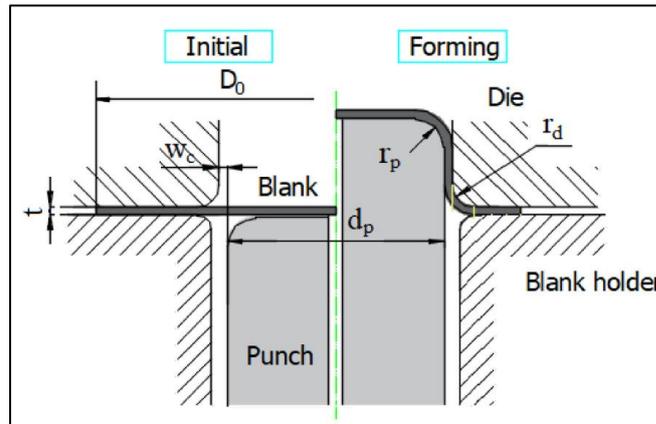

Fig. 4. Geometry of deep drawing assembly: r_p – Punch radius; r_d – die corner radius;
W_c – Clearance between punch and die

H. Zein (2014) has studied spring back prediction and Thinning of sheet metal in the deep drawing. Thinning and Thickness distribution of sheet metal blank within the deep drawing processes are impacts by the geometry of punch. The blank is made of M.S. The material is demonstrated as an elastic–plastic material with isotropic elasticity by the Hill anisotropic yield criterion for the plasticity to term the anisotropic characteristics of the sheet metal. Finite Element model is developed for the numerical simulation for deep drawing via ABAQUS/ with the anisotropic material property and shorten the boundary conditions. For validation, the Fe result compared with experimental results. Afterward the developed model predicts the thickness distribution, thinning and spring back of the blank as tormented by the die design geometrical parameters and physical parameters. Results show that the cup fails due to thinning increased while the die shoulder radius (r_d) < thickness of the blank (t), whilst for r_d>10t, thinning is stable. So, from result it conclude that the r_d should be 10 x sheet thickness. Also, the spring back of sheet metal blank in the deep drawing processes affected by geometry of die. These results indicate that for the r_d < 6 x thickness of the blank (t), the cup has a large spring back %, whilst for $r_d \geq 10t$, the spring back % have smaller values. So, it is recommended that r_d should be 10 times sheet thickness. S Yaghoubi (2020) has studied Optimization of the geometrical parameters of HMDD process of 2024 aluminum alloy at elevated temprature. A Group Method of Data Handling (GMDH) process used to train a neural network with the aim of study of the process behaviour. Based on the uniformity of the final product and maximum reduction in sheet thickness, an objective function was created. To achieve the optimal values for process variables, The Bees Algorithm (BA) was used. The die corner radius is chief parameter and its excessive increase reason of the wrinkling at the sheet periphery and decreases the homogeneity of the final part. It is clear from study that if the die corner radius increasing from 4 to 8 mm, the max thickness reduction and the thickness variation of the product are reduced by 2.0% and increased by 10.0%, correspondingly. As the increase of this parameter has a direct effect on the sheet wrinkling and therefore on the product quality, it is predictable that the effect of the die corner radius on the uniformity of the final cup would be greater compared with its influence on the sheet rupture.

2.9 Clearance

P. Arora (2021) did A Survey on Formability of Material and its Effects during Deep Drawing Process. The choice of the punch-to-die clearance depends on the requirements of the drawn part and on the work metal. Because there's a decrease and so a gradual increase inside the thickness of metallic as it's miles drawn over the die radius, clearance in step with facet of seven to fifteen percentage extra than stock thickness allows prevents burnishing of the aspect wall and punching out of the cup bottom. Clearance between the punch and die for a rectangular shell, at the side walls and on the ends is identical as within the round cup. Radius on the nook could also be the maximum amount 50% greater than stock thickness to avoid ironing in those areas. H. Zein (2014) has examined Thinning and spring back prediction of sheet metal in the deep drawing process. Thinning and Thickness distribution of deep drawing processes are impacts by the geometry of punch. The blank is made of M.S. FE model is developed for the numerical simulation for deep drawing via ABAQUS/ with the anisotropic material property and shorten the boundary conditions. For validation, the Fe result compared with experimental results. Axial clearance is the difference between die radius and punch radius (WC = DR–PR) and it's an significant parameter. It is shown that with the reducing the radial clearance (WC), the distribution in sheet metal thickness is increaes. In addition, for the WC < blank thickness (t), the cup fails due to thinning. Whilst for the radial clearance WC > t, thinning is stable. The radial clearance which is less than 0.5t is not suitable because the % of reduction in thickness is more than 45%, while the maxallowable % of reduction in thickness is 45%. From the variation of the springback % with the radial clearance (WC), it is shown that the springback % is reduced with increasing the radial clearance (WC). Moreover, If the radial clearance (WC) that is less than the blank thickness (t), the cup fails due to increased thinning.

S Yaghoubi (2020) has examined the Optimization of the geometrical parameters of HMDD process of 2024 aluminum alloy at elevated temperature. A Group Method of Data Handling (GMDH) process used to train a neural network with the purpose of study to the process behaviour. Based on the maximum reduction in sheet thickness and uniformity of the final product, the objective function was created. To achieve the optimal values for process variables, The Bees Algorithm was used. With an increase in the gap between the punch and die, resulting in a certain decrease in the essential forming force. The main problem faced by a high clearance is the increase in the thickness variation due to the existence of a large gap so it means of reduction in the final product quality. Clearance should be minimized because the product uniformity is more important than the required forming force in sheet metal forming operations. The amount of max thickness reduction and thickness variation of the final product for clearances of 2.2 mm to 2.4 mm. It shows that with the clearance rise from 2.2 to 2.4, the thickness variation and the max thickness reduction of the final product increased by 10.4%, reduced by 1.3% and respectively.

2.10 Springback

Springback prediction is one of the major challenges in sheet metal forming to produce dimensional accuracy parts. The springback behaviour is determined by angle of springback. To meet the requirements for dimensional accuracy of a sheet metal part, the springback must be compensated and the deep drawing process has to be designed accordingly. During forming, elastic energy is stored in the product. When removing a part from the deep-drawing tool, the resultant residual stresses with an elastic component reason of the unwanted changes of the part`s geometry in forming. Specially sheet materials with low elastic modulus and high yield strength tend to an incremental springback. Among other things, these materials comprise aluminium alloys of the 7000 series. Thus, a fundamental understanding of the material behaviour of these materials is related for designing a sheet metal forming process.
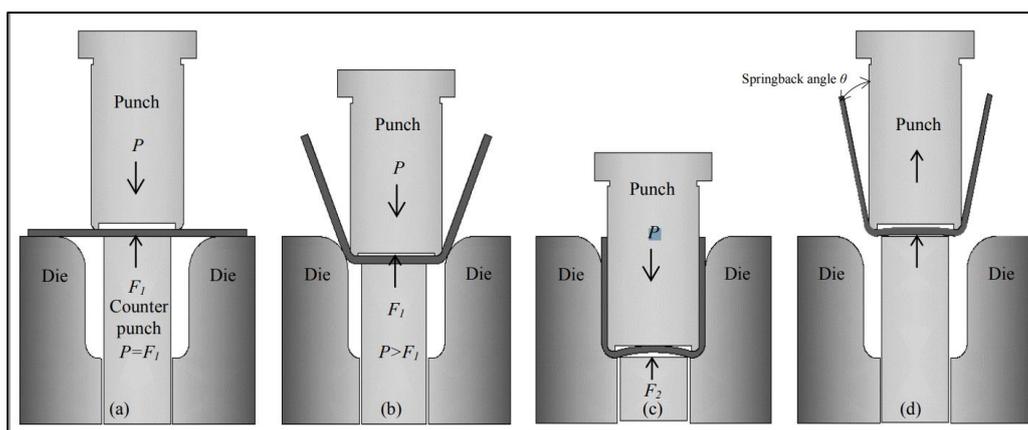
Fig 5. Schematic illustrations of U-bending with bottom pushing-up

A. Takalkar (2018) has a review on effect of thinning, wrinkling and spring-back on deep drawing process. The Taylor's theory for elastic–plastic media with aspects of Sach's theory will be used for spring-back prediction with low cost and less time. The spring-back angle in valley region is decreased with an increment of punch radius and punch angle. The prediction of spring-back may be done using multi-cyclic stress-strain curves generated from FE simulation and gas forming process simulation. The surface roughness and variation in material properties affect the spring-back action just in case of the micro deep drawing of a cup. P. Hetz (2020) has Investigation of the Springback Behaviour of High-strength Aluminium Alloys Based on the Cross Profile Deep Drawing Tests. AA7020-T6 and AA7075-T6 material are used for investigation of springback. Within this contribution, cross profiles are formed in a deep drawing tool and after that it digitized. A rise in the tool radius of punch and die as well as die diameter tends to higher springback for both materials. But, the BHF has no significant influence on the springback. The springback angles for AA7075-T6 are greater than for AA7020-T6 because of the higher yield strength level. The results for AA7075 have also demonstrated that this material is barely limitedly formable at room temperature and small radius. R. Lal (2018) has investigated the Study of factors affecting Springback in Sheet Metal Forming and Deep Drawing Process. The springback is affected by the several parameters such as BHF, ratio of die corner radius to blank thickness and blank thickness, etc. These parameters were investigated. Spring back % in deep drawing process was studied numerically (using FEA software). The numerical results gotten shows that springback can be reduced by the increasing the value of the initial blank thickness. Also, the spring back will be decreased with the increasing BHF, and if BHF is too high then it may cause tearing of sheet. The spring back was also increases, with the increasing of punch nose radius. E Ouakdi (2012) has studied Calculation of springback under the effect of die radius and holding force in a stretch bending test. Springback decreases non-linear with stretching height. With An increase in BHF, sliding of the sheet between the blank holder and the die reduces springback by increasing the tension. The bigger the entrance radius of the die, the lesser the concluding springback.

3. Research gap

The research survey was reflected different types of research on thinning, thickness distribution, LDR and spring back in metal forming. It was reflected on different kind of research paper regarding Pre bulging pressure, Chamber pressure, coefficient of friction, Blank holder force, Drawing ratio, Punch speed and punch velocity, Punch Radius, Die corner radius, clearance and spring back effect in metal forming. There is possibility of work in Coefficient of friction, Drawing ratio, Punch radius, die corner radius, clearance and spring back effect in metal forming and optimization process for effective output from changing punch design, die design, blank holding force and punch velocity.

4. Problem statement

Oil drain cup material is EDD 513 of 1.5mm sheet thickness. In oil drain cup, crack occurs during deep drawing process. Crack is the major defect of the part. The part wall thinning is used in industry to indicate probability of fracture. Therefore, the maximum wall thinning was selected as a fracture criteria. The Fracture occurs at contact location between the oil drain cup and punch corner. At that point, there exists the highest strain that causes the largest thinning and due to large thinning at that location, the fracture occurs. The fracture is due to wall thinning at bottom radius. As the punch increments, the crack and thinning enhances.

5. Objectives

To improve uniformity of the sheet thickness of oil drain cup by reducing the sheet thinning. Maximum sheet thinning is the cause of fracture (Crack). FEA simulation and experimental development of oil drain cup will be carried out. FEA simulation will be carried out in Altair inspire form software. To improve LDR ratio, optimize the various geometrical and process parameters.

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Acknowledgements

The CAMEL Model as a Yardstick to Evaluate the Shadow Banks – the NBFCs of India

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Abstract

The Shadow banks - NBFCs (Non- Banking Financial Companies) are certainly valuable and crucial institution for the development and welfare of the Indian economy and living standards. Hence it is essential to compute and estimate their performance which should be done with compatible equipment such as CAMEL Model. This study has selected top 10 NBFCs on the criteria of market capitalization. The period of study is from 2016-17 to 2020-21. Examining these 10 NBFCs with five parameters of the CAMEL Model, it is surfaced that M & M financial services stands at the pinnacle score ranking 1st in the list, and L & T Finance remained at the foot of the list ranking 10th. The study also discovered that a company's performance cannot be judged relying on a single parameter such as market capitalization and must include consideration of various aspects and sections like the Capital, Asset Quality, Management Efficiency, Earning Capability and adequate liquidity as suggested in the CAMEL Model.

Keywords: Non -Banking Financial Companies, Shadow Banks, CAMEL Model

1. Introduction

India, being a destination of multifarious diversities in economy, financial activities and businesses emerges a vital need for existence of an efficient supporting hand of banks and NBFCs which can fulfil the financial and advisory assistance required for nation and its people. If banks prevail with gleaming knight amour in this nation today, the NBFCs –Shadow Banks, also cover a wide spectrum of tasks walking along with those banking institutions radiating its own shine. These two in conjunction, form a kingdom, flourishing prosperously and treading on the path of development successfully and continuously.

A country so budding with population, demands high increase in industrial and economic development and progress. This brings in picture the monetary issues. To settle the financial chaos, revolving around citizens and the Government, NBFCs are setup and harboured. Non-banking financial companies or Shadow banks are those financial institutions which provide banking services but are not given banking license by RBI.

NBFCs are an appreciably simple, smooth and easy mode which funds in many infrastructure projects and small scale companies which are important for any country. Like the banks, the presence of NBFCs is also important in the growth of the financial market. It provides small ticket loans, helps in mobilization of small savings, affordable housing projects, capital formation, gives long term credit, specialized credit, aids in employment, attracts foreign grants and acts as a Government's Instrument.

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NBFCs have productively reached rural areas, helped the weaker sections of the society, as well as small scale industrial sector, which has upgraded India's overall economy. They become a catalyst in providing modern and necessary facilities to the people of India.

As it provides so many innumerable services and facilities across the nation and at present more and more customers are getting acquainted and taking benefit of these services, it becomes necessary to gauge the financial health of these Shadow banks. Hence, this study is to check the soundness of these NBFCs for safeguarding the interest of the investors and the respective stake holders.

To appraise the soundness of the shadow banks - NBFCs, the globally acclaimed CAMEL model is deployed. After deciding the model for evaluation, the CAMEL approach, the top 10 Non-Banking Financial companies – "Shadow Banks" with the highest market capitalization is selected. This model shall analyse the performance of these selected Shadow banks on the basis of each parameter that is capital adequacy, asset quality, efficiency of the management, earning capability and the liquidity. Each parameter has been given equal weightage in the study.

2. Literature Review

(Ray & Shantu, 2021) The Central Bank of the country, RBI has developed and is promoting the Small finance Banks, as an element of Niche Banking. The Small Finance Banks encompasses all the weaker and unorganized sectors of the economy. These banks are investigated using the CAMEL rating for the study period 2019-20. Inferences are drawn using Anova Test and also Post Hoc Test is employed to draw the conclusions.

(kaur, Sunanda, Tungal, & Pandey, 2019) The paper is related to microfinance, better known as micro credit and envelopes major 4 Micro financial institutions on the criteria of the highest loan providers within the period of 3 years that is from 2015 to 2017. Apart of the various other methods to weigh the performance of such institutions the researchers have selected the most popular CAMELS model. All the parameters as suggested in the model are calculated for each and every institution to know their financial soundness and in the end necessary suggestions are also made by the researcher.

(Akhtar, Ahmad, & Md.Islam, 2018) A study on Non-Banking Financial Institutions located in Bangladesh is undertaken by the Author on 33 NBFIs of Bangladesh. Out of these 33, owned by the government are 3, 11 are owned jointly and rest 19 are owned on private basis. To estimate their soundness CAMELS Model is employed in the study. Ratings from 1 to 5 are assigned. Rating 1 being the more favourable and rating 5 as the least favourable. The findings surfaced that only 1 among the 33 rated at Strong, 15 scored at Satisfactory, 13 ranked as Fair and 3 showed Marginal financial soundness during the scrutiny period of June 2016.

(Kaur, 2016) usually CAMEL model is used to assess the banks but this study has undertaken a research on Non-Banking Financial Companies (NBFCs) that is Gold Loan providers operating in India, namely; Muthoot Finance Ltd. And Manappuram Finance Ltd. There is an ever increasing demand of Gold in India and hence the gold loan market has also shown growth in the present years. By using Simple Arithmetic mean, Independent t-test, SPSS- 16.0, the study concludes that though both performed well overall, Manappuram Finance Ltd is well off in capital adequacy whereas Muthoot Finance Ltd leads in the matter of management efficiency.

(Khatri, 2015) Regional Rural Banks' importance is highlighted in the study and that they are eminently important for lending the loans to the rural people and the farmers for at apt time and in an appropriate manner. These banking institutions not only provide

credit facilities but are also a source of finance, employment to rural people and the remotest location of our country, India. Thus the researcher has attempted to surface the performance of Dena Gujarat Grameen Bank by CAMELS Model using different ratios over a selective period of time. The ratios which are a part of the model have been calculated individually and as a whole. Techniques like the line chart to depict the analysis of ratios and the trend of the credit facilities provided in the rural area was illustrated. The main emphasis is on the regional rural banks' performance in the period after the merger.

(Bansal & Mohanty, 2013) The researchers in this paper has included five banks of India based on market capitalization and they are SBI, HDFC Bank, ICICI Bank, Axis Bank and Kotak Mahindra Bank for the study period of 2007 to 2011. The CAMEL Model is used to know their performance and the study concludes that HDFC has ranked first, followed by SBI Bank as second rank, Kotak Mahindra Bank is on third rank, fourth rank is of ICICI Bank and 5th rank is secured by Axis Bank. To achieve these ranking number of financial ratios are calculated according to the parameters of the given model.

3. Research Gap

CAMEL Model is a globally used appliance to put banks under the microscope and survey their performance. What has been lacking, is to accommodate this model with NFBCs- Shadow banks. Barely few research works and studies have been undertaken with CAMEL Model's surveillance style for NFBCs. Therefore, this study sets to optimize the productivity of researches which computes the performance of NBFCs (Shadow Banks) by opting for the generally acclaimed CAMEL Approach.

4. Scope of the Study

The present study covers 10 Non-financial banking companies which operated during the period of 2016-17 to 2020-21. Financial ratios that will calculate the capital adequacy, asset quality, management efficiency, earnings quality and liquidity standing are used to test the performance of the NBFC.

5. Objectives of the Study
- To measure the capital adequacy of selected shadow banks
- To analyze the asset quality of selected shadow banks
- To evaluate the management efficiency of selected shadow banks
- To determine the earnings quality of selected shadow banks
- To assess the liquidity status of selected shadow banks

6. Research Methodology

To analyse and rate a bank's overall performance, U.S developed a CAMEL rating system, which is used to examine the banks in and outside U.S. It is a Supervisory Rating system. Federal Financial Institutions Examination Council (FFIEC) were the first to adopt it in 1979 and called it Uniform Financial Institutions Rating System (UFIRS), which was modified to CAMEL. Later it was used to access the financial condition of the non- banking financial institutions as well.

CAMEL Model is a model based on financial ratios calculating from the financial statement of the NBFCs. It is tool of management to determine the financial condition of the NBFCs. The study is analytical in nature.

6.1 Method of Analysis

CAMEL Components for Analysis of Selected Non- Banking Financial Companies

This model offers a simple way to ascertain and compare the financial position of a wide range of banks and NFBC with the help of the five parameters that are the initials of the five components unanimously form the word CAMEL.

• C- Capital adequacy

Capital and its source play a significant role in finding out the CAMEL rating of any institution. The Capital Adequacy Ratio - signifies that the NBFC has sufficient capital with reference to the risk weighted assets. RBI has recently declared a minimum ratio of 15% for NBFC operating in India. This ratio enables to analyze the financial solvency of NBFCs and whether the different risk associated with different assets is adequately covered by its existing capital. Higher Capital Adequacy Ratio is always better as it reflects better financial condition of the NBFC.

• A- Asset quality

Assets basically refers to the loans provided by the NBFCs which are shown in the balance sheet. These loans are judged by their portfolio quality and the level of risk that these assets are exposed to causing into non -performing assets.

• M- Management

To judge the management efficiency like planning, organizing, staffing, controlling and ability to react to financial stress this parameter is incorporated in CAMEL approach. The overall profitability, earning potentials, managing liquidity position, handling risks and facing the challenges of internal and external change in the environment is the task of the management of the NBFCs.

• E- Earnings

NBFC`s earnings, earning growth stability, net margins and trend are surveyed here in this parameter of the CAMEL Model. There are different ratios to calculate the Earnings criteria like Return on Equity, Return on Assets, Dividend Pay-out Ratio and likewise.

• L-Liquidity

The cash flow and availability of liquid cash and its equivalents also affects the rating. To maintain adequate cash flow requires efficient management of assets and liabilities. They both need to be accurately and optimal synchronized so as to reap the maximum gains.

Each of these parameters are looked into separately to judge whether the NBFC is in good health. The real time health of a NBFCs or Shadow banks can be known through this model at a given period of time and hence necessary and corrective measures can be suggested, sometimes well in advance which can save the NBFC from further losses.

6.2 Sample Size

Top 10 NBFCs according to market capitalization is selected for the study as on January 2022.

Table 1. Name of Companies Selected for the Study

Sr. No	Company name	Market Cap (Rs. Cr)	Last Price (Rs)
1	Bajaj Finance	445,033.13	7,155.90
2	Muthoot Finance	57,434.41	1,423.90
3	Shriram Transport finance Corp	32,565.16	1,233.05
4	Sundaram finance	25,610.55	2,253.00
5	Poonawalla finance	21,291.17	264.4
6	M & M financial services	19,163.07	153.7
7	L & T Finance	18,690.38	75.5
8	Motilal Oswal financial services	13,621.88	912.8
9	Manappuram Finance	12,958.30	157.1
10	Shriram City union finance	11,854.10	1,770.00

6.3 Sampling Technique

Convenient sampling technique is used in the study. The samples are selected based on market capitalization of the selected NFBCs.

6.4 Period of Study

The study covers five years from 2016-17 to 2020-21 to rate the performance of selected NBFC- shadow banks under study.

6.5 Method of Data Collection

All the data are Secondary data and are taken from Annual Reports of the NBFCs, RBI bulletins & other websites like Money control which provides the required financial data for the study.

7. Data Analysis and Interpreteation

Capital to Risk Weighted Asset Ratio / CRAR

	Bajaj Finance	Muthoot Finance	Shriram Transport finance Corp	Sundaram finance	Poonawalla finance	M and M financial services	L and T Finance	Motilal Oswal financial services	Manappuram Finance	Shriram City union finance
2021	28.34	27.39	22.5	22.1	20.3	26.4	20.54	50	23.33	23
2020	25.01	25.47	21.99	18.4	29.9	19.6	18.31	47.6	21.4	27.8
2019	20.66	26.05	20.27	19.4	24.87	20.3	16.98	29.2	23.27	29.9
2018	24.71	26.59	17.38	18	20.7	22.7	17.92	37.78	26.89	32.5
2017	20.3	24.88	16.63	17.9	20.4	17.2	16.42	39.31	26.12	23.91
Mean	23.80	26.08	19.75	19.16	23.23	21.24	18.03	40.78	24.20	27.42

Fig. 1. Capital to Risk Weighted Asset Ratio / CRAR

Total Loan and Advance/ Total Assets

	Bajaj Finance	Muthoot Finance	Shriram Transport finance Corp	Sundaram finance	Poonawalla finance	M and M financial services	L and T Finance	Motilal Oswal financial services	Manappuram Finance	Shriram City union finance
2021	81.75	85.19	21.14	84.13	82.82	77.82	10.10	8.58	82.09	80.15
2020	82.18	84.43	23.32	83.92	86.26	87.74	10.08	3.24	79.16	85.92
2019	87.72	91.76	25.63	88.89	87.64	91.31	5.61	9.18	85.03	91.75
2018	0.31	95.83	26.52	85.25	89.58	91.96	11.04	11.85	87.99	94.37
2017	0.79	89.29	30.86	83.21	88.23	92.41	8.89	30.54	89.52	93.58
Mean	50.55	89.3	25.49	85.08	86.91	88.25	9.14	12.68	84.76	89.15

Fig. 2. Total Loan and Advance/ Total Assets

Asset Turnover Ratio

	Bajaj Finance	Muthoot Finance	Shriram Transport finance Corp	Sundaram finance	Poonawalla finance	M and M financial services	L and T Finance	Motilal Oswal financial services	Manappuram Finance	Shriram City union finance
2021	17.01	16.63	13.43	11.31	17.87	75.58	1.33	24	20.16	16.75
2020	17.26	17.27	14.5	11.49	16.8	90.07	4.19	20.58	18.11	18.99
2019	16.02	18.06	14.74	11.08	14.88	101.74	4.79	21.33	19.37	19.64
2018	15.88	20.35	13.67	10.87	15.2	102.67	4.94	25.68	20.05	18.87
2017	15.63	18.65	14.55	12.29	17.31	110.22	4.35	11.36	22.87	18.06
Mean	16.36	18.19	14.18	11.41	16.41	96.06	3.92	20.59	20.11	18.46

Fig. 3. Asset Turnover Ratio

Fig. 4. Return on Equity Ratio/ ROE

	Bajaj Finance	Muthoot Finance	Shriram Transport finance Corp	Sundaram finance	Poonawalla finance	M and M financial services	L and T Finance	Motilal Oswal financial services	Manappuram Finance	Shriram City union finance
2021	11	24.42	11.53	13.09	-29.78	0.77	1.05	20.17	24.6	12.45
2020	15.34	26.08	13.89	13.05	-0.39	3.86	3.4	7.11	23.11	13.88
2019	19.88	20.13	16.19	22.33	10.76	14.01	3.41	12.42	17.99	15.47
2018	16.02	22.75	18.12	13.63	11.11	14.37	3.46	16.51	18.07	12.79
2017	19.13	18.1	11.12	13.22	0.29	13.6	6.04	12.89	21.92	11.05
Mean	16.27	22.30	14.17	15.06	-1.60	9.32	3.47	13.82	21.14	13.13

Fig. 5. Percent of Liquid Asset / Total Assets

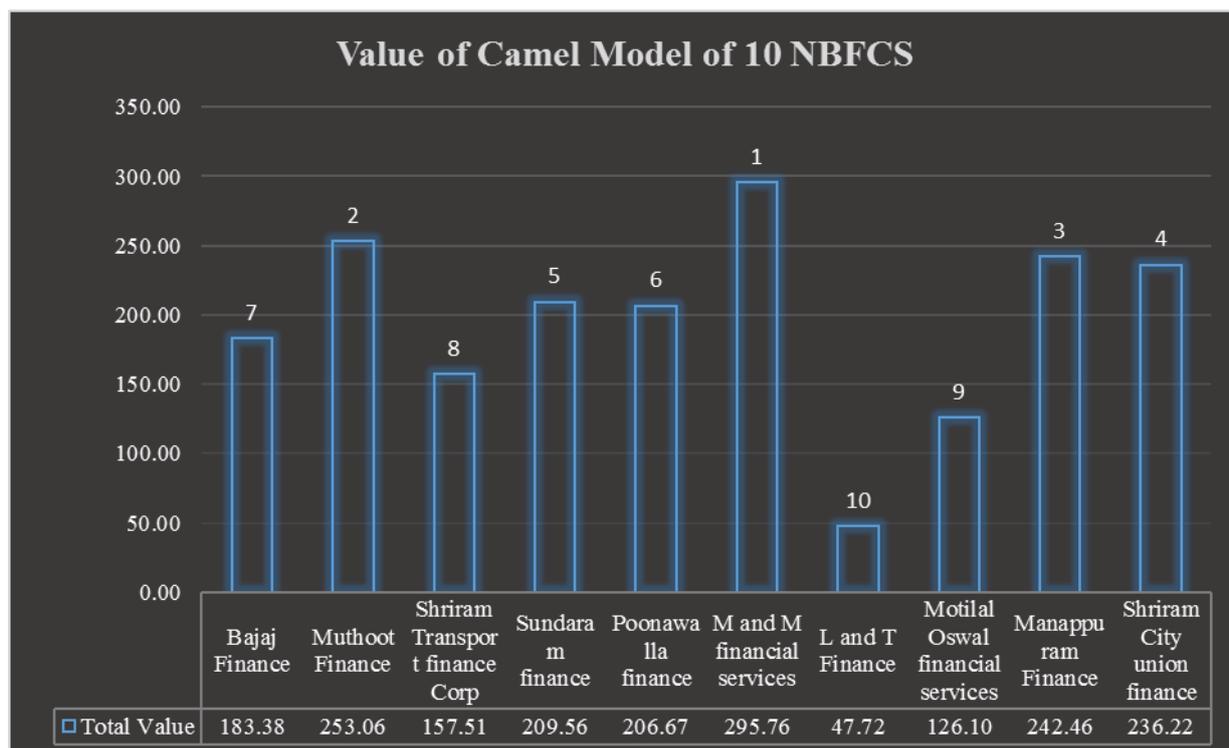|	Bajaj Finance	Muthoot Finance	Shriram Transport finance Corp	Sundaram finance	Poonawalla finance	M and M financial services	L and T Finance	Motilal Oswal financial services	Manappuram Finance	Shriram City union finance
2021	97.05	96.88	96.41	86.2	90.16	82.77	21.39	52.93	91.3	95.53
2020	97.23	96.51	96.7	86.14	93.32	90.45	10.9	32.8	92.05	96.05
2019	97.69	96.65	95.57	92.05	94.84	93.01	8.62	40.4	90.8	96.23
2018	43.2	97.86	97.27	89.17	93.62	92.92	14.24	35.07	94	96.4
2017	46.79	98.06	33.64	40.7	36.68	45.3	10.62	29.95	93.08	56.06
Mean	76.39	97.19	83.92	78.85	81.72	80.89	13.15	38.23	92.25	88.05

Fig. 6. Value of Camel Model of 10 NBFCS

Interpretation of Figure 1:

The analysis of Figure 1 depicts that the CRAR of Motilal Oswal financial services was all time high and the least CRAR during the study period was of Land T Finance. All the 10 NBFC were able to maintain minimum threshold of 15% of CRAR, all throughout the five years as stated and required by the RBI notification.

Interpretation of Figure 2:

Loans and advances to Total Asset ratio is taken as a criterion for measuring the soundness of NBFC. Larger issuance of loans stands a risk of those credit turning into bad loans. To be on the safer side lesser the loans, lower is the risk of creation of NPA. Keeping this concept in view it is clear that L & T and Motilal Oswal financial services has lower ratio of Total Loans to Total Assets from 2016-17 to 2020-21. Sundaram Finance, Poonawalla Finance and M & M financial services share almost the same ratio and they are followed by the rest of the NBFCs.

Interpretation of Figure 3:

It is very evident from the Figure 3 that M & M financial services is the leader when it comes to calculating of the Asset Turnover Ratio. This NBFC is far ahead of the rest in the list. In contrast to this L & T Finance has proven to be the worst performer in the context of Asset turnover ratio. Expect the above two companies the remaining eight NBFCs have been playing at quite an average level in the industry.

Interpretation of Figure 4:

A very interesting fact has surfaced from Figure 4 data analysis and that is the Return On Equity ratio of all the NBFCs expect Poonawalla Finance are positive and all have fared well during 2016-17 to 2020-21. Poonawalla Finance's ROE slumped drastically in the year 2021 and recorded the ratio as low as -29.78 %. It also faced a negative ROE of -0.39 in 2020. The highest ROE among all the above NBFCs is that of Muthoot Finance having a mean value of 22.30.

Interpretation of Figure 5:

As seen in figure 5, Muthoot Finance enjoys the highest liquidity position as it has a mean of 97.19 placing it in the first position

while considering the percent of Liquid Asset to Total Assets ratio. This NBFC remained successful in maintaining this ratio above 97 percent for straight three years from 2019 to 2021. It is followed by Manappuram Finance with the mean of 92.25. The least in the ladder is L & T Finance which has acquired a mere mean value of 13.15.

Interpretation of Figure 6:

The Total value in figure 6 is derived from the summation of the means of each variable of CAMEL Model as shown in table 2, that is capital adequacy, quality of the asset, efficiency of the management, earning capability and liquidity of 10 NBFCs under the study.

M & M financial services' performance have been top notch acquiring the total value of 295.76 and therefore it stands first in the ranking system. Muthoot Finance competing well, has derived the total value of 253.06 keeping itself at rank second. Manappuram Finance- 3th rank and Shriram City Union Finance- 4th rank showcase nearly similar total values of 242.46 and 236.22 respectively. Similarly, the NBFCs at 5th and 6th rank, Sundaram Finance and Poonawalla Finance, also display a very marginal difference in their total values. The 7th rank is claimed by Bajaj Finance followed by Shriram Transport Finance Corp at 8th rank and Motilal Oswal financial services at 9th rank. L & T Finance's CAMEL evaluation highlights its lagging behind scores which plunges this NBFC at the bottom most with debasing total value of 47.72 compared to its counterparts.

Table 2: Value of CAMEL Model of 10 NBFCs

Sr.No	Name of the Company	C	A	M	E	L	Total Value	Rank
1	Bajaj Finance	23.80	50.55	16.36	16.27	76.39	183.38	7
2	Muthoot Finance	26.08	89.30	18.19	22.30	97.19	253.06	2
3	Shriram Transport finance Corp	19.75	25.49	14.18	14.17	83.92	157.51	8
4	Sundaram finance	19.16	85.08	11.41	15.06	78.85	209.56	5
5	Poonawalla finance	23.23	86.91	16.41	-1.60	81.72	206.67	6
6	M & M financial services	21.24	88.25	96.06	9.32	80.89	295.76	1
7	L & T Finance	18.03	9.14	3.92	3.47	13.15	47.72	10
8	Motilal Oswal financial services	40.78	12.68	20.59	13.82	38.23	126.10	9
9	Manappuram Finance	24.20	84.76	20.11	21.14	92.25	242.46	3
10	Shriram City union finance	27.42	89.15	18.46	13.13	88.05	236.22	4

8. Findings and Conclusion

The shadow banks - NBFCs scrutinized in this study through CAMEL Model are the 10 companies with highest market capitalization. While ranging at the top also, they reflect high variation when analysed with regards to the different parameters of the model and show vivid modulation in the statistical inferences. This signifies their competitive aptitude amongst each other. As it can be seen that most of the NFBCs are close runner ups to each other.

Furthermore, the study reveals the craft work of the economic world today as we see above that Bajaj Finance having the highest market capitalization among the rest 9 NBFCs has been downsized to 7th position according to the CAMEL Approach. Likewise, disparity is also seen in case of Shriram City Union Finance Company having ranked 4th in spite of being at the bottom of the list.

By this we extract that intricacies of the market of present day can only be completely understood by magnifying into greater details and checking various financial and supervisory frameworks and tools that are available and not just a single variable that is market capitalization.

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Design and Analysis of Suspension System

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Abstract

An Independent wheel suspension system is used nowadays in almost all new modern cars. A conventional system that uses dependent suspension is not of much use as it creates more jerks in the car body. Normally, when any bump or hindrance comes across the vehicle, the suspension system reduces the disturbance in the car. The dependent system relates to chassis and car body frames. So, with any jerk, the car body faces the disturbance. In Independent wheel vehicle suspension, the spring relates to the wheel, which absorbs all shock and does not allow any jerk in the car body. The research work covered a brief literature review on the analysis of an independent suspension system. First studied existing suspension design as per standard design procedure then identifying design issue in existing design by using mechanism calculation. By using CAD tools like Solid work for a critical component of independent suspension for analysis purposes and according to result for the conclusion.

Keywords: Design, Analysis, CAD Tools, Independent Suspension System, Mechanism.

1.   Introduction

A suspension system is an assembly of springs, shock absorbers and linkages that connects a vehicle to its wheels. In a running vehicle, it is the suspension system that keeps the occupants comfortable and isolated from road noise, bumps, and vibrations. The suspension system also provides the vehicle excellent handling capabilities, allowing the driver to maintain control of the vehicle over rough terrain or in case of sudden stops. Additionally, the suspension system prevents the vehicle from damage and wear.
The basic components of the suspension system include springs, shock absorbers, kinetic parts, and auxiliary devices. The springs absorb impacts and provide cushioning when a wheel hits a bump in the road. The springs also resist the wheel's movement and rebounds, pushing the wheel back down. The type, number, and location of the springs differ based on a different type of suspension system, which will be demonstrated in the next section. The shock absorbers (dampers) restrain the spring motions and prevent the spring from continuing vibrating. In a suspension system, one shock absorber is located at each wheel.

1.1   Classification of Suspension System
The suspension system is always derived in some mechanical ways. The designs of the suspension systems are classification in two main groups:
•   Dependent suspension system (solid axle) and
•   Independent suspension system.
Each group can be functionally quite different, and they are studied and discussed accordingly. Recently, both suspension systems can be found on ordinary vehicles and commercial vehicles.

1.2   The Dependent Suspension System
The dependent suspension system is known as a solid axle when both wheels (left and right) are mounted the same solid axle (Figure 1). In this case, any movement of any wheel will be transmitted to the opposite wheel causing them to camber together. Solid drive axles usually are used on the rear axle of many passenger cars, trucks, and the front axle in many four-wheel-drive vehicles [13].

The advantage of solid axles is considered the camber angle which is not affected by the rolling of the vehicle body. Therefore, produce little camber in cornering, except for that which arises from slightly greater compression of the tires on the outside of the turn. Besides, wheel alignment is readily maintained, which contributes to minimize tire wear. The disadvantage of solid steerable axles is their susceptibility in shimmy steering vibrations, heavy mass, etc. The most types of solid axles are Hotchkiss, Four links and De Dion.

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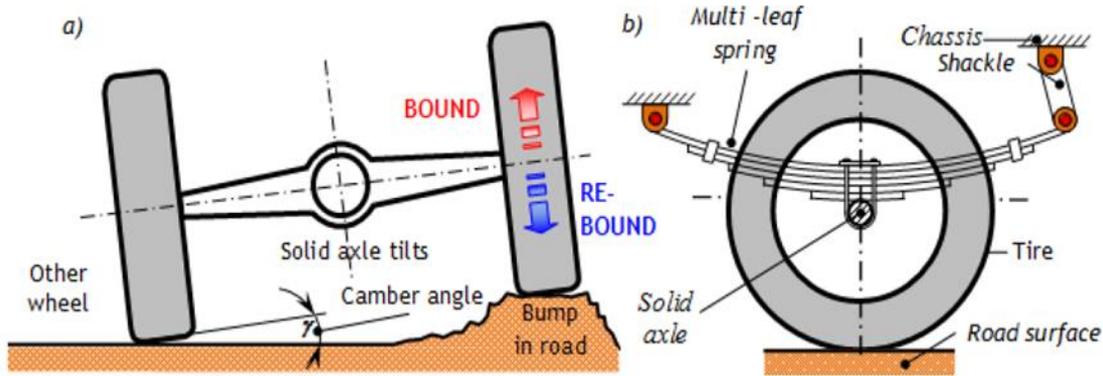*E-mail address:dhaval.patel@git.org.in*

Fig. 1. The dependent suspension system (solid axle); a) Front view and b) Side view

1.3   The Independent Suspension System
The independent suspension system allows one wheel to move upward and downward with a minimum effect on the other wheel (Figure 2). Most of the passenger cars and light truck use independent front suspension system because provide much more space for installing vehicle engine, allow much more displacement of the wheel, better resistance in steering vibration (wobble and shimmy) as well as offer higher performance in passenger comfort. As disadvantages of the independent suspension system can be considered the complexity of the design and manufacturing cost due to an increasing number of parts.
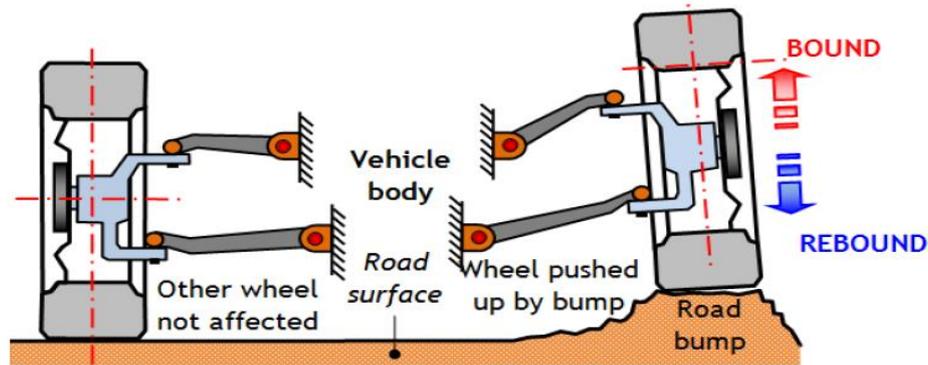

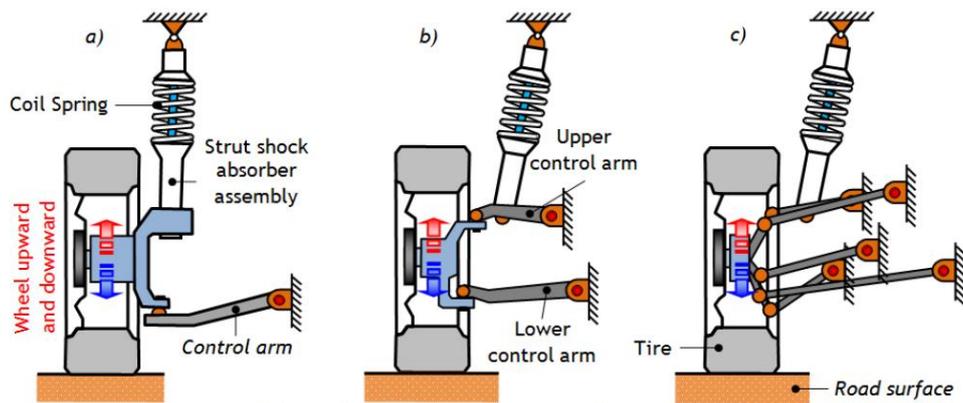Fig. 2. The independent suspension system (front view)

Fig. 3. The independent suspension system.
a) MacPherson strut, b) double wishbone and c) multi-link suspension system

Over the years, many types of independent suspension systems have been tried to develop such as MacPherson, double wishbone, multi-link, trailing arm, and swing axle. Many of them have been discarded for different reasons, with only basic concepts, MacPherson strut, double wishbone, and multi-link suspension system have found application in many types of vehicles [1][2].
The MacPherson strut consists of a single control arm and a strut assembly (spring and shock absorber) which allows tire and wheel to move upward and downward. The major components of the system are shown in Figure 3.a. It may be used on both the front and rear axles. This suspension system design allows reducing the number of parts, lower un-sprung mass as well as smooth driving comfort.

McPherson strut, a clever compromise that permits reasonable performance compare by low cost but never matches the performance or adjustability such as double wishbones or multi-link suspension system. Furthermore, this type of suspension requires sufficient vertical space and a strong top mount[4] [6].

2.   CAD Tool-Solid Work 2020

Solid Works 2020 is a 3D mechanical design system built with adaptive technology and solid modeling capabilities.
The Solid Works 2020 software includes features for 3D modeling, information management, collaboration, and technical support with DSS you can:
1.   Create 3D models and 2D manufacturing drawings.
2.   Create adaptive features, parts, and subassemblies.
3.   Manage thousands of parts and large assemblies.
4.   Use third-party applications, with an Application Program Interface (API).
5.   Use VBA to access the Autodesk Inventor API. Create programs to automate repetitive tasks. On the Help menu, choose Programmer Help.
6.   Import SAT, STEP, and AutoCAD and Autodesk Mechanical Desktop (DWG) files for use in Autodesk Inventor. Export Autodesk Inventor file to AutoCAD, Autodesk Mechanical Desktop, and IGES formats.
7.   Collaborate with multiple designers in the modeling process.
8.   Link to web tools to access industry resources, share data, and communicate with colleagues.
9.   Use the integrated Design Support System (DSS) for help as you work.
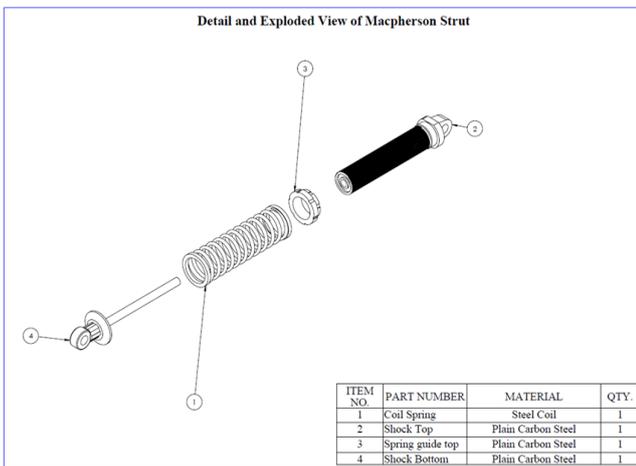

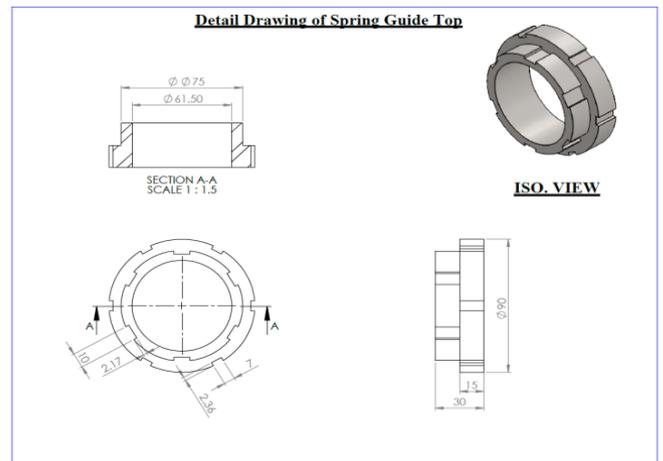Fig. 4. Exploded View of Macpherson Strut Suspension
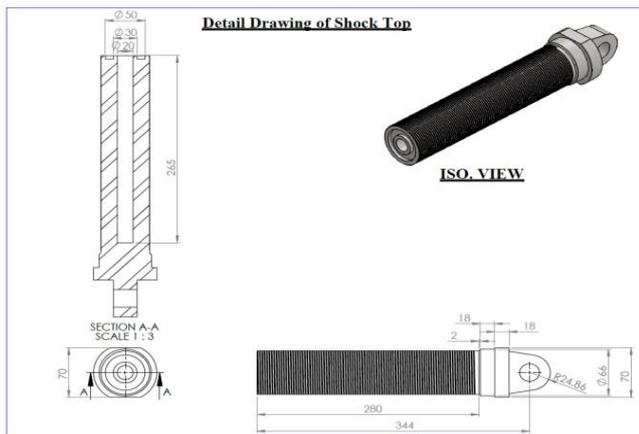

Fig. 5. Detail drawing of Spring Guide Top

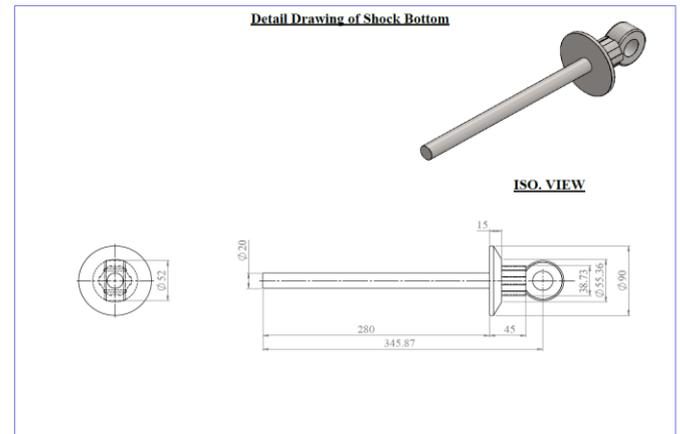Fig. 6. Detail drawing of Shock Top

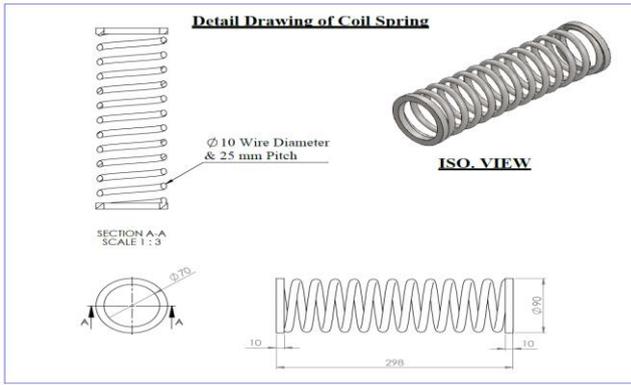Fig. 7. Detail drawing of Shock Bottom
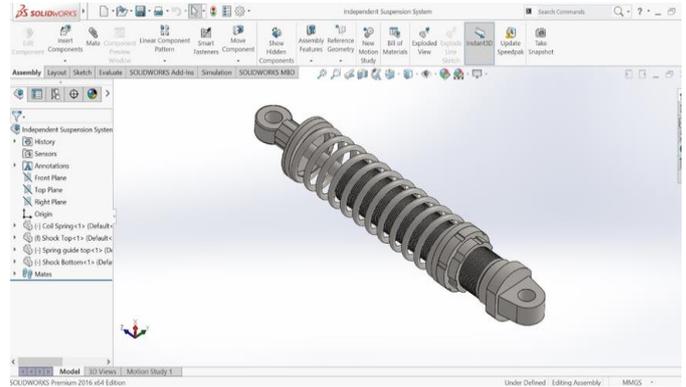
Fig. 8. Detail drawing of Coil Spring

Fig. 9. Isometric view of Macpherson Strut Suspension

Fig.4 is reflected exploded view of Macpherson Strut Suspension. As shown in Fig. 8 to 8, there is the detail of different components of Macpherson Strut Suspension. Using part features creates all components of the structure. All assemblies are created using various components (part) by constrained their relative motion.

Using part modeling environment to create part modeling. First to make the geometry of sketch with respect their practical data to measure the thickness of plate and amount of extruded part by using extrude command in feature operation. Further using the new sketch on the base extruded component and sketch an existing extruded feature to identifying model width.

3.   Finite Element Analysis (FEA)

Solid Works 2020 precision finite element model-building tool offers many design scenarios and mesh enhancement capabilities. Solid Works 2020 enables several design classes, including 2- and 3-D surface and solid models, beam or truss and plate/shell. Solid Works 2020 also enables engineers to build compound models having mixed element types. Solid Works 2020 provides access to Merlin Meshing Technology for automatic surface mesh enhancement or enables engineers to work directly on an FEA model surface for manual mesh enhancement. Engineers can choose tetrahedral, brick or hybrid (bricks outside and tetrahedral inside) solid FEA meshes.

Solid Works 2020's linear static and dynamic stress analysis capabilities determine stresses, displacements and natural frequencies as well as predict dynamic response to static and dynamic loading. These capabilities are highlighted throughout this brochure. Solid Works 2020's FEA, Mechanical Event Simulation, modeling, and CAD/CAE interoperability tools are designed to help engineers develop products that are more reliable and less costly to produce with faster time-to-market. To provide the best cost/benefit solution for each customer, Solid Works 2020's High Technology Core Packages and Extenders can be purchased at special combination pricing or separately to best fit individual needs while allowing for future growth and change.

The finite element method (FEM), sometimes referred to as finite element analysis (FEA), is a computational technique used to obtain approximate solutions of boundary value problems in engineering. Simply stated, a boundary value problem is a mathematical problem in which one or more dependent variables must satisfy a differential equation everywhere within a known domain of independent variables and satisfy specific conditions on the boundary of the domain. Boundary value problems are also sometimes called field problems. The field is the domain of interest and most often represents a physical structure.

The field variables are the dependent variables of interest governed by the differential equation. The boundary conditions are the specified values of the field variables (or related variables such as derivatives) on the boundaries of the field. Depending on the type of physical problem being analyzed, the field variables may include physical displacement, temperature, heat flux, and fluid velocity to name only a few.
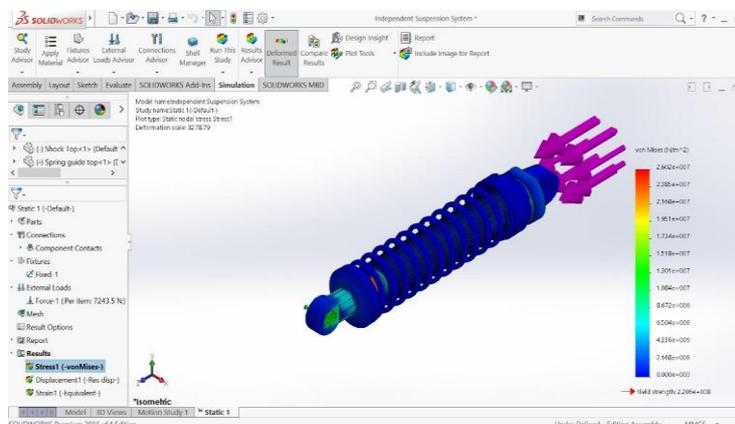

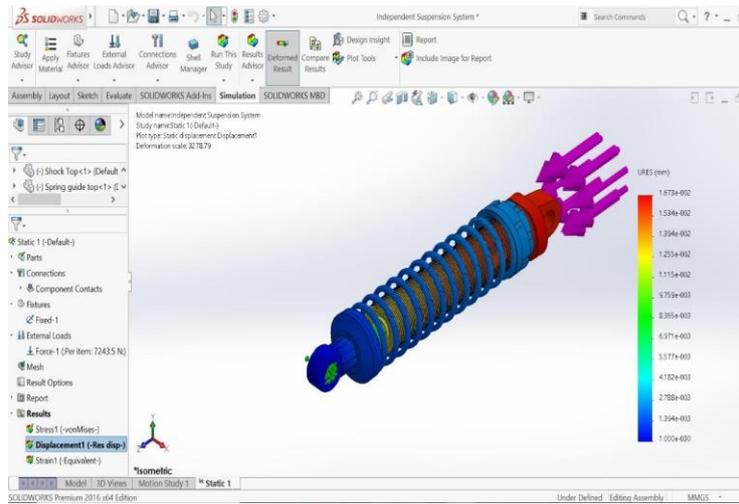Fig. 10. Von mises Stress analysis of Macpherson Strut Suspension

Fig. 11. Deformation of Macpherson Strut Suspension
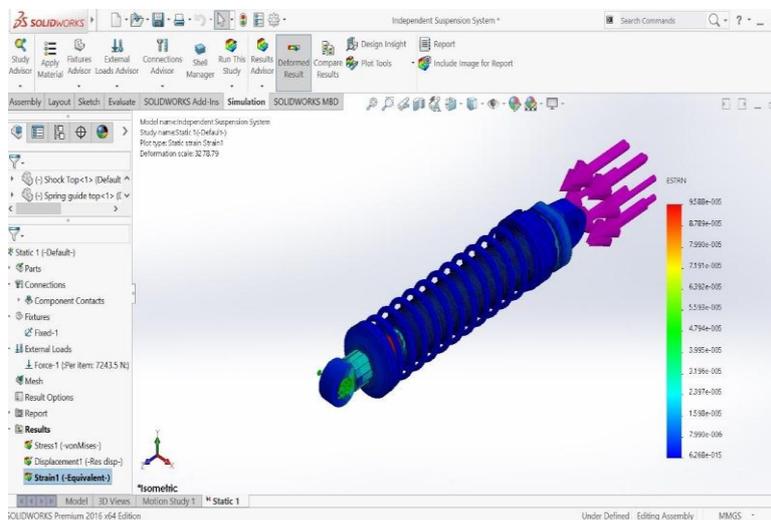
Fig. 12. Strain of Macpherson Strut Suspension

Table 1. Result

Stress in MPa	Deformation in mm	Strain
26.01	0.0167297	0.0958758

4.   **Conclusion**

The research survey was reflected in different types of suspension systems for the different vehicles but here focused on an independent wheel vehicle suspension system.

It was reflected on design and analysis of suspension of such vehicle likes Formula Student Race Car, An All-Terrain Vehicle, BAJA 2016 of Allterrain vehicle and Terrain Vehicle with Four Wheel Drive.

It was reflected in the design and analysis of suspensions such as analysis methods likes Model Establishment and Parameter Analysis, Vibration Analysis, etc.

Some research papers indicated optimization methods like Adaptive fuzzy controller, clipped-optimal control algorithm, Genetic Algorithm, etc.

Some research papers indicated real data analysis like a universal suspension test rig.

Some research papers indicated an analysis of such a suspension system like Double Wishbone Suspension System, MPV Suspension System, etc.

By using Solid work 2020 for CAD modeling as per design consideration of Macpherson Strut Suspension as functional analysis in consideration as static analysis to gives von mises stress, deformation and strain are 26.01MPa, 0.0167297mm and   0.0958758 respectively.

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22. Race Car Vehicle Dynamics by Milliken

A Survey on Application of Noble Gases and its Binary Mixtures in High Temperature Gas Cooled Reactors

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Abstract

This paper presents a comprehensive survey on the use of noble gases and its binary gas mixtures as primary coolant for heat extraction in high temperature gas cooled reactors. It also discusses and compares the advantages & disadvantages of using various binary gas mixtures with respect to conventional noble gases in high temperature applications. Helium (He) gas is widely used as a coolant for high temperature reactors due to its good transport and thermal properties. But on the other hand, due to extremely low density of helium, very high input circulation power is required when compared to other noble gases and their binary mixtures. As an alternative, it has been found out that mixing pure helium gas with a relatively dense gas like Carbon dioxide (CO_2), Xenon (Xe), Krypton (Kr), Nitrogen (N_2), Argon (Ar) may overcome the deficiency of high circulation power. Recent research works on application of various binary mixtures (He-CO_2, He-Xe, He-N_2 etc ;) in high temperature reactors have indicated that they have the advantage in terms of reduction of circulation power and compact size of equipments over pure He gas. Also, it is important to mention that out of various mixtures studied, it is found that He-CO_2 binary mixture at an optimum mole fraction offers the best solution in terms of reducing the input circulation power while also maintaining the cooling performance of the reactor.

Keywords: Helium, Binary Gas Mixtures, High Temperature Reactor

Nomenclature	
Ar	*Argon*
CFD	*Computational Fluid Dynamics*
CO_2	*Carbon Dioxide*
DEMO	*Demonstration Power Plant*
Kr	*Krypton*
N_2	*Nitrogen*
SFR	*Sodium cooled Fast Reactor*
VHTR	*Very High Temperature Reactor*
Xe	*Xenon*

1. Introduction

High temperature gas cooled reactors have gained attention in recent times owing to requirement of higher efficiency (> 45%) as compared to water cooled reactors. Earlier most of high temperature reactors were cooled by water but they have their own limitations in terms of maximum critical temperature (374 °C) at critical pressure of 7.73 MPa. In order to increase the reactor exit temperature, it is essential to increase the operating pressure of water (close to 20 MPa) in order to have comparable efficiency of gas cooled reactors. There are also inherent safety and handling issues of activated water in irradiated conditions. In contrast gas cooled reactors like breeding blankets of experimental fusion reactors [1],[2], proposed DEMO reactor [3], Very High Temperature gas-cooled Reactor (VHTR) [4] [5], Sodium cooled Fast Reactor (SFR) [6], can attain higher exit temperature and hence, higher efficiency of the reactor. These reactors can be broadly classified in two categories – nuclear fission and fusion. Under nuclear fission type of reactors, VHTR and SFR operates at maximum temperature of 950 °C and 550 °C. In nuclear fusion category, breeding blankets operates at maximum temperature of 550 °C. It is reported that noble gases have an advantage of chemical inertness and thermodynamic stability at high temperatures which is quite essential for operation of high temperature gas cooled reactors. It includes noble gases like He, Xe, Kr, Ar etc.

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Helium gas is considered as the most promising coolant of all the noble gases due to its high thermal conductivity, low dynamic viscosity, good heat capacity, thermally stability at high pressure and temperature, low neutron cross-section and compatibility to structural materials. On the other hand, helium gas has the lowest density of all the above mentioned noble gases which in turn makes it undesirable from input circulation power point of view. Also, the bigger size of the turbomachines with more number of stages and more inventory space requirement is also expected due to its low density. Therefore, as an alternative and as per the recent research works in high temperature reactors applications have highlighted that it is possible to reduce the input circulation power by mixing the pure helium gas with a relatively dense gas (CO_2, N_2, Xe etc). These mixtures will result in compact size of the equipment of the reactor and in turn, may also increase the overall efficiency of the reactor.

2. Motivation

Helium gas is widely accepted as primary coolant for heat extraction in high temperature gas cooled reactors due to its superior thermal and transfer properties. It is considered in both nuclear fusion and fission type gas cooled reactors where the maximum operating temperature can be in excess of 500 °C. The detailed comparison of thermo-physical properties of helium versus other noble gases & CO_2 at reference operating conditions of 8 MPa, 700 K is presented in table-1.

Table 1. Thermo-physical properties of various noble gases and CO_2 [7]

Parameters	He	Xe	Kr	Ar	CO_2
Molecular weight (g/mole)	4.003	131.29	83.80	40	44
Density (kg/m^3)	5.43	181.70	113.50	53.75	60.45
Thermal conductivity (W/m-k)	0.285	0.0126	0.0196	0.0354	0.051
Dynamic viscosity (Pa-s)	3.6×10^{-5}	5.06×10^{-5}	5.12×10^{-5}	4.41×10^{-5}	3.24×10^{-5}
Heat capacity (kJ/kg-k)	5.19	0.173	0.259	0.532	1.167

From above table, it is evident that helium gas has the best thermodynamic properties like high thermal conductivity, low dynamic viscosity and high heat capacity compared to other noble gases and CO_2, except its low density at high pressure and high temperature conditions. To highlight this particular deficiency of low density of pure helium gas, a basic circulation power was performed for a high speed helium turbomachine with following process parameters highlighted in table-2.

Table 2. Process parameters of a typical helium circulator [8]

Technical parameters	Value
Type	Centrifugal (2-stage)
Pressure (In/Out), MPa	7.8/8.3
Temperature (In/Out), °C	60/80
Nominal mass flow rate, g/s	225
Nominal rotational speed, RPM	72000

Using Standard equation for power calculation and other losses, where:

$$P = Z_{avg} \times R \times m \times \gamma \times \frac{(T_2 - T_1)}{(\gamma - 1)}$$

- ▪ P = Power, kW
- ▪ Z_{avg} = Average compressibility factor
- ▪ R = Real Gas constant
- ▪ m = Mass flow rate (kg/s)
- ▪ Υ = Specific heat ratio (1.67)
- ▪ T_2 = Discharge temperature, °C
- ▪ T_1 = Inlet temperature, °C

From above calculation, it is found that even for a very low compression ratio of ~1.07, around 30 kW of input circulation power is required. This input power is quite significant considering such low pressure rise and highlights high specific heat ratio and low density of helium. Hence, based on the above preliminary findings, it is desirable to optimize the circulation power of helium gas which may be possible to achieve by mixing it with relatively dense gases.

3. Detailed Literature Survey

Yeon-Gun Lee et al; [1] had proposed a helium-based binary gas mixture as an alternate to helium gas as primary coolant for heat extraction of First Wall of Korea Helium Cooled Molten Lithium Test Blanket Module. In this study, CO_2 was selected and

evaluated as an additive gas due to its high density and relatively good thermal characteristics. CO_2 is a naturally abundant gas and has been widely used as a coolant in the early fission gas-cooled reactors and industries. CO_2 also has low neutron cross-section with no activating issues and good chemical stability with metals. They performed CFD analyses with He-CO_2 mixture as a coolant. Using pure helium as a reference coolant, the fluid velocity and the associated circulation power to assess the thermal performance were found from the CFD simulations for various molar compositions (Refer Fig 1). The results shows that the optimal CO_2 mole fraction is estimated to be 0.4 (refer Fig 2) and the circulation power can be reduced compared to 13% of that of pure helium. It also implies that the thermal efficiency of a He-cooled blanket system can be fairly enhanced by means of the proposed binary mixing since the input circulation power is reduced.
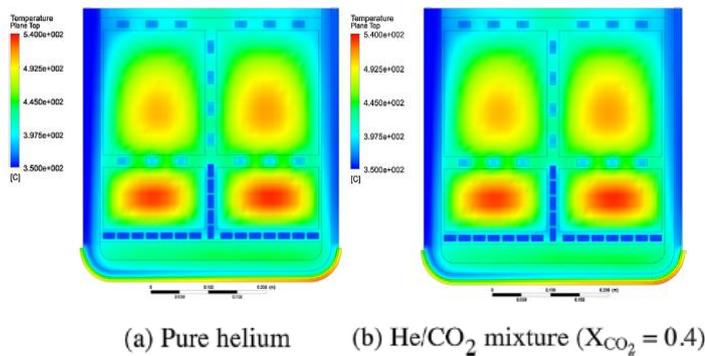

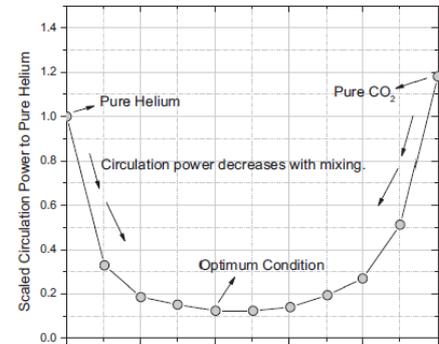Fig. 1. SEQ Figure * ARABIC 2. Temperature profile of First Wall

Fig. 2. SEQ Figure * ARABIC 1. Circulation power of He-CO_2 mixture compared with helium

Haifei Deng et al [2] also proposed a similar He-CO_2 binary mixture as primary coolant for heat extraction on their Helium gas cooled Ceramic Breeder Test Blanket Module as an alternate to helium gas. They performed CFD analysis on a single-group flow channel by circulating the binary mixture 4 times and 5 times to estimate the effect on circulation power. The results of thermal-hydraulics parameters can been referred in Fig 3. They found that the optimal CO_2 mole fraction is estimated to be in range of 0.4-0.6 (refer Fig 4) and the circulation power can be reduced by 9% compared to pure helium. They also found out that the circulation power is less influenced by the number of circulation times in a single-group flow channel.
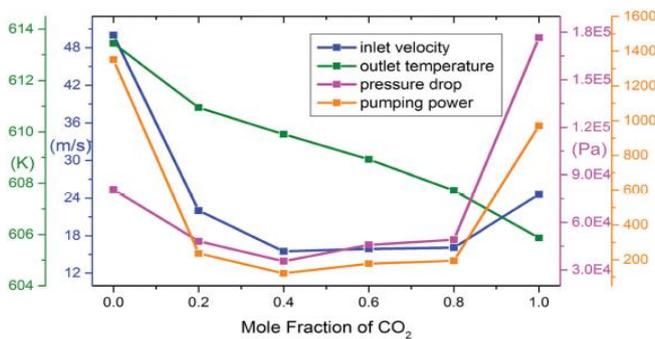
Fig. Thermal-hydraulic parameters variation of coolant with mole fraction of additive CO_2 gas
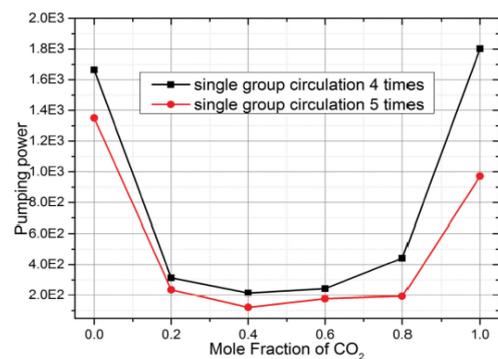
Fig. Variation of circulation power with mole fraction of additive CO_2 gas

Jan Stepanek et al; [3] proposed a comprehensive view of the benefits of using various working media and thermal cycle layouts for efficient conversion of thermal energy from the helium-cooled DEMO reactor for electricity production. The selected working media are water-steam, supercritical CO_2, and helium. Study results compare suitability of using the water-steam, S-CO_2, and helium cycles for different outlet temperatures of the source as well as a view of their complexity in terms of size and number of components. The results shows that the Rankine cycle is the most effective solution from thermodynamics point of view (refer schematic from Fig 6), but S-CO_2 cycles can compete with it in compact size, complexity, cost, and operational flexibility and higher efficiency (refer Fig 5).
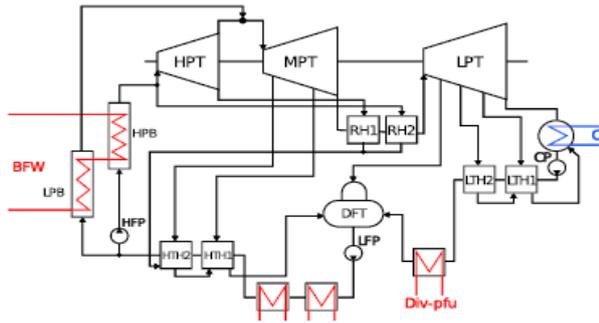
Fig. 5. Power output and cycle efficiency on blanket and first wall PHTS (BFW) outlet temperature
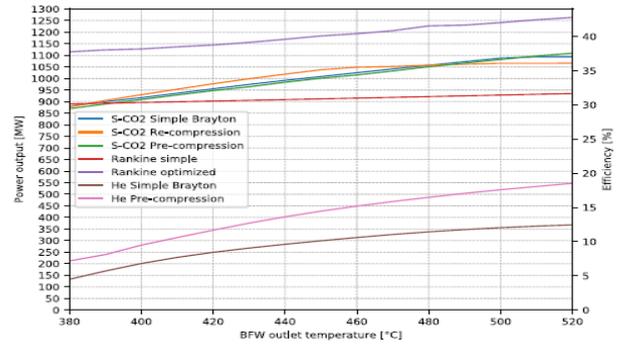
Jean-Michel Tournier, Mohamed S. El-Genk [4] [5] investigates the performance of Very High Temperature Reactor (VHTR) power plants with helium as working fluid in direct and indirect Closed Brayton Cycles (refer schematic in Fig 7), and compared with binary mixture working fluids of He–Xe and He–N$_2$ at molecular weight of 15 g/mole. They have found that above mixtures results in higher forced convection heat transfer coefficients (7% and 4.6% respectively) compared to pure helium gas. Also, it results in less number of stages and hence, more compact size of turbomachines in case of He-Xe and He-N$_2$ mixtures (refer Fig 8). It is also to be noted that for the same piping and heat exchange components design, the loop pressure losses with He–Xe are three times those with He gas.
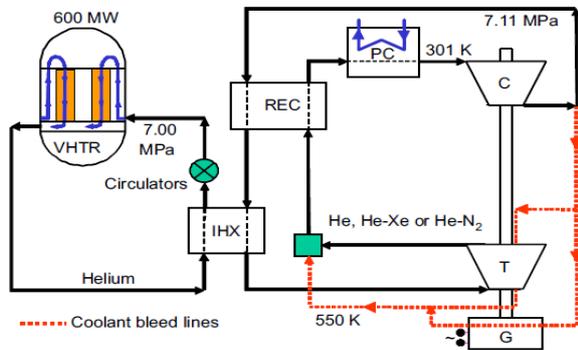
Fig. 7. Schematic of VHTR plant with indirect CBC
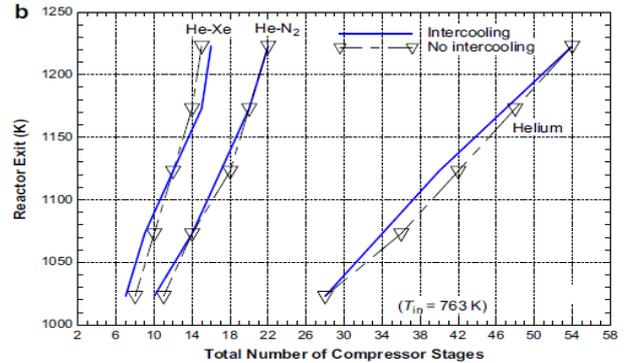
Fig. 8. Number of stages of the He, He–Xe and He–N$_2$ turbo-machines in indirect CBCs

**Woo Seok Jeong, Jeong Ik Lee, Yong Hoon Jeong [6]** presents an alternative of power conversion cycle (Brayton cycle) instead of an indirect Rankine cycle for a supercritical CO$_2$ fluid in Sodium cooled Fast Reactor (SFR). To prevent any hazards from sodium–water reaction, a SFR with the Brayton cycle using Supercritical Carbon dioxide (S-CO$_2$) as the working fluid can be an alternative approach to improve the current SFR design.

However, the S-CO$_2$ Brayton cycle is more sensitive to the critical point of working fluids than other Brayton cycles. This is because compressor work is significantly decreased slightly above the critical point due to high density of CO$_2$ near the boundary between the supercritical state and the subcritical state. For this reason, the minimum temperature and pressure of cycle are just above the CO$_2$ critical point. They performed study by mixing S- CO$_2$ with various gases like He, Ar, N$_2$ and O$_2$. It is expected that the cycle efficiency will increase with critical temperature and pressure at slightly above critical point of CO$_2$ (Fig 9). The highest cycle efficiency (+1.73%) reported is with CO$_2$-He binary mixture amongst all other mixtures (Fig 10).
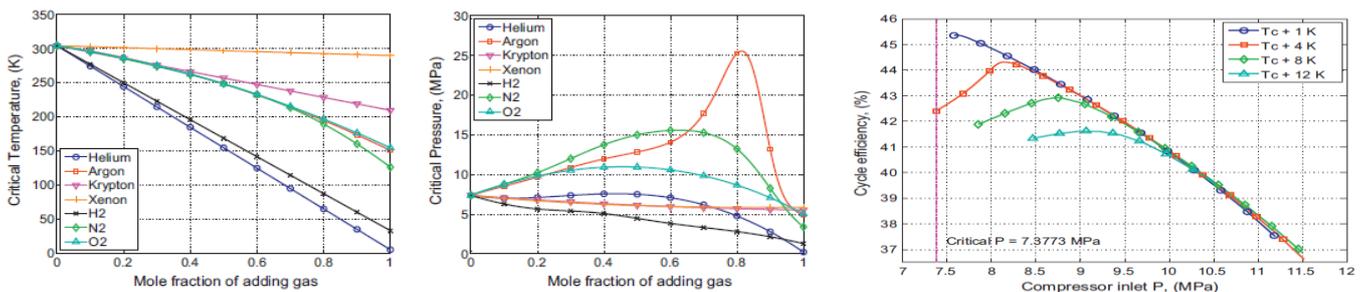
Fig. 10.Cycle efficiency along with various compressor inlet temperature and pressure

4. Discussion

Based on the survey of available literatures on binary gas mixtures, following points can laid out:

- Binary gas mixtures of helium and a relatively dense gas (CO_2 and Xe) is able to reduce the input circulation power in the range of 10% -15% as compared to helium gas.
- The relative size of the turbomachines in terms of shaft length and numbers of stages is reduced.
- The storage space for keeping the inventory is reduced.
- There is an increase in the overall thermal efficiency (~1.75%) of He-Xe mixture compared to pure helium gas.

Also, one more important point is to be noted that He-CO_2 binary gas mixture looks more promising compared to other mixtures (He-Xe, He-Kr etc ;) since CO_2 gas has greater density. It is abundant in nature unlike Xe and Kr and it has also thermodynamically proven as a coolant in various high temperature reactors. It has good compatibility with structural materials and has relatively low neutron cross-section, unlink Xe and Kr which have activation issues under irradiated environment. The only major drawback is CO_2 relatively low thermal conductivity and heat capacity compared to pure helium gas.

5. Conclusion

He-CO_2 is found as the most suitable binary gas mixtures to be used as primary coolant for heat extraction in high temperature gas cooled reactors as a replacement of helium. From the above detailed survey, it has been found that, He-CO_2 gas mixture reduces the circulation power by a magnitude and on the other hand, is able to maintain the thermal-hydraulic performance of the reactor. It is proposed that a Computational Fluid Dynamics (CFD) analysis is required to carry out this optimization works to assess the effect of binary mixture on the reduction of circulation power at an optimum mole fraction of the binary mixture and also to assess the cooling performance of the reactor.

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An Analysis of Financial Health of Selected Steel Companies Listed In BSE

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Abstract

This study used the Z score approach to estimate the amount of financial distress of three firms listed on the BSE: Jindal Stainless, Usha Martine, and Techno Craft for the period from 2016-17 to 2020-21. For the purposes of the analysis, only secondary data is employed. The data used in this study is from annual report and provace data base and analysed in Microsoft Excel. Altman analyses four different types of financial performance indicators that may be combined to determine the difference between a firm in financial crisis and one that is not. This model has been successfully used to a number of financial crisis and bankruptcy studies. The results reveal that the average Z score of Jindal stainless is 1.452, Usha martine 0.522, and Technocraft 1.578, indicating that all three firms are financially distressed and likely to go bankrupt in the future.

Key Words: Steel Companies, Altman Z score model, Financial Health

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1. Introduction

The financial health of a company is critical to its successful operation. Poor financial health endangers a company's survival and leads to business collapse. Corporate profitability has plummeted, but debt burdens have risen. Corporation failures are a widespread issue in both emerging and industrialised economies. The steel business is noted for being a high-risk sector. In today's world of cutthroat competition, there are numerous reasons why manufacturing industries such as steel fail, and thus effective tools and models to predict bankruptcy in advance would assist industries, creditors, and the general public in avoiding the negative consequences of a company going dry or bankrupt. Altman's Z score model is a prominent and extensively used bankruptcy prediction model for manufacturing enterprises, in which he employed multivariate analysis and numerous ratios to forecast bankruptcy in advance. The relevance of Altman's Z score model has not been put to the test in previous studies on the Indian steel sector by applying it to companies that have gone through difficult times or bankruptcy proceedings in the past, and thus it is the need of the hour to study if the model works accurately for various divisions of the Indian steel sector.

2. Literature review

(Dalvadi & Pandit, 2018)The researcher used the springate score method to assess the financial distress of eight chosen public sector enterprises from 2011-12 to 2016-17. According to the Springate score model, four public sector firms are financially distressed and four public sector enterprises are financially healthy out of eight public sector enterprises.

(C, 2016) The study analysed the Altman Z score on Nifty 50 companies excluding banks and financial companies for the study period. The score attempts to estimate the likelihood of a company's default due to financial difficulties based on the company's current financial information. The results suggest that out of 50 firms, 26 are in the safe zone, 9 are in the grey zone, and 5 are in the distress zone. The outcome demonstrates that the Z score is not meant to forecast when a company would declare for formal bankruptcy. It is instead a measure of how closely a company resembles other companies that have declared bankruptcy.

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(Imanzadeh, Mahdi, & Sepehri, 2011) The goal of this study was to give the theoretical foundations of the research and to compare the results obtained by applying the springate and zmijewski models for company bankruptcy prediction. Data from 2004 to 2008 were examined. The data was analysed using binomial non parametric techniques. The results indicate a considerable difference in bankruptcy prediction between the two models. Furthermore, the springate model predicts bankruptcy more conservatively than the Zmijewski model.

(Bhunia, 2007) The researcher conducted a study on 64 private pharmaceutical businesses from 1996 to 2005 and used multiple discriminate analysis on chosen financial measures from several segments such as liquidity, profitability, stability, and efficacy to construct a business failure prediction model.

2.1 Objective

The study's objective is to examine a company's financial health using the Altman Z score methodology.

2.2 Hypothesis

H_{01} There is no significant difference in Z score value of selected companies.

H_{02} There is significant difference in Z score value of selected companies

3. Research design

3.1 Sample selection

The research is analytical in nature. Three companies from the middle and small sectors of the steel industries listed on the BSE were chosen using a purposive sample approach for a five-year period beginning in 2016-17 and ending in 2020-21. The decision is based on the availability of data. Three companies selected from steel industry are:

Sr. No	Company's Name
1	Jindal Staileness
2	Usha Martine
3	Teachnocraft

3.2 Data collection and period of the study

The necessary information is gathered from the CMIE Prowess database and the firms' annual reports. Data collected for five year period from 2016-17 to 2020-21.

3.3 Tools and techniques

The Altman Z Score approach was used to analyse data.

The Altman Z score is determined by five financial ratios: profitability, leverage, liquidity solvency, and activity ratio. In this
study, the Z score model for manufacturing enterprises is applied is as under.

Z score = 1.2A + 1.4B + 3.3C + 0.6D + 0.999E

Where,

A = working capital / total assets i.e. liquidity ratio

B = retained earnings / total assets i.e. efficiency ratio

C = earnings before interest and tax/ total assets i.e. profitability ratio

D = market value of equity/ total liabilities i.e. solvency ratio

E = sales/ total assets i.e. activity ratio

Z score analysis

Z score value	Zone	Interpretation
Below 1.81	Distress Zone	Failure is certain
1.81 - 2.99	Gray Zone	Uncertain to predict
More than 2.99	Safe Zone	Healthy financial position

4.   Analysis and interpretation

The tables below indicate the five ratios applied in the Altman Z score model, as well as the Z score value of selected companies from 2016-17 through 2020-21.

Table 1. Altman Z score value of Jindal Stainless Steel

Year	A	B	C	D	E	Z Score value
2016-17	0.105	0.007	0.315	0.005	0.777	1.210
2017-18	0.128	0.039	0.342	0.002	0.965	1.477
2018-19	0.103	0.017	0.266	0.002	1.128	1.517
2019-20	0.095	0.019	0.253	0.004	1.098	1.469
2020-21	0.115	0.054	0.356	0.010	1.055	1.589

The above table shows the Z score value of Jindal Stainless Steel for the period of five years from 2016-17 to 2020-21. Its shows in the above table that Z score value of company for the five years are less than 1.81 which shows that this company is financially distressed for last five years.

Table 2. Altman Z score value of Usha Martine Ltd

Year	A	B	C	D	E	Z Score value
2016-17	-0.073	-0.066	0.105	0.002	0.479	0.448
2017-18	-2.471	-0.055	-0.094	0.003	0.198	-2.419
2018-19	-0.035	0.012	-0.041	0.002	0.250	0.189
2019-20	0.138	0.363	1.437	0.014	0.912	2.864
2020-21	0.152	0.091	0.378	0.035	0.872	1.528

The above table shows the Z score value of Usha Martine Ltd for the period of five years from 2016-17 to 2020-21. This table shows that Z score value of the company is 2.864 in the year 2019-20 which indicate during this period company's financial position is healthy. In other all four years the Z score value of the company is less than 1.81 which indicate company is financially distressed during that period.

Table 3. Altman Z score value of Technocraft Ltd

Year	A	B	C	D	E	Z Score value
2016-17	0.316	0.109	0.423	0.261	0.700	1.809
2017-18	0.226	0.103	0.391	0.243	0.685	1.648
2018-19	0.229	0.088	0.350	0.107	0.710	1.484
2019-20	0.265	0.078	0.297	0.116	0.645	1.402
2020-21	0.345	0.079	0.288	0.272	0.562	1.546

The above table shows the Z score value of Technocraft Ltd for the period of five years from the year 2016-17 to 2020-21. This table shows the Z score value of the company is 1.809 in the year 2016-17 which indicate during this period company's financial position is uncertain to predict. In other all four years the Z score value of the company is less than 1.81 which indicate company is financially distress during that period.

Table 4. Altman Z score value of all the companies for the study period

Year	JINDAL STAILNESS	USHA MARTINE	TECHNOCRAFT
2016-17	1.210	0.448	1.809
2017-18	1.477	-2.419	1.648
2018-19	1.517	0.189	1.484
2019-20	1.469	2.864	1.402
2020-21	1.589	1.528	1.546
AVERAGE	1.452	0.522	1.578

The above table shows average Z score value of all the company for the period from year 2016-17 to 2020-21. This table indicate that in Jindal Stainless ltd has Z score value less than 1.81 for the study period. In Usha martine ltd in first three year Z score value is less than 1.81 and then in fourth year Z score value is 2.864 which is more than 1.81 and less than 2.99. In other four years Z score value is less than 1.81 for the Usha Martine Ltd. Technocraft company shows that in the year 2016-17 Z score value is 1.81 which indicate that during that period company's financial position is uncertain to predict. In other all years Z score value is less than 1.81 which shows that company is financially distressed during that period.

Table 5. Average Z score value of all the companies for the study period

COMPANY NAME	AVERAGE Z SCORE	PREDICTION
JINDAL STAILNESS	1.452	Financially Distressed
USHA MARTINE	0.522	Financially Distressed
TECHNOCRAFT	1.578	Financially Distressed

Chart 1: Average Z score value of all the companies for the study period
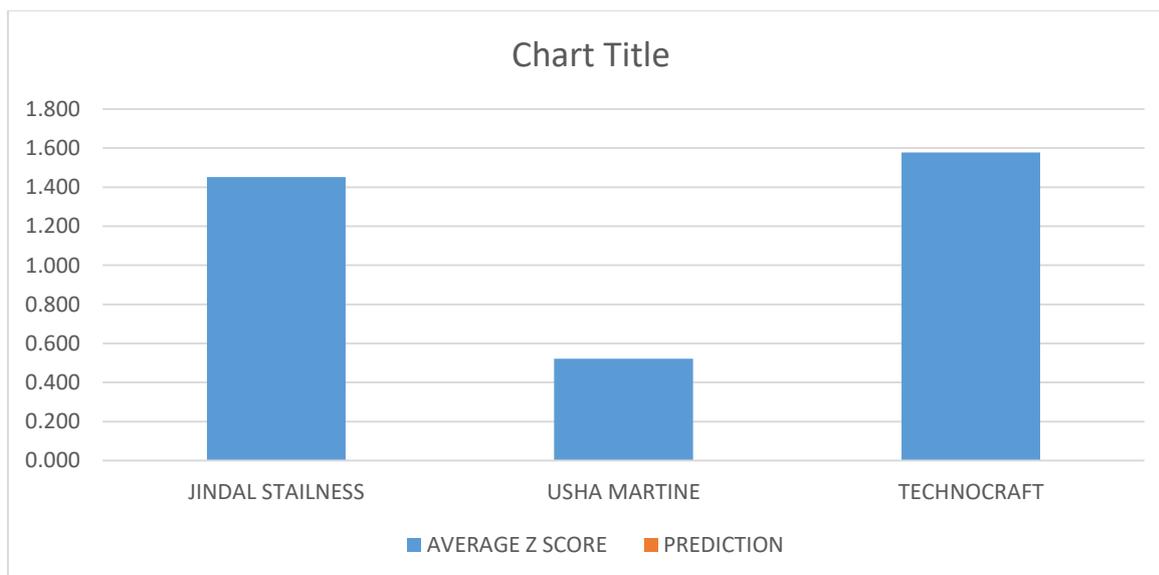
The above table and chart shows the average Z score value of the all the companies for the period from 2016-17 to 2020-21 which indicate Z score value is less than 1.81 for all the company which indicate that all the companies are financially distressed position during the five years.

5. Conclusion

Using the Altman Z score model, the researcher attempts to forecast the financial distress of three medium and small-scale steel businesses listed on the BSE from 2016-17 to 2020-21. The financial status is divided into three categories. Specifically, there are three zones: distress, grey, and healthy.

The results reveal that the average Z score of Jindal stainless is 1.452, Usha martine 0.522, and Technocraft 1.578, indicating that all three firms are financially distressed and likely to go bankrupt in the future.

According to the findings of the investigation, each firm, namely Jindal stailness, Usha Martin Ltd, and Technocraft, is in a state of difficulty. This result shows a financially unhealthy situation and predicts that these firms will go bankrupt in the near future. Companies must enhance their liquidity and profitability positions, as well as endeavour to raise their sales and stock market value.

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Acknowledgement

A Survey: Artificial Intelligence as a Strategic Initiative for Cyber Defence

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Abstract

Cyber Defence plays an important role in information technology. Artificial intelligence (AI) techniques have grown rapidly in recent years, Artificial intelligence gives extensive and spreads topological in nourishing cyber defence capabilities by increasing intelligent defence system, cyber infrastructures are highly vulnerable to intrusion and other threats. Hence, there is a need for more ultra-modern cyber defence system that need to flexible, adoptable, and able to detect a wide variety of threats and make intelligent real-time decisions. The purpose of this survey is to study technical-AI based cyber defence system which can detect and support against threats and cyber attacks as well as to give the scope for future work.

Keywords: Artificial Intelligence, Cyber Defence, Cyber Attacks, Cyber Threats, Intrusion Detection.

1. Introduction

The development of the technology and communication system started the new era of cyber movement, People and firms now almost fully rely on the use of the technology for their activities. It improved efficiently but this system has also led to greater risk from cyber threats, the increased use of technology means that the vital components of critical infrastructures are exposed to cyber attacks [1, 2].

The fact is that the most network-centric cyber attacks are carried out by intelligent agents such as computer worms and viruses; protecting the information of critical infrastructure and database from such disturbance and attacks is highly important, and is one of the major challenges in the future [3,4].

Cyber attack is also done by terrorists to spread propaganda and disinformation, fund raising, plan campaigns and provide information on them. They could try to launch cyber attacks on country's critical infrastructure in the future. Hence, combating them with intelligent system that can detect, evaluate and respond to cyber attacks has become a requirement [4]. Furthermore, cyber intrusion are not localized they are a global menace that poses threat to any system in the world at a growing rate. This is why we need innovative approaches such as AI-methods that provide learning capability to software which will assist humans in fighting cyber attacks [11, 15].

AI offers various possibilities; numerous nature-inspired computing methods of AI such as (computational intelligence, neural networks, intelligent agents, artificial immune system, machine learning, data mining etc.) have been increasingly playing an important role in cyber crime detection and prevention. When it comes to the future of cyber defence security, AI techniques seems very promising area of research that focuses on improving the security measures for cyber defence [4].

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The purpose of this study is to present applying AI techniques for cyber defence, to demonstrate how these techniques can be effective for detection & prevention of cyber attacks, as well as to give the scope for future world.

2. Cyber Defence: Definition, Need and Issues.

Cyber defence is a computer network defence mechanism which includes response to actions and critical infrastructure protection and information assurance for organizations, government entities and other possible networks. Cyber defence focuses on preventing, detecting and providing timely responses to attacks or threats so that no infrastructure or information is tampered with. With the growth in volume as well as complexity of cyber attacks, cyber defence is essential for most entities in order to protect sensitive information as well as to safeguard assets [3, 4].

With the understanding of the specific environment, cyber defence analyzes the different threats possible to the given environment. It then helps in devising and driving the strategies necessary to counter the malicious attacks or threats. A wide range of different activities is involved in cyber defence for protecting the concerned entity as well as for the rapid response to a threat landscape. These could include reducing the appeal of the environment to the possible attackers, understanding the critical locations & sensitive information, enacting preventative controls to ensure attacks would be expensive, attack detection capability and reaction and response capabilities. Cyber defence also carries out technical analysis to identify the paths and areas the attackers could target [5, 6].

Cyber defence provides the much-needed assurance to run the processes and activities, free from worries about threats. It helps in enhancing the security strategy utilizations and resources in the most effective fashion. Cyber defence also helps in improving the effectiveness of the security resources and security expenses, especially in critical locations [7, 8].

Cyber defence risks pervade every organisation and aren't always under IT's direct control. Business leaders are forging ahead with their digital business initiatives, and those leaders are making technology-related risk choices every day. Increased cyber risk is real—but so are the data security solutions [12].

Cyber defence system is crucial for government and other organizations that directly affect the nation's – or world's – wellbeing and safety. Cyber attacks to government, military groups and defence suppliers are starting to supplement or replace physical attacks, putting nations in danger [13].

Today, cyber attacks are no longer stopped by antivirus software or firewalls. The risk of cyber attacks is constantly increasing and for companies and institutions it is no longer a question of "if" it will happen but rather "when". This is why cyber defence is of such great importance .Cyber security is important because it encompasses everything that relates to protecting our data from cyber attackers who want to steal this information and use it to cause harm. This can be sensitive data, governmental and industry information, personal information, personally identifiable information (PII), intellectual property [22].

Ensuring that our data remains safe is one of the biggest challenges of Cyber Security. Cyber Security challenges come in many forms, such as ransom ware, phishing attacks, malware attacks, and more. India ranks 10th globally in terms of local cyber-attacks and has witnessed 121 million incidents in 2021 already [3].

List of the top challenges of cyber defence system:

- Ransom ware attacks
- IOT attacks
- Cloud attacks
- Phishing attacks
- Block chain and Crypto currency attacks
- Software vulnerabilities
- Machine learning and AI attacks

- BYOD policies
- Insider attacks
- Outdated hardware
- Intelligence/awareness

3.   The Impact of AI in Cyber Defence

Now it is essential to automate threat detection and management because extent of threats has grown beyond the point where they can be managed by people. Artificial intelligence helps to analyze web traffic and investigate suspicious automatically. Using artificial intelligence one can discover attacks before cybercriminals to access sensitive information. Also AI engine learns continuously from massive amount of data they analyze. This type of lifelong learning makes it possible to automate the defence system organization, fighting alone against potential threats. AI is regarded as a science that finds ways to solve complex problems that cannot be solved without applying some intelligence. AI application in the field of cyber defence is growing as strategic consist of those ways in which computers simulate human intelligence behaviour, such as thinking, learning, planning etc [4, 7, 8].

AI classical approach of focusing on individual human behaviour, knowledge representation and methods of inference, therefore, the intelligent agents. Was developed, on the other hand, Distributed Artificial Intelligence (DAI), which focuses on human behaviour accordingly cooperation, interaction and exchange of knowledge between different entities (agents). How the process of finding a solution to the problems is based on distributed knowledge sharing and cooperation among agents about the problem, it developed the concept of intelligent multivalent technology, technology that meets current needs. If an agent is an entity cognitive self-understanding its environment can work alone and has an internal system of decision-making that act globally, around other agents in multi-agent systems, the group of autonomous agents Mobile cooperate in a coordinated and intelligent to solve a specific problem or class of problems [7, 8].

3.1 Intrusion Detection

The general problem of simulating intelligence has been simplified to specific sub-problems:
Which have certain characteristics or capabilities that an intelligent system should exhibit? The Following characteristics have received the most attention.
- Deduction, reasoning, problem solving (embodied agents, neural networks, statistical approaches to AI);
- Knowledge representation;
- Learning (machine learning);
- Planning (multi-agent planning and cooperation);
- Social Intelligence (empathy simulation);
- Perception (speech recognition, facial, recognition, object recognition);
- Natural Language Processing (information retrieval – text mining, machine translation);
- Motion and Manipulation (navigation, localization, mapping, motion planning);
- Creativity (artificial intuition, artificial imagination); and
- General Intelligence (Strong AI).

The process of finding a solution in distributed resolution problems relies on sharing knowledge about the problem and cooperation among agents. It was from these concepts that the idea of intelligent multi-agent technology emerged. An agent is an autonomous cognitive entity which understands its environment, i.e. it can work by itself and it has an internal decision-making system that acts globally around other agents. In multi-agent systems, a group of mobile autonomous agents cooperate in a coordinated and intelligent manner in order to solve a specific problem or classes of problems [3, 4].

AISs are computational models inspired by biological immune systems which are adaptable to changing environments and capable of continuous and dynamical learning. Immune systems are responsible for detection and dealing with intruders in living organisms. AISs are designed to mimic natural immune systems in applications for computer security in general, and intrusion detection systems (IDSs) [15, 16].

Genetic algorithms are yet another example of an AI technique, i.e. machine learning approach founded on the theory of evolutionary computation, which imitate the process of natural selection. They provide robust, adaptive, and optimal solutions even for complex computing problems. They can be used for generating rules for classification of security attacks and making specific rules for different security attacks in IDSs [9, 10].

Many methods for securing data over networks and the Internet have been developed (e.g. antivirus software, firewall, encryption, secure protocols, etc.); however, adversaries can always find new ways to attack network systems. An intrusion detection and prevention system (IDPS) is software or a hardware device placed inside the network, which can detect possible intrusions and also attempt to prevent them. IDPSs provide four vital security functions: monitoring, detecting, analyzing, and responding to unauthorized activities [14, 20].

4.   Application of Artificial Intelligence in Cyber Defence System

Wang et al. (2008) stated that the future of anti-virus detection technology is in application of Heuristic Technology which means "the knowledge and skills that use some methods to determine and intelligently analyze codes to detect the unknown virus by some rules while scanning". Available academic resources show that AI techniques already have numerous applications in combating cyber crimes. For instance, neural networks are being applied to intrusion detection and prevention, but there are also proposals for using neural networks in "Denial of Service (DoS) detection, computer worm detection, spam detection, zombie detection, malware classification and forensic investigations". AI techniques such as Heuristics, Data Mining, Neural Networks, and AISs, have also been applied to new-generation anti-virus technology. Some IDSs use intelligent agent technology which is sometimes even combined with mobile agent technology. Mobile intelligent agents can travel among collection points to uncover suspicious cyber activity. This section will briefly present related work and some existing [21].

- AI APPLICATION:
  - Application of Neural Networks
  - Application of Intelligent Agent
  - Application of Expert System

4.1 Application of Neural Networks(ANN)

ANN is a computational mechanism that simulates structural and functional aspects of neural networks existing in biological nervous systems. They are ideal for situations that require prediction, classification or control in dynamic and complex computer environments. The neural nets will include a wider range or variety of artificial neurons. So, neural nets offer a practicality of massively parallel learning and decision-making. Their most distinguished feature is that the speed of operation. They're well matched for learning pattern recognition, for classification, for choice of responses to attacks etc. they will be enforced either in hardware before in software system. Neural nets are well relevant in intrusion detection and intrusion bar [17, 18].

NeuroNet – a neural network system which collects and processes distributed information, coordinates the activities of core network devices, looks for irregularities, makes alerts and initiates countermeasures. Experiments showed that NeuroNet is effective against low-rate TCP-targeted distributed DoS attacks. There are proposals to use them in DoS detection, pc worm detection, spam detection, zombie detection, and malware classification and in rhetorical investigations. One of the major reasons for the recognition of neural nets in cyber security is their quickness or fast speed, if enforced in hardware or utilized in graphic processors [4, 21].

There are new developments within the neural net's technology: third generation neural nets prickling neural networks that imitate organic neurons a lot of realistically, and supply a lot of application opportunities. Neural networks in face recognition system plays an important role in AI for cyber-defence [19].

4.2 Application of Intelligent Agent

Intelligent agents are self-sufficient computer generated force that communicate with each other to share information and participate to each other so as to arrange and actualize proper reactions if there should arise an occurrence of unforeseen occasions. Their mobility and adaptability in the environments they are conveyed in, and in addition their collaborative nature, intelligent agent technology appropriate for fighting cyber assaults [18, 19].

Gou et al. (2006) designed MWDCM - a multi-agent system for computer worm detection and containment in metropolitan area networks, which automatically contains the propagation of worms that waste a lot of network bandwidth and cause router crashes. The experiments showed that their system effectively thwarts worm propagation even at the high worm infection rates. These intelligent systems are very useful in protecting against DDoS (Distributed Denial of Service) assaults. Infrastructure must be installed as for the movement and communication supports the cyber agents [13].

For efficient and operational picture of a Cyber space, we need a Multi-agent Tool, for example, neural network-based intrusion detection and hybrid multi-agent techniques. Intelligent agents are often described schematically as an abstract functional system similar to a computer program. Helano and Nogueira (2006) introduced a synthesis based mobile intelligent multi-agent system approach for combating cyber intrusions. They implemented their system in Prolog and applied it to combating DoS and distributed DoS attacks automatically and without human intervention. They tested their approach on investigating distributed DoS attacks and defence mechanisms. The results showed that cooperation and ability to adapt in intelligent agent groups considerably raises defence effectiveness [3, 13].

4.3 Application of Expert System

An expert system is a computer program that uses artificial intelligence (AI) technologies to define the judgment and behaviour of a human or an organization that has expert knowledge and experience in a particular field. Expert systems have played a large role in many industries including in financial services, telecommunications, healthcare, customer service, transportation, video games, manufacturing, aviation and written communication. An expert system incorporates a knowledge base containing accumulated experience and an inference or rules engine -- a set of rules for applying the knowledge base to each particular situation that is described to the program [21].

Current systems may include machine learning capabilities that allow them to improve their performance based on experience, just as humans do. A more recently developed expert system, ROSS, is an artificially-intelligent attorney based on IBM's Watson cognitive computing system. ROSS relies on self-learning systems that use data mining, pattern recognition, deep learning and natural language processing to mimic the way the human brain works. Expert systems and AI systems have evolved so far that they have spurred debate about the fate of humanity in the face of such intelligence, pondering if computing power has surpassed our ability to control it [20].

The Security expert system follows a set of rules to battle cyber-attacks. It checks the process with the knowledge base if it is good known processes then the security system ignores otherwise the system would terminate the process.

4.4 Other Application of AI

Machado et al. (2005) presented a novel network intrusion detection model based on mobile intelligent agent technology and AISs. They also implemented their design and showed that it is capable of differentiating between various attacks, security violations, and several other security breaches. Also there are many innovations which are done recently, here are some examples [12].

- Adding Intelligence to RPA
- Intelligent Process Automation(IPA)
- Machine Learning for Amateurs
- Advancement in Computer Vision
- AI-infused Chabots
- The Transformation of Digital Workflow etc.

5. Challenges in Cyber Defence

The main challenge is the difficulty of making a solid model of what acceptable behaviour is and what an attack is; hence, they may give a high number of false positive alarms, which may be caused by atypical behaviour that

is actually normal and authorized, since normal behaviour may easily and readily change. The active use of Artificial Intelligence is not the only challenge that the organization and cyber defence professionals need to face. There are others, caused by shortcomings in the current approach to security [12].

- Distant infrastructure. Today, systems communicate across continents, sending sensitive data AI over the world. These transfers don't undergo sufficient protection and are easier to break into.
- Manual detection. Human teams don't have 24/7 focus on security threats and suspicious patterns. Most of the time, systems go unmonitored.
- Reactivity of security teams. Most security experts focus on facing threats rather than predicting them.
- Dynamic treats. Hackers have many strategies for hiding their locations, IPs, identities, and methods. The cyber defence field, on the other hand, is a lot more transparent and open for research – data, created by businesses, is easily accessible by criminals.
- An intrusion detection system, no matter how efficient, may be disabled by attackers if they can learn how the system works.
- Another problem involves supplying intrusion detection systems that will conform to legal regulations, security requirements and/or service-level agreements in real world.

6.   The Way Forward in AI

It's of little surprise that cyber security is a priority for all organizations, more so at a time when the world is moving towards digitalization. AI consultants are keenly building advanced solutions to provide a profound and strong defence mechanism. Cyber security needs much more attention. Given human limitations and the fact that agents such as computer viruses and worms are intelligent, network-centric environments require intelligent cyber sensor agents which will detect, evaluate and respond to cyber attacks in a timely manner [23].

With AI-powered tools here are few predictions on how AI will change (enhance) the cyber defence system?
- Using AI tools to monitor security incidents
- Integrating machine learning into firewalls to flag any anomaly
- Identifying the origin of cyber attacks through NLP applications
- Using RPA bots to automate rule-based tasks and processes
- Monitor and analyze mobile endpoints for cyber threats

Furthermore, a lot more research needs to be done before we are able to construct trustworthy, deployable intelligent agent systems that can manage distributed infrastructures. Future work must search for a theory of group utility function to allow groups of agents to make decisions. It is recommended to teams to not only find preventive cyber attack solutions with AI but also look to the tech to plan an aftermath [22].

7.   Conclusion

AI is considered as a standout amongst the most encouraging advancement in the information age and cyber security. The fast development of information technology had a lot of positive impact and brought many conveniences into our lives. However, it also caused issues that are difficult to manage such as the emergence of cyber crimes. Therefore enhancing security execution and better protect system from an expanding number of refined cyber threats. As the technology continues to evolve, criminal cases change correspondingly. Every day we are faced with increasing number and variety of cyber crimes, since this technology presents an easy way for criminals to achieve their goals.

Organizations predict that hackers will start actively using AI in the near future, and lets' face it, typical tools can't accommodate such risks. As it is, most organizations aren't ready to face highly intelligent viruses, malware, ransom ware, and other forms of cyber threats. One thing is certain; adopting AI solutions can already help businesses spend less time and effort on their daily security tasks, while also keeping them better prepared for new risks. IT's both the weapon against current threats and investment in the future. The technology is getting more available which means; soon no business will have a reason to delay adopting AI. Instead of waiting for custom tools to implement AI on a large level, it's better to be ahead of the situation and start building powerful custom AI security too.

This paper has briefly presented advances made so far in the field of applying AI techniques for combating cyber crimes, their challenges and desired characteristics, as well as given the scope to way forward in cyber defence.

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Power Generation by Regenerative Braking Systems in Electrical Vehicles

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Abstract

Presently what the globe wants could be a methodology or a technology that saves energy from obtaining wasted. Energy conservation is that the hour of want. just in case of cars, energy conservation will be done by exploitation regenerative braking systems. When driving associate automobile, an excellent quantity of mechanical energy is wasted once brakes area unit applied, that then makes the beginning up fairly energy overwhelming. the most aim of this project was to develop a product that stores the energy that is often lost throughout braking, and reuses it. the employment of regenerative braking system in cars provides US the means that to balance the mechanical energy of the vehicle to some extent that is lost throughout the method of braking. The authors of the paper have mentioned and conferred 2 methods of victimization the K.E. that usually gets wasted by converting it into either energy or into current. Flywheel is employed for changing the K.E. to mechanical energy. Also, motor is employed to convert K.E. into electrical energy.

Keywords: Regenerative, Braking, Hybrid vehicles, Kinetic energy recovery system (K.E.R.S.), Flywheel, Motor, Hydraulic Power.

1. INTRODUCTION

Nowadays electrical vehicles become common as we all know it is inexperienced vehicle manufacturing zero emission to the air that is general reason behind depletion of layer. There are not any virulent gases releases from vehicle to dirty the atmosphere. In recent years the electrical vehicle population starts increasing in line with demand within the market. Besides, government is additional serious for the assembly of electrical Vehicles. All the humanities are attempting to avoid wasting Mother Nature & natural resources like crude & gases within the earth. In twentieth century, transport technology like management technology and integrative technology are developing aggressively. Somehow, the limitation of driving mileage still becomes Associate in Nursing obstacle for the event of electrical vehicles.
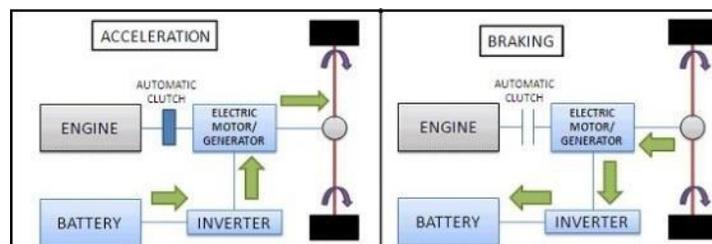
This technology had largely replaced the standard braking system within the vehicles as a result of the standard braking system always utilizes mechanical friction methodology to dissipate kinetic energy as energy so as to attain the impact of stopping.

Studies show that in urban driving, concerning one third to 1 half of the energy needed for operation of a vehicle is consumed throughout braking. Base on the energy perspective, the kinetic energy could be a surplus energy once the electrical motor is in

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the braking state since it dissipated the energy as heat and causes a loss of the general energy. This wasted energy really may be reborn to a helpful energy particularly for the hybrid and car. Therefore, regenerative braking had been enforced within the automotive braking system to recapture this wasted energy. additionally, the total energy saves relies on the driving condition, usually it is simpler in town driving instead of road whereas little braking happens.

2. LITERATURE REVIEW

(Yimin Gao and Mehrdad Ehsani 2001) The desirable braking system of a land vehicle is that it can stop the vehicle or reduce the vehicle speed as quickly as possible, maintain the vehicle direction stable and recover kinetic energy of the vehicle as much as possible. In this paper, an electronically controlled braking system for EV and HEV has been proposed, The results show that significant amount of energy can be recovered and braking performance of the vehicle is perfect. (SR Cikanek, KE Bailey - Proceedings of the 2002 American) This paper discusses a regenerative braking system (RBS) for a parallel hybrid electric vehicle (PHEV) that performs regenerative energy recovery based on vehicle attributes, thereby providing improved performance, efficiency and reliability at minimal additional cost. A detailed description of the regenerative braking algorithm is presented along with simulation results from a dynamic model of the PHEV exhibiting the regenerative braking performance.(X Nian, F Peng, H Zhang - IEEE Transactions on Industrial …, 2014) Regenerative braking can improve energy usage efficiency and can prolong the driving distance of electric vehicles (EVs). A creative regenerative braking system (RBS) is presented in this paper. The RBS is adapted to brushless dc (BLDC) motor, and it emphasizes on the distribution of the braking force as well as BLDC motor control. In this paper, BLDC motor control utilizes the traditional proportional-integral-derivative (PID) control, and the distribution of braking force adopts fuzzy logic control.

3. OBJECTIVE

- Use in electrical vehicles for generates the electricity and storage in some unit.
- World's leading automakers like Ferrari, Renault, BMW, McLaren, Tesla ar developing hybrid and conjointly complete electrical cars and are attempting to feature this Regenerative braking systems (RBS) to them.
- The potency of IC engine vehicles is 20-25%.By victimization electrical vehicles the potency will increase by five hundredth. (i.e., 70-75%). victimization RBS it contributes to the development of the potency of electrical vehicles by providing braking feature and conjointly saving most of the energy at a similar time, that gets wasted. thus by this method the potency will be enhanced close to by V-J Day (i.e., 85-90%).

4. REGENERATIVE BRAKING EFFICIENCY

The energy potency of a traditional automobile is merely concerning twenty%, with the remaining eighty% of its energy being born-again to heat through friction. The miraculous issue concerning regenerative braking is that it should be able to capture the maximum amount as half that wasted energy and place it back to figure. may this might} scale back fuel consumption by ten to twenty five % Hydraulic regenerative braking systems could give even a lot of spectacular gains, probably reducing fuel use by twenty five to forty five% . during a century that will see the top of the Brobdingnagian fuel reserves that have provided North American country with energy for automotive and different technologies for several years, and within which fears concerning carbon emissions square measure returning to a peak, this other potency is changing into more and more necessary.

5. CONVERSION OF KINETIC ENERGY TO ELECTRICAL ENERGY USING MOTOR

The most common kind of regenerative brake involves victimization associate electrical motor as associate electrical generator. The operational of the regenerative braking system depends upon the rule of associate electrical motor, that's that the required component of the system. motor gets activated once some current is competent it. But, when some external force is applied to activate the motor (during the braking), then it behaves as a generator and generates electricity. this suggests that whenever motor runs in one direction, the voltage gets regenerate into mechanical energy, that's then accustomed accelerate the vehicle and whenever the motor runs in different means, it performs functions of a generator, that then converts energy into current, that then creates it possible to utilize the movement force of the shaft to point out the electrical motors, that ends in produce voltage for storage at intervals the battery and at an equivalent time reducing the speed of the automotive with the regenerative resistance of the electrical motors. This electricity is then used for recharging the battery.

6. EXPECTED OUTCOMES

- It ought to store energy whereas braking that is its primary objective

- It ought to come back the keep energy whenever needed simply

- It ought to be compact and simple to put in

- It ought to give adequate stopping/braking force to the vehicle

- once utilized in conjunction with typical braking systems, it ought to simply switch as per demand half-dozen. Its style ought to be versatile so it will cater to the wants of a good form of vehicles.

7. CONCLUSION

Regenerative braking is associate degree energy recovery mechanism that slows a vehicle or object by changing its mechanical energy into a kind which might be either used straight off or keep till needed.

Once the driving force hits the brakes, energy that's normally lost as heat is instead reborn into electricity and stored during a battery. The regenerative braking system employed in the vehicles satisfies the purpose of saving a locality of the energy lost throughout braking. Also it will be operated at warmth vary and square measure efficient as compared to standard braking system.

The results from a number of the check conducted show that around 30% of the energy delivered will be recovered by the system. The results say that the force driven by the vehicles is measured. electric power generated by motor, generator and battery is extremely helpful and thence it ought to employed in electrical vehicles. The regulator absorbs energy once braking via a clutch system swiftness the automotive down and rushing up the wheel.

8. FUTURE SCOPE

Regenerative braking systems required detailed analysis and process improvement inputs to develop a modern and improved system that increases the amount of energy saved and helps the vehicle to stop quicker. As time elapses, designers and engineers can engineer excellent regenerative braking systems, thus these systems can replace traditional regenerative braking system as we know them today. All vehicles in motion will get benefit from these systems by recapturing energy which may have been lost through the traditional braking method.

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Role of AI in Education: Importance and Challenges

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Abstract

Computerized reasoning (AI) is transforming the world in surprising ways; while some of its consequences are certainly beneficial, the invention may also cause widespread and long-term harm. The integration of AI into various aspects of human life is underway, and the complex moral concerns that have arisen because of the planning, implementation, and use of the technology serves as a reminder that the time has come to return to what future engineers and creators, as well as experts, are acknowledging about AI. It is critical to train future members of the AI community, as well as other partners, to consider the ways in which AI may influence people's lives and to accept their responsibilities to increase AI's benefits while minimizing its projected harms. This might be achieved in part by including a more thorough and accurate assessment of AI morality into the teaching curriculum. In this study, we briefly outline several approaches to AI morals and discuss a number of recommendations related to AI morality education.

Keywords: Deep stacked CNN, Sigmoid Activation, Dlib, OpenCV.

1. Introduction

Artificial Intelligence (AI) and Machine Learning (ML) are essential drivers of progress and improvement across many industries, including education. When we separate it, an understudy's goal is simple: obtain a degree or certificate that demonstrates their understanding. By smoothing down the instruction cycle, artificial intelligence can help understudies achieve this goal. AI may have a significant impact on the educational journey of understudies by granting admission to the appropriate courses, improving communication with educators, and freeing up more time to focus on other aspects of life [1].

Perhaps the most important trend in education is personalization. Understudies now have a personalized manner to cope with learning programmer based on their own unique experiences and preferences thanks to AI [2]. Artificial intelligence can adapt to each understudy's level of knowledge, learning speed, and desired outcomes to ensure that they get the most out of their education. Furthermore, AI-controlled systems may assess understudies' previous learning tales, identify flaws, and provide the most suited courses for development, opening several possibilities to a personalized learning chance [3].

While it is common for understudies to want additional assistance outside of the classroom, many instructors are unable to engage with understudies late at night. In these cases, artificial intelligence advisors and chatbots are the right solution. While no chatbot can truly replace a teacher, AI devices can help students improve their skills and focus on weak areas outside of the classroom. They provide a one-on-one learning experience without requiring the instructor to be available at all hours of the day to answer questions. In fact, an AI-powered chatbot can reply to basic questions in only 2.7 seconds [4].

There's nothing more perplexing than submitting a question only to have it answered three days later. Educators and employees are often bombarded with repetitive questions. Through support robotization and conversational understanding, artificial intelligence may aid understudies in finding answers to their most frequently posed concerns in seconds. Not only does this save up a lot of time for professors, but it also helps understudies spend less time looking for answers or waiting for a response to their queries [5]. All understudies may study whenever and wherever they choose thanks to AI-powered instruments. Every understudy learns at their own pace and having day in and day out access makes it easier for understudies to figure out what works best for them without having to hunt for it [6].

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Most teachers and staff aren't afraid to admit they struggle with time management, which is understandable considering the number of items on their daily agendas. Instructors should devote more time to teaching understudies one-on-one, diving into research, and continuing their own education, but they lack the resources to do so [7]. Artificial intelligence may assist instructors in saving time by automating tasks, breaking down understudy execution, and closing the instructional gap. AI-powered chatbots having access to a school's entire data base can answer a variety of basic and mundane questions posed by students without involving an employee. By removing the instructor from the equation, AI helps them to focus on example planning, educational program research, and creating understudy commitment [8].

The power of AI may automate even the most mundane tasks, such as regulatory work, paper evaluation, assessing learning designs, and responding to general enquiries, to name a few. According to a Telegraph report, teachers spend 31% of their time planning visuals, preparing assessments, and completing regulatory work. Nonetheless, with the use of mechanization technologies, educators may computerize manual cycles, giving them more time to focus on demonstrating core skills [9]. EdTech has advanced tenfold, from online reading materials to entirely remote presentations. AI is now being used to help students and educators enhance and automate both learning and teaching tasks. We'll see more developed learning results for everybody as the AI company grows and development takes center stage [10].

2. Literature Survey

The current state of moral awareness in relation to AI and education is mostly limited to data protection, security, and appropriate use of personal data. Concerns are also growing about the impact of such collaborators on students in scenarios where the accessibility of menial assistants supporting understudies' learning cycles or instructors' exposition is increasing [11]. Understudies may also discover it difficult to confront or put stock in improvement when using a learning companion who remembers and assists the understudy in remembering their earlier setbacks [12]. According to a study published [13] there were more negative effects with the empathetic form of a specialist who assisted understudies in remembering what they had learned.

Wearables and bright companions track a huge quantity of our and our children's activities. A trip to the gym, a specialist, or a store, or a relaxing evening at home, can provide psychometric, physiological, monetary, emotional, and social data that can be used to build a complete client model and, as a result, perhaps work on tailored and appropriate responses [14]. However, when client models that capture a person's personal thoughts and feelings are shared with their workplace, family, friends, or the public, it can have a negative impact on that person. When we examine the learning and training environment, such observation should have been evident as a means for spotting harassment and assisting children in adapting [15].

As instructional innovation becomes more endowed with more dazzling functions, potential social and moral difficulties arise [16]. A writing audit focused on the use of (humanoid) robots in the study hall and looked at their moral influence on four fronts: (1) protection; (2) supplanting people; (3) effects on children; and (4) obligation [17]. Simultaneously, many key questions about AI, including as the concept of knowledge, how to balance individual and aggregate interests, how to handle moral issues, and what robotization will imply for the labor market, cannot be answered just through innovation. These investigations necessitate multidisciplinary approaches and, as a result, a change in the task and content of instructional developers [18].

Simulated intelligence can expand and perhaps replace human tasks and activities across a wide range of applications. The present rate of AI development is high, necessitating cultural, institutional, and mechanical changes, as well as new open doors for further progression across numerous domains, such as business and the boardroom, government, the public sector, and research and innovation [19]. To fully realize this potential, study valuable open doors, and address challenges, humanities and sociologies must be included into discussions about legislation, finance, morals, and the impact of AI and advanced innovation. With our unavoidably algorithmic cultural structures, we could only chart a path ahead into a profitable and trustworthy future if we worked together [20].

The rapidly rising capabilities and prevalence of AI-based frameworks in our lives raise serious concerns regarding the impact, administration, morality, and accountability of these technologies throughout the world [21]. How could decisions be made on when, why, and how AI should be used? How can the many views and needs of those who use, interact with, and are affected by these innovations be considered? How would we equip AI frameworks with the capabilities they need while ensuring that they don't exacerbate current inequities and tendencies, or even create new ones? These questions cannot be answered just from the perspective of software engineering or design.

Indeed, we can claim that AI is not a design discipline at this time, but it does require a wide range of contributions from other disciplines and participants. This is where instruction and learning research come into play. Brain research, humanism, software engineering, education, and mental science are all part of the learning sciences discipline, which is multidisciplinary. By combining learning research with AI creative work, those who promote AI will have a better understanding of teaching and learning, which will lead to more widely available AI techniques and applications. Simultaneously, such collaborative initiatives

improve the ability of skilled professionals, instructors, and students to grasp and be certain while using AI [22]. Nonetheless, recent AI and mechanical technology school programs provide engineers with a broad range of skills.

3. AI's Educational Advantages

Whenever you feel like it, you can go to school. Young people expend a lot of energy in a hurry. They prefer to use their cell phones or tablets to complete routine tasks. Simulated intelligence-based programs allow students to study for an additional ten or fifteen minutes. In addition, mentors can provide continual feedback to understudies.

Due to the needs of the understudy, many options are available. Because of the understudies' level of knowledge, interesting issues, and so on, simulated intelligence-based arrangements can alter. In general, the framework will help understudies with their weak aspects. Considering their deficiencies, it provides learning resources. For instance, before beginning to use the programs, the understudy takes a test; the application analyses it and recommends relevant projects and courses [24], [13-17].

3.1 Coaches on the internet.

Artificial intelligence-based stages provide virtual guides to track the progress of the understudy. Obviously, only human instructors can fully appreciate the researchers' needs, but it's helpful to get immediate feedback from the virtual guide.

3.2 There's a chance you'll notice flaws.

Different instructional classes enable understudies to discover the gaps in their knowledge. For example, the Coursera platform may alert the instructor if a large number of students chose incorrect replies to a given question. As a result, the guide may be able to concentrate on the chosen topic.

3.3 Better dedication.

VR and gamification are helping to integrate understudy into the educational system by making it more intuitive.

3.4 Personalization.

Different AI-powered computations can break down a client's information and preferences to provide more personalized ideas and planning plans. Artificial intelligence in education allows institutions to provide tailored learning opportunities for their students. AI can deduce the understudy's learning pace and needs based on information provided by the understudy. As a result of the findings, schools can tailor course paths to improve learning based on students' strengths and weaknesses. Even the most amazing of guides regard creating personalized coursework that caters to each understudy's increasing needs as difficult. Advances in computer-based intelligence make it easier for schools to make better-informed decisions.

3.5 Making a programmed educational plan.

AI advancement provides a significant benefit to educators. They no longer have to construct an educational strategy without any prior planning. As a result, mentors spend less time seeking for important instructional resources.

3.6 It's a once-in-a-lifetime opportunity to find a good tutor.

Because instructional stages feature a large number of educators, the understudy has the opportunity to speak with specialists from other countries. The AI-enabled instructional stage allows you to track and analyses student progress in real time. Teachers may use AI gadgets to continually monitor and examine their students' progress. It means that the teachers won't have to wait until the end of the year to compile the annual report sheets. Similarly, AI makes suggestions to teachers on which areas need to be rehashed or clarified more. In this scenario, AI-assisted shrewd examination is carried out.

3.7 Saves time and boosts productivity

There is apprehension about AI since it has human-like qualities such as acquisition, decisive reasoning, and critical thinking. As a result, the common belief is that AI will eventually replace instructors. This isn't the case. How AI handles the weight of time-consuming work that instructors and schools must deal with on a daily basis. There are also custom composing services, such as Online Writers Rating, that may help with any tedious writing projects. It frees up time for teachers to focus on teaching the understudies and other essential responsibilities.

For example, while using a linguistic instrument, the instructor does not need to correct understudy' punctuation more than once. The AI-powered gadgets may be used by students to learn word articulations, meaning, and proper usage. Simulated intelligence instruction is also advantageous to international understudies who are yet learning a new language. Routine tasks, such as

participation, can also be handled by AI. As a consequence, AI standard project phases such as Robot LAB provide expertise and adequacy in information, outcomes, and work procedure.

3.8 Student-Teacher Interactions that are Beneficial and Improved

Artificial intelligence training makes cooperation easier and more beneficial for both students and educators. Some understudies may not be interesting enough to ask questions in class. This might be due to apprehension over receiving fundamental criticism. As a result, with AI-assisted gadgets, they may feel more comfortable asking questions outside of the group. They might deliver specific feedback to the understudy with relation to the teacher. During class, there isn't always enough time to respond to questions completely. They can also provide one-on-one guidance to any understudy who requires it.

3.9 Increasing efficiency in administrative tasks

Every educational institution has a large number of school administrator responsibilities to manage on a daily basis. Adding AI to their frameworks can help with the computerization of such tasks. It suggests that executives will have an easier time running and putting up the institution. Schools might also make use of editing and rewriting services. Such administrations can help ensure that authoritative archives are well-written and devoid of errors. depending on their previous performance experience and delicate talents.

4. AI's Newest Challenges in Education

Despite the advantages of artificial intelligence in education, there are still a few challenges. Among the problems are the following [3-24]:

4.1 The Price of AI Technology

Computer-based intelligence training is too expensive. Spending plans should be increased when new innovations emerge to pay the costs. Aside from the installation of AI programming, schools will also have to consider the cost of product maintenance. As a result, schools with limited resources may see it attempting to implement AI-enhanced learning. They also won't be able to take advantage of the time-saving benefits of automating authoritative tasks.

4.2 Defenseless in the Face of Cyber-Attacks

Man-made reasoning software is extremely vulnerable to digital attacks. Because it holds such a large amount of data, programmers are always devising new ways to attack it. Imagine having your whole database of understudies, instructors, guardians, and administrators compromised. It's possible that having their personal data exposed may be exceedingly harmful to the victims of such cyber-attacks. The introduction of information security assurance programming is one of the things that a school may accomplish. Even yet, programmers can occasionally find their way into educational institutions.

4.3 There isn't much room for flexibility.

Regardless of how clever AI advanced mechanisms are, they can't nurture an understudy's mentality as well as an instructor can. While educators may teach various critical thinking approaches, AI does not have any educational options.

Simulated intelligence also operates on the garbage in, garbage out principle. While it can detect errors, it cannot correct them. As a result of a human error in data ascribing, AI really completes the insightful cycle. Nonetheless, the final result will reveal flaws. As a result, time is wasted, and the contact must be repeated several times.

5. Methods for providing Intelligent education

Machine Learning is one form of Artificial Intelligence. In general, ML will analyze data, find conclusions, and decide on our thoughts. It means that the ML-based stage may be taught using a large amount of data. It may then be used to complete a variety of tasks [15-19].

5.1 Individualized Instruction

The ability to focus on the specific needs of the understudy is enabled by man-made consciousness. Many large trainings organized, such as Carnegie Learning, are investing in AI to provide more tailored courses. Individual guidance, testing, and criticism are all possible nowadays. As a result, students work with the content they've studied and fill in the gaps in their understanding.

As Artificial Intelligence improves, it may become possible to evaluate and analyses the appearances of understudies. In the event that the content is too complicated, the stage might alter the illustration to meet their needs.

5.2 Assistants that speak to you

Voice assistants like Amazon Alexa, Apple Siri, and Google Home allow students to engage with a variety of learning resources without having to communicate with a teacher. As a result, you may use the teaching stage anywhere and at any time. For example, Alexa is used by Arizona State University for basic grounds maintenance. The aide might answer routine questions or monitor the understudy's schedule. Furthermore, using such associations is quite interesting and energizing for pupils, so they are female horse involved with the learning cycle.

5.3 Content with Intelligence

From digital course readings to redesigned interfaces, savvy content represents a variety of learning tools. Let's consider two different models. Content Technologies, Inc. is a company that uses Artificial Intelligence to enhance things. Its primary goals are to automate corporate procedures and improve client understanding. The firm has successfully developed solutions for the training industry. Cram101, for example, may divide the content of the course reading into sections. They might include a portion overview, exams, and so forth. Another company that focuses on creating smart content stages is Netex Learning. The setup is jam-packed with AI-powered features, such as continual criticism and an extensive instructional programmed. Netex stage also provides customizable cloud stages with virtual preparation and meetings, and the sky is the limit from there.

5.4 Worldwide Learning

Simulated intelligence provides several opportunities for information to be shared from one side of the globe to the other. Understudies can concentrate on various courses and preparation programmed by utilizing Artificial Intelligence arrangements. There are several stages in which intuitive learning materials from the top mentors are obtained. Artificial intelligence also opens access for students who speak a variety of languages or who have vision or hearing impairments. Presentation Translator, for example, is an AI-based arrangement that creates captions in real time. Understudies can hear or read in their own language thanks to AI Speech Recognition.

6. Conclusion

In the field of education, computerized reasoning has brought about a few positive advances. AI improves everything from homeroom cooperation to coursework learning and administrative operations. Furthermore, when new AI advancements are made, the benefits continue to improve and increase. On the other hand, AI, schooling isn't without its challenges. Instructors are wary of implementing automatic and fundamental changes that may render them defenseless against attacks. They must also consider cost ideas as well as the lack of AI flexibility in critical thinking. These dreadful sensations that arise because of AI problems can get strongly established on occasion. Instructors and schools, on the other hand, cannot afford to disregard AI's usefulness in increasing learning and interpersonal skills.

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Android Rooting and Customization

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Abstract

Android is today's most popular operating system and is used worldwide and because of this it has wide area of users, so as user increases customization also increases. If we look back Android has amazing journey from Android Donut Version 1.6 to Android 11 with many changes in the operating system from version to version. As for security reasons operating systems restricts user to perform some advanced task or customization so to overcome these developers have made some special customization which we can apply and can become Super User. This paper is going to tell everything about Android Customization and how to perform in certain Android mobile. Custom Rom are developed in which a user becomes a Super User and can-do customization as needed.
Keywords: Android, Operating System, SuperUser, Customization, Custom Rom.

1. Introduction

When comparing with the other operating systems in the market we can see that there are many choices available, for example Android, iOS, Windows Operating Systems. But when comparing in customization amongst the OS, Android is most widely preferred as it is the modified version of Linux Kernel and most importantly it is Open Source which means it is completely free of cost and can be accessible throughout the world. The term "Customization" means to develop something different from what it is originally shipped from the factory. In this paper the thorough process of what is needed, what are the merits and demerits of this techniques and what are the risks involved in this will be covered.

1.1. Prerequisite

Android is a deep sea if looked according to developers as it is highly customizable. For this there are prerequisite, if requirement does not match then there are highly possible chances of getting device bricked. First thing is that after performing this task your phone will be out of warranty so make sure that phone is already out of warranty.
- Step-1: Mobile device must be rooted.
- Step-2: Bootloader should be unlocked.

If these two steps are done for the device, then we can go further for the Custom Recovery (TWRP) Installation, Custom Rom installation and applications. There are certain definitions which will be covered in this paper.

1.2. Definitions

1) **Android:-**Android is a mobile operating system based on a modified version of the Linux kernel and other open source software, designed primarily for touchscreen mobile devices such as smartphones and tablets.[1]
2) **Rooting Android:-**Rooting is the process of allowing users of the Android mobile operating system to attain privileged control (known as root access) over various Android subsystems.[2]
3) **Stock Recovery:-**Stock recovery is the recovery which comes pre-installed with the operating system and which is restricted to perform superuser permissions.
4) **Custom Recovery:-**Team Win Recovery Project (TWRP) is an open-source software custom recovery image for Android-based devices and provides a touchscreen-enabled interface that allows users to install third-party firmware and back up the current system which are functions often unsupported by stock recovery.[3]
5) **Bootloader:-**The bootloader runs on device start-up and is in charge of loading the operating system on the phone. It is generally in charge of verifying that phone system information hasn't been tampered with and is genuine.[1]
6) **Root Checker**:- It is an application which verifies that whether root permissions are properly installed or not. There are various root checker applications which are available on the Google Play Store which can be downloaded into the device freely.

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7) **Stock Rom:-**Rom which comes pre-installed with the android device and it is proprietary to the makers of the devices and customization is not possible in this kind of rom as restriction are there for the user to perform superuser tasks.

8) **Kernel:-**The kernel is a computer program at the core of a computer's operating system that has complete control over everything in the system. It is the "portion of the operating system code that is always resident in memory" and facilitates interactions between hardware and software components.[4]

9) **Custom Rom:-**Custom rom's are quite different from the stock rom's as this are made keeping in mind to give full access to the user of the android and doing customization as per needs. Here all superuser permissions are accessible as this is a custom rom.

10) **Firmware:-** In computing, firmware is a specific class of computer software that provides the low-level control for a device's specific hardware. Firmware can either provide a standardized operating environment for more complex device software (allowing more hardware-independence), or, for less complex devices, act as the device's complete operating system, performing all control, monitoring and data manipulation functions. Firmware is held in non-volatile memory devices such as ROM, EPROM, EEPROM, and Flash memory.[5]

11) **Dalvik Cache:-** Dalvik is a discontinued process virtual machine (VM) in Android operating system that executes applications written for Android.[6]

12) **Flash Memory:-** Flash memory is an electronic non-volatile computer memory storage medium that can be electrically erased and reprogrammed.[7]

13) **ADB:-** The Android-Debug-Bridge (abbreviated as *adb*) is a software-interface for the android system, which can be used to connect an android device with a computer using an USB cable or a wireless connection. It can be used to execute commands on the phone or transfer data between the device and the computer.[8]

14) **Fastboot:-** *Fastboot* is a protocol and it has a tool with the same name included with the Android SDK package used primarily to modify the flash filesystem via a USB connection from host computer.[9]

15) **USB Debugging:-** The main function of this mode is to build a bridge between an Android device and a computer with Android SDK (Software Development Kit) which is a development platform for the developers to design and test their Android apps and mods.[10]

16) **GApps:-** GApps stands for Google Application and it is vital file for any custom rom as it contains the basic application which are provided from the google like Phone, Contacts, Messages, Camera, YouTube, etc.

2. Literature Survey

2.1 Impact of Android Phone Rooting on User Data Integrity in Mobile Forensics.
Author: - Almehmadi, T., & Batarfi, O.
In this paper the author have explained about the main root cause and how big the challenges are when the rooted android is hacked, furthermore they have described about the Data Integrity of the user which is being compromised on an Android Rooted device if proper care of data is not taken.[17]

2.2 Rooting Your Android Device.
Author: -Sheran Gunasekera.
In this paper the author has described the advantages and disadvantages of the rooting android in fully fledged emulator and just shown the working process of how rooting can be done in specific android device, furthermore they have talked about why to root your device and what are the risks hidden behind it.[18]

2.3 Rooting of Android Devices and Customized Firmware Installation and its Calibre
Authors: - R Pal, RK Das, RR Anand.
In this paper they have talked about general trivia of what Android mobile phones are capable of, for example Call, Music, Gaming, etc. They have also talked about the information about what is recovery and how it is very useful when dealing with rooting process and also a rough idea on Overclocking the CPU of an Android Device.[19]

2.4 Android Rooting and Risks Involved.
Author: - Vishal Gaikar.
In this paper the author has talked about the rooting process in Tablet and what sort of recoveries are available in the market for the tablets and how it can be implemented in the Tablet, furthermore paper describes about the administrative rights which are available only after the rooting process is successful. Author has also given a general trivia on Computer based rooting process and gaining access root. In the advantages section this paper describes about the firmware access which are the core files of any Android Operating System which can be edited as per the user requirements. Lastly paper describes about the stability issues found in the device which might come if the process of rooting is not done properly and various other terms related to the performance of the Android Device.[20]

3. Installation Process

3.1. *Device Rooting Process*

For this paper I have taken Xiaomi Mi4i Android Device for rooting and installation of the rom. For this there are numerous ways to execute the plan but as for this paper I have taken toolkit.zip file for rooting the device [12], TWRP(Team Win Recovery Project 2.8.6.0) Custom recovery[12], crDroid Nougat 7.1 Custom Rom.[12], GApps 7.1[13].

Here is the step-by-step guide for rooting the Mi4i device.

- **Step-1: -** Make sure that you have got your backup from the device.
- **Step-2: -** Download the required USB Drivers from the internet depending upon the device.
- **Step-3: -** In device go to Setting icon-> About Phone -> Tap MIUI Version 7-8 times and you will become developer.
- **Step-4: -** In device go to Setting icon-> Additional Settings-> You will find Developer Options.
- **Step-5: -** After enabling Developer Options, inside it turn on USB Debugging option.
- **Step-6: -** Now connect the device to the computer/laptop through original USB cable.
- **Step-7: -** Unzip the file toolkit.zip on your computer/laptop.
- **Step-8: -** Make sure to keep all the extracted files in one folder.
- **Step-9: -** Open Start.bat file.
- **Step-10: -** Select option 1 from the list and hit enter, wait for the process to complete.
- **Step-11: -** Once the process is completed the device will reboot and SuperSu application will be installed on the device.

3.2. *Installing TWRP Recovery*

TWRP stands for Team Win Recovery Project and it is open-source custom recovery image for Android Devices and there are various versions which are available over the internet for almost all Android Devices, as of now for me I have installed TWRP custom recovery image version 2.8.6.0.

Here is the step-by-step installation guide for TWRP custom recovery image.

- **Step-1: -** Make sure that the device is rooted.
- **Step-2: -** In device Tap Setting icon-> About Phone -> Tap MIUI Version 7-8 times and you will become developer.
- **Step-3: -** In device Tap Setting icon-> Additional Settings-> You will find Developer Options.
- **Step-4: -** Now connect the device to the computer/laptop through original USB cable.
- **Step-5: -** Unzip the file toolkit.zip on your computer/laptop.
- **Step-6: -** Make sure to keep all the extracted files in one folder.
- **Step-7: -** Open Start.bat file.
- **Step-8: -** Select option 2 from the list and hit enter, wait for the process to complete.
- **Step-9: -** Once the process is completed the device will reboot.
- **Step-10: -** In the device go to Setting icon-> About Phone-> Check Updates-> Click upper right hand three dots-> Click Reboot to Recovery.
- **Step-11: -** The device will reboot into the recovery mode and you have successfully installed TWRP Recovery.

3.3. *Installing Custom Rom and GApps*

Custom rom or Custom firmware is something like giving Android a new shape in one own's perspective, for example after a period of time Mobile Companies stop pushing the updates to the devices like going from one Android version to another (Android 5.0 to Android 6.0). To overcome this customization takes place where a unsupported device can also go to the higher version of Android by some tweaks. Talking about GApps it goes from the version to version and also from size to size for example if you want only basics application to run on the android then select the Pico version from the tab and hit the download button which will automatically download a zip file which can be later installed in the recovery and if you want each and every application from google to run on your device then download Full version from the tab and save it in the computer/laptop which again will be used later in the installation process.

Here is the step-by-step installation process for the Custom rom/firmware.

- **Step-1: -** Download the required custom rom/firmware and GApps from the internet for the device.
- **Step-2: -** Place it in the mobile's internal storage folder name downloaded_rom.
- **Step-3: -** First do a Android Backup using TWRP Recovery.
- **Step-4: -** For this go to recovery mode by tapping some dedicated button's combination or through the system update.
- **Step-5: -** Tap on Backup button then select System, Data, and Boot to make a complete backup of your current rom.
- **Step-7: -** Go back to main screen of TWRP recovery and click on Wipe button.

- **Step-8: -**Do a Factory Reset.
- **Step-9: -**Again tap on the Wipe button and select Advanced Wipe button.
- **Step-10: -**Select Dalvik Cache, System, Cache icon and wipe the selected.
- **Step-11: -**Go back to main screen and click on Install button.
- **Step-12: -**Select both the files (Custom rom and GApps) which was kept in downloaded_rom folder and then confirm flash.
- **Step-13: -**Wait for the process to complete and once it is completed, select reboot.
- **Step-14: -**Initial boot may take several minutes but don't worry it will boot.
- **Step-15: -**Complete the initial startup process and voila! you have successfully installed Custom rom/firmware and GApps on your device.
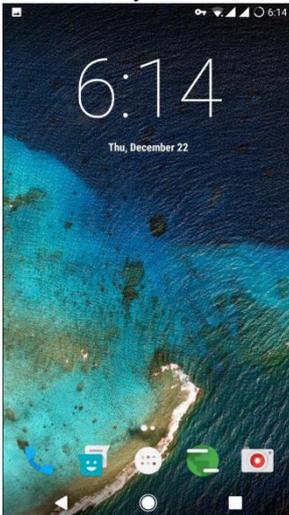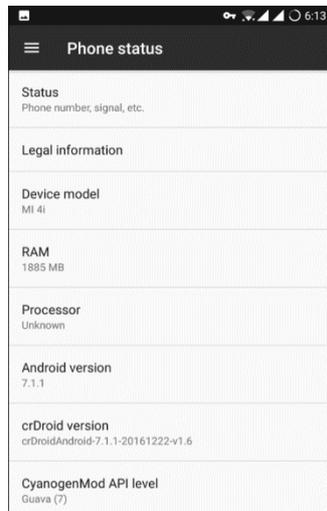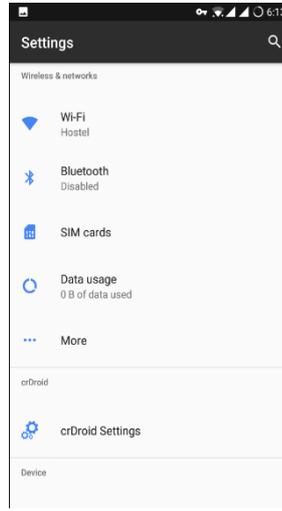
Fig-1 crDroid Main Screen(A).

Fig-2 crDroid Phone Status Screen(B).

Fig-3   crDroid   Settings Screen(C).

(A)   (B)   (C)

4. Advantages And Disadvantages of Rooting Android

4.1. Advantages of Rooting Android

There are lots of advantages of rooting Android, rooting gains the access of the Super User through which user becomes inevitable as they can run any kind of program they want to run on the device. Rooting has also capabilities to remove system applications which comes pre-installed in the mobile. It has also capabilities of running special applications which are specially made for root users and which are mostly available over the internet but some of the applications like File Checker Root Explorer, Root Checker are officially available in Google Play Store. Through some tweaks you can also install complete applications into SD card if mobile supports SD card slot which can be a lot helping hand in freeing up the internal storage space in handset. Mobile becomes durable for longer period of use because when manufactures stops giving updates to phone but still through custom rom you can update to the latest version of the Android. After rooting Ads are also removed/blocked instantly from any applications or games same as like computer/laptop browser. User can access the main Android core files (root files) in which the complete programming is done of the operating system and can also edit, update or delete the files from the same. The main advantage through rooting is one can Clock the speed of the CPU (Central Processing Unit) like over clock the CPU for getting maximum power from the Chipset and same ways under clocking the speed to extend the better life of the chip, application like No Frills CPU Control can do these things with ease and which is freely available on Google Play Store and there are many more applications which can do these things available over the internet. After rooting the Android there are infinite number of tweaks available over internet for customization and optimization for the handset.

4.2. Disadvantages of Rooting Android

In this world nothing is 100% perfect so but obvious rooting your handset have equally disadvantages which may or may not affect to the user directly, so if user is new to rooting then this is a pretty arduous task to accomplish and without any problems. The main disadvantage of rooting Android is bricking the device. Brick device meaning if any of the task is missed or any corrupt file is flashed then the device is unusual for sure and it is called brick, to overcome this type of issue there are 2 ways, one is to go to the manufacture's service center to fix the issue and second doing it by yourself. One more main issue after rooting is the warranty will void for sure once you successfully root the device. It is amazing to have the super user access but this kind me tricky for some of the users as if you misplace some core Android file or update or delete the files then this can end up into some serious trouble and

in end making it unusual. Another problem related to rooting is tweaking risks, so if the user flashes wrong kernel or wrong custom rom which is not made for the device in the first place then this can create major issues with the device and either two things can happen one is bricking the device and second is nothing will happen. Regarding the updates to the device no matter ho long it takes for the manufactures to build the updates for the device but if they are supporting the device then for surely the update will come to the device, but if device is rooted then this can be messy as the updates will no longer come to the devices or if it comes then may not install as device is registered with different recovery. Talking about the ad blocking in the device then this is a big advantage for the user but disappointing for the developers as they make revenue from the ads which are showing to the user and if user stops this then at some point of time developers have to discontinue the project which makes the application or game useless as no further updates/fixes will be provided from the developer end and in the long time it affects the user only as after a period of time because of the errors in the application will stop using it and deleting it from the handset.

5. Risks Involved

5.1. Risks in Customization

Up to this far we have talked about what is Android rooting, how it is done and what is customization in android and also advantages and disadvantages of it. Now let us see what are the risks involved in this practice. First and major risk is that at some point of time if the file is corrupt and if tried to flash then the device will be bricked and completely unusable. Secondly is the cost and time effort needed in this kind of work if something goes wrong in the installation process. Thirdly in recent events because of demanding in Android customization, manufacture's locks the devices bootloader and can only be unlocked by requesting to unlock the same to the manufacture, giving them valid reason that why they need bootloader unlocked and sadly there is no other way to overcome this problem so if user is rejected for the permission, then they need to apply again and again until company gives the authorization. Fourthly, there is no security kind of thing in this kind of practice so the device with root access and custom rom installed becomes highly vulnerable to the threats, so there is no such think called privacy in the handset. If device gets the virus or is hacked then there is no way to overcome from this kind of situation unless to change the rom or doing a hard factory reset. Customization can also be risky if the core tweaks application is not used properly as this may degrade the performance of the device and even worse, over heating of the device causing to shut down the system forcefully, because of this the life span of the device may reduce drastically and end up into becoming an e-waste.

6. Conclusion

Android is excellent platform for customization but comes with great responsibilities and prize, so be clear as in this paper both pros and cons are discussed so it is up to the user that is this worth doing it or should walk away from this kind of practices whether it is worth taking the risk for the same or not and if answer is yes then user must be thoroughly clear about the customization process as a single mistake can take the life away from the device. There is plethora of techniques available over the internet doing the same thing but with different tools and technologies so for future implementation of this practice it can be done without need of unlocking the bootloader.

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A Literature Review on House Price Prediction based on Fuzzy Logic

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Abstract

The house price prediction systems have proved to be the best ways for a client to help in buying a house based on their likes and dislikes. The main objective of the House Price Prediction is to give a range of properties to the client's requirements things like surroundings, technology, and amenities. A few of these systems are based on Soft Computing Techniques like Fuzzy Logic, Fuzzy inference system, and Neuro-Fuzzy inference system. The fuzzy logic technique has been taken into the considerations for the prediction system as it represents uncertainty, and it can be viewed as an extension of multivalued logic.

Keywords: Fuzzy Logic, House Price Prediction, Real Estate Prediction, Fuzzy Inference system, Soft Computing, Neuro-Fuzzy Inference system

1.   Introduction

A home is a basic necessity for everyone living in the world, and humans want it to be a perfect place for their kids to grow, to spend their lifetime in peace at the place they wish to have all the wonderful amenities. The demand for house is increasing gradually depending upon the population. And, as we talk about buying a House not all human beings want to buy/ own a lavish home. But they surely need a house with their desired amenities in the chosen surroundings.
The problem here is to predict the House Prices based on an individual like and dislikes. And here comes Fuzzy Logic comes for the rescue. As we all are aware of how does a Human think, and Raheel Farooq quotes "The biggest challenge for human mind is human mind" and this explains that we cannot think in one way so to understand our variety of thinking, Fuzzy Logic is by far the best way possible for House Price Prediction.

2.   Theory Background

Soft computing is a commendable system that helps in resolving complex real-life problems by providing a range of possible outcomes. The House Price prediction system using Soft Computing algorithms will give the buyer a fair price of the property. So, they cannot be cheated and not end up paying extra to the builders/brokers. More importantly, soft computing works on uncertainty, imprecision, approximation but also provides a precise solution based on real-life problems.
Fuzzy Logic can be defined as a method resembling human behaviour and giving intermediate values rather than giving the output in 0 or 1 or YES or NO.
In the real world many times we encounter a situation when we can't determine whether the state is true or false, their fuzzy logic provides very valuable flexibility for reasoning.
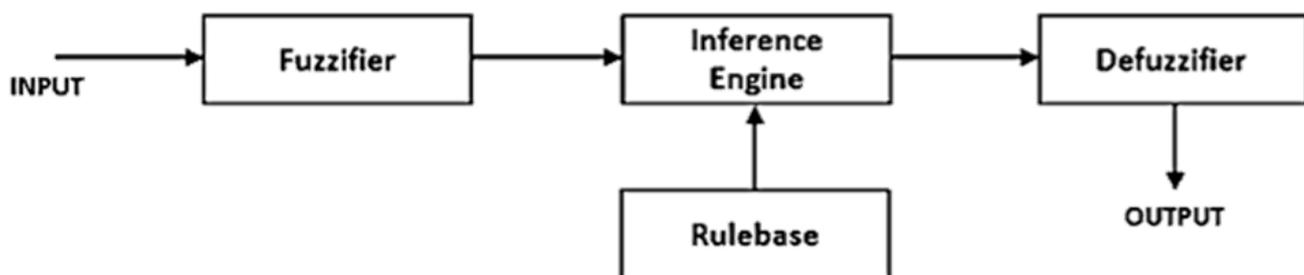

Fig. 1. Fuzzy Inference System

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House Price Prediction is an approach to predict the house pricing for the easiness of people, to find their own house based on their wishes. Whether, it is a Bungalow, Flat, Tenement or just a cottage, people would be able to get options to select from. In House Price Prediction, soft computing will be helping the client to see a variety of houses/ properties depending upon its desires and amenities required.

3.   Literature Review

House price prediction is a vast topic, which is implemented through a variety of Computer Science Methods. Like Machine Learning, Linear Regression, Decision Tree, Deep Learning, Fuzzy Logic, ANFIS (Adaptive-Neuro Fuzzy Inference System), and Linear performance pricing.

In proposed model of Machine Learning, the dataset is divided into two parts: Training and Testing. 80% of data is used for training purpose and 20% used for testing purpose. The training set include target variable. The model is trained by using various machine learning algorithms, out of which Random forest regressions predict better results. For implementing the Algorithms, they have used Python Libraries NumPy and Pandas. [1]

In another paper based on Machine Learning has used the multivariate linear regression model to perform the prediction. Also, it is compared with other Machine Learning models like Lasso, LassoCV, Ridge, RidgeCV and decision tree regressor. Multivariate linear regression and LassoCV performs the best with 84.5% accuracy. [6]

In Deep Learning Model study, the authors have developed a mode based on using Heterogeneous Data Analysis Along with Joint Self-Attention Mechanism. The Heterogeneous Data is to supplement house information, and it also assigns the weights automatically depending different features or samples. [2]

House price prediction using polynomial regression with Particle Swarm Optimization the authors have Washington DC house price prediction using polynomial regression and particle swarm optimization methods. They have also improved particle swarm optimization method with two methods. One is changing the topological structure of particle relations and the second improvement is the introduction of new particle control mechanisms. [3]

The present study uses data of sales transactions and the valuation of real estate properties from Pune city. For modeling the prediction process, the data is converted into the format of variables and the corresponding outcome in terms of the value of the property. The results are presented by using the performance matrices such as MAPE and R2, where Mean Absolute Percentage Error (MAPE) is most commonly used to forecast the error of any model. [4]

Real Property Value Prediction Capability Using Fuzzy Logic and ANFIS study uses data of sales transactions and the valuation of real estate properties from Pune city. For modeling the prediction process, the data is converted into the format of variables and the corresponding outcome in terms of the value of the property. The results are presented by using the performance matrices such as MAPE and R2, where Mean Absolute Percentage Error (MAPE) is most commonly used to forecast the error of any model. [5]

Determining the best price with linear performance pricing and checking with fuzzy logic paper aims to compare and verify findings with the LPP method and Fuzzy Logic results. This article explained linear performance pricing (LPP), backed up its accuracy with fuzzy logic, and showed how it can be used to efficiently provide the focus needed to achieve cost reduction. Besides, although it is widely used in the automotive industry in the USA and Europe, there is little discussion in the literature about its support with LPP and fuzzy logic. [7]

ANFIS approach is first time applicable to the real estate property assessment. This study has shown that ANFIS can yield results that are comparable to those obtained using the traditional regression approach. The main contribution of this study is clear demonstration that ANFIS is a viable approach in real estate value assessment and is worthy of further exploration. [8]

In [9] the authors have aimed to developed four different methods in order to estimate the real market price of 380 properties owned by Midtown Realty Group in Miami, Florida. the FIS models that also explain satisfactorily nonlinear relationships of the variables with the dependent variable; however, the problem we have in these models is that they must be well defined number of inputs and the relationships they have with each other, that is, the rules that explain the fuzzy inference model.

In [10] paper a study has been shown to compare different methods like ANN, FL, and FLSR for house price prediction. The major focus was on FL and FLSR, and on Fuzzy Regression. Fuzzy Regression Model was explained through a graph of predicted and actual values. Also, a Result comparison is also done with MAE (Mean Absolute Error), which shows considerable reduction is achieved in FIS and FLSR where the error rate drops by more than 25000 compared to the MAE of ANN model.

5. Observation

This survey paper presents an overview of recent updates on House Price Prediction with these different methods: Fuzzy Logic, Machine Learning, Deep Learning, Polynomial Regression with Particle Swarm Optimization, ANFIS and Adaptive Neuro-Fuzzy inference system. From a few Machine Learning methods Random forests gives better result. In the Polynomial Regression with Particle Swarm optimization method, the methods have been imporvised in two ways. One is changing the topological structure of particle relations and the second improvement is the introduction of new particle control mechanisms. The studies based on Fuzzy logic compared with LPP, used with ANFIS Neuro fuzzy inference system shows that Fuzzy Logic can be a viable solution for House Price Prediction and to provide a variety of houses on the demands of the clients.

6. Conclusion

With this literature survey, we have come to know that there is a scope of improvement in the field of House Prediction in the fields like ANFIS, LPP, Machine Learning. Mainly, in ANFIS a larger dataset can be given to the machine to perform the predictions and get the accurate outputs.

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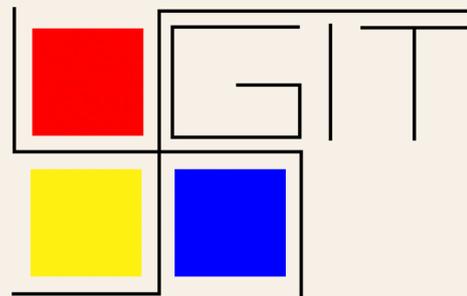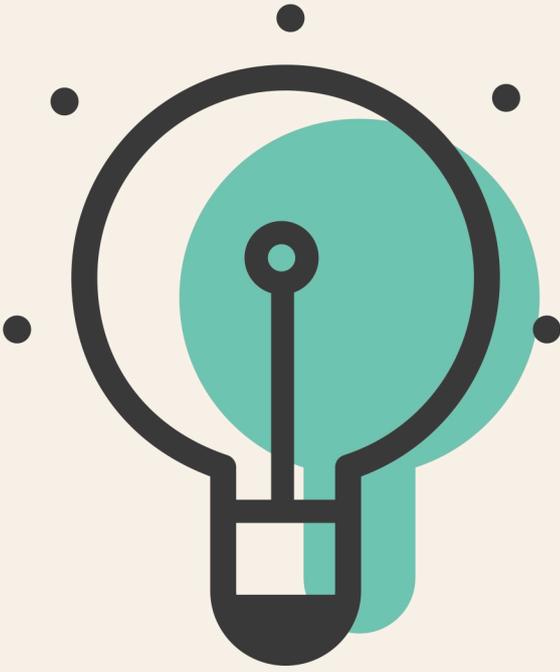
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