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Automatic Railway Horn System Using Node MCU

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Abstract

The Automatic Railway Horn System (ARHS) presented in this project employs techniques to dynamically adjust the frequency of the train horn based on various parameters such as train speed, proximity to crossings, and other safety considerations. Traditional railway horn systems often lack adaptability and may not adequately address changing environmental conditions. The proposed ARHS aims to enhance safety and minimize noise pollution by intelligently modulating the horn frequency in real-time. The system integrates sensors along the railway track to detect train movement, monitor proximity to crossings, and gather relevant environmental data. A microcontroller unit processes this information and executes an algorithm designed to determine the appropriate frequency modulation based on the inputs received. This algorithm considers factors such as train speed, distance to crossings, and time of day to dynamically adjust the horn frequency.

Keywords: Automatic, Railway, Node MCU, horn system, controller

INTRODUCTION

Railway crossings are critical points where the safety of both pedestrians and motorists intersects with the operation of trains. The traditional approach to warning systems at these crossings typically involves the use of fixed-tone horns, which lack adaptability and fail to adequately address varying environmental conditions and safety requirements [1-11]. Thus, the demand for more dynamic and adaptive solutions to improve safety and reduce noise pollution is urgent. A unique ID. Computer and physical environment need to be more closely connected as automation and artificial intelligence becomes widespread in industry. Tags are inserted into the item and transmit a captured ID to readers [12-17]. The readers can be placed at fixed positions within a chemical processing plant-based product, such as "goods out" or "goods in," and they will detect the ID of each item that passes by [18]. This project's Automatic Railway Horn System (ARHS) would be a major development in railway safety technology. By harnessing the principles of this system aims to dynamically adjust the frequency of the train horn in response to real-time parameters such as train speed, proximity to crossings, and surrounding environmental conditions. This adaptability allows for a more nuanced and effective warning signal, improving safety for pedestrians, motorists, and train operators alike [19-26]. In this introduction, we will provide an overview of the motivation behind the development of the ARHS, the challenges it seeks to address, and the objectives of the project. We will also outline the structure of the paper, highlighting the key components of the ARHS and the methodology employed in its design and implementation [27-38].

The system integrates sensors along the railway track to detect train movement, monitor proximity to crossings, and gather relevant environmental data. A microcontroller unit processes this information and executes an algorithm designed to determine the appropriate frequency modulation based on the inputs received. This algorithm considers factors such as train speed, distance to

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crossings, and time of day to dynamically adjust the horn frequency [39-46]. Overall, the ARHS represents a proactive approach to railway safety, leveraging advanced signal processing techniques to optimize horn output while minimizing noise pollution and enhancing situational awareness at railway crossings [47-55].

The primary use of the automatic rail horn systems is in railways. Crossings where they can give timely warnings to pedestrians and drivers. In densely crowded cities, automated horn systems may be of particular benefit. areas where railway crossings intersect with heavy vehicular and pedestrian traffic [56-63]. Automatic means of transport may be useful for railway lines passing through industrial zones. Horn systems to alert workers and vehicles to approaching trains.

NEED OF SYSTEM

At the intersection of two major concerns, there is a need for an automatic railway horn system: Community noise pollution and railway safety. The traditional manual operation of train horns at railway crossing, which is necessary to signal approaching trains and ensure safety compliance, often leads to excessive noise pollution for nearby residents. There are inherently high-risk areas at railway crossings, where trains cross the road and pose a possible danger to pedestrians, motorists Excessive noise from trains' horns may have adverse effects on the health and well-being of persons Individuals living in the vicinity of railway crossings. This exposure to loud noise has been lifelong linked to sleep disturbances, stress, and hearing impairments, highlighting the urgent need to address the problem of noise pollution.[64-67] One of the primary reasons for studying embedded systems in the context of cloud-based device control is the proliferation of IoT applications across diverse industries. Healthcare, transportation, agriculture, manufacturing, and smart cities are among the industries that use IoT devices revolutionizing operations, enabling predictive maintenance, optimizing resource utilization, and enhancing user experiences. To guarantee adherence to safety requirements and noise limits, railway authorities and regulatory agencies enforce stringent norms for the use of train horns. But manually enforcing these rules can be difficult and prone to human mistake. An automated approach not only streamlines compliance but also enables dynamic adaptation to changing regulatory requirements and environmental conditions, thereby ensuring consistent adherence to standards.

LITERATURE REVIEW

Railway crossings represent critical points of interaction between railway infrastructure and road traffic, posing significant safety challenges. Traditional horn systems utilized at these crossings often lack adaptability and may not effectively address varying environmental conditions and traffic situations. To address these challenges, researchers have explored the application of advanced signal processing techniques, such as in the design of Automatic Railway Horn Systems (ARHS).

This study proposes a smart railway crossing system that integrates Internet of Things (IoT) and Wireless Sensor Networks (WSN) to enhance safety and efficiency. The system incorporates sensors to detect train movement and proximity to crossings, with real-time data processing to trigger appropriate warning signals, including horn alerts. While not specifically focusing on FM modulation, the study highlights the importance of intelligent systems in railway safety. Jha et al. propose an intelligent railway level crossing system that utilizes microcontroller-based control units to manage warning signals. The system incorporates sensors to detect approaching trains and adjust warning signals accordingly. While not specifically implementing FM modulation, the study emphasizes the need for adaptable and responsive warning systems at railway crossings.

Researchers describe the design and development of an Arduino microcontroller-based automatic railway gate management system. The system employs sensor inputs to detect approaching trains and control gate operations accordingly. While not specifically addressing horn systems, the study highlights the significance of automated control mechanisms in railway safety. While the literature review indicates significant research interest in improving railway safety through automated systems, there is a gap in the exploration of Frequency Modulation (FM) techniques specifically for railway horn systems. This project aims to address this gap by developing an Automatic Railway Horn System (ARHS) utilizing modulation to provide a more adaptable and effective warning signal at railway crossings.

BLOCK DIAGRAM

The LCD 16×2, RF ID, buzzer, and Node MCU are the components shown in the block diagram in Figure 1. Overall, the block diagram depicts a system architecture where the NodeMCU serves as the central controller, interfacing with peripherals such as the LCD, RFID reader, and buzzer to enable user interaction, data processing, and device control functionalities.

CIRCUIT DIAGRAM:

Here The NodeMCU is connected to the LCD 16×2 display via GPIO pins for displaying system status and messages as shown in Figure 2. RFID reader is interfaced with the NodeMCU for user authentication. When a valid RFID card or tag is detected, the NodeMCU triggers the appropriate action, such as activating the horn system. The NodeMCU (Node Microcontroller Unit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, WiFi networking, and even an SDK and contemporary operating system. This makes it a fantastic option for any form of Internet of Things (IoT) project. The ESP8266 is difficult to access and use as a chip, though. For the most basic functions, like turning it on or sending a keystroke to the chip's "computer," you must solder wires with the proper analogue voltage to its pins. It must also be programmed using low-level machine instructions that the chip hardware can understand. Using the ESP8266 as an embedded controller chip in mass-produced devices does not present a challenge at this level of integration. For enthusiasts, hackers, or students wishing to experiment with it in their own Internet of Things projects, it is a major burden.

FLOW CHART

16×2 LCD is an Alphanumeric display that can show up to 32 characters on a single screen as shown in Figure 3. When you scroll the text one at a time, more characters are displayed. The I2C module is used to reduce the number of pins needed for this screen. It'll allow only four pins to be used for the display. All microcontroller boards, such as 8051, AVR, Arduino, can be used with an LCD display. The PIC and ARM Microcontrollers. To communicate more effectively with users, the majority of projects are requiring an LCD monitor.

IMPLICATION

Safety

Implementing an Automatic Railway Horn System using Frequency Modulation (FM) can result in an efficient and reliable warning system that enhances railway safety. Here's how the system could function and the potential benefits it offers: Enhanced Safety: The primary objective of the project is to enhance safety at railway crossings by developing railway horn system (ARHS) that dynamically adjusts the horn signal based on real time parameters such as train speed, proximity to crossings, and environmental conditions. The system aims to provide a more effective warning signal to pedestrians and motorists, thereby reducing the risk of accidents and improving overall safety.

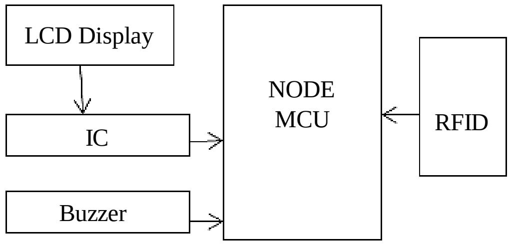

Figure 1. Block diagram of proposed system.

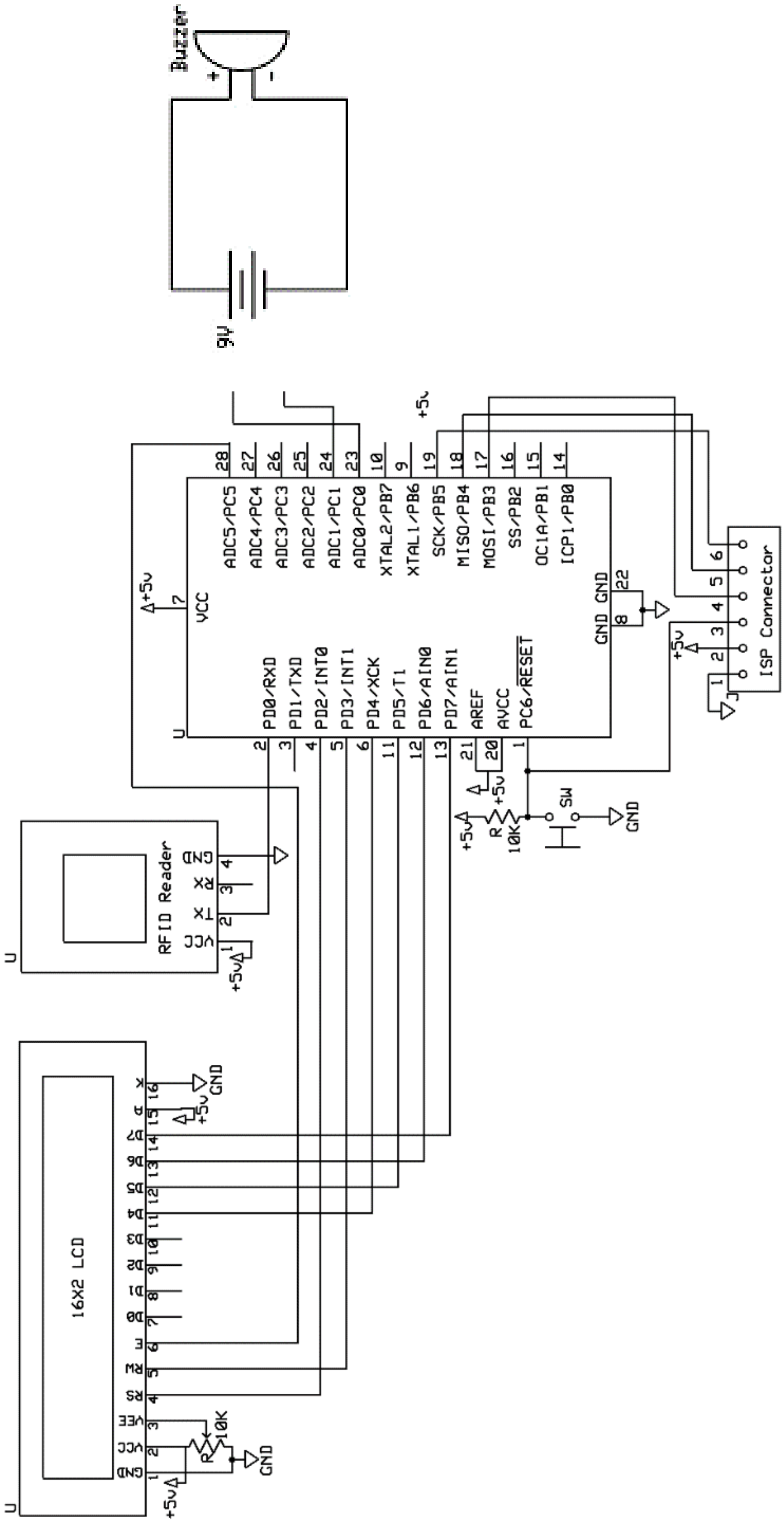

Figure 2. Circuit diagram of proposed system.

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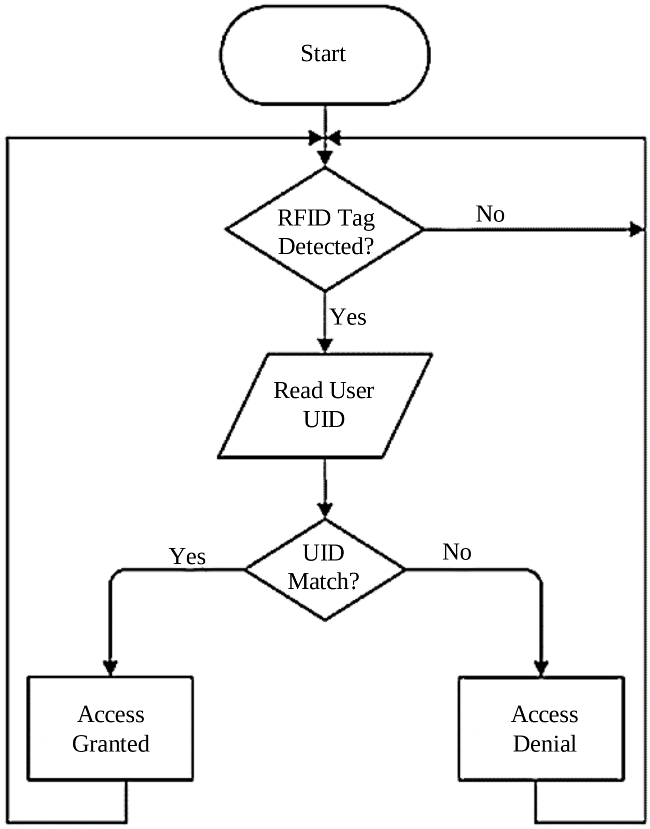

Figure 3. Flow chart of proposed system.

Noise Pollution Reduction

Another objective is to minimize noise pollution generated by traditional fixed-tone horn systems. By utilizing Frequency Modulation (FM) techniques, the ARHS can tailor the horn signal to the specific situation, producing a warning sound that is both effective and less intrusive to surrounding areas.

Feature Engineering: Conduct in-depth feature engineering to extract nuanced patterns from the text. Utilize techniques such as word frequency analysis, n-gram modeling, and semantic feature extraction to empower the model with a nuanced understanding of linguistic cues associated with fake news.

Adaptability

The project seeks to develop a highly adaptable system capable of integrating with existing railway infrastructure and adjusting its operation according to varying environmental factors and traffic conditions. This adaptability ensures that the ARHS remains effective across different railway networks and geographical locations.

RESULTS

Implementing an Automatic Railway Horn System is shown in Figure 4. Can result in an efficient and reliable warning system that enhances railway safety. Here's how the system could function:

Distance Measurement

The sensors calculate the distance to detected obstacles based on the time taken for ultrasonic Waves to reflect back.

Frequency Modulation

Depending on the measured distance, the system adjusts the frequency of the FM signal. Closer obstacles result in higher frequencies, while farther obstacles correspond to lower frequencies.

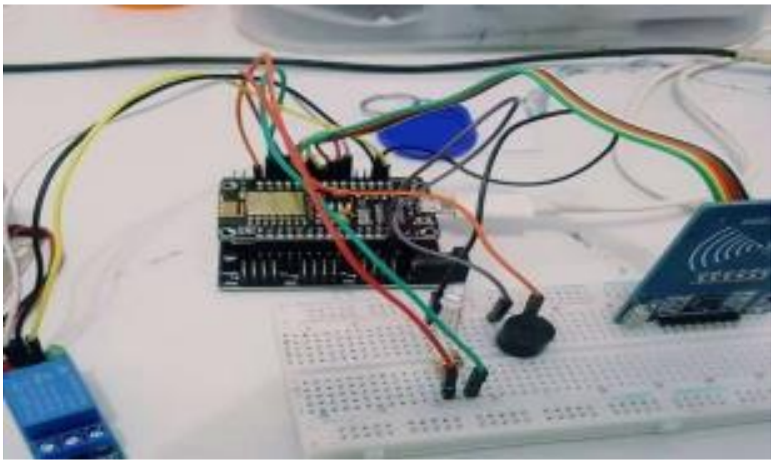

Figure 4. Implementation of system.

Audible Warning

As the train approaches obstacles, the changing frequency of the generates a dynamic warning sound. This sound alerts nearby individuals of the approaching train, improving safety. In remote or rural areas where manned crossings may not be feasible, automatic A cost effective solution for safety can be provided by horn systems.

CONCLUSION

To sum up, the installation of an Automatic Railway Horn System offers a potential option to improve railway protection. By integrating ultrasonic sensors, frequency modulation technology, and audio output systems, this approach offers several notable advantages:

1. The system provides real-time warnings to individuals on or near railway tracks, alerting them to the approach of a train well in advance.
2. Utilizing frequency modulation allows for the creation of warning signals that dynamically adjust based on the distance to obstacles Unlike traditional railway horns that emit continuous loud sounds, the FM-based system generates targeted warning signals, minimizing unnecessary noise pollution in the surrounding environment. By providing timely warnings to both pedestrians and vehicles about approaching trains, the system helps prevent accidents and collisions, thereby improving overall railway safety.

REFERENCES

1. Akshay D.R. Schneider Electric, Bangalore, K. Uma Rao, RV College of Engineering, Bangalore, “Low-Cost smart hand glove for Physically Challenged”, June 13,2011.
2. Ali, S. Munawwar, B. Nadeem, "Electronic Speaking Glove for Speechless Patients", August 2010.
3. N. P. Bhatti, A. Baqai, B. S. Chowdhry, M. A. Unar, “Electronic Hand Glove for Speech Impaired and Paralyzed Patients", EIR Magazine, May 2009.
4. M. Wald, "Captioning for Deaf and Hard of Hearing People by Editing Automatic Speech Recognition in Real Time", May 2017.
5. Swapnil Takale, and; Dr. Altaaf Mulani. (2022). DWT-PCA based Video Watermarking. Journal of Electronics, Computer Networking and Applied Mathematics (JECNAM). 2(06), 1–7.
6. Swapnil Takale, Dr. Altaaf Mulani, “Video Watermarking System”, International Journal for Research in Applied Science and; Engineering Technology (IJRASET),
7. Dr. Altaf Mulani Swapnil Takale, “A video watermarking technique with video and image as watermark using DWT and PCA” Journal of Northeastern University, Vol 25 Page No. 1005-3026, Volume 10, Issue III, Mar-2022.
8. Mulani, A. O., and; Mane, P. B. (2017). Watermarking and cryptography based image authentication on reconfigurable platform. Bulletin of Electrical Engineering and Informatics, 6(2), 181-187.

9. Deshpande, H. S., Karande, K. J., and; Mulani, A. O. (2014, April). Efficient implementation of AES algorithm on FPGA. In 2014 International Conference on Communication and Signal Processing (pp. 1895-1899). IEEE.
10. Swami, S. S., and; Mulani, A. O. (2017, August). An efficient FPGA implementation of discrete wavelet transform for image compression. In 2017 International Conference on Energy, Communication, Data Analytics and Soft Computing (ICECDS) (pp. 3385-3389). IEEE.
11. Mane, P. B., and; Mulani, A. O. (2018). High speed area efficient FPGA implementation of AES algorithm. International Journal of Reconfigurable and Embedded Systems, 7(3), 157-165.
12. Kulkarni, P. R., Mulani, A. O., and; Mane, P. B. (2017). Robust invisible watermarking for image authentication. In Emerging Trends in Electrical, Communications and Information Technologies: Proceedings of ICECIT-2015(pp. 193-200). Springer Singapore.
13. Mulani, A. O., and; Mane, P. B. (2016). Area efficient high speed FPGA based invisible watermarking for image authentication. Indian journal of Science and Technology.
14. Kashid, M. M., Karande, K. J., and; Mulani, A. O. (2022, November). IoT-based environmental parameter monitoring using machine learning approach. In Proceedings of the International Conference on Cognitive and Intelligent Computing: ICCIC 2021, Volume 1 (pp. 43-51). Singapore: Springer Nature Singapore.
15. Mulani, A. O., and; Mane, D. P. (2017). An Efficient implementation of DWT for image compression on reconfigurable platform. International Journal of Control Theory and Applications, 10(15), 1-7.
16. Mandwale, A. J., and; Mulani, A. O. (2015, January). Different Approaches for Implementation of Viterbi decoder on reconfigurable platform. In 2015 International Conference on Pervasive Computing (ICPC) (pp. 1-4). IEEE.
17. Nagane, U. P., and; Mulani, A. O. (2021). Moving object detection and tracking using Matlab. Journal of Science and Technology, 6, 86-89.
18. Jadhav, M. M. et al (2021). Machine learning based autonomous fire combat turret. Turkish Journal of Computer and Mathematics Education (TURCOMAT), 12(2), 2372-2381.
19. Mane, D. P., and; Mulani, A. O. (2019). High throughput and area efficient FPGA implementation of AES algorithm. International Journal of Engineering and Advanced Technology, 8(4).
20. Mulani, A. O., and; Shinde, G. N. (2021). An approach for robust digital image watermarking using DWT-PCA. Journal of Science and Technology, 6(1).
21. Shinde, G., and; Mulani, A. (2019). A robust digital image watermarking using DWT-PCA. International Journal of Innovations in Engineering Research and Technology, 6(4), 1-7.
22. Kalyankar, P. A., Mulani, A. O., Thigale, S. P., Chavhan, P. G., and; Jadhav, M. M. (2022). Scalable face image retrieval using AESC technique. Journal of Algebraic Statistics, 13(3), 173-176.
23. Kulkarni, P., and; Mulani, A. O. (2015). Robust invisible digital image watermarking using discrete wavelet transform. International Journal of Engineering Research and; Technology (IJERT), 4(01), 139-141.
24. Mulani, A. O., and; Mane, D. P. (2018). Secure and area efficient implementation of digital image watermarking on reconfigurable platform. International Journal of Innovative Technology and Exploring Engineering, 8(2), 56-61.
25. Deshpande, H. S., Karande, K. J., and Mulani, A. O. (2015, April). Area optimized implementation of AES algorithm on FPGA. In 2015 International Conference on Communications and Signal Processing (ICCSP) (pp. 0010-0014). IEEE.
26. Ghodake, M. R. G., and; Mulani, M. A. (2016). Sensor based automatic drip irrigation system. Journal for Research, 2(02).
27. Mulani, A. O., and; Mane, P. B. (2019). High-Speed area-efficient implementation of AES algorithm on reconfigurable platform. Computer and Network Security, 119.
28. Mulani, A. O., and; Mane, P. B. (2014, October). Area optimization of cryptographic algorithm on less dense reconfigurable platform. In 2014 International Conference on Smart Structures and Systems (ICSSS) (pp. 86-89). IEEE.

29. Takale, S., and; Mulani, A. (2022). DWT-PCA Based Video Watermarking. Journal of Electronics, Computer Networking and Applied Mathematics (JECNAM) ISSN, 2799-1156.
30. Patale, J. P., Jagadale, A. B., Mulani, A. O., and; Pise, A. (2023). A Systematic survey on Estimation of Electrical Vehicle. Journal of Electronics, Computer Networking and Applied Mathematics (JECNAM) ISSN, 2799-1156.
31. Mulani, A. O., Jadhav, M. M., and; Seth, M. (2022). Painless machine learning approach to estimate blood glucose level with non-invasive devices. In Artificial Intelligence, Internet of Things (IoT) and Smart Materials for Energy Applications (pp. 83-100). CRC Press.
32. Kondekar, R. P., and; Mulani, A. O. (2017). Raspberry Pi based voice operated Robot. International Journal of Recent Engineering Research and Development, 2(12), 69-76.
33. Maske, Y., Jagadale, A. B., Mulani, A. O., and; Pise, A. C. (2023). Development of BIOBOT System to Assist COVID Patient and Caretakers. European Journal of Molecular and Clinical Medicine, 3472-3480.
34. Maske, Y., Jagadale, M. A., Mulani, A. O., and; Pise, M. A. (2021). Implementation of BIOBOT System for COVID Patient and Caretakers Assistant Using IOT. International Journal of Information Technology and;Amp, 30-43.
35. Jadhav, H. M., Mulani, A., and; Jadhav, M. M. (2022). Design and development of chatbot based on reinforcement learning. Machine Learning Algorithms for Signal and Image Processing, 219-229.
36. Gadade, B., and; Mulani, A. (2022). Automatic System for Car Health Monitoring. International Journal of Innovations in Engineering Research and Technology, 57-62.
37. Kamble, A., and; Mulani, A. O. (2022). Google assistant based device control. Int. J. of Aquatic Science, 13(1), 550-555.
38. Mandwale, A., and; Mulani, A. O. (2015, January). Different Approaches for Implementation of Viterbi decoder. In IEEE International Conference on Pervasive Computing (ICPC).
39. Mulani, A. O., Jadhav, M. M., and; Seth, M. (2022). Painless Non-invasive blood glucose concentration level estimation using PCA and machine learning. The CRC Book entitled Artificial Intelligence, Internet of Things (IoT) and Smart Materials for Energy Applications. Internet of Things (IoT) and Smart Materials for Energy Applications.
40. Boxey, A., Jadhav, A., Gade, P., Ghanti, P., and; Mulani, A. O. (2022). Face Recognition using Raspberry Pi. Journal of Image Processing and Intelligent Remote Sensing (JIPIRS) ISSN 2815-0953.
41. Takale, S., and; Mulani, D. A. Video Watermarking System. International Journal for Research in Applied Science and; Engineering Technology (IJRASET), 10.
42. Shinde, M. R. S., and; Mulani, A. O. (2015). Analysisof Biomedical Image Using Wavelet Transform. International Journal of Innovations in Engineering Research and Technology, 2(7), 1-7.
43. Mandwale, A., and; Mulani, A. O. (2014, December). Implementation of Convolutional Encoder and; Different Approaches for Viterbi Decoder. In IEEE International Conference on Communications, Signal Processing Computing and Information technologies.
44. Ghodake, R. G., and; Mulani, A. O. (2018). Microcontroller Based Automatic Drip Irrigation System. In Techno-Societal 2016: Proceedings of the International Conference on Advanced Technologies for Societal Applications (pp. 109-115). Springer International Publishing.
45. Mulani, A. O., and; Mane, P. B. (2016), "Fast and Efficient VLSI Implementation of DWT for Image Compression", International Journal of Control Theory and Applications, 9(41), pp.1006-1011.
46. Shinde, R., and; Mulani, A. O. (2015). Analysis of Biomedical Image‖. International Journal on Recent and; Innovative trend in technology (IJRITT).
47. Patale, J. P., Jagadale, A. B., Mulani, A. O., and; Pise, A. (2022). Python Algorithm to Estimate Range of Electrical Vehicle. Telematique, 7046-7059.
48. Utpat, V. B., Karande, D. K., and; Mulani, D. A. Grading of Pomegranate Using Quality Analysis‖. International Journal for Research in Applied Science and; Engineering Technology (IJRASET), 10.

49. Mulani, A. O., Jadhav, M. M., and; Seth, M. (2022). Painless Non-invasive blood glucose concentration level estimation using PCA and machine learning. The CRC Book entitled Artificial Intelligence, Internet of Things (IoT) and Smart Materials for Energy Applications.
50. Mandwale, A., and; Mulani, A. O. (2016). Implementation of High Speed Viterbi Decoder using FPGA. International Journal of Engineering Research and; Technology(IJERT.
51. Kambale, A. (2023). Home automation using google assistant. UGC care approved journal, 32(1).
52. Sawant, R. A., and; Mulani, A. O. Automatic PCB Track Design Machine. International Journal of Innovative Science and Research Technology, 7(9).
53. Abhangrao, M. R., Jadhav, M. S., Ghodke, M. P., and; Mulani, A. Design And Implementation Of 8-bit Vedic Multiplier. JournalNX, 24-26.
54. Seth, M. (2022). Painless Machine learning approach to estimate blood glucose level of Non-Invasive device. Artificial Intelligence, Internet of Things (IoT) and Smart Materials for Energy Applications.
55. Korake, D. M., and; Mulani, A. O. (2016). Design of Computer/Laptop Independent Data transfer system from one USB flash drive to another using ARM11 processor. International Journal of Science, Engineering and Technology Research.
56. Mulani, A. O., Birajadar, G., Ivković, N., Salah, B., and; Darlis, A. R. (2023). Deep learning based detection of dermatological diseases using convolutional neural networks and decision trees. Treatment du Signal, 40(6), 2819-2825.
57. Pathan, A. N., Shejal, S. A., Salgar, S. A., Harale, A. D., and; Mulani, A. O. (2022). Hand Gesture Controlled Robotic System. Int. J. of Aquatic Science, 13(1), 487-493.
58. Dr. Altaf O. Mulani. (2024). A Comprehensive Survey on Semi-Automatic Solar-Powered Pesticide Sprayers for Farming. Journal of Energy Engineering and Thermodynamics (JEET) ISSN 2815-0945, 4(02), 21–28. https://doi.org/10.55529/jeet.42.21.28
59. Sandeep Kedar and A. O. Mulani (2024), IoT Based Soil, Water and Air Quality Monitoring System for Pomegranate Farming, NATURALISTA CAMPANO, Vol. 28, Issue 1.
60. Bhanudas Gadade, A O Mulani and A.D.Harale (2024). IOT Based Smart School Bus and Student Monitoring System. NATURALISTA CAMPANO, Vol. 28, Issue 1.
61. Anil Dhanawade, A. O Mulani and Anjali. C. Pise. (2024). Smart farming using IOT based Agri BOT. NATURALISTA CAMPANO, Vol. 28, Issue 1.
62. Dr. Shweta Sadanand Salunkhe and Dr. Altaf O. Mulani. (2024). Solar Mount Design Using High-Density Polyethylene. NATURALISTA CAMPANO, Vol. 28, Issue 1.
63. Sarda, M., Deshpande, B., Deo, S., & Karanjkar, R. (2018). A comparative study on Maslow’s theory and Indian Ashrama system.”. International Journal of Innovative Technology and Exploring Engineering, 8(2), 48-50.
64. Deo, S., and; Deo, S. (2019). Cybersquatting: Threat to domain name. International Journal of Innovative Technology and Exploring Engineering, 8(6), 1432-1434.
65. Shambhavee, H. M. (2019). Cyber-Stalking: Threat to People or Bane to Technology. International Journal on Trend in Scientific Research and Development, 3(2), 350-355.
66. Deo, S., and; Deo, D. S. (2019). Domain name and its protection in India. International Journal of Recent Technology and Engineering.
67. Sarda, M., Deshpande, B., Deo, S., and ; Pathak, M. A. (2018). Intellectual Property And Mechanical Engineering-A Study Emphasizing The Importance Of Knowledge Of Intellectual Property Rights Amongst Mechanical Engineers. International Journal of Social Science and Economic Research, 3(12), 6591-6596.

