



Wearable System for Predictive Asthma Care: Early Trigger Detection and Medication Reminders

D.S.Nivetha Joice, K.Ajitha , J.Ananthajothi , S.Arikesavan

Assistant Professor, Dept. of BME, MAM School of Engineering, Siruganur, Trichy, Tamil Nadu, India

Student, MAM School of Engineering, Siruganur, Trichy, Tamil Nadu, India

Student, MAM School of Engineering, Siruganur, Trichy, Tamil Nadu, India

Student, MAM School of Engineering, Siruganur, Trichy, Tamil Nadu, India

Publication History: Received: 25.02.2026; Revised: 20.03.2026; Accepted: 25.03. 2026; Published: 28.03.2026.

ABSTRACT: This project focuses on developing a wearable system designed to support asthma patients through early detection of environmental triggers and timely medication reminders. Asthma is a chronic respiratory disease that can worsen due to changes in air quality, temperature, and humidity. The proposed system continuously monitors these environmental parameters using embedded sensors. It analyzes the collected data in real time and predicts potential asthma-triggering conditions. Once a risk is detected, the system alerts the user through visual and audio notifications. Additionally, it reminds patients to take their medication at the right time. This proactive approach helps in preventing severe asthma attacks. Overall, the system improves patient safety, reduces emergency situations, and enhances quality of life.

KEYWORDS: Wearable Healthcare System, Asthma Monitoring, Environmental Sensors, IoT-Based Health Monitoring, Medication Reminder System

I. INTRODUCTION

Asthma is a widespread respiratory condition affecting millions of people globally, and it is highly sensitive to environmental conditions. Factors such as pollution, dust, humidity, and temperature fluctuations can trigger sudden asthma attacks. Traditional asthma management methods rely on manual monitoring through mobile apps or weather updates, which may not always be accurate or timely. With the advancement of biomedical and wearable technologies, continuous monitoring has become possible. This project introduces a smart wearable device that tracks environmental conditions in real time. The system integrates sensors, a microcontroller, and alert mechanisms to provide immediate feedback to users. It enables early intervention and reduces the dependency on manual monitoring. Hence, it serves as an efficient solution for modern asthma care.

OBJECTIVE

The main objective of this project is to design and develop a wearable device that assists asthma patients in managing their condition effectively. It aims to continuously monitor environmental parameters such as air quality, humidity, and temperature. Another goal is to detect harmful environmental changes before they affect the patient. The system also provides real-time alerts to warn users about unsafe conditions. Additionally, it includes a medication reminder feature to ensure timely inhaler usage. The device is designed to be compact, portable, and energy-efficient for daily use. Overall, the objective is to improve patient safety and provide a preventive healthcare solution.

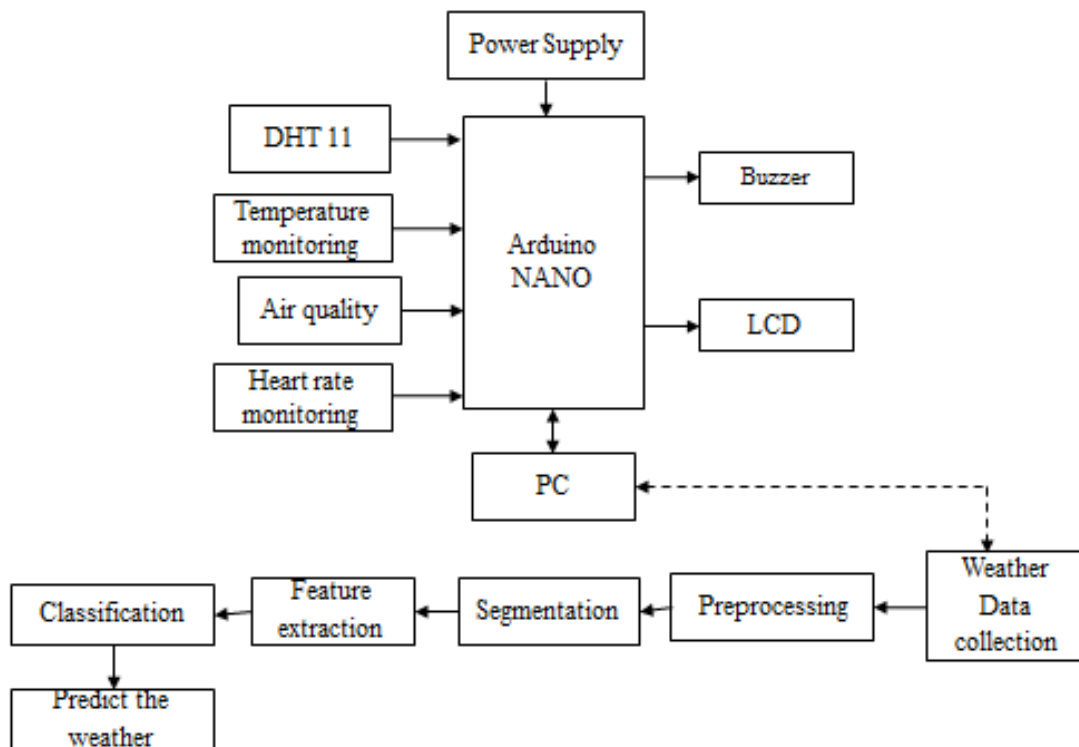
II. PROBLEM STATEMENT

Asthma patients are highly vulnerable to sudden environmental changes, especially variations in air quality and humidity levels. Most existing systems do not provide continuous monitoring or early warning alerts. Patients often depend on mobile applications or weather reports, which may not reflect real-time local conditions. This delay in information can lead to severe asthma attacks. Furthermore, there is no integrated system that combines environmental sensing with medication reminders. Lack of awareness and delayed response increases health risks. Therefore, there is a need for an automated system that provides real-time monitoring and predictive alerts for asthma management.

III. PROPOSED SYSTEM

The proposed system is a wearable device that continuously monitors environmental and physiological parameters using sensors. It collects data related to air quality, temperature, humidity, and heart rate. This data is processed by a microcontroller to identify abnormal conditions. Predictive algorithms are used to forecast potential asthma triggers before they become harmful. When unsafe conditions are detected, the system alerts the user through a buzzer and display unit. It also reminds patients to take their medication on time. The system is designed to be portable and easy to use in daily life. This ensures continuous monitoring and timely preventive action for asthma patients.

BLOCK DIAGRAM



IV. DESIGN AND SELECTION OF COMPONENTS

1. POWER SUPPLY

The power supply unit is responsible for providing stable and regulated electrical power to all components in the system. It converts the input voltage into suitable levels required for sensors and the microcontroller. Voltage regulators are used to maintain a constant output and prevent fluctuations. Capacitors are included to filter noise and ensure smooth operation. A reliable power supply is essential for continuous monitoring and system stability. For wearable applications, the power unit must be compact and energy-efficient. Proper design of the power supply increases the overall reliability of the system.

2. ARDUINO NANO

Arduino Nano is the main microcontroller used in this project to control all operations. It is based on the ATmega328P and operates at 5V with a clock speed of 16 MHz. The board has multiple digital and analog input/output pins for interfacing with sensors. It processes real-time data collected from sensors and controls output devices like buzzer and LCD. Its small size makes it suitable for wearable applications. It can be easily programmed using Arduino IDE. The Arduino Nano ensures efficient and accurate system performance.



3. DHT11 SENSOR

The DHT11 sensor is used to measure temperature and humidity in the environment. It provides digital output, making it easy to interface with the microcontroller. The sensor is cost-effective and suitable for basic monitoring applications. It continuously tracks environmental conditions and helps detect changes that may trigger asthma. Although it has moderate accuracy, it is sufficient for general-purpose monitoring. It consumes low power, making it ideal for wearable systems. Its reliability and simplicity make it a popular choice in IoT applications.

4. AIR QUALITY SENSOR

The air quality sensor detects harmful gases and pollutants present in the environment. It measures parameters such as smoke, carbon dioxide, and volatile organic compounds. This helps in identifying unsafe air conditions that can trigger asthma attacks. Real-time monitoring enables the system to provide early warnings. It plays a crucial role in maintaining respiratory health. The sensor can be integrated with IoT systems for data analysis. It enhances the effectiveness of the overall system.

5. TEMPERATURE SENSOR

The temperature sensor is used to measure ambient or body temperature. It detects abnormal temperature variations that may affect the patient's health. The sensor provides accurate and real-time data to the microcontroller. It helps in identifying sudden environmental changes. Its compact size and low power consumption make it suitable for wearable devices. Continuous monitoring ensures better health management. It also contributes to early detection of potential health issues.

6. HEART RATE SENSOR

The heart rate sensor measures the pulse rate of the user. It works by detecting blood flow changes using optical sensing methods. The sensor provides real-time physiological data for health monitoring. It helps in identifying abnormal heart activity during asthma attacks. Continuous tracking improves patient safety and awareness. It can be easily integrated with wearable devices. This sensor adds an extra layer of health monitoring to the system.

7. BUZZER

The buzzer is used as an alert system to notify users during critical conditions. It produces sound signals when triggered by the microcontroller. The buzzer ensures that the user is immediately aware of unsafe environmental conditions. It is simple, low-cost, and effective. It plays a vital role in emergency alert systems. The audio feedback helps users respond quickly. It improves the overall safety of the device.

8. LCD DISPLAY

The LCD display is used to show real-time data collected from sensors. It displays parameters such as temperature, humidity, air quality, and heart rate. The display helps users easily understand the current environmental conditions. It is energy-efficient and compact. The LCD improves user interaction with the system. It can also display warning messages when abnormal conditions are detected. It is widely used in embedded systems for visual output.

V. SOFTWARE REQUIREMENTS

1. ARDUINO IDE

Arduino IDE is used for writing, compiling, and uploading code to the microcontroller. It provides a user-friendly interface for programming. The IDE supports various libraries for sensor integration. It allows easy debugging and testing of code. It is widely used for embedded system development. The software ensures smooth communication between hardware and program. It is essential for system implementation.

2. PROTEUS 8.13

Proteus is a simulation software used to design and test electronic circuits. It allows virtual testing of the system before hardware implementation. This reduces errors and saves development time. The software supports a wide range of electronic components. It provides accurate simulation results. Engineers can analyze circuit behavior effectively. It improves the efficiency and reliability of the design process.

VI. RESULTS AND ANALYSIS

The developed system successfully monitors environmental parameters in real time. It detects harmful conditions such as poor air quality and high humidity levels. The system generates alerts immediately when unsafe conditions are



identified. Sensor readings are accurate and consistent during testing. The response time of the system is fast and reliable. The medication reminder feature ensures timely preventive action. Overall, the system improves early detection of asthma triggers. It significantly enhances patient safety and reduces health risks.

REFERENCES

1. J. Woo, J. -H. Lee, Y. Kim, G. Rudasingwa, D. H. Lim and S. Kim, "Forecasting the Effects of Real-Time Indoor PM2.5 on Peak Expiratory Flow Rates (PEFR) of Asthmatic Children in Korea: A Deep Learning Approach," in *IEEE Access*, vol. 10, pp. 19391-19400, 2022, doi: 10.1109/ACCESS.2022.3148294.
2. G. S. Bhat et al., "Machine Learning-Based Asthma Risk Prediction Using IoT and Smartphone Applications," in *IEEE Access*, vol. 9, pp. 118708-118715, 2021, doi: 10.1109/ACCESS.2021.3103897.
3. 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
4. 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
5. 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
6. 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
7. 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.epr.2025.112428
8. 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
9. 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.
10. 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.
11. 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.
12. 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
13. 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
14. 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
15. U. Wickramarathne, M. Jayawickrama and S. Tissera, "Predictive Analytics-Driven Wearable System for Personalized Asthma Management in Disabled Patients," 2025 International Technical Conference on Circuits/Systems, Computers, and Communications (ITC-CSCC), Seoul, Korea, Republic of, 2025, pp. 1-6, doi: 10.1109/ITC-CSCC66376.2025.11137728.
16. J. N. V. R. S. Kumar, B. N. Nishant, S. V. Suraj, I. S. S. Rao, S. R. Pappu and B. Lokesh, "An IoT-Based Asthma Intensity Prediction Using Classification Models," 2024 2nd International Conference on Sustainable Computing and Smart Systems (ICSCSS), Coimbatore, India, 2024, pp. 404-410, doi: 10.1109/ICSCSS60660.2024.10625043.
17. L. -P. Hung, Z. -J. Wu, X. -Y. Liu and C. -A. Yang, "The Construction of Warning Mechanism for Asthma Patient Based on AIoT," 2023 Congress in Computer Science, Computer Engineering, & Applied Computing (CSCE), Las Vegas, NV, USA, 2023, pp. 1355-1359, doi: 10.1109/CSCE60160.2023.00227.
18. Kiran, A., Rubini, P., & Kumar, S. S. (2025). Comprehensive review of privacy, utility and fairness offered by synthetic data. *IEEE Access*.



19. **Gopinathan, V. R. (2024).** Real-Time Financial Risk Intelligence Using Secure-by-Design AI in SAP-Enabled Cloud Digital Banking. *International Journal of Computer Technology and Electronics Communication*, 7(6), 9837-9845.
20. **Udayakumar, R., Elankavi, R., Vimal, R., & Sugumar, R. (2023).** Improved Particle Swarm Optimization with Deep Learning-Based Municipal Solid Waste Management in Smart Cities. *Environmental & Social Management Journal*, 17(4).
21. **Anand, L. (2023).** An Intelligent AI and ML-Driven Cloud Security Framework for Financial Workflows and Wastewater Analytics. *International Journal of Humanities and Information Technology*, 5(02), 87-94.
22. **Soundappan, S. J. (2020).** Big Data Analytics in Healthcare: Applications for Pandemic Forecasting. *International Journal of Advanced Research in Computer Science & Technology*, 3(1), 2248-2253.
23. **Rajasekar, M. (2024).** Real-Time Predictive DevOps Intelligence for Risk-Aware Digital Business Processes in Cloud and SAP Ecosystems. *International Journal of Advanced Research in Computer Science & Technology*, 7(4), 10713-10718.
24. **Poornima, G., & Anand, L. (2024, May).** Novel AI Multimodal Approach for Combating Against Pulmonary Carcinoma. In *2024 5th International Conference for Emerging Technology (INCET)* (pp. 1-6). IEEE.
25. **Prabha, P. S., & Rengarajan, A. (2025).** Adaptive Cloud Resource Allocation Using Attention-Driven Deep Reinforcement Learning. *Engineering, Technology & Applied Science Research*, 15(6), 29334-29340.
26. **Jagadeesh, S., & Sugumar, R. (2017).** A Comparative study on Artificial Bee Colony with modified ABC algorithm. *European Journal of Applied Sciences*, 9(5), 243-248.
27. **Varma, K. K., & Anand, L. (2025, March).** Deep Learning Driven Proactive Auto Scaler for High-Quality Cloud Services. In *International Conference on Computing and Communication Systems for Industrial Applications* (pp. 329-338). Singapore: Springer Nature Singapore.
28. **Kumar, S. A., & Anand, L. (2025).** A Novel EEG-Based Deep Learning Framework for Enhancing Communication in Locked-In Syndrome Using P300 Speller and Attention Mechanisms. *KSII TRANSACTIONS ON INTERNET AND INFORMATION SYSTEMS*, 19(11), 3841-3855.
29. **Poornima, G., & Anand, L. (2025).** Medical image fusion model using CT and MRI images based on dual scale weighted fusion based residual attention network with encoder-decoder architecture. *Biomedical Signal Processing and Control*, 108, 107932.
30. **Archana, R., & Anand, L. (2025).** Residual u-net with Self-Attention based deep convolutional adaptive capsule network for liver cancer segmentation and classification. *Biomedical Signal Processing and Control*, 105, 107665.
31. **Kumar, S. A., & Anand, L. (2025).** A Novel EEG-Based Deep Learning Framework for Enhancing Communication in Locked-In Syndrome Using P300 Speller and Attention Mechanisms. *KSII Transactions on Internet and Information Systems*, 19(11), 3841-3855.
32. **Rengarajan, A. (2025).** Cloud-Based AI-Driven Threat Detection Framework for Smart Grid Cybersecurity. *International Journal of Future Innovative Science and Technology*, 8(6), 16065.
33. **Murugeshwari, B., Sudharson, K., Panimalar, S. P., Shanmugapriya, M., & Abinaya, M. (2020).** SAFE-Secure Authentication in Federated Environment using CEG Key code.
34. **Raj A. A., & Sugumar, R. (2023).** Early Detection of COVID-19 with Impact on Cardiovascular Complications using CNN Utilising Pre-Processed Chest X-Ray Images. *2023 International Conference on Applied Intelligence and Sustainable Computing (ICAISC)*, IEEE.
35. **Jagadeesh, S., & Sugumar, R. (2017).** A Comparative study on Artificial Bee Colony with modified ABC algorithm. *European Journal of Applied Sciences*, 9(5), 243-248.
36. **Selvi, G. V., Anbarasan, A. B., Murthy, B. A., & Prabavathy, S. (2023).** An Application Oriented Integrated Unequal Clustering Algorithm for Wireless Sensor Network. In *Underwater Vehicle Control and Communication Systems Based on Machine Learning Techniques* (pp. 140-154). CRC Press.
37. **Sruthi, R. S., Ananya, S., & Murugeshwari, B. (2010).** Web Based Virtual Control System Laboratory and On-Line Temperature Control of Electrophoresis Equipment using LabVIEW. *International Journal of Computer Applications*, 975, 8887.
38. **Vimal Raja, G. (2021).** Mining Customer Sentiments from Financial Feedback and Reviews using Data Mining Algorithms. *International Journal of Innovative Research in Computer and Communication Engineering*, 9(12), 14705-14710.
39. **MATHEW, A. R. (2025).** Neurosecurity and Brain-Computer Interfaces.
40. **Soundappan, S. J. (2024).** AI-Driven Customer Intelligence in Enterprise Lakehouse Systems Sentiment Mining Governance-Aware Analytics and Real-Time Data Synchronization. *International Journal of Advanced Engineering Science and Information Technology (IJAESIT)*, 7(5), 14905.
41. **Mathew, A. (2025).** Human-AI Collaboration in Security Operations: Measuring Alert Trust, Automation Bias, and Analyst Upskilling in AI-Augmented SOC Environments. *International Journal of Computer Technology and Electronics Communication*, 8(5), 11375-11380.



41. Soundappan, S. J. (2022). AI-Based Fault Detection and Isolation for Reliability in Modern Power Systems. *International Journal of Research Publications in Engineering, Technology and Management (IJRPETM)*, 5(4), 7106-7110.
42. Poornima, G., & Anand, L. (2024, April). **Effective Machine Learning Methods for the Detection of Pulmonary Carcinoma. In 2024 Ninth International Conference on Science Technology Engineering and Mathematics (ICONSTEM) (pp. 1-7). IEEE.**Garg, V. K., Soundappan, S. J., & Kaur, E. M. (2020). Enhancement in intrusion detection system for WLAN using genetic algorithms. *South Asian Research Journal of Engineering and Technology*, 2(6), 62–64.
43. Rengarajan, A., Jayakumar, C., & Sugumar, R. (2012). Optimization Of Recent Attacks Using Internet Protocol. *National Journal of System and Information Technology*, 5(1), 8.
44. Mathew, A. (2024). AI TRiSM: Trust, Risk, and Security Management in Cybersecurity. *Cybersecurity*, 4(3), 84-90.
45. Mathew, A. (2025). Deep seek vs. ChatGPT: A deep dive into AI Language mastery. *Int J Multidisciplinary Res*, 7(1), 1-5.