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IOT BASED AQI MONITORING APP

Submitted in partial fulfilment of the requirements of the

S.E Field Project in

Artificial Intelligence and Data Science

by

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Department of Artificial Intelligence and Data Science

Vivekanand Education Society's Institute of Technology

2024-2025



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Department of Artificial Intelligence and Data Science

CERTIFICATE

This is to certify that **Ms.Hridayaa Borhade, Mr.Tarun Parkar, Ms.Asawari Patil, Ms.Navya Prabhu and Mr.Varun Shivanikar**, of Second Year of Artificial Intelligence and Data Science studying under the University of Mumbai have satisfactorily presented the Field Project entitled **IoT BASED AQI MONITORING APP** as a part of the FIELD PROJECT for Semester-IV under the guidance of **Dr. Mrs. Kanchan Chavan** in the year 2024-2025.

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Head of Department

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DECLARATION

We, **Ms.Hridayaa Borhade, Mr.Tarun Parkar, Ms.Asawari Patil, Ms.Navya Prabhu and Mr.Varun Shivanikar** from **D6ADA**, declare that this project represents our ideas in our own words without plagiarism and wherever others' ideas or words have been included, we have adequately cited and referenced the original sources.

We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our project work.

We declare that we have maintained a minimum 75% attendance, as per the University of Mumbai norms.

We understand that any violation of the above will be cause for disciplinary action by the Institute.

Yours Faithfully

1. _____
2. _____
3. _____
4. _____
5. _____

(Name & Signature of Students with Date)



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ACKNOWLEDGEMENT

We would like to express our heartfelt gratitude to everyone who contributed to the successful completion of our project, **"IoT-Based AQI Monitoring App."**

First and foremost, we extend our sincere appreciation to our faculty members for their invaluable guidance, support, and encouragement throughout the project. Their expertise and constructive feedback played a crucial role in shaping our work.

We are deeply grateful to our mentor for their continuous assistance and insightful suggestions, which greatly enhanced our understanding and execution of the project. Their mentorship was instrumental in refining our approach and overcoming technical challenges.

We also extend our gratitude to the industry professionals who provided us with practical insights and real-world perspectives. Their knowledge and experience enriched our project and helped bridge the gap between theoretical concepts and practical applications.

Lastly, we would like to acknowledge our peers, friends, and family for their unwavering support and motivation. Their encouragement kept us focused and determined throughout this journey.

Thank you all for your invaluable contributions.

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ABSTRACT

Air pollution is no longer just an environmental concern—it's a growing crisis affecting millions of lives daily. Poor air quality contributes to respiratory diseases, cardiovascular conditions, and overall reduced life expectancy. Yet, real-time monitoring remains limited to expensive infrastructure and government networks, leaving the common citizen unaware of the air they breathe. This project aims to bridge that gap by developing an **IoT-based Air Quality Index (AQI) monitoring application**, designed to provide **affordable, real-time, and accessible** air quality data to individuals, researchers, and policymakers.

Our system integrates advanced sensors such as **BME688, MQ135, DHT11, SEN55, and SCD40** to monitor key environmental parameters, including **temperature, humidity, AQI levels, particulate matter (PM2.5, PM10), volatile organic compounds (VOC), nitrogen oxides (NOx), CO₂ levels, and dust concentration**. The collected data is processed and wirelessly transmitted to a **mobile application**, where users can track live readings, visualize trends through interactive graphs, and receive health-based notifications and alerts.

What sets this project apart is the fusion of **IoT, AI, and Data Science** to enhance air quality analysis. Instead of just presenting static readings, our system can **detect patterns, predict pollution trends, and provide early warnings** about hazardous conditions. Additionally, by integrating a **multi-location monitoring feature**, users can compare air quality across different areas, making this solution **highly scalable** for urban planning and community-driven environmental initiatives.

Through this project, we envision a future where individuals are no longer passive observers of air pollution but **active participants in monitoring and mitigating its impact**. By making AQI monitoring **smarter, more accessible, and data-driven**, this application has the potential to revolutionize how we interact with and respond to air quality challenges in real time.



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1.1 Overview of the Project

Air pollution is a silent crisis, affecting millions globally and contributing to severe respiratory diseases, cardiovascular issues, and climate change. With urbanization, industrial expansion, and increasing vehicular emissions, air quality is deteriorating at an alarming rate. While government agencies deploy large-scale AQI monitoring networks, these solutions are often expensive, limited in coverage, and inaccessible to individuals who need localized, real-time data.

This project introduces an IoT-based AQI Monitoring Application that leverages sensor technology, AI, and cloud computing to provide real-time air quality insights. Our system integrates sensors such as BME688, MQ135, DHT11, SEN55, and SCD40 to track temperature, humidity, particulate matter (PM2.5, PM10), CO₂ levels, VOCs, NO_x, and dust concentration. The data is processed and displayed on a mobile application, where users can monitor air quality, receive alerts, and analyze trends through AI-powered predictions.

Unlike traditional monitoring stations, this system is affordable, portable, and scalable, making it useful for individuals, researchers, industries, and smart city initiatives. By democratizing air quality monitoring, this project shifts AQI awareness from passive observation to active decision-making, empowering users to take control of their environment.

1.2 Importance of Real-World Problem Solving

Air pollution is not just an environmental issue—it is a daily reality affecting millions of lives. Prolonged exposure to pollutants like PM_{2.5}, PM₁₀, VOCs, NO_x, and CO₂ leads to serious health complications, from respiratory diseases to neurological disorders. Yet, despite these risks, most people remain unaware of the actual air quality in their surroundings. Existing AQI data is often limited to generalized city-wide averages, which fail to capture local pollution hotspots that can vary significantly within just a few kilometers.

Key Benefits & Impact:

- **Empowering Individuals with Real-Time Data** – Users can track air quality specific to their location, helping them make immediate health-conscious decisions, such as limiting outdoor activity, using air purifiers, or wearing masks when necessary.
- **AI-Powered Predictive Insights** – Instead of merely displaying current AQI levels, the system analyzes trends, detects pollution spikes, and predicts upcoming air quality changes, allowing users to prepare in advance.
- **A Smarter Approach to Smart Cities** – Urban planners and municipal authorities can use live environmental data to identify pollution sources, optimize traffic flow, and enforce better industrial regulations.
- **Industrial Safety & Compliance** – Factories, manufacturing units, and construction sites can monitor emissions in real time, ensuring compliance with environmental laws and safeguarding worker health.
- **Bridging the Knowledge Gap** – Most people understand air pollution as a broad concept, but few have direct, tangible insights into their immediate environment. This app brings personalized air quality awareness to the user's fingertips, making it not just informative but actionable.

Beyond personal use, this system serves as a scalable model for research, policy-making, and public health initiatives. By combining IoT, AI, and real-time analytics, this project shifts air quality monitoring from passive observation to active decision-making, fostering a culture of environmental responsibility and awareness at an individual and societal level.

1.3 Scope of the Project

This project integrates multiple technologies to provide real-time, AI-powered air quality monitoring. The key aspects include:

- Sensor-Based Monitoring – Using advanced sensors to track pollutants, temperature, and humidity.
- IoT & Cloud Integration – Wireless data transmission for real-time updates and remote access.
- Mobile App Development – A user-friendly platform for live AQI readings, alerts, and historical trends.
- AI & Data Science – Predictive modeling to forecast pollution trends and detect anomalies.
- Multi-Location Monitoring – Enabling users to track air quality across different areas.

Broader Impact

This system is more than a monitoring tool—it's a step toward a smarter, healthier, and more informed future. By combining IoT, AI, and real-time analytics, it provides individuals and communities with the data they need to make proactive environmental and health decisions. Whether for personal use, industrial monitoring, or urban planning, this project represents a new era of intelligent air quality management.

2. Objective & Problem Statement

2.1 Clear Definition of the Problem

Air pollution is a growing concern that affects public health, environmental sustainability, and urban development. Despite its severe consequences, real-time, location-specific air quality monitoring remains inaccessible to the majority of people. Government-operated AQI monitoring stations provide city-wide data, but they fail to capture localized variations, leaving individuals, industries, and policymakers without precise, actionable insights.

Key issues include:

- Lack of localized real-time monitoring – Air quality can vary drastically within a small geographic area, yet most available data only provides general city-wide averages.
- Delayed or incomplete pollution data – Many air quality reports rely on periodic sampling rather than continuous real-time updates, making it difficult to respond to sudden pollution spikes.
- Health risks due to unawareness – Individuals, particularly those with respiratory conditions, lack timely information on when and where air quality is hazardous, leading to prolonged exposure to harmful pollutants.
- Industrial non-compliance & urban pollution management – Industries and construction sites contribute significantly to pollution but often lack real-time tracking mechanisms to monitor and mitigate their impact.
- Limited predictive analytics – Existing AQI solutions mainly provide static readings rather than forecasting pollution trends using AI-driven insights.

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2.2 Industry & Sector Challenges Being Addressed

This project tackles challenges across multiple sectors, integrating IoT, AI, and real-time data analytics to create a scalable, innovative, and cost-effective AQI monitoring solution.

Public Health & Individual Safety

- Provides personalized, real-time air quality insights to help individuals adjust outdoor activities, use protective measures, and reduce health risks.
- Generates automated health alerts when pollution levels exceed safe limits.

Urban Planning & Smart Cities

- Helps municipal authorities track pollution sources, regulate traffic emissions, and improve green infrastructure.
- Enables data-driven policymaking for cleaner urban environments.

Industrial & Environmental Compliance

- Assists industries in monitoring air pollution levels in real time, ensuring adherence to environmental regulations.
- Reduces workplace exposure risks for employees in high-pollution environments.

AI-Powered Predictive Analytics

- Uses machine learning models to identify pollution patterns, detect anomalies, and forecast future air quality levels.
- Transforms passive air quality monitoring into a proactive, data-driven approach

5. Proposed Solution

5.1 Description of the Mobile Application Being Developed

The AirAware mobile application is an IoT-powered platform designed to monitor and analyze air quality in real-time. The app provides users with instant access to Air Quality Index (AQI) levels and other environmental parameters, enabling them to make informed decisions about their surroundings.

The application features an intuitive user interface that displays temperature, humidity, AQI levels, and sensor data. The dashboard offers real-time updates collected from connected sensors such as DHT11 and MQ135, ensuring that users receive accurate air quality measurements.

Key functionalities include:

- **User Authentication & Profile Management:** Users can create profiles, log in securely, and manage personal information such as location and contact details.
- **Sensor Integration:** The app communicates with multiple sensors, capturing CO₂ levels, particulate matter (PM2.5, PM10), volatile organic compounds (VOC), and nitrogen oxides (NO_x).
- **Real-Time AQI Meter:** Displays air quality readings categorized into Good, Moderate, Unhealthy, and Very Unhealthy, helping users understand pollution levels.
- **Graphical Data Representation:** Users can visualize AQI trends through interactive graphs, which display fluctuations in pollution over time.
- **Health Notifications & Alerts:** The app provides health recommendations based on AQI levels, advising users to take precautions when necessary.
- **Settings & Customization:** Users can change passwords, adjust appearance settings, and even calibrate sensors for improved accuracy.

By leveraging IoT technology, the AirAware mobile app serves as a powerful tool for individuals, researchers, and policymakers seeking to monitor and mitigate air pollution.

5.2 How AI & Data Science Principles Are Applied

The AirAware app integrates Artificial Intelligence (AI) and Data Science to enhance air quality monitoring beyond traditional sensor-based systems. AI-driven analytics play a crucial role in data processing, pattern recognition, and predictive modeling.

1. Real-Time Data Processing & Anomaly Detection

- The app collects continuous environmental data from multiple sensors, which is then cleaned, filtered, and processed using machine learning algorithms.
- AI-powered models detect abnormal fluctuations in AQI levels, identifying sudden pollution spikes or sensor inaccuracies.

2. Predictive Analysis & Trend Forecasting

- Using historical air quality data, predictive models forecast pollution trends over different timeframes.
- Machine learning algorithms analyze factors such as temperature, humidity, and pollutant levels to estimate future AQI variations.
- These forecasts allow users and policymakers to take proactive measures in mitigating pollution effects.

3. Personalized Health Recommendations

- The system utilizes AI to categorize users based on sensitivity levels (e.g., children, elderly, respiratory patients) and provides tailored recommendations.
- Based on exposure levels, the app suggests wearing masks, staying indoors, or using air purifiers when air quality deteriorates.

4. Multi-Location Data Aggregation

- The app compares AQI levels across multiple locations and uses clustering techniques to identify high-risk areas.
- It enables users to make informed travel or residential decisions based on pollution patterns.

5. Sensor Calibration & Optimization

- AI-driven calibration techniques ensure that sensors maintain optimal accuracy by adjusting to environmental conditions and historical discrepancies.
- This self-learning approach minimizes sensor drift and improves long-term reliability.

By incorporating AI and Data Science, AirAware transforms raw sensor readings into actionable insights, making air quality monitoring smarter and more effective.

5.3 Key Features and Functionalities

The AirAware app is designed with user-centric features that enhance its accessibility, usability, and impact. The key functionalities include:

1. Real-Time Air Quality Monitoring

- Users can track live AQI levels, temperature, humidity, and pollutant concentrations.
- Readings are updated continuously using IoT sensors and cloud-based storage.

2. Interactive AQI Graphs & Visualizations

- The app displays historical AQI trends through visually appealing graphs, allowing users to identify pollution patterns.
- Different pollutants such as PM2.5, PM10, CO₂, NO_x, VOCs can be analyzed separately.

3. Health-Based Notifications & Alerts

- The system provides real-time alerts when air quality reaches hazardous levels.
- Health notifications advise users to take precautions such as avoiding outdoor activities or wearing masks.

4. Sensor Management & Connectivity

- Users can view a list of connected sensors (e.g., DHT11, MQ135) and check their real-time status.
- The app alerts users about sensor malfunctions or calibration requirements.

5. Multi-Location AQI Comparison

- Users can compare air quality in different locations, helping them choose the safest environment.
- Useful for travelers, urban planners, and environmental researchers.

6. Customizable User Experience

- The settings menu allows users to change passwords, update profiles, and customize the app's appearance.
- Users can configure notification preferences based on personal health sensitivity.

7. AI-Powered Predictions

- The app predicts future AQI trends based on historical data, weather conditions, and pollutant levels.
- Helps users prepare for potential pollution surges in their area.

By integrating IoT, AI, and real-time analytics, the AirAware mobile application provides a comprehensive, user-friendly, and intelligent air quality monitoring solution.



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