

# Study of Maintenance of Medical Equipment and Scope of AI in Enhancing Efficiency of Current System

– Shikha Gupta\*

Associate Professor, Chandigarh University

 shikha.g.206@gmail.com  <https://orcid.org/0000-0003-3255-3526>

– Pooja Sharma

Research Scholar, Chandigarh University

 poojae7625@cumail.in  <https://orcid.org/0000-0002-2575-5317>



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## ABSTRACT

**Purpose:** Motive of this paper is to study the reliability of selected medical equipments in relation with the type of maintenance strategy being used. Also, this research examines the risks in relation to patient outcomes. By conducting a survey, we can study the current maintenance system of medical equipment being used in Indian hospitals, their level of efficacy and the scope of AI to overcome the challenges in current system. The research work done in this review could be applied in further development maintenance strategies by using AI.

**Design Methodology and Approach:** This empirical research is based on the review of different papers.

**Finding:** In order to prevent the frequent breakdown of medical equipments due to poor maintenance, planning and management, it is necessary to ascertain the shortcomings and areas of improvement and thereby regulate an adequate system for the correct maintenance and use of medical instrumentation.

**Originality/Value:** This paper gives us new scope for research in the field of effective management of hospital equipments with the help of latest technology like AI.

**Paper Type:** View Point

**KEYWORDS** AI | Health Care | Equipment Maintenance | System | Medical

### \*Corresponding Author (Shikha et Al)

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## Overview of AI

AI refers to the computing technology and the process associated with human intelligence. In the previous decades AI and ML systems have attained many tasks just like human being that are bound of or thought. AI now days used to handle certain type of works like controlling your house, lights, kitchen, healthcare, self driving and many more that you can think off.

1950	<ul style="list-style-type: none"> <li>• Cybernetics and early neural networks</li> <li>• Turing's test</li> <li>• Game AI</li> <li>• Symbolic reasoning and the Logic Theorist</li> </ul>
1956–1974	<ul style="list-style-type: none"> <li>• Dartmouth Conference 1956: the birth of AI</li> <li>• Micro-worlds</li> <li>• The optimism</li> </ul>
1974–1980	<ul style="list-style-type: none"> <li>• Critiques from across campus</li> <li>• Perceptions and the attack on connectionism</li> <li>• Utilizing logic and symbolic reasoning</li> <li>• Another approach: frames and scripts</li> </ul>
1980–1987	<ul style="list-style-type: none"> <li>• The rise of expert systems</li> <li>• The knowledge revolution</li> <li>• The revival of connectionism</li> <li>• Artificial neural network (ANN)</li> </ul>
1987–1993	<ul style="list-style-type: none"> <li>• A New and Different AI</li> </ul>
	<p>winter</p> <ul style="list-style-type: none"> <li>• The importance of having a body: nouvelle AI and embodied reason</li> </ul>
1993–2011	<ul style="list-style-type: none"> <li>• Milestones and Moore's law</li> <li>• Intelligent agents</li> <li>• Implementation of Rigor</li> <li>• AI behind the scenes</li> <li>• Predictions</li> </ul>
2011–2020	<ul style="list-style-type: none"> <li>• Deep learning</li> <li>• Big Data</li> <li>• Artificial general intelligence</li> </ul>

Figure1 -History of Artificial Intelligence

AI is basically a method that helps computer to behave or perform functions like human being. It is a process in which we analyze and compute data in intelligent ways to perform some task. AI is basically constructing that intelligent system which can perform some task that only humans can do. It basically uses various hardware and software to simulate these approaches and techniques.

## Type of AI

In computer science AI contains so many disciplines and sub disciplines that deal with specific subjects. These disciplines are ranges in different ways

- A. NLP
- B. KRR
- C. PR
- D. ML
- E. ANN

### A. Natural Language Processing (NLP)

It's towards interpreting person's speech and changing over to mechanism reasonable structure. For instance, recognizing verbal communication in advanced cells can comprehend person's verbal communication and produce data according to our needs.[3]

### B) Knowledge Representation and Reasoning (KRR)

It is utilized in speaking to data in PC reasonable structure so as to finish a predefined task. Knowledge basically defines as Intelligence which is retrieve and save it in a information base that is used so that they can take decision of their own [3].

### C) Pattern Recognition (PR)

It is marvel of characterizing specific information of various modules dependent on their particular properties. In support of model, there are two distinct programs as define in figure1. Expect another information point X, and now it must be arranged regardless of whether it has a place with classes that depends on properties information point X. The accompanying graph shows example acknowledgment

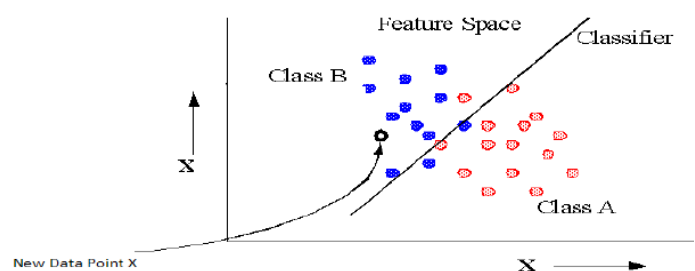


Figure 2 Pattern Recognition

### D) Machine Learning (ML)

ML manages study; investigation and development of calculations for making a mechanism to study for settling choices. ML calculations refer to contribution as precedent information explicitly called as preparing information. On behalf of the instance, making a self-ruling vehicle which takes bearings on its own by utilizing previous information.

### E) Artificial Neural Networks (ANN)

This is formed through the motivation from natural nerve cell with the mechanism of working of human mind. It fundamentally contains Info deposit, Unseen coating and Yield coating. While each of the coatings supports in speculation procedure, Information level takes preparing information, at that point ANN is prepared with it and then the forecast is possible from the manufactured model. The accompanying graph speaks to ANN.

### AI Applications in Healthcare

Before conveying AI frameworks in MSA, it is supposed to be organized by data that is formed from clinical drills, for instance, screening, determination & treatment mission and study proportional gathering in topics, connection among to pitching to see and outcome of premium.

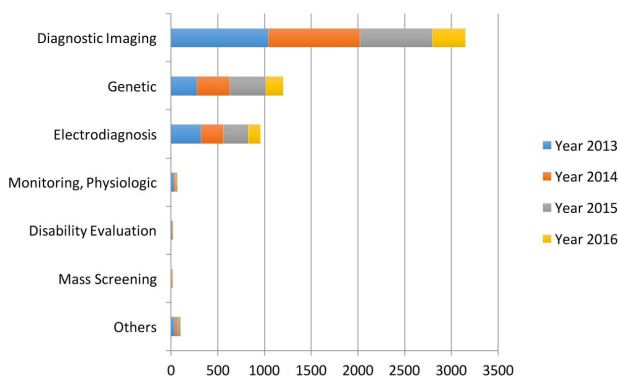


Figure 3- AI literature-Data type

### Maintenance Evolution

As the awareness about significance of maintenance management is increasing, the procedure has experienced successive alterations over recent years. Support progress has essentially expanded because of multifaceted nature in assembling measures and wide scope of items, developing attention to the effect of upkeep on the climate and well being of faculty, the benefit of the business and nature of items.

In the initial years, failure maintenance has been used as the first preference of most of the companies. Then later preventive maintenance will come into picture and become popular soon. The most important aspect of preventive maintenance is time-based managements. Time based management is basically very important that include replacement of parts and maintenance of parts so that unexpected failure can be easily evaluated.

Then in early 80's Conditional based maintenance came that include inspection based and continuous based. This policy based management activities were rather based on facts where there is a proof of deteriorations to reduce worthless planned actions. The concept of prognostic introduced that basically work on fault detections before it happened. Even after increase in the raising of information technologies still many issues were not addressed. There are so many gaps between real applications and academic models .There is so much to explore in this field, health care institutions don't track producer's guiding principle and don't profit from maintenance brilliance in so far as other organizations. Researches in this field only recommend how to assess and improve the consistency of device in their design or manufacturing phase deprived of considering consistency assessments and maintenance strategies of the equipment in regards to their operations.

In today's hospitals, a common growing issue is the effective management and maintenance of the critical medical equipments, the quality of the help and the effectiveness. On the off chance that capability the executives of clinical gear upkeep is to be applied, the administration construction ought to apply proper arranging, the board and usage measures. This is fundamental for giving quality well being administrations while saving assets. Clinical hardware the board includes assessment and preventive/restorative upkeep tasks.

The productive administration of support and fix work should be arranged and actualized utilizing suitable upkeep procedures to keep the gadgets protected and useful as per the essential useful details. Not with high introductory speculations, clinical hardware requires ceaseless and

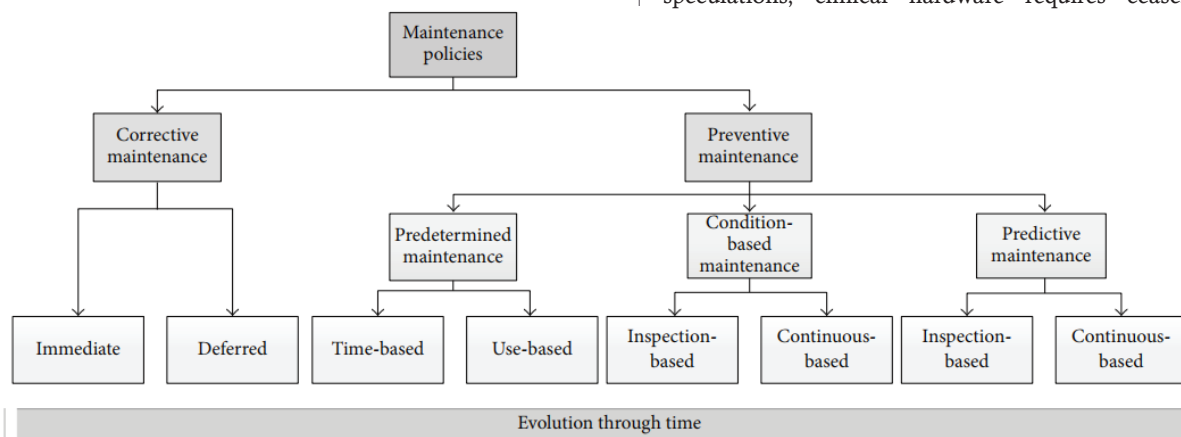


Figure 4- Evolution Through Time

exorbitant support during its valuable life. The issue of upkeep is the central matter of conversation of the administration of clinical gadgets. Amazing support is the condition of execution, danger, assets and expenses to accomplish this objective.

The primary support strategies created comprise of mediations on hardware, which run until it stops inadvertently (breakdown) set up because of wear or due to surrenders. The intercession is viewed as good as long as the hardware/framework is working at any rate satisfactory level (responsive support). This turn of events and increment of the unpredictability of clinical hardware and gadgets have prompted modernizing and refreshing support methods and approaches. Contingent upon the costs identified with the extra shares and resources, separately the misfortunes because of the time spent in fix, a few kinds of support strategies have been created. Because of the manner in which the wellbeing administrations are coordinated, the specialized staff in the wellbeing units ought perform upkeep and fix function as well as be effectively engaged with the securing and the executives of the gear. For instance, they can design hardware benefits and oversee stocks; they can give specialized consultancy to acquirement and can create specialized quotes. I can likewise make spending conjectures with respect to the upkeep expenses of clinical hardware.

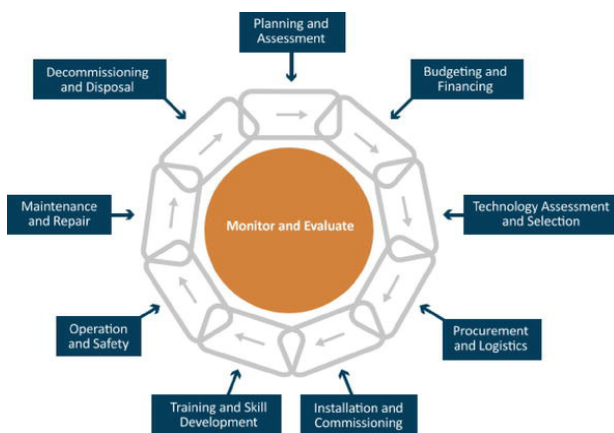


Figure 5- Life cycle of the medical equipment

## Literature Reviews

There are so many research and models have been conducted in medical area especially in

Output: This paper shows a procedure for creating methodologies for relieving activity and support disappointments. The procedures are connected to central underlying drivers of momentum gear disappointment, and which are relied upon to control professional's better deal with the activity and upkeep parts of basic clinical gadgets. By detailing such systems, better results are normal for basic analytic and treatment gadgets, henceforth better medical

care conveyance to patients needing such administrations. The proposed approach implants an information assortment and organizing system which helps the chiefs investigate and focus on hardware disappointments. In light of the prioritization cycle, an orderly and organized underlying driver investigation is recommended for surveying the central main drivers of gear disappointment, for which, relief methodologies are planned. The methodology differences from existing inspections in writing wherever hazard evaluation is frequently accomplished with the perspective on focusing on hardware disappointment, to the detriment of breaking down the central main drivers, and forming relief methodologies.

**Gaps:** Be that as it may, a few constraints are additionally evident, all the more explicitly, identified with the requirement for assessing the viability of the systems proposed in this examination. This requires genuine execution of the methodologies and assessing their results on activity and support results.

Output: We presume that it is conceivable to restore most of

Clinical gear to support utilizing just a moderately little set of abilities, without bringing in extra parts and utilizing as it were restricted monetary assets.

Gaps: Most endeavors at clinical hardware support and the executives limit working for asset helpless settings have zeroed in on conventional methodologies. In other words, adjusting educational plans created in and for asset rich settings, for example, The US or Europe, to asset helpless settings. Notwithstanding, this methodology expects to be that the issues looked by experts in an asset helpless setting are equivalent to those looked by experts in an asset rich situation.

Output: The scientists reasoned that the support rehearses at the three clinics are not powerful. This was finished up based on absence of work request framework to catch all work to oversee works, no expertise preparing projects and helpless extra stock and buying framework. The help conveyance evaluated at 26% and one of the elements adding to this low appraising is helpless upkeep rehearses. It was along these lines pertinent to presume that helpless support rehearses influenced administration conveyance. Unwavering quality Focused Upkeep ought to be utilized to accomplish a decent pace of hardware accessibility. The choice model proposed considers the various kinds of hardware classified as either basic or common gear. The board obligation in proposed model will encourage accomplishment of huge hardware accessibility.

Gaps: Extra support work force and preparing on current patterns in upkeep significant achievement of the proposed



RCM model. Executing this model will boost the help conveyance of the three medical clinics that accompanying proposals thought about by the emergency clinics.

- Collaboration amid hardware administrators that upkeep laborers to encourage quick reaction to gear breakdowns.
- Administration obligation to preparing of representatives with respect to new patterns in upkeep and new gear activity.
- Improvement of the support task documentation framework and planning.

Output: In this regard, a methodology for observing support from different perspectives can be executed by consolidating the arrangement of upkeep administration calls and key execution pointers. This thus empowers stargazed administration to be achieved, which can be applied to the appraisal and alteration of upkeep systems and strategies. Indeed, planned support can't generally block issues before they emerge.

Gap: Another administration programming, presently being created at a provincial layer that executing the imaginative arrangement of KPIs expected in this work. Dispatching that give public emergency clinics in Tuscany with an incredible chance to cover the standards of proof based support and will make the chance that think about various emergency clinics in future works.

Output: A wellbeing checking interface will be assembled appropriately to be accessible online for professionals of the specialist co-op without the requirement for them to be introduced actually with the hardware

Gaps: The projected procedure that has been talked about already functional with extra disappointment modes and other clinical machines also progress the nature of administrations, patients' wellbeing, decrease related peril and expenses because of unexpected disappointments. Besides, some ML strategies are touchy information extent, more information will be gathered into expectation model is rethought.

Output: This examination is significant on assessing the status of exploration tending to the preventive upkeep improvement issues of clinical gadgets. As practically nothing has been done here, the examination was centered around yields of exploration papers which have demonstrated the accomplishment of cutting edge support streamlining models on different businesses.

Gaps: Instead of simply keeping principles, and producer's rules, medical services experts should actualize proof based support to comprehend relative upkeep productivity studies

and roll out important improvements to upkeep strategies and activities, particularly, when numerous examinations have demonstrated how these methodologies for clinical gear are itemized and powerful.

(ii) RCM and Entire prolific maintenance signify a major breakthrough in receiving maximum output from medical equipment in comparisons with other industry applications and would support medical care service to explain signal based strategies for enhancing their level of productivity.

(iii) By implementing Risk-based prioritization methods, we can classify the critical medical devices require a firm maintenance program. Some studies have revealed that optimization modeling can benefit medical maintenance.

(iv) Very few studies have talked state based care policy in comparison to defensive and corrective maintenance.

(v) There is lot of scope for research in multi objective optimization models.

(vi) Some of the gaps in the study are Minimal and perfect repair assumptions. Defective maintenance is not overviewed to asses MEMPs effectiveness.

(vii) Black box models are often used to assesses degradation

## System for medical equipment.

This paper has reviewed and assessed the current status of research related to maintenance of medical devices. In fact, this is the premier paper that addressed the concern in a view. As per the review, there are total 34 studies which include 27 papers, 2 theses and 5 books related to maintenance of medical devices.

Gaps: Many research works have been done on selecting the strategy for maintenance in different industries however a systematic approach can help in selecting the strategy. Decision making methods can help managers to choose the best maintenance strategy.

Output: This paper studies the relation between criticality of machine and importance of maintenance in enhancing the productivity. Companies hardly prioritize maintenance based on machine criticality due to lack of assessments.

Gaps: The practices currently used for maintenance planning are hardly effective in today's scenario of production and digitalized manufacturing. A data-guided dynamic path is required that determine machine seriousness which in turn leads towards increased in productivity.

Output: This review ascertains a categorization for medical equipment maintenance management. To make the right decision, all the items involved in the process should be



considered. Bio-medicals can take a benefit from choosing a maintenance management process.

**Gaps:** Perhaps the main constraints are absence of familiarity with different dialects to utilize the aftereffects of Non-English language contemplates. Maybe, more factors could be distinguished if the consequences of Non English examinations could be added. Absence of admittance to full-writings of some article was likewise another limit.

**Output:** This work has set perceptions on evaluating the dignity that examination handling precautionary support streamlining issues in clinical gadgets. Considering very little that introduced in the field, examination that widened to assess other research papers which have exhibited to a huge degree the accomplishment of cutting edge upkeep improvement models on different ventures. We profoundly dissected ten angles deciding a model of support advancement issue: upkeep arrangements and activities, upkeep goals, support viability, demonstrating crumbling, framework data what's more, design, information sources, and improvement strategies.

**Gaps:** Over the period of time, maintenance management has gained extreme significant for several type of institutes. It is a function which was ignored by corporate leaders in past. A review of literature on maintenance models was done by considering normious papers published related to the matter between 2000 to 2017. The information retrieved from various models will allow users to reassess the technique to manage the maintenance function, particularly in a medical institution.

**Gaps:** Henceforth, it is a challenge to design a maintenance model which that blend maintenance management, risk management and patient safety, is the current protest that biomedical engineers must aspect nowadays.

The motivation behind this exploration was to overview the upkeep frameworks of clinical gear in four accustomed emergency clinics that focal area of Thailand under the Service of General Wellbeing utilizing rules from the clinical hardware support standard that is the norm for authoritative associations, HR, specialized gear, work spots, providers and stores, support, and quality assurance. The target populace was 552 laborers, comprising of 8 clinic managers, 535 clinical hardware clients, and 9 clinical gear experts, in four clinics.

**Gaps:** Clinical gear support by and large clinic (focal district) in the service of general well being Clinic. Clinic synopsis of value framework in efficient of clinical hardware support in the normal level which following the base guidelines and necessities.

## Medical Research

One of the applications of AI is to identify the pattern of large and complex data set in a more superior and faster way than the earlier framework. AI can help us to find the scientific literature for appropriate studies and consolidate separate type of data, for example, to assist discovery of drug discovery. Eve has been intended by researchers using AI to enhance drug discovery process and make it more reasonably priced. In health care. With the help of AI we can match suitable patients to clinical studies helpful for medical research.

## Limitations of AI

AI is dependent on digital data, so there is chances that inconsistency in the accessibility and superiority of data could limit the true prospective of AI. For analyzing large as well as complex data sets, considerable computing power is vital. The possibilities of AI in the NHS has created enthusiasm amongst many researchers, others point of view with respect to the practical challenges. For e.g. irregularly digitization of medical records, be deficient in of accessibility and consistency in Health service IT systems, records in digital way, as well as classification of data. Sharing of medical data through digital mode is not acceptable. AI cannot be compared with humans. Clinical practice has lead to some judgments that AI currently is unable to imitate, appropriate knowledge. There are a few discussions going on about whether some human information is comprehended and whether it very well may be instructed. Furthermore, we can conduct a survey to study and understand the maintenance and service scheduling of critical medical equipments in hospitals.

## Conclusion

In the field of healthcare and research, AI technologies are being considered or trialed for a variety of purposes, which includes detecting disease, managing the chronic conditions, delivering the health services, and discovery of drugs. Artificial intelligence can conceivably help to address significant wellbeing challenges, yet these are confined by the predominance of wellbeing insights that exists and furthermore by the absence of capacity of AI to have a few attributes like compassion like human. Numerous moral and social issues are being raised by the utilization of AI and a considerable lot of them reach out past the utilization of information in human services innovations explicitly. One of the key difficulties for standpoint of AI advances is guarantee that AI is made and utilized with straightforwardness and it is in a state of harmony with open enthusiasm for the segment. In order to prevent the frequent breakdown of medical equipments due to poor maintenance, planning and management, It is necessary to ascertain associate degreed regulate an adequate system for the correct maintenance and use of medical instrumentation. Based on the data and

feedback received from hospitals and medical institutions, AI can play an important role in enhancing the maintenance of medical equipments by designing a program on scheduling.

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- Faculty of Sciences and Techniques, Mechanical Engineering Laboratory, Sidi Mohammed Ben Abdellah University, 2202 Fes, Morocco
- Correspondence should be addressed to H. Mahfoud; hassana.mahfoud@usmba.ac.ma
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- Instituto de Ingeniería y tecnología; Universidad Autónoma de Ciudad Juárez Ciudad Juárez, Chihuahua, México. Instituto de Ingeniería y tecnología; Universidad Autónoma de Ciudad Juárez Ciudad Juárez, Chihuahua, México. Corresponding Author;
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### Reviewers Comment



**Reviewer’s Comment 1:** The study brings to light the maintenance of medical equipments and the use of AI to maintain the medical equipments. The study is empirical in nature and the finding of the study gives huge scope to the medical industry to take up new strategies to maintain their medical equipments.

**Reviewer’s Comment 2:** The author has brought a unique context of maintaining the medical equipments. The study mentions about the different types of AI technology and different maintenance strategies. The blending of maintenance techniques along with AI can be the future of medical industry. However further study of AI is required to implement the same.

**Reviewer’s Comment 3:** The research work is of immense importance to the medical industry. The medical equipments are the important part and parcel of medical service .The thought of the author on Maintaining these equipments is one of its kind. The industry can implement AI with huge investment and trials. The work leads scope for future study in different parts of the country to get a comprehensive opinion on the same.



Shikha Gupta and Pooja Sharma  
“Study of Maintenance of Medical Equipment and Scope of AI in Enhancing Efficiency of Current System”  
Volume-12, Issue-4, Oct-Dec 2020. (www.gjeis.com)

<https://doi.org/10.18311/gjeis/2020>

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### Editorial Excerpt



The article has 8% of plagiarism which is the accepted percentage as per the norms and standards of the journal for the publication. As per the editorial board's observations and blind reviewers' remarks the paper had some minor revisions which were communicated on a timely basis to the author (Shikha & Pooja) and accordingly all the corrections had been incorporated as and when directed and required to do so. The comments related to this manuscript are noticeably related to the theme "**Maintenance of medical equipments and scope of AI in enhancing the efficiency of current system**" both subject-wise and research-wise. The paper is an empirical study which explored the strategies to maintain the medical equipments. The findings of the study give new scope for research in the field of effective management of hospital equipments with the help of latest technology like AI. The study throws light on the use of AI in maintaining the medical equipments. Overall, the paper promises to provide a strong base for further studies in the area. After comprehensive reviews and editorial board's remarks the manuscript has been categorised and decided to publish under "**Research Thought**" category.

### Acknowledgement



The acknowledgement section is an essential part of all academic research papers. It provides appropriate recognition to all contributors for their hard work and effort taken while writing a paper. The data presented and analyzed in this paper by (Shikha & Pooja) were collected first handily and wherever it has been taken the proper acknowledgment and endorsement depicts. The author is highly indebted to others who had facilitated in accomplishing the research. Last but not least endorse all reviewers and editors of GJEIS in publishing in a present issue.

### Disclaimer



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