Digitization of the Classroom AI and IoT Influence in the Education Sector

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ABSTRACT
The necessity for education to be digitalized in the modern day is increasing as part of organizational development and innovation through a variety of academic applications. Even with its promise, the education industry still has difficulties putting technology to good use and reaping its benefits. Through the Internet of Things (IoT), technological integration has produced automatic embedded systems that include components like sensors, network infrastructure, actuators, IoT devices, and digital media. Many facets of teaching and learning benefit from this synergy. The most recent technological developments must be embraced by educators in order to improve instruction and other educational procedures. The creation of a "Smart Academic System" in the sphere of education is aided by the use of digitalization and Internet of Things technologies.

Keywords: Integrated Circuit,

1.Introduction

Modern technology, including artificial intelligence (AI), has become a vital part of our life in the digital age, enabling us to quickly adjust to a changing environment. With its web capabilities, the internet-based digital era offers a number of benefits that set it apart from more traditional means of inquiry that frequently run into problems. Software agents can communicate with one other in this situation without the need for human interaction. In its most basic form, the Internet of Things (IoT) is a network of devices linked by network systems, hardware, and software intended for data gathering and interchange. IoT is employed in a number of sectors, including telecommunications, finance, tourism, and education. IoT improves learning and adds value to learning environments and structures in the education sector. IoT envisions a world in which practically anything may be connected and intelligently interact, despite the fact that many people only equate connectivity with computers, tablets, and smartphones. Through

IoT, the physical world is essentially merging into one massive information system. In order to attain "SMART EDUCATION," educational institutions around the globe require IoT and digital infrastructure in the age of the internet. At the moment, educational institutions assist learning processes with digitization and IoT capabilities, which encourages greater levels of collaboration between the institutions, staff, and students.

a.IoT:

Digitalization in the Classroom IoT technology, which offers creative solutions, is crucial for education in the contemporary digital world. Smart objects are used on campuses using IoT technology in education to update the classroom and enhance the quality of instruction. Digitalized and Internet of Things (IoT) smart campus systems improve the virtual learning environments for students. With the use of smart objects, the iCampus model seeks to enhance both learning and campus administration. A suggested framework in "The Cloud of Things" (COT) with a smart box strategy for facilities like rooms and buildings is introduced by the "Living Lab" concept. The foundations of iLearning are covered in this paper, along with pervasive interactive programming (PiP), a teaching tool that defines rules for Internet of Things distributed computing processes and gives examples of rule translations. (2013, Chin).

Multiple IoT devices are used in technology-based smart classrooms to enhance teaching and learning. Nevertheless, there are a number of difficulties when using IoT technology on campuses. Even with these difficulties, IoT technology improves learning environments tremendously. both saves time and effort and improves educational quality. Applications based on Internet of Things technology will leverage various signal types to store data in databases (Gul, 2017).

The advantages and functionalities of the smart campus system, built on Internet of Things (IoT) products, include physical exams used in management and education. This system incorporates topology structure and digital era hardware components such as smart cameras, smart scanners, actuators, and sensors for doors, windows, and fans.

It has been suggested that developing IoT technology can significantly enhance users' lives and open new avenues for economic growth. The goal of the paper is to examine the system's architecture in detail, focusing on IoT modules like scan, light, thermostat, alarm, smart classroom, and smart library, among others (Han, 2011).

IoT technology also secures library systems. With numerous volumes inside and outside the institute library, books can easily get lost, making intelligent library systems essential. This paper outlines the first portion of an RFID-based library management system currently used in education. The second segment describes a proposed library system that includes an LCD, a Motorola MC 9090 for book identification, an NFC sensor at the entry point to read data, and an LPS that updates the library server with information about rack locations and architectural design (Brian, 2014).

Given the growing need for IoT in the educational sector and the necessity to train the current generation, open elective IoT introduction courses have been introduced for students from various streams. These courses cover all tiers of IoT architecture design. The report outlines the issues with the course material and how students are learning, using an IoT prototype system created through a tiered approach to analyze the course's impact on program outcome (PO)-driven active learning. This essay assessed the curriculum's activities or value-added learning (Raikar, 2016).

IoT plays a significant role in today's smart education system, independent of time, distance, and whether the study is real or virtual. This article explores deep IoT applications, such as smart libraries, smart classrooms, smart electric learning, and smart attendance record systems. By using in-depth knowledge of IoT network protocols, new methods and applications are compared based on their costs and needs. Comparing various applications and their benefits and drawbacks serves as a helpful resource for all educational sectors using IoT objects. This essay provides a thorough explanation of several IoT applications, including smart attendance systems, smart classrooms, smart libraries, and smart e-learning (Das, 2015).

IoT technology is beneficial for laboratory management, thanks to its effective indoor localization algorithm model. Such efforts influence the acquisition of theoretical techniques. XBee radios and Arduino microcontrollers are the main components of the framework. IoT implementation made available to students through online educational courses is helpful for carrying out lab tasks related to indoor localization (Atabekov, 2016).

This paper outlines billions of interconnected devices or machines through IoT, which can be operated by people or by anything, anywhere, at any time. This study noted the usage of IoT technologies in higher education. The challenges encountered in various types of education are being identified using these components. Digitalization and IoT in the Smart Academics System enhance multiple areas of education within institutions (Hanan, 2017).

The smart and digitalized academic IoT system enables various educational domains to be improved within institutions. In terms of education services, teaching and learning, security, and safety, these domains have streamlined the procedure, thus enhancing education and training processes.

2. Academic components:

Institutional components, the application of technology from an IOT-based academic perspective. Technology used to improve an institution's overall performance and the caliber of its educational institutions. The several applications that fall under the same classifications. Astute Academic Management: Smart education refers to educational institutions that use smart technology for classroom management, control, and instruction. This created a fresh approach to teaching for the academic sector and assisted students in increasing their enthusiasm in studying. For a smart education system, the researcher created a smart IOT framework that included several smart IOT devices for various uses. Every academic discipline was covered in depth by this framework, including smart classroom, smart learning and teaching, smart laboratories, smart libraries, and smart project supervision. By creating digital education, this framework is employed in Smart Learning and Teaching to improve features of educational institutions. a) Smart Learning and Teaching and Smart Classroom: These two concepts are related to one another. They are both IOT-based. For educational and instructional objectives, smart classrooms make use of smart IOT components. IOT technology is used in the smart classroom to make teaching and learning more intelligent. Using smart gadgets in the classroom makes teaching and learning easier and more conducive. An advanced teaching and learning environment can be created by combining various smart devices, or IOT items, into a smart classroom. A few instances of smart e-learning applications are smart lab sessions, smart IOT-enabled classrooms, online note-sharing, mobile phones, etc. All of these clever IOT services enable digitization-based education and preserve device connectivity for electronic learning in the classroom. IOT-enabled classrooms are beneficial for the institute's e-learning apps, which are employed for e-learning concepts' real-time activity. Students have access to this shared information, which includes online and e-content that administrators can manage. These IOT e-learning resources are incredibly beneficial to students and reasonably priced. Using IOT services to create intelligent learning activities works incredibly well. The quick evolution of IOT technology application in education for topic note sharing, simple learning methods, and improving classroom effectiveness through instructional strategies. Intelligent Classroom and Intelligent E-Learning Programs • Intelligent Whiteboard: The primary smart gadget in the classroom is an electronic digital whiteboard that can be connected to IOT sources to facilitate learning and preserve teaching and learning data. The administrator has control over updating the display board, which is utilized for interactive learning and information sharing to access subject data notes.
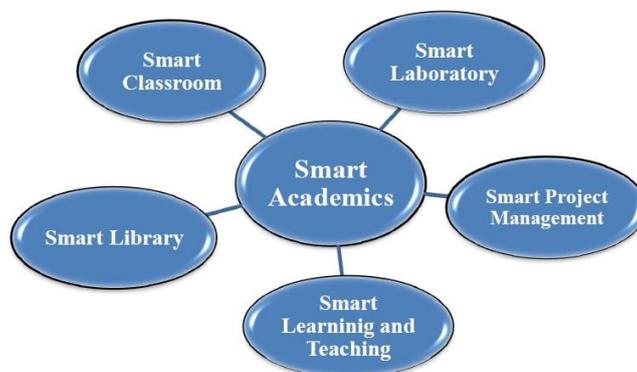

Figure 1. Smart Academic Structure

A.Smart Virtual Classroom Monitoring

With IoT-enabled classroom systems, students can attend lectures virtually. Flipped classrooms can monitor all activities, update information, and synchronize with e-learning systems. This platform facilitates a blended learning environment, allowing easy sharing of notes in groups. It supports various functions like content sharing, creating chapter-wise titles, assigning assignments, and quizzes to students. This setup fosters collaborative teaching and learning environments.

b.Smart E-ID System:

The Smart electronic ID card offers an efficient method for authentication, identification, and monitoring of students. These smart cards can store multiple identification factors for each individual within an institution. Different coded systems on the cards cater to various users, such as faculty members, staff, and students, each with a unique authentication ID. These cards also enhance security by tracking individuals within the organization.

E-ID devices can monitor and record student activities, making it easier to track individual or group progress. They also provide detailed reports to parents, covering aspects like attendance, healthcare, extracurricular activities, campus facilities, and lab access. Educational institutions use these E-ID cards to transfer information seamlessly through the IoT platform.

3. Research Issue

Implementing IoT systems in educational environments simplifies and accelerates tasks while eliminating the need for manual attendance tracking by teachers. Sensors can automatically detect students' presence, store, and print attendance records, making it easy to monitor attendance both in classrooms and during exams.

1. Fingerprint-Based System: This automated attendance management system uses IoT technology to record attendance via fingerprint sensors. It stores records in a central database and employs nodes, RFID sensors, and biometric fingerprint machines in educational institutions. The system relies on data confirmation and uses RFID sensors to detect tags, collect data, store it on a server, and generate attendance reports.

2. Smart Classroom Roll Caller System (SCRCS): Installed in classrooms, SCRCS reads student ID card details to calculate total class attendance, enhancing student performance monitoring. Another variation uses face recognition to take attendance. RFID roll call systems save time and ensure accurate data maintenance.

3. Face Detection and Recognition System: This IoT-based automatic attendance system saves time and effort. It captures images of institution members, analyzes, and recognizes faces using image processing algorithms. Recognized faces are processed, attendance is recorded, stored on a server or cloud, and a report is generated.

4. E-ID Card Accessing System: Using RFID technology, this system collects attendance records by placing HF and UHF readers at doorways and entrances. Passive RFID card tags attached to student ID cards enable automatic information access and attendance tracking.

4. Digital Classroom Enhancements and Smart Learning Gadget:

Educational institutions are incorporating a variety of smart gadgets and digital displays, such as indoor LCD displays, LED video walls, motorized projector screens, large format displays, digital podiums, touch screen displays, and touch screen panels, to create modern and interactive learning environments. These smart learning tools automate various tasks, reducing human effort and simplifying processes. The education system has also integrated mobile apps and software to facilitate the teaching and learning process.

a.Smart Evaluation and Feedback: Evaluation and feedback are integral to the learning process, particularly in e-learning systems. These systems use feedback to assess learner performance and suggest improvements. The feedback system in e-learning includes comments, advice, recommendations, evaluations, and interpretations. It fosters collaboration and communication among students, enhancing the e-learning experience. Smart feedback systems (SPS) feature tag-based

and graphical interfaces, addressing various objectives such as planning, designing, creating blended virtual learning environments, assessing faculty, authoring systems, and providing program perspectives. SPS systems are structured with different components and step-by-step feedback presentation tailored to learners' needs.

b.Smart Audio System in the Classroom: The smart audio facility in educational institutes offers numerous advantages for delivering lectures online and storing them in databases. It includes an amplifier system that distributes sound evenly to every student's desk, ensuring multimedia clarity and allowing teachers to speak comfortably at a natural volume. Amplified learning focuses on clear audio delivery, enhancing the overall learning experience. The smart audio system in smart classrooms employs wireless technology to adjust the volume of microphones and speakers effectively.

c.Smart Notice Board: The digital GSM-based smart notice board is a convenient tool for disseminating the latest news and updates to students. This SMS-based automatic display board is used in educational settings to provide instructions and recent news. It integrates various systems to create a user-friendly application for delivering important information to students.

d.Smart AR/VR Enabled Technology in Smart Classrooms: Augmented reality (AR) and virtual reality (VR) technologies are revolutionary concepts in education, fostering creative and interactive learning experiences for students. These digital technologies enhance students' creative thinking and are particularly useful in practical learning subjects.

e.Virtual Reality (VR): VR provides students with real-time visual experiences of various activities, allowing them to interact with and understand concepts more effectively. It offers an immersive experience, making students feel as though they are part of the actual scenario, thus enhancing both physical and emotional engagement with the subject matter..
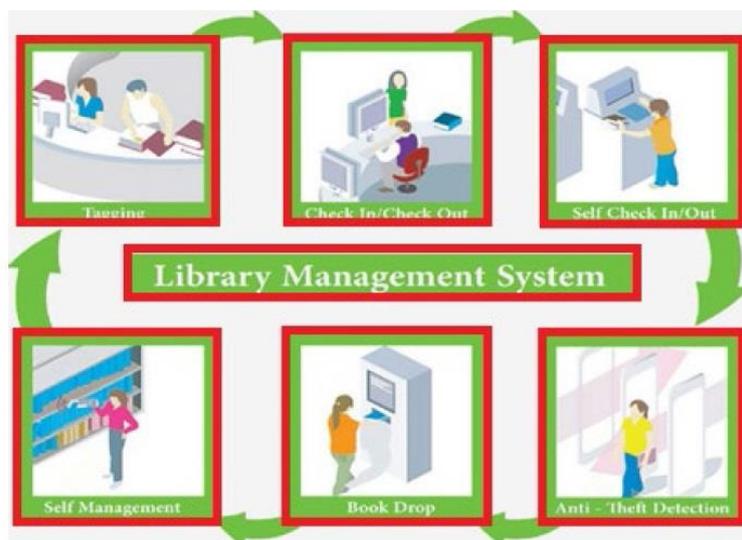

Figure 2. Smart Library

Convenient sampling is used in this study, which means that respondents were chosen based on their availability and willingness to take part.

Sample Size: 100 customers and 100 small retailers (kirana store owners) are included in the study's sample size.

5. Findings of Smart Library System in Education

The traditional library system needs to be replaced with new IoT applications to create a Smart Library System. This advanced technology in education leverages IoT and mobile technology to simplify and enhance library management.

The smart system reduces workload, saves time, ensures security, facilitates safe transactions, and allows users to easily locate books.

The Smart Library System integrates mobile applications that users can install on their phones. Through these applications, users can access library details, issue, and return books directly from their mobile devices. The app provides information on the availability of books, magazines, papers, research articles, journals, and projects. It also uses the LPS technique to detect the location of books and manage book transactions. Additionally, the app shows the details of all the books in the library on authorized mobile devices.

The Smart Library maintains detailed information about the books and the members, including students, staff, and admins. It records the entry and exit details of students, utilizing cameras for detection and ID cards for accessing the library system. Various IoT tools and applications are employed in educational institutions, such as RFID microcontroller systems for card readers, NFC book tracing systems, LCD screens for book issue details, OPAC systems, mobile access to tags, and Wi-Fi-based local positioning systems (LPS).

1. Smart Book Racks: These racks have an LED alarm system that activates when a book is misplaced, aiding in efficient book searches and improving overall library efficiency.

2. Smart Cameras: Surveillance cameras cover the entire library, enhancing security, monitoring conditions, identifying unauthorized activities, and solving system issues. This helps track library users effectively.

3. Automatic Work: RFID readers automate tasks. When a student issues or returns a book, the system automatically updates the database with the book's information.

4. Sensors: Various sensors are utilized in the smart library system to automate tasks. All devices are connected to a central database or cloud system. Different sensors serve different purposes, such as light sensors, tags, scanners, cameras, computers, LPS, RFID, barcode readers, biometric machines, and temperature sensors.

6.Smart Laboratory System

The Some traditional laboratory devices have been upgraded with smart IoT hardware kits and gadgets. In this system, devices are interconnected for better data access. An embedded board with sensors performs the system's actual tasks, providing students with real-time environmental experiences in practical subjects. The smart laboratory system includes various real-time tools like cameras, projectors, PIR sensors for light detection, PT voltage sensors, LDR sensors for light intensity detection, DHT11 sensors for temperature and humidity detection, and web applications that control the smart laboratory system. Smartphones and computer systems, along with IoT devices, are interconnected within a network facility.

Resistors are connected to a transformer to apply an attenuator circuit system for voltage control. Sensors, temperature, and voltages are monitored and controlled using smart devices in electrical and electronics engineering educational institutes. The objective of developing smart laboratories is to consider environmental parameters for data analysis to ensure effective utilization of processes. The global network framework is based on interoperable communication protocols for identifying physical and virtual interfaces. Connecting multiple smart elements creates a smart environment experience. This system comprises various models and hardware and software applications used for different experimental work.

IoT devices and digitalization enhance laboratory work and provide real-time experiences. In the library, an automatic attendance system eliminates the need for manual attendance during sessions. Higher-level desktop systems are used in Information Technology programs for practical concepts and advanced software, connected to a network for information storage. Digital projectors are used in sessions to explain practical concepts in Information Technology, Mechanical, and Electronics programs through animated 3D presentations, offering a better understanding of practical sessions.

Electrical circuits and microprocessors connect laboratory devices to sensors that gather information and store it on a server through internet facilities, such as Arduino electrical circuits. AR/VR tools provide effective, real-time

experiences of concepts. Virtual Reality (VR) offers students real-time activity experiences in practical settings, used in Mechanical and Electrical departments to explain real working examples from industries and factories. Augmented Reality (AR) is used for graphical and 3D presentations of concepts through video and audio representations, mainly in Civil and Mechanical departments..

7. Conclusion

IoT technology in academics enhances activities to improve future prospects. Smart classrooms implementing IoT devices function on the E-learning platform, integrating social learning applications with various educational features. Smart classroom and E-learning applications are interconnected, improving the quality of learning and teaching, enhancing student performance, and functionally developing the educational structure.The Smart Project Management system is beneficial for student project work through effective devices. IoT tools and digital technology offer different ideas for project development. Smart learning devices boost student thinking power, highlighting the impact of smart and connected products on project dimensions and providing recommendations to improve project stages. This changes the project environment, enhances structured product capabilities, standardizes project practices, and identifies essential project skills.The Smart Project Management system includes features for developing projects. IoT tools facilitate monitoring students during experimental practical sessions. Advanced project management features include collaboration with apps, software, and smart hardware devices. These connections between software algorithms and IoT devices, along with digitalization via the internet, provide better practical outputs. The essential feature is the use of a smart research lab for project practice, emphasizing the need for institutes to develop smart research labs for student project experiments.

Reference

1. Gul S, Asif M , Ahmad S, Yasir M, Majid M, Arshad S, (2017), "A Survey on Role of Internet of Things in Education", IJCSNS International Journal of Computer Science and Network Security, VOL.17 No.5.
2. Han W, (2011), "Research of Intelligent Campus System Based on IOT", The Impact of Visual Transcoder on self-similarity of Internet flow, Jin D and Lin S(Eds.): Advances in MSEC Vol. 1, AISC 128, © Springer-Verlag Berlin Heidelberg, pp. 165–169.
3. Itai A, Johnson M(2016), Internet of Things in Higher Education
4. Runathong W, Wongthai W, Panithansuwan1 S, (2017), "A System for Classroom Environment
5. Srinivas M(2019), IOT Elements, Kanetakar Y(2019), 21 IOT Experiments
6. Monitoring Using the Internet of Things and Cloud Computing", ICISA2017 Conference Paper, March 20th- 23rd, 2017 in Macau, China ,pp.732-742. Manikandan, G. and Anand, M. "Design of 128-Point FFT using Mixed Radix with Combined SDF-SDC Structure for OFDM Application", Journal of Engineering and Applied Sciences, vol. 12, no. 21, pp.5423-5428, 2017
7. Qi, Z.; Wang, T.; Chen, J.; Narang, D.; Wang, Y.; Yang, H. Learning-based Path Planning and Predictive Control for Autonomous Vehicles With Low-Cost Positioning. IEEE Trans. Intell. Veh. 2021, early access. [CrossRef]
8. Zhang, Z.; Wu, R.; Pan, Y.; Wang, Y.; Wang, Y.; Guan, X.; Hao, J.; Zhang, J.; Li, G. A Robust Reference Path Selection Method for Path Planning Algorithm. IEEE Robot. Autom. Lett. 2022, 7, 4837–4844. [CrossRef]
9. Kennedy, J.; Eberhart, R. Particle swarm optimization. In Proceedings of the ICNN'95-international conference on neural networks, Perth, WA, Australia, 27 November–1 December 1995; Volume 4, pp. 1942–1948.
10. Manikandan, G. and Anand, M. "Design of Low power Reconfiguration based modulation and demodulation for OFDM communication systems", International Journal of Applied Engineering Research, vol. 12, no. 14, pp. 4433-4442, 2017.
11. D. Sugumaran, Y. M. Mahaboob John, J. S. Mary C, K. Joshi, G. Manikandan and G. Jakka, "Cyber Defence Based on Artificial Intelligence and Neural Network Model in Cybersecurity," *2023 Eighth International Conference on Science Technology Engineering and Mathematics (ICONSTEM)*, Chennai, India, 2023, pp. 1-8, doi: 10.1109/ICONSTEM56934.2023.10142590 .
12. M. Kathikeyan, A. Roy, S. S. Hameed, P. R. Gedamkar, G. Manikandan and V. Kale, "Optimization System for Financial Early Warning Model Based on the Computational Intelligence and Neural Network Method," *2022 5th International Conference on Contemporary Computing and Informatics (IC3I)*, Uttar Pradesh, India, 2022, pp. 2059-2064, doi: 10.1109/IC3I56241.2022.10072848.

13. Ganesh Babu.R, P.Karthika, and Manikandan G "polynomial equation based localization and Recognition intelligent vehicles access using sensor in MANET" International conference on computational Intelligence and data science, Vol. 167, pp. 1281-1290, 2020

14. Ganesh Babu.R, G.Ramesh, and Manikandan G A survey of fog and cloud computing framework based on IoT signal solutions for secure communication, International Journal of Advanced Science and Technology. Vol 29, 6s,(2020), pp. 2473-2479.

15. Manikandan,G. and Anand, M. "Mixed Radix 4 & 8 based SDF-SDC FFT Using MBSLS for Efficient Area Reduction", Indian Journal of Public Health Research and Development,vol. 9, Issue 10, 2018.

16. R. Lakshmi and K. Karunanithi "Implementation of Three and Two Switch Inter- Leaved Forward Converters"., International Journal of Innovative Technology and Exploring Engineering (IJITEE) Vol.8 Issue12, October, pp. 5467-5471, 2019

17. R. Lakshmi and K. Karunanithi "Analysis and Implementation of Three and Two Switch Inter-Leaved Forward Converters"., Jour of Adv Research in Dynamical & Control Systems, Vol. 11, No. 8, pp. 78-85, 2019.

18. Mahajan, K ,Follicle Detection of Polycystic Ovarian Syndrome (PCOS) Using Yolo, 2023 9th International Conference on Advanced Computing and Communication Systems (ICACCS), Volume 1, Pages 1550-1558, https://doi.org/10.1109/ICACCS57279.2023

19. R. Lakshmi, Joseph Henry and K. Rajan "Comparison of Transient Responses of Two Switch and Three Switch Forward Converter Systems"., International Journal of Trend in Research and Development, Volume 4(6), Nov-Dec, 2017

20. Mahajan, K., & Gokhale, L. (2019, February 17). "Process of Data Visualization: Voyage from Data to Knowledge". International Journal of Computer Sciences and Engineering, Volume 7(2), Pages 57-63. 10.26438/ijcse/v7i2.5763

21. .R. Lakshmi, Joseph Henry and K. Rajan "Simulation and Implementation of the Three Switch Serial Input Interleaved Forward Converter"., International Journal of Pure and Applied Mathematics, Volume 119, No. 10, 1105-1115, 2018

22. Mahajan, K , Praggya Nigam (2023). A Study of Mapping of Impact of Temperature on Brain Waves" Journal of Biomechanical Science & Engineering, ISSN:1880-9863, Pages 162-171 DOI 10.17605/OSF.IO/TF8NC

23. R. Lakshmi, K. Karunanithi and P. Chandrasekar "Fuzzy logic control of two switch & three switch serial input interleaved forward converters", Indonesian Journal of Electrical Engineering and Computer Science, Vol.16, No.1, pp. 147-155, 2019 DOI:10.11591/ijeecs.v16.i1.pp147-155

24. Mahajan, K , Praggya Nigam (2023). A Study of Mapping of Impact of Temperature on Brain Waves" Journal of Biomechanical Science & Engineering, ISSN:1880-9863, Pages 162-171 DOI 10.17605/OSF.IO/TF8NC

25. R. Lakshmi, R Gomalavalli, N Ramesh Raju, and K Murali Kumar "Comparison of Transient Responses of Two Switch forward converter with sliding mode controller and HC-Fuzzy controller", Journal of Emerging Technologies and Innovative Research pp 277-287, January Volume 10, Issue 1, 2023.

26. Pawar, R., & Mahajan, K. (2017, March). Benefits and Issues in Managing Project by PRINCE2 Methodology. *International Journal of Advanced Research in Computer Science and SoftwareEngineering (IJARCSSE)*, Volume – 7, Issue – 3, 190-195.DOI:10.23956/ijarcsse/V7I3/0134

27. R Lakshmi, N Ramesh Raju, S Ramesh, K Murali Kumar,and V Mamatha "Performance of Induction Motor And BLDC Motor With Fuzzy Logic Controller For EV Applications", International Journal of Advance Research and Innovative Ideas in Education pp 217-224, Vol-9 Issue-4, 2023.

28. R Kavitha, M K Gupta, " Heat Transfer Enhancement in a Double Pipe Heat Exchanger with Copper Oxide Nanofluid: An Experimental Study"*Materials Today: Proceedings, ISSN 3446-3449, Vol. 56, pp. 3446-3449, 2022, https://doi.org/10.1016/j.matpr.2021.11.096*

29. BrahmduttBohra, Manoj Kumar Gupta, "Achieving uneven Clustering in Wireless Sensor Networks using Fuzzy Logic", *Materials Today: Proceedings, ISSN 3446-3449,* Vol. 51, pp. 2495-2499, 2022, https://doi.org/10.1016/j.matpr.2021.11.629

30. Manoj Kr Gupta "Analysis of Connecting Rod under Different Loading Condition Using ANSYS Software", *Design Engineering,ISSN 0011-9342*, Vol. 2021, Issue 5, 2021, pp. 619-627, 2021.

31. Manoj Kr Gupta, V K Bajpai, T K Garg,"Dynamic & Vibration Analysis of Stack: A Case Study,"*International Journal of Interdisciplinary Innovative Research & Development*, *ISSN 2456-236X*, Vol. 05, Issue 01, pp. 429-432, 2020.

32. Manoj Kr Gupta, V K Bajpai, T K Garg,'Mathematical Model to Predict the Plume Behavior under Abnormal Conditions in Indian Context', *International Journal of Grid and Distributed Computing, Italy*, *ISSN: 2348-2354,* Vol. 13, No. 1, pp. 2348-2354, 2020.

33. Manoj Kr Gupta, Vikrant Bansal, T K Garg,'Criteria for Fatigue Design of Steel Stacks: A Case Study', *Journal of Critical Reviews*,*ISSN: 2394-5195*, Vol. 7, pp. 3063-3072, 2020.doi: 10.31838/jcr.07.17.384

34. Manoj Kr Gupta, V K Bajpai, T K Garg,"Algorithm for Optimization of Design Parameters of Small Stacks",*International Journal of Management, Technology and Engineering*, *ISSN 2249-7455,* Vol. 9 (7), pp. 933-943, 2019.

35. Manoj Kr Gupta, V K Bajpai, T K Garg, "Latest Measures to Keep Chimneys in Step with plant Changes", '*International Journal of Engineering Research & Technology'*, *ISSN 2278-0181*, Vol. 3 (5), May 2014, pp. 333-336.

36. Manoj Kr Gupta, V K Bajpai, T K Garg,"Fatigue Design of Smoke Stacks",*International Journal on Design and Manufacturing Technologies, Chennai,ISSN 0973-9106*, Vol. 8 (1), pp. 21-26, 2014.

37. Manoj Kr Gupta, V K Bajpai, T K Garg,"Design of Smoke Stacks*", Journal of The Institution of Engineers (India), Calcutta*, *ISSN 0020-3408*, Vol. 91 (2), pp. 17-21, 2010.

38. Manoj Kr Gupta, V K Bajpai, T K Garg, "Design of Vibration-Dampers for Steel Chimneys with Latest Features",*International Journal on Design and Manufacturing Technologies, Chennai,ISSN 0973-9106*, Vol.3 (2), pp. 39-42, 2009.

39. Mahajan, K., & Gokhale, L. (2018, March). Comparative Study of Static and Interactive Visualization Approaches. International Journal on Computer Science and Engineering (IJCSE), 10(3). Volume 10, Issue 3, Pages 0975-3397 DOI:10.21817/ijcse/2018/v10i3/181003016

40. N. Madhumithaa, G. Manikandan, S. Kalaivany, R. Selvameena, P. K. Patjoshi and M. Aarif, "Stochastic Sequential Development of Supply Chain Management System and Performance Index in Dynamic Environment," *2022 5th International Conference on Contemporary Computing and Informatics (IC3I)*, Uttar Pradesh, India, 2022, pp. 2039-2043, doi: 10.1109/IC3I56241.2022.10072721.

41. A. N. Gnana Jeevan, K. Keerthika, S. Rao Terli, S. T. Naitik, K. G. S. Venkatesan and G. Manikandan, "A Novel Approach for Predicting wide range of traffic congestion using deep learning Technique," 2022 International Conference on Innovative Computing, Intelligent Communication and Smart Electrical Systems (ICSES), 2022, pp. 1-6, doi: 10.1109/ICSES55317.2022.9914313 .

42. B. S. Rao *et al.*, "A Novel Machine Learning Approach of Multi-omics Data Prediction," *2022 International Conference on Innovative Computing, Intelligent Communication and Smart Electrical Systems (ICSES)*, 2022, pp. 1-5, doi: 10.1109/ICSES55317.2022.991434. (IEEE Xplore, Scopus)

43. Manoj Kr Gupta, V K Bajpai, T K Garg,"Long-Term Structural Integrity of Steel Stacks: Proposed Tools for Inspection & Maintenance", *International Journal of Mechanical Engineering, N Delhi,ISSN 0974-5823*, Vol. 3 (1), pp 109-111, 2010.

44. Manoj Kr Gupta, V K Bajpai, T K Garg, "Optimization of Design Parameters of Steel Chimneys", *International Journal on Design and Manufacturing Technologies, Chennai,ISSN 0973-9106*, Vol. 4 (2), pp. 40-46, 2010.

45. Dr. Kirti Nilesh Mahajan & Niket P. Tajne. (2017). Transliteration of Indian Ancient Script to Braille Script using Pattern Recognition Technique: A Review. International Journal of Computer Applications, Volume – 975, Pages 8887, 33-38. DOI:10.5120/ijca2017914162

46. Mahajan, K," A Multi Perspective Analysis of Internationalization Strategies" (July 2023), World Journal of Management & Economics, ISSN: 1819-8643 (print), E-ISSN: 1998-1392 (online), Volume 16, Issue 1, Indexing ABDC Category Journal, https://wesro.org/volume-16-issue-01/

47. Kravcik M, Ullrich C, and Igel C, (2017), "The Potential of the Internet of Things for Supporting Learning and Training in the Digital Age", O. Zlatkin-Troitschanskaia et al. (Eds.), Book of Positive Learning in the Age of Information pp 399-412.

48. Perumal K and Manohar M, (2017), "A Survey on Internet of Things: Case Studies, Applications, and Future Directions", from book Internet of Things: Novel Advances and Envisioned Applications in Big Data 25, pp.281-297

49. Pervez S, Rehman S, Alandjani G, (2018), "Role Of Internet Of Things (IOT) In Higher Education", 4th International Conference on Advances in Education and Social Sciences, Istanbul, Turkey, ISBN: 978- 605-82433-4-7, pg no 792 – 800.

50. Raikar M, Desai P, Naragund J, (2016), "Active learning explored in Open elective course: Internet of Things (IOT)", 2016 IEEE 8th International Conference on Technology for Education, 978-1-5090-6115-0/16, pp 15-18