As per UGC guidelines an electronic bar code is provided to secure your paper

International Journal for Modern Trends in Science and Technology
Volume 12, Issue 03, pages 428-430.
ISSN: 2455-3778 online
Available online at: http://www.ijmtst.com/vol12issue03.html
DOI: https://doi.org/10.5281/zenodo.19125677

AERI Sense - An IoT + FWD Air Quality Monitoring and Regulation System with Linear Regression Model

Susmitha Mukund Kirsur | Pavanaj S Achar | Adithya S Vasishta | Bharath N | Vijay M

Department of CS-ICB, BMS College of Engineering, Bengaluru, Karnataka 560004, INDIA.

To Cite this Article
Susmitha Mukund Kirsur, Pavanaj S Achar, Adithya S Vasishta, Bharath N & Vijay M (2026). AERI Sense - An IoT + FWD Air Quality Monitoring and Regulation System with Linear Regression Model. International Journal for Modern Trends in Science and Technology, 12(03), 428-430. https://doi.org/10.5281/zenodo.19125677

Article Info
Received: 17 February 2026; Revised: 12 March 2026; Accepted: 15 March 2026.

KEYWORDS

IoT, AQI, Linear Regression, ESP32, Air purifier automation, Air quality monitoring, AES-256, JWT

ABSTRACT

AERISense integrates IoT, FWD and Artificial Intelligence to measure, predict, and regulate air quality within rural and semi-urban environments. The system uses ESP32-based nodes equipped with DHT22 (temperature–humidity) and MH-Z19B (CO2) sensors to collect real-time data. The computation of AQI from raw sensor data, illiterate friendly color-coded alert and pop-up generation, predicted future AQI and air purification automation based on threshold is handled by the NodeJS backend which is secured with JWT based authentication, live updates are broadcasted using SocketIO and the MongoDB database used is secured with AES-256 GCM encryption. The system comes with zone-based monitoring and map-view for the zones and sub-zones.

INTRODUCTION

One of the most seen yet rising concern in the country is air pollution. Not fully automated measures like NCAP, Clean Air Fund have been implemented by the Govt. of India to improve AQI in the country. The achieved system is a reasonable - cost solution with IoT based continuous AQI monitoring and automated air purification, color coded alerts, pop-ups, future AQI prediction.

STRUCTURE OF PAPER

The paper is organized as follows: In Section 1, the introduction of the paper is provided along with the structure, important terms, objectives and overall description. In Section 2 we discuss related work. In Section 3 we have the complete system architecture. Section 4 shares information about the methodology. Section 5 showcases all the results and defined objectives achieved. Section 6 tells us about the future scope, Section 7 tells about the security features and concludes the paper with acknowledgement and references.

OBJECTIVES

The predominant air quality monitoring systems even though remotely monitor air quality data require some level of human intervention for the regulation or action-part.

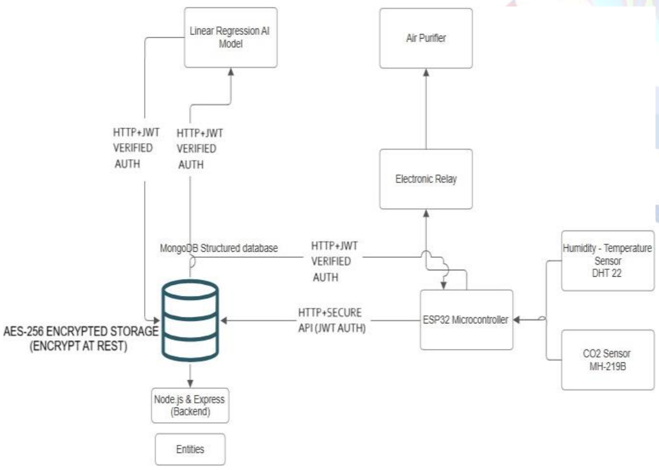
This project aims to serve as a one stop solution to both monitor and regulate air quality with the ESP and sensor array plus the air purification technology.

RELATED WORK

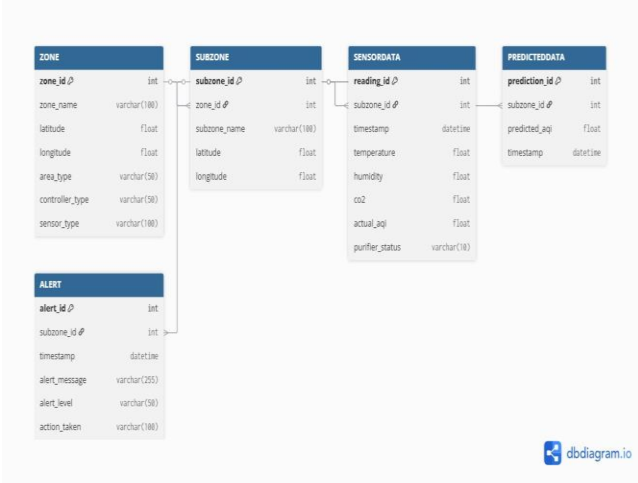
ESP o Arduino IoT - based environmental computing or monitoring systems have been proven to effectively track real-time air variations using reasonable - cost components, offering practical alternatives to industrial monitoring stations. These studies demonstrate improved accessibility in rural, remote or underdeveloped regions. [1]

Research on AQI forecasting models suggests that lightweight methods such as Linear Regression provide reliable short-term predictions while remaining resource-efficient for embedded IoT devices, unlike deep learning approaches requiring extensive datasets. [2]

SYSTEM ARCHITECTURE



The architecture consists of an ESP32 microcontroller, DHT22 + MH-Z19B sensors, a Node.js backend, a MongoDB database, a Linear Regression prediction module, relay-controlled purifiers, and a Socket.IO based dashboard.



METHODOLOGY

A. Sensor Data Collection and AQI Computation

The ESP32 collects temperature, humidity, CO2, and computes a surrogate AQI. Data is transmitted to the backend every 5 seconds.

B. Linear Regression Prediction (AI Prediction)

AQI is predicted using recent trend data:

$$AQIpredicted = AQIcurrent + \Delta avg$$

_id: ObjectId('691369cbd9410c1e6bcbe0c3')
subzone: ObjectId('6912282b50922f9d26090f83')
alert_message: "Predicted AQI Unhealthy - take precautions"
alert_level: "High"
action_taken: "PredictionWarning"
timestamp: 2025-11-11T16:52:27.707+00:00
__v: 0

C. Alert Generation

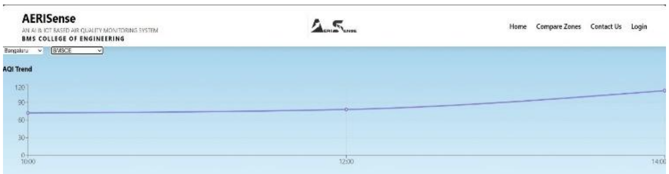
Categories: Normal (0–100), Moderate (101–150), Unhealthy (>150). Alerts are stored in MongoDB and emitted to clients via Socket.IO.

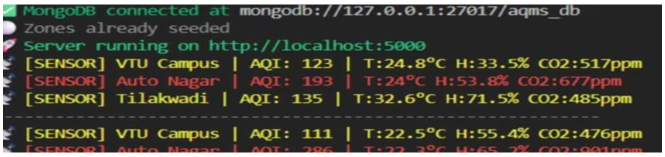
D. Purifier Automation

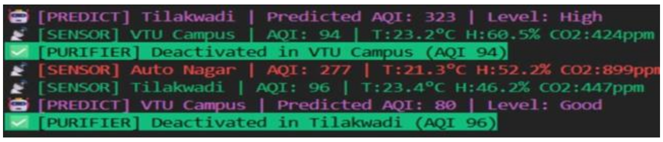
If AQI > 150, relay ON (purifier ON). If AQI ≤ 100, relay OFF (purifier OFF).

RESULTS

The AQMS backend demonstrated reliable performance during continuous sensor data acquisition and processing under simulated conditions. Data transmitted from ESP32 nodes across multiple virtual zones was logged at regular intervals. The Linear Regression–based AQI prediction module accurately captured short- term pollution trends, generating early warning indicators before threshold violations occurred.







FUTURE SCOPE AND CONCLUSION

The AQMS demonstrates an affordable IoT–AI approach for monitoring and regulating air quality [35]. The system predicts AQI trends, issues alerts, and automates purifier control [36]. Future work includes deploying real hardware in the field and adopting more advanced ML models [37].

SECURITY FEATURES

The AQMS incorporates multiple cybersecurity mechanisms to protect sensor data, backend services, and actuator control [40].

JWT-based authentication restricts access to critical APIs such as purifier control [41]. Encrypted storage ensures sensor readings and computed AQI values remain protected at rest [32, 41]. Secure Socket.IO handshakes validate tokens before real-time data exchange [33].

CORS policies restrict API access to trusted origins, while token persistence ensures secure session continuity [33]. Conditional rendering prevents unauthorized UI actions [34]. XSS prevention, trail logs, local asset integrity checks, and automated failsafes collectively enhance system resilience [34].

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

REFERENCES

[1] J. Singh and R. Prasad, "Low-cost IoT air sensing networks," IEEE Sensors Journal, 2018 [38].

[2] A. Sharma and B. Natarajan, "Lightweight AQI forecasting methods for embedded devices," Elsevier Atmos. Environ., 2021 [38, 39].

[3] K. Rao and M. Kulkarni, "Automated environmental regulation systems using IoT," Springer, 2022 [39].