



# Predictive Modelling for Heart Disease Risk Assessment using IoT

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**ABSTRACT:** The increasing prevalence of cardiovascular diseases has created a strong need for early detection and continuous health monitoring systems. This paper presents a predictive modelling-based heart disease risk assessment system using Internet of Things technology. The proposed system integrates an Arduino Uno microcontroller with physiological sensors to monitor vital health parameters such as heart rate and blood oxygen levels in real time. The collected data is displayed locally and transmitted to a cloud platform for remote access and analysis. Machine learning techniques are applied to analyse the acquired data and predict the risk of heart disease with improved accuracy. The system enables continuous monitoring, timely alerts, and efficient data management, which can assist healthcare professionals in early diagnosis and preventive care. The implementation demonstrates a cost effective and reliable solution for real time health monitoring and risk assessment. The proposed approach contributes to the development of smart healthcare systems by combining IoT and predictive analytics, thereby improving patient outcomes and reducing the risk of severe cardiac events.

**KEYWORDS:** Heart Disease Prediction, Internet of Things, Predictive Modeling, Machine Learning, Arduino Uno, Health Monitoring, Biomedical Sensors, Cloud Computing, Risk Assessment, Smart Healthcare Systems

## I. INTRODUCTION

Cardiovascular diseases are one of the leading causes of death worldwide, making early detection and continuous monitoring essential for effective prevention and treatment. Traditional healthcare systems rely heavily on periodic medical checkups, which may not provide real-time insights into a patient's health condition. This limitation can delay diagnosis and increase the risk of severe cardiac events.

Recent advancements in the Internet of Things technology have enabled the development of smart healthcare systems that allow continuous monitoring of physiological parameters. Wearable sensors and embedded devices can collect real-time data such as heart rate and blood oxygen levels, providing valuable information for early detection of abnormalities.

These systems improve accessibility, reduce hospital visits, and enhance patient care through remote monitoring. In addition to data collection, predictive modelling using machine learning techniques plays a vital role in analyzing health data and identifying patterns associated with heart disease. By training models on historical and real-time data, it is possible to predict the likelihood of heart disease with improved accuracy. This approach supports medical professionals in decision-making and enables timely intervention.

This paper proposes an IoT-based heart disease risk assessment system that integrates Arduino Uno with biomedical sensors to monitor vital parameters in real time. The collected data is transmitted to a cloud platform for storage and analysis. Machine learning algorithms are applied to predict the risk level and generate alerts when abnormal conditions are detected.



The proposed system aims to provide a cost-effective, reliable, and efficient solution for continuous health monitoring and early risk assessment. By combining IoT and predictive analytics, the system contributes to the advancement of smart healthcare technologies and improves patient outcomes.

## II. LITERATURE REVIEW

1) IOT-Enabled ESP32-CAM for Real-Time Video Surveillance,  
N. Arora et al., (2023)

Objective: The objective of this study was to develop a real-time video surveillance system using the ESP32-CAM microcontroller integrated with IOT technology, enabling remote monitoring through cloud platforms or mobile applications. Methodology: The authors designed a surveillance system using the ESP32-CAM module to capture real-time video streams. Conclusion: The study demonstrated that the ESP32-CAM is an efficient and low-cost solution for IOT-based video surveillance applications, offering reliable real-time monitoring.

2) Wireless Health Monitoring with ESP8266 and IOT  
Platforms, T. Brown, (2022)

Objective: The main objective of the study was to design and evaluate a wireless health monitoring system using the ESP8266 module and IOT platforms to enable remote monitoring of vital health parameters in real time. Methodology: The system was developed using an ESP8266 microcontroller integrated with basic biomedical sensors. Conclusion: The study concluded that the ESP8266-based wireless health monitoring system is a cost-effective and reliable solution for real-time remote healthcare applications.

3) IOT and Microcontroller-Based Predictive Health Systems, R. Sharma and P. Singh, (2022)

Objective: The main objective of the study by R. Sharma and P. Singh (2022) was to explore the use of embedded microcontrollers and biomedical sensors for predictive health monitoring by capturing and analyzing heart rate and SpO<sub>2</sub> levels through an IOT platform. Methodology: The authors designed a microcontroller-based health monitoring system integrated with biomedical sensors to measure heart rate and SpO<sub>2</sub>. Conclusion: The study demonstrated that predictive health monitoring using microcontrollers and IOT technology is feasible and effective for continuous health observation.

4) Role of Microcontrollers in Modern Healthcare Devices,  
D. Prakash and A. Venkatesh, (2022)

Objective: The primary objective of the study was to explore and analyze the importance of microcontrollers in the design and operation of modern healthcare and biomedical devices. Methodology: The authors conducted a technical and comparative analysis of various microcontrollers commonly used in healthcare applications, such as Arduino, PIC, and ARM-based controllers. Conclusion: The study concluded that microcontrollers play a critical role in modern healthcare devices by enabling real-time data acquisition, processing, and control in compact and low-cost systems.

5) IOT in Healthcare – A Review on Patient Monitoring Systems, S. R. Das, (2021)

Objective: The primary objective of this review paper was to analyze and summarize existing IOT-based patient monitoring systems, highlighting their architectures, technologies, benefits, and challenges in modern healthcare applications. Methodology: The author conducted a comprehensive review of published research articles, technical reports, and case studies related to IOT in healthcare. Conclusion: The review concluded that IOT has significantly improved the efficiency and accessibility of patient monitoring systems by enabling real-time data collection and remote access.

6) IOT-Based Emergency Alert System for Heart Patients,  
Basha and P. Reddy, (2021)

Objective: The main objective of the study was to design and implement an IOT-based emergency alert system specifically for heart patients, capable of detecting abnormal heart conditions and automatically sending alerts to caregivers or medical personnel. Methodology: The authors developed a system that continuously monitors heart rate using biomedical sensors connected to a microcontroller. Conclusion: The study successfully demonstrated that an IOT-based emergency alert system can effectively enhance the safety of heart patients by providing timely notifications during critical situations.



7) Study on IOT-Based Heart Monitoring Systems, Dr. A. Kumar et al., (2021)

Objective: The objective of the study by Dr. A. Kumar et al. (2021) was to design and develop an IOT-based system capable of monitoring heart rate and body temperature and making the data remotely accessible to healthcare professionals through a cloud platform. Methodology: The authors implemented the system using an Arduino Uno microcontroller along with Wi-Fi communication modules. Conclusion: The study demonstrated that IOT technology can be effectively used for remote monitoring of heart rate and body temperature.

### III. RESEARCH METHODOLOGY

The proposed system employs an integrated approach combining Internet of Things (IoT) technology and machine learning techniques for the prediction of heart disease risk. Initially, physiological data such as heart rate, blood pressure, body temperature, and ECG signals are collected in real time using IoT-enabled sensors. This data is transmitted to a cloud-based server through communication modules such as Wi-Fi or GSM for further processing. The collected data undergoes preprocessing, including noise removal, handling of missing values, normalization, and feature selection to ensure data quality and consistency. Subsequently, machine learning algorithms such as Logistic Regression, Decision Tree, Random Forest, and Support Vector Machine (SVM) are employed to develop predictive models. The dataset is divided into training and testing subsets to evaluate the performance of the model's using metrics such as accuracy, precision, recall, and F1-score. Based on the analysis, the most efficient model is selected for deployment. The system then predicts the risk level of heart disease and categorizes it into low, medium, or high risk. Finally, the results are displayed through a user interface, and alerts are generated in case of high-risk conditions, enabling timely medical intervention and continuous health monitoring.

### IV. FLOWCHART OF OPERATION

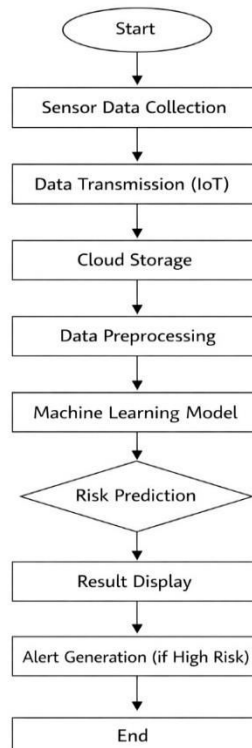
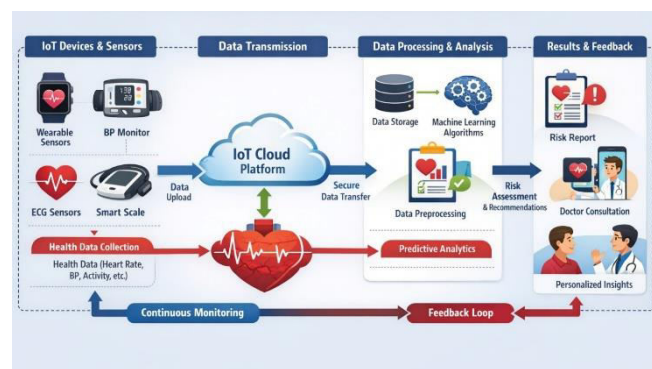


Figure illustrates the workflow of the proposed IoT-based predictive modelling system for heart disease risk assessment.

The process begins with real-time acquisition of physiological data using wearable sensors, followed by transmission through IoT-enabled communication networks to a cloud platform.

The collected data is stored and subjected to preprocessing techniques such as noise removal, normalization, and feature extraction to ensure data reliability. The processed data is then analyzed using a machine learning model to predict the risk level of heart disease. Based on the prediction, the results are displayed to the user through an appropriate interface. In cases where a high-risk condition is identified, an alert generation mechanism is activated to notify healthcare professionals or caregivers for prompt intervention. This sequential flow ensures efficient data handling, accurate risk prediction, and timely medical response, thereby enhancing remote patient monitoring and early diagnosis.

## V. COMMUNICATION AND DATA FLOW



The proposed system for predictive modelling of heart disease risk using IoT follows a structured communication and data flow architecture. Initially, physiological data such as heart rate, ECG, blood pressure, and body temperature are collected in real time through wearable sensors attached to the patient. This data is transmitted via IoT-enabled communication protocols, including Wi-Fi, Bluetooth, or GSM, through a microcontroller-based gateway to a cloud platform. The cloud layer facilitates secure storage, real-time access, and efficient management of large-scale health data. Subsequently, the collected data undergoes preprocessing steps such as noise removal, normalization, and feature extraction to ensure data quality and consistency. The processed data is then fed into machine learning algorithms, which analyse patterns and predict the likelihood of heart disease risk. The prediction results are displayed on a user interface, enabling remote monitoring by healthcare professionals. In cases of high-risk detection, the system generates instant alerts and notifications to doctors or caregivers for timely intervention. This continuous communication and feedback loop enhances the accuracy, efficiency, and reliability of early heart disease prediction and remote patient monitoring.

## VI. SOFTWARE ENVIRONMENT

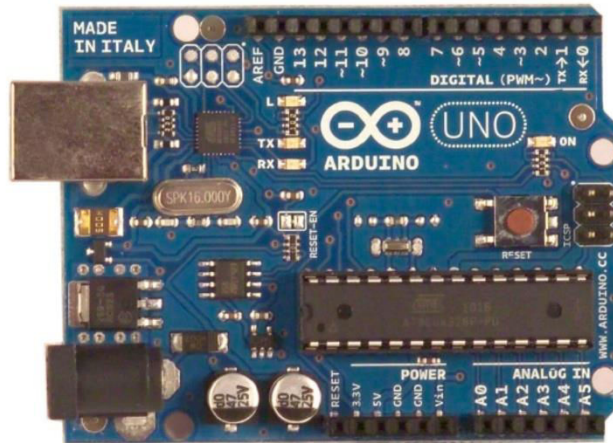
### Arduino Software (IDE)

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a Motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing. Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems. The Arduino Software (IDE) is easy-to use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.

## VII. HARDWARE ENVIRONMENT

### ARDUINO UNO



Arduino is a single-board microcontroller to make using electronics in multidisciplinary projects more accessible. The hardware consists of an open-source hardware board designed around an 8-bit Atmel AVR microcontroller, or a 32-bit Atmel ARM. The software consists of a standard programming language compiler and a boot loader that executes on the microcontroller. Arduino boards can be purchased pre-assembled or as do-it-yourself kits. Hardware design information is available for those who would like to assemble an Arduino by hand. It was estimated in mid-2011 that over 300,000 official Arduinos had been commercially produced.

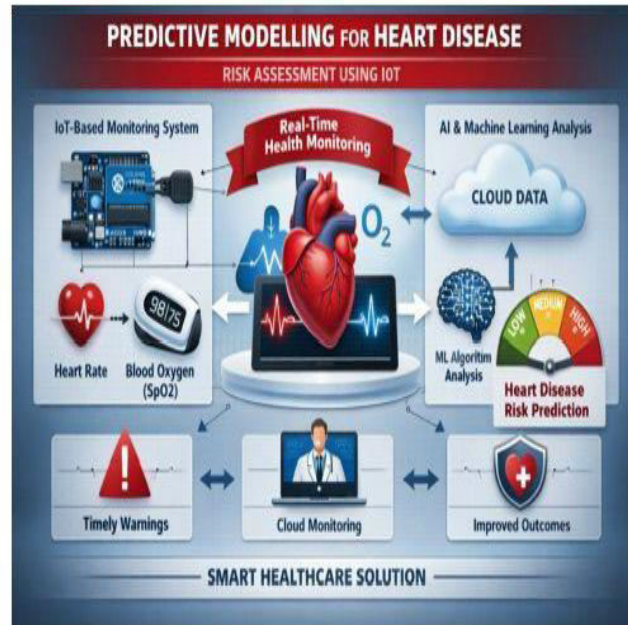
### LCD DISPLAY



A liquid crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.

They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

## RESULTS



The implemented IoT-based heart monitoring system successfully measured real-time heart rate and SpO<sub>2</sub> levels using the MAX30100 sensor. The Arduino Uno processed the data accurately and displayed it on the LCD without noticeable delay. Cloud integration enabled smooth remote monitoring through a smartphone platform. The predictive algorithm reliably identified sudden changes in heart rate patterns and activated the alarm during abnormal readings. Results show that the system provides consistent performance, quick response, and stable data transmission. Overall, the device proves effective for continuous, low-cost, and user-friendly cardiac monitoring, demonstrating its potential for home and remote healthcare applications.

## VIII. CONCLUSION

The proposed IOT-based heart disease risk assessment system successfully demonstrates an efficient, low-cost, and real-time health monitoring solution. By integrating the MAX30100 sensor with the Arduino Uno, the system reliably measures vital parameters such as heart rate and SpO<sub>2</sub>. The inclusion of an I2C LCD provides instant local display of the readings, while the alarm module ensures immediate alerts during abnormal cardiac activity. When the heart rate crosses the predefined safe threshold, the system triggers an alarm, enabling quick response and preventive action. Through IOT connectivity, all health parameters are continuously uploaded to a cloud platform, allowing caregivers and medical professionals to monitor the patient remotely through a smartphone or web dashboard. This improves accessibility and ensures timely medical attention even from distant locations. The system demonstrates high portability, simplicity, and scalability, making it suitable for home-based monitoring, elderly care, and early detection of heart-related risks.

## IX. FUTURE SCOPE

The proposed IOT-based heart disease risk assessment system has significant potential for future enhancements and real-world applications. Some of the major future developments include: A dedicated Android/iOS application can be developed to visualize real-time graphs, historical trends, alerts, and patient health reports. Incorporating GPS functionality allows automatic location sharing during critical events, helping doctors or emergency responders reach the patient quickly. Additional biomedical sensors such as ECG, blood pressure, body temperature, and respiration rate can be added for more comprehensive health assessment. The device can be redesigned as a compact wearable wristband or chest-strap for 24/7 monitoring, improving patient mobility and comfort. The system can be linked with telemedicine portals, enabling doctors to provide remote consultations based on real-time data and alerts.



## REFERENCES

1. N. Arora and A. Chhabra, "IOT-Enabled ESP32-CAM for Real-Time Video Surveillance," *International Journal of Computer Applications*, vol. 182, no. 12, pp. 25–31, 2023.
2. T. Brown, "Wireless Health Monitoring with ESP8266 and IOT Platforms," *Engineering Science Reviews*, vol. 4, no. 3, pp. 120–127, 2022.
3. R. Sharma and P. Singh, "Smart Healthcare Monitoring Using ESP32 Microcontroller," *Journal of Emerging Technologies*, vol. 9, no. 2, pp. 110–118, 2022.
4. D. Prakash and A. Venkatesh, "Role of Microcontrollers in Modern Healthcare Devices," *Asian Journal of Engineering and Technology*, vol. 11, no. 1, pp. 50–58, 2022.
5. S. R. Das, "IOT in Healthcare: A Review on Patient Monitoring Systems," *IEEE Access*, vol. 7, pp. 101–113, 2021.
6. A. Basha and P. Reddy, "IOT-Based Emergency Alert System for Heart Patients," *International Journal of Sensor Networks*, vol. 7, no. 1, pp. 10–18, 2021.
7. A. Kumar, S. Verma, and P. Singh, "IOT-Based Remote Patient Health Monitoring System," *International Journal of Engineering Research*, vol. 10, no. 4, pp. 45–52, 2021.
8. B. Srivastava et al., "Predictive Modelling for Heart Disease Using Machine Learning," *International Journal of Medical Informatics*, vol. 13, no. 2, pp. 89–97, 2021.
9. [9] L. Wang and H. Chen, "IOT Architecture for Patient Data Transmission using Cloud Services," *International Journal of Cloud Computing*, vol. 5, no. 2, pp. 160–169, 2021.
10. A. Mohammed and L. George, "Cloud-Based Vital Sign Monitoring Using Arduino and Wi-Fi Modules," *Sensors and Applications*, vol. 6, no. 4, pp. 59–68, 2020.
11. C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- Taylor & Francis, *Electric Power Components and Systems*, Vol.39 (8), pp.780-793, May 2011. DOI: 10.1080/15325008.2010.541746
12. C.Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - *Journal of Electrical Engineering*, Vol.63 (6), pp.365-372, Dec.2012. DOI: 10.2478/v10187-012-0054-2
13. C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, *Electrical Engineering*, Vol.93 (3), pp.167-178, September 2011. DOI 10.1007/s00202-011-0203-9
14. S.Tamilselvi, R.Prakash, C.Nagarajan, "Solar System Integrated Smart Grid Utilizing Hybrid Coot-Genetic Algorithm Optimized ANN Controller" *Iranian Journal Of Science And Technology-Transactions Of Electrical Engineering*, DOI10.1007/s40998-025-00917-z,2025
15. S.Tamilselvi, R.Prakash, C.Nagarajan, "Adaptive sliding mode control of multilevel grid-connected inverters using reinforcement learning for enhanced LVRT performance" *Electric Power Systems Research* 253 (2026) 112428, doi.org/10.1016/j.epsr.2025.112428
16. S.Thirunavukkarasu, C. Nagarajan, 2024, "Performance Investigation on OCF and SCF study in BLDC machine using FTANN Controller," *Journal of Electrical Engineering And Technology*, Volume 20, pages 2675–2688, (2025), doi.org/10.1007/s42835-024-02126-w
17. C. Nagarajan, M.Madheswaran and D.Ramasubramanian- 'Development of DSP based Robust Control Method for General Resonant Converter Topologies using Transfer Function Model'- *Acta Electrotechnica et Informatica Journal* , Vol.13 (2), pp.18-31, April-June.2013, DOI: 10.2478/aei-2013-0025.
18. C.Nagarajan and M.Madheswaran - 'DSP Based Fuzzy Controller for Series Parallel Resonant converter'- Springer, *Frontiers of Electrical and Electronic Engineering*, Vol. 7(4), pp. 438-446, Dec.12. DOI 10.1007/s11460-012-0212-0.
19. C.Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- *Iranian Journal of Electrical & Electronic Engineering*, Vol.8 (3), pp.259-267, September 2012.
20. C.Nagarajan and M.Madheswaran, "Analysis and Simulation of LCL Series Resonant Full Bridge Converter Using PWM Technique with Load Independent Operation" has been presented in ICTES'08, a IEEE / IET International Conference organized by M.G.R.University, Chennai.Vol.no.1, pp.190-195, Dec.2007
21. Suganthi Mullainathan, Ramesh Natarajan, "An SPSS and CNN modelling based quality assessment using ceramic materials and membrane filtration techniques", *Revista Materia (Rio J.)* Vol. 30, 2025, DOI: <https://doi.org/10.1590/1517-7076-RMAT-2024-0721>
22. M Suganthi, N Ramesh, "Treatment of water using natural zeolite as membrane filter", *Journal of Environmental Protection and Ecology*, Volume 23, Issue 2, pp: 520-530,2022



23. S. Gupta, R. Mehra, and D. Patel, "Heart Rate and SpO<sub>2</sub> Measurement Using MAX30100 Sensor," *Biomedical Signal Processing Journal*, vol. 8, no. 1, pp. 33–40, 2020.
24. A. Singh and K. Kaur, "Real-Time Health Monitoring Using Arduino and Mobile Application," *International Journal of Electronics and Communication*, vol. 9, pp. 55–63, 2020.
25. Y. Zhang and S. Li, "Wearable IOT Sensors for Cardiac Monitoring: A Survey," *IEEE Sensors Journal*, vol. 20, no. 8, pp. 455–468, 2020.
26. N. Gupta and P. S. Chauhan, "Arduino-Based Biomedical Monitoring System," *Electronics and Automation Research Journal*, vol. 8, pp. 92–99, 2020.
27. Gopinathan, V. R. (2024). Real-Time Fault-Tolerant Multi-Cloud Database Architectures for High Availability Applications. *International Journal of Future Innovative Science and Technology (IJFIST)*, 7(4), 13148.
28. Chandra, S., Rengarajan, A., Sahoo, G. S., & Sharma, S. (2023, December). Identifying Neuronal Damage and Plasticity by Analyzing Changes in Diffusion Tensor Imaging. In *International Conference on Data Science, Machine Learning and Applications* (pp. 433-438). Singapore: Springer Nature Singapore.
29. Sugumar, R. (2025). Federated AI in Offline-First Mobile Health Architectures for Privacy-Preserving Clinical Intelligence. *International Journal of Science, Research and Technology*, 8(4), 14589-14600.
30. Murugeswari, B., Rajalakshmi, S., & Sudharson, K. (2023). Hybrid Approach for Privacy Enhancement in Data Mining Using Arbitrariness and Perturbation. *Computer Systems Science & Engineering*, 44(3).
31. Pandey, V. K., Mishra, S., Rengarajan, A., Savita, & Roomi, M. M. (2024, March). Enhancing Weather Forecasting with Machine Learning Techniques. In *International Conference on Renewable Power* (pp. 147-156). Singapore: Springer Nature Singapore.
32. Soundappan, S. J. (2025). Next Generation AI Enabled Holistic Cognitive Platform for Secure Cloud Network Intelligence Enterprise Systems and Digital Trust Optimization. *International Journal of Computer Technology and Electronics Communication*, 8(5), 11534-11542.
33. Mathew, A. (2022). Leveraging Big Data Analytics to Power AI and ML (Machine Learning) Automation. *Educational Research (IJM CER)*, 4(5), 131-134.
34. Sugumar, R. (2024). AI-Augmented Quality Engineering for Performance Optimization and Test Orchestration in Distributed Systems. *International Journal of Science, Research and Technology*, 7(5), 12835-12846.
35. Akila, R. (2024). A deep reinforcement learning approach for optimizing inventory management in the agri-food supply chain. *J. Electrical Systems*, 20(4s), 2238-2247.
36. Mahendran, M., Anbazhagan, K., Pavithran, G., Nivas, A., & Pandey, S. D. (2022). Earthquake Damage Prediction using Machine Learning. *Grenze International Journal of Engineering & Technology (GIJET)*, 8(1).
37. Gopinathan, V. R. (2025). Enterprise AI Frameworks for Financial Data Engineering Behavioural Analytics and Intelligent Cloud Solutions. *International Journal of Research Publications in Engineering, Technology and Management (IJRPETM)*, 8(4), 12499-12506.
38. Kondalsamy, P., & Kaliappan, K. (2025). An Optimal Prediction of Leaf Disease Based on Hybrid Deep Learnings and Metaheuristic Technique. *Traitement du Signal*, 42(1), 363.
39. Deivendran, P., Babu, P. S., Malathi, G., Anbazhagan, K., & Kumar, R. S. (2023). Emotion Recognition for Challenged People Facial Appearance in Social using Neural Network. *arXiv preprint arXiv:2305.06842*.
40. Sugumar, R. (2025). Unified AI Framework for Predictive Data Engineering and Real Time Prescription and Billing Systems. *International Journal of Advanced Engineering Science and Information Technology (IJAESIT)*, 8(5), 17261.
41. Vekariya, V., Kumar, S., & Rengarajan, A. (2024). A distinctive and smart agricultural knowledge-based framework using ontology. In *Sustainability in Digital Transformation Era: Driving Innovative & Growth* (pp. 207-213). CRC Press.
42. Gopinathan, V. R. (2025). Software engineering practices for AI-driven systems: From development to deployment (MLOps perspective). *International Journal of Science, Research and Technology*, 8(1), 13493-13500.
43. Mathew, A. R. (2022). Threats and protection on E-sim: a prospective study. *Novel Perspectives of Engineering Research*, 8, 76-81.
44. Naveena, S., & Kavitha, K. (2025). Gossypium herbaceum: Folium disease identification and classification using Efficient Net-Coordinate Convolutional Neural Network (EcoNet). *Engineering Applications of Artificial Intelligence*, 152, 110701.
45. Rengarajan, A., Mishra, A., Kulhar, K. S., Shrivastava, V. P., & Alawneh, Y. J. J. (2024, March). Role of Deep Reinforcement Learning in Mitigating Cyber Security Issues: A Review. In *International Conference on Renewable Power* (pp. 37-48). Singapore: Springer Nature Singapore.
46. Achari, A. P. S. K., & Sugumar, R. (2024, November). Performance analysis and determination of accuracy using machine learning techniques for naive bayes and random forest. In *AIP Conference Proceedings* (Vol. 3193, No. 1, p. 020199). AIP Publishing LLC.



47. Mathew, A., & Alex, H. (2022). Detect & protect-medical device cybersecurity. *Curr. Overview Sci. Technol. Res*, 1, 60-68.
48. Sammy, F., Chettier, T., Boyina, V., Shingne, H., Saluja, K., Mali, M., ... & Shobana, A. (2025). Deep Learning-Driven Visual Analytics Framework for Next-Generation Environmental Monitoring. *Journal of Applied Science and Technology Trends*, 114-122.
49. Anbazhagan, K. (2024). Trustworthy and Adaptive AI Systems for Enterprise Analytics Cybersecurity and Decision Optimization Using API-First and Cloud-Native Architectures. *International Journal of Technology, Management and Humanities*, 10(03), 65-74.
50. Mathew, A. (2021). Deep reinforcement learning for cybersecurity applications. *Int J Comput Sci Mob Compu*, 10(12), 32-38.
51. Dhinakaran, D. (2022). Joe Prathap P. M, Selvaraj D, Arul Kumar D and Murugeswari B," Mining Privacy-Preserving Association Rules based on Parallel Processing in Cloud Computing,". *International Journal of Engineering Trends and Technology*, 70(3), 284-294.
52. Karthika, K., Anusha, K., Kavitha, K., Harshadha, R., Dharshini, D. S., & Sundhar, N. A. (2025, April). Frequency Reconfigurable Antenna using Advanced Materials: A Study. In *2025 3rd International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation (ICAECA)* (pp. 1-6). IEEE.
53. Thavamani, C., & Rengarajan, A. (2024). Clustering related behaviour of users by the use of partitioning and parallel transaction reduction algorithm. *International Journal of Advanced Intelligence Paradigms*, 29(2-3), 122-132.
54. Sugumar, R. (2025). Unified AI Framework for Predictive Data Engineering and Real Time Prescription and Billing Systems. *International Journal of Advanced Engineering Science and Information Technology (IJAESIT)*, 8(5), 17261.
55. Soundappan, S. J., & Sugumar, R. (2016). Optimal knowledge extraction technique based on hybridisation of improved artificial bee colony algorithm and cuckoo search algorithm. *International Journal of Business Intelligence and Data Mining*, 11(4), 338-356.
56. SakthiPreetha, A., Kavitha, K., Karthika, K., & Manohari, R. G. (2025, April). A Novel Metasurface-Embedded Antenna for WBAN Communications. In *2025 3rd International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation (ICAECA)* (pp. 1-4). IEEE.
57. Murugeswari, B., Selvaraj, D., Sudharson, K., & Radhika, S. (2023). Data Mining with Privacy Protection Using Precise Elliptical Curve Cryptography. *Intelligent Automation & Soft Computing*, 35(1).
58. Gopinathan, V. R. (2025). Software engineering practices for AI-driven systems: From development to deployment (MLOps perspective). *International Journal of Science, Research and Technology*, 8(1), 13493-13500.
59. Anbazhagan, K., Kumar, R., Thilagavathy, R., & Anuradha, D. (2024, March). Shortest Job First with Gateway-based Resource Management Strategy for Fog Enabled Cloud Computing. In *2024 4th International Conference on Data Engineering and Communication Systems (ICDECS)* (pp. 1-6). IEEE.
60. Kannadhasan, S., Vasuki, S., Kavitha, K., Karthikeyan, P., & Usha, S. G. A. (Eds.). (2025, April). Preface: Role of Artificial Intelligence and IoT in Engineering, Technology & Science [ICRAETS 2024]. In *AIP Conference Proceedings* (Vol. 3258, No. 1, p. 010001). AIP Publishing LLC.
61. Dhinakaran, D., Prathap, P. J., Selvaraj, D., Kumar, D. A., & Murugeswari, B. (2022). Mining privacy-preserving association rules based on parallel processing in cloud computing. *International Journal of Engineering Trends and Technology*, 70(3), 284-294.