International Scientific Journal of Engineering and Management (ISJEM) ISSN: 2583-6129
Conference Proceedings: Volume: 05 ACME – 2026 DOI: 10.55041/ISJEM.ACME028
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

Enviro Detect: IOT Integrated DNN Emission Analyzer

Bhukya Raja Kumar [1], M. Bhagya Lakhmi [2], Samakari Sreedhar [3], M. Bhuvanachandra [4], K. Jaagruthi [5] ,Rachamreddy Dharani [6]

[1,2,3,4,5,6] *Computer Science and Information Technology, Siddharth Institute of Engineering & Technology*

Abstract- This project focuses on developing a predictive system for air quality monitoring using machine learning techniques. The goal is to forecast future hazardous gas levels and AQI values based on historical air quality data. The system analyzes pollutants like CO, NO2, Ozone, and PM2.5, which are key factors affecting air quality. By utilizing advanced machine learning algorithms such as LSTM + GRU Hybrid, CNN-LSTM, and Stacked Bi-LSTM with Dropout, the system can predict AQI values and categorize them into categories like GOOD, Moderate, Unhealthy, and Hazardous. Additionally, the system integrates Explainable AI (XAI) techniques, specifically SHAP plots, to provide transparency in the model's decision-making process, enabling users to understand how predictions are made. The front-end of the system is built using HTML, CSS, and JavaScript, while the back-end is powered by Flask, ensuring efficient data processing and model deployment. This project aims to offer accurate predictions for air quality, providing essential information to users about potential health risks and empowering them to take proactive measures to reduce exposure to hazardous gases. The system aims to contribute to better environmental management by helping both individuals and authorities monitor and predict air quality effectively.

Keywords: AQI, air quality prediction, machine learning, Flask, LSTM, GRU, CNN, SHAP, XAI, environment.

1. INTRODUCTION

Air pollution is a significant environmental issue that affects human health and well-being across the globe. Monitoring air quality is essential to understanding the risks posed by air pollutants, such as Carbon Monoxide (CO), Nitrogen Dioxide (NO2), Ozone, and Particulate Matter (PM2.5). While accurate monitoring systems exist, they often lack predictive capabilities and the ability to forecast future air quality conditions. This project aims to address these limitations by developing a predictive system for air quality monitoring. Using advanced machine learning algorithms, such as LSTM + GRU Hybrid, CNN-LSTM, and Stacked Bi-LSTM with Dropout, this system forecasts future AQI values and hazardous gas concentrations. The predictions will be made available through a user-friendly web interface with visualizations of model predictions, supported by Explainable AI (XAI) methods like SHAP plots to interpret the decision-making process. The system, built using Flask for the backend and HTML, CSS, and JavaScript for the front-end, will help users anticipate air quality conditions and take proactive actions to protect health.

2. SYSTEM ANALYSIS

Existing System:

Air quality monitoring systems collect pollutant data using sensors and use statistical methods to calculate AQI. However, they mainly show current air quality, lack future prediction capability, and do not clearly explain the reasons behind the results.

Limitations of Existing System:

- **Limited Accuracy**: Traditional systems often suffer from low accuracy, especially when dealing with complex or diverse plant species and diseases.
- **Manual Inspection**: Reliance on human expertise leads to errors in diagnosis and is time-consuming, especially when large datasets or large-scale crops are involved.
- **Lack of Scalability**: Existing systems cannot scale effectively to handle the large number of plant species or diverse disease types.
- **Inefficient Computation**: Systems that rely on basic machine learning models or image processing techniques are computationally inefficient and struggle with accurate predictions.

3. PROPOSED SYSTEM

The proposed system improves air quality monitoring by using machine learning models (LSTM-GRU, CNN-LSTM, and Bi-LSTM) to predict future AQI and hazardous gas levels such as CO, NO_2, Ozone, and PM2.5. It also uses Explainable AI (SHAP) to show why predictions are made. The system includes a user-friendly front end (HTML, CSS, JavaScript) and a Flask-based back end for data processing and predictions, helping users and policymakers take preventive actions.

Advantages of Proposed System:

- **Predictive Capability:** The system forecasts future air quality conditions, enabling users to take preventive measures in advance, unlike traditional systems that only show current data.
- **Improved Accuracy:** By using advanced machine learning models such as LSTM, GRU, and CNN-LSTM, the system can analyze complex air quality patterns and provide more accurate predictions.
- **Transparency:** With Explainable AI techniques like SHAP plots, users can understand how the model makes predictions and which pollutants influence the results.
- **Real-Time Predictions:** The system processes user inputs instantly and provides quick updates on air quality forecasts.
- **Scalable and Flexible:** The Flask-based backend allows the system to scale easily to multiple cities or regions and handle large datasets.
- **Comprehensive Monitoring:** It tracks multiple pollutants such as CO, NO_2, Ozone, and PM2.5, giving a complete picture of air quality.

Diagram 1: System Architecture

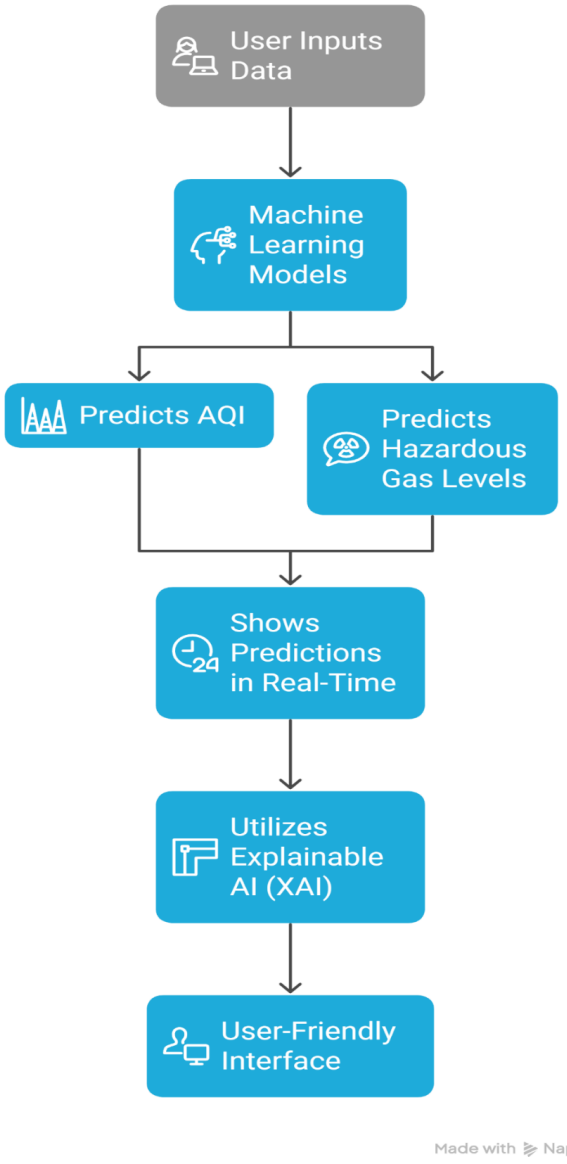

Fig -1: Figure

EXPERIMENTAL RESULTS:

The proposed AI-based Air Quality Prediction System demonstrates the following results:

- Improved accuracy in predicting AQI and pollutant levels.
- Better analysis of air pollution trends using deep learning models.
- Reduced prediction errors compared to traditional methods.
- Transparent results through Explainable AI (SHAP).
- Early warning of poor air quality through future forecasting.

4. CONCLUSION

The project developed an advanced air quality prediction system using machine learning models such as Random Forest, XGBoost, LSTM, and GRU to predict AQI values and categories. The system achieved high accuracy, with Random Forest and XGBoost performing best for classification and Random Forest Regressor for AQI value prediction. It also uses SHAP plots to explain predictions. Overall, the system provides a reliable and user-friendly tool for forecasting air quality and supporting better environmental and health decisions.

FUTURE SCOPE

The system can be further improved by integrating real-time sensor data instead of relying only on historical datasets, which would allow more accurate and timely AQI predictions and early warnings. The system can also be expanded to include additional pollutants such as PM10, SO_2, VOC, and NH_3, providing a more comprehensive view of air quality. Future improvements may involve using advanced deep learning models and ensemble techniques to increase prediction accuracy and training the model with larger regional and global datasets to improve its adaptability across different locations. Additionally, developing a mobile application for real-time updates, implementing map-based geographical visualization of AQI data, integrating health data for personalized recommendations, and enabling predictive maintenance for sensors can make the system more efficient, intelligent, and user-friendly for individuals, environmental agencies, and policymakers.

REFERENCES

1. Singh, M., & Kumar, S., Predicting air quality index using XGBoost. Introduces the use of the XGBoost algorithm for effective AQI prediction

2. Predictive Capabili**ty:** The system forecasts future air quality conditions, enabling users to take preventive measures in advance, unlike traditional systems that only show current data.

3. Singh, R., & Bhardwaj, A., Accurate air pollution prediction using machine learning techniques: A case study. Discusses the use of machine learning methods to improve the accuracy of air pollution prediction.

BIOGRAPHY

I, **BHUKYA RAJA KUMAR**, currently working as Head of the Department (HOD) and Assistant Professor in the Department of Computer Science & Information Technology at Siddharth Institute of Engineering & Technology, Puttur, Andhra Pradesh, India. I completed my M.Tech in Computer Science and Engineering from Gurunanak Engineering College, Ibrahimpatnam and B.Tech in Information Technology from Sreekavitha Engineering College, Khammam, and I am currently pursuing my Ph.D. in Computer Science and Engineering. My research interests include Machine Learning, Artificial Intelligence, and Data Mining. I published research papers, hold IAENG and AICTSD memberships, and qualified APSET-2021, TSSET-2022 and UGC NET-2025.