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AeroSense

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ABSTRACT:

Smart India Hackton

Problem Statement ID:1616

Problem Statement Title:

The technological solutions for capturing AQI values through mobile and other forms of stations

This project investigates the application of drone technology for real-time air quality monitoring, overcoming the drawbacks of fixed monitoring stations, which often provide less representative data due to their stationary placement. By equipping drones with advanced sensors, this system will monitor essential air quality parameters, including particulate matter (PM2.5, PM10), nitrogen dioxide (NO2), sulfur dioxide (SO2), and carbon dioxide (CO2). The mobility of drones enables the collection of extensive air quality data from various locations, offering a more precise depiction of pollution levels affected by factors such as industrial operations and temporary construction.

The gathered data will be sent to a mobile application, allowing users to monitor real-time air quality indices (AQI) and receive notifications about pollution spikes. This project seeks to improve public awareness of air quality while supporting long-term environmental monitoring and research initiatives. This initiative uses drone technology to gather real-time data. It aims to improve public health and support better decisions in ecological policy-making.

Keywords: Air Quality Monitoring, AQI Measurement, IoT Sensors, Real-Time Data, Pollution Detection,

Introduction:

Air pollution is an escalating global issue that profoundly affects public health, climate balance, and urban sustainability. Traditional air quality monitoring stations are effective for localized measurements but often fail to capture real-time fluctuations in pollution levels, especially in dynamic environments such as industrial zones, construction sites, and high-traffic areas. Furthermore, the delayed availability of data hampers prompt intervention and informed decision-making.

Aerosense has created a drone-based mobile air quality monitoring system that provides real-time, high-resolution pollution detection. By combining advanced air sensors (BME 680) with autonomous drones, the system can gather, analyze, and transmit AQI data from various locations. AI algorithms process the collected data to detect pollution patterns, pinpoint hazardous zones, and trigger automated alerts for rapid emergency response.

Literature Review :

Air Pollution Monitoring Systems

Several studies highlight the importance of air quality monitoring in tackling increasing pollution concerns. While traditional monitoring stations operated by government agencies offer reliable data, their fixed locations restrict comprehensive coverage. Mobile sensor-based solutions, such as drones and IoT-based monitoring, have proven to be effective alternatives. Researchers have emphasized the advantages of real-time data collection, broad spatial coverage, and automated processing in mobile air quality monitoring.

Drone-Based Sensing Technologies

Drones equipped with air quality sensors have gained recognition for their capability to effectively monitor large areas. Studies indicate that drones can be equipped with sensors for PM2.5, CO2, NOx, and SO2 to monitor pollution levels effectively. Studies also examine factors influencing drone performance, including altitude, flight patterns, and sensor precision. Drone-based systems offer enhanced flexibility and scalability in environmental monitoring compared to fixed monitoring stations.

Emergency Response Integration

Contemporary environmental monitoring systems are progressively adopting emergency response features. Research indicates that linking real-time alerts with government agencies, such as fire departments, health ministries, and law enforcement, can improve disaster management. Studies on IoT-based emergency response frameworks suggest that automated alerts can greatly enhance Response times for fire incidents., hazardous gas leaks and air pollution-related health threats.

Data Processing and Analytics

Machine learning and large-scale data analytics "play an important role" in air quality monitoring. Numerous studies investigate predictive models for air quality forecasting and anomaly identification. Researchers highlight the significance of cloud-based data processing and edge computing for efficiently managing large-scale environmental data. The application of AI in detecting pollution sources and analyzing trends is a growing research field relevant to Aerosense.

Government Regulations and Policies

Following environmental rules is vital for air quality monitoring systems. Various global and national rules set limits on air pollution and safe exposure levels. Research on environmental policies stresses the need for accurate data, public access, and standard rules in air quality monitoring.

Conclusion:

Aerosense has been verified as an innovative and practical system for air quality monitoring and emergency response, according to reviewed research. By utilizing drone-based sensing, real-time data processing, and automated alerts, Aerosense effectively addresses the limitations of traditional monitoring systems. Future studies should aim to improve sensor accuracy, follow regulations, and enhance AI-driven data analysis for better system performance.

Discussion and Methodology :

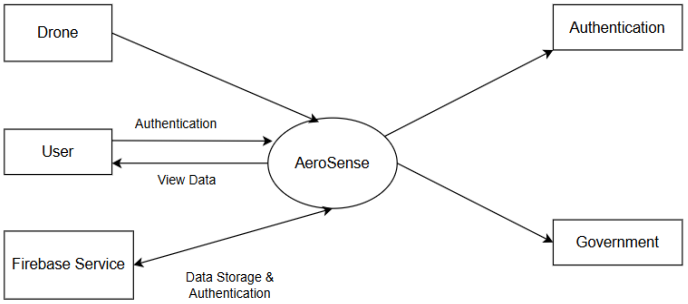

Figure 1. DFD 0

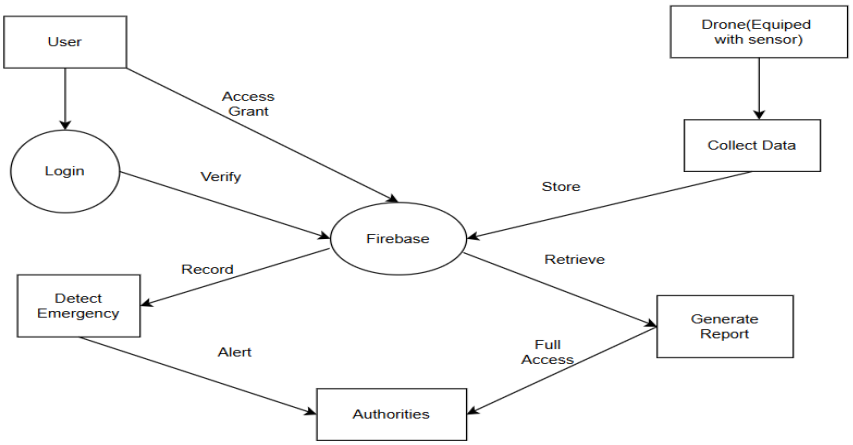

Figure 2. DFD 1

The Data Flow Diagram (DFD) for the AeroSense project shows how data moves between different parts of the system, including users, processes, and storage. The data flows in this order:

1. **User Login & Authentication:**

- The user starts by logging into the system
- The login process checks the user's details and sends a request to Firebase for authentication.
- If the verification is successful, Firebase allows the user to access the system.

2. **Data Collection by Drone:**
- The Drone (equipped with sensors) collects real-time air quality data, including pollution levels and AQI values.
- The data we collect is sent to Firebase for storage and further processing.

3. **Data Storage & Retrieval:**
- If the verification is successful, Firebase grants the user access to the system.
- This data is accessible and can be used to create reports and analyze trends.

4. **Emergency Detection Process:**
- The Detect Emergency module constantly checks the stored data.
- If pollution levels transcend set limits, the system logs the emergency and alerts the authorities.

5. **Report Generation:**
- The Generate Report process collects air quality data from Firebase and creates detailed reports.
- These reports help users and authorities track pollution trends and take necessary actions.

6. **Authorities Access & Alerts:**
- Authorities get emergency alerts from Firebase when dangerous pollution levels are located.

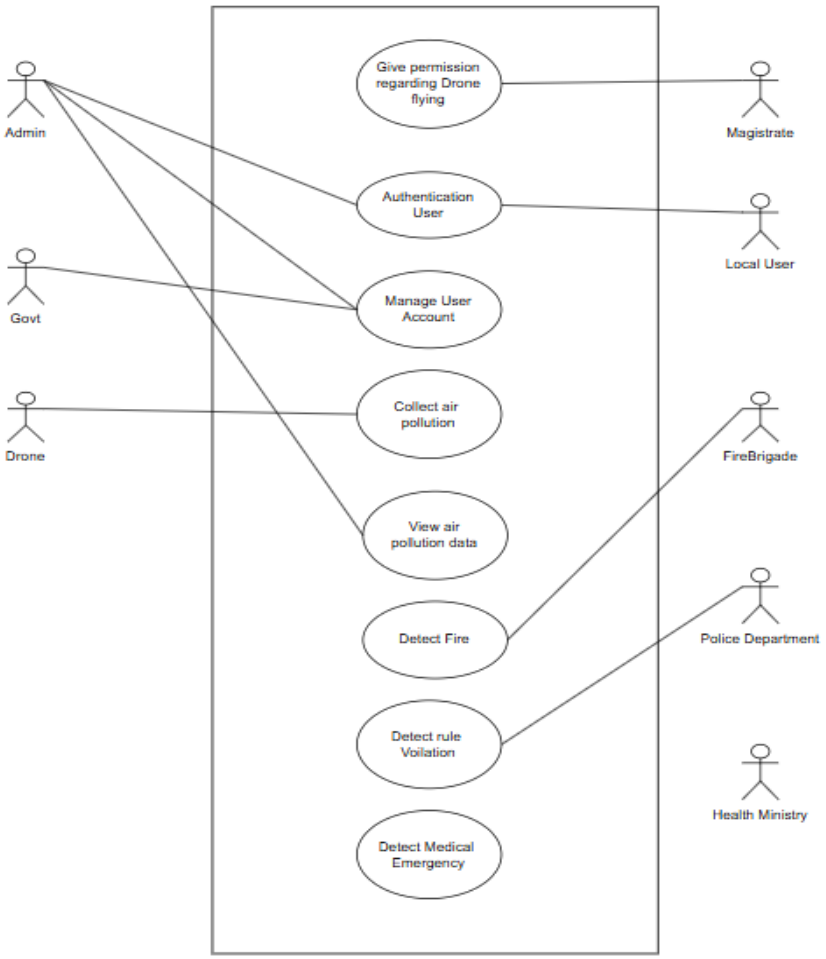

Figure 3. Use Case Diagram

Conclusion :

The AeroSense project introduces a novel method for real-time monitoring of the Air Quality Index (AQI) using drones equipped with pollution sensors. By integrating IoT data collection, GPS tracking, and cloud analytics, the system provides accurate air quality readings for specific locations. This solution overcomes the limits of traditional AQI monitoring, like fixed sensors and delayed reports, by providing real-time data from different locations. This project can greatly help environmental agencies, policymakers, and researchers combat air pollution more effectively.

Future improvements may include AI-based predictions, better drone automation, and integration with government pollution control systems to enhance air quality monitoring and decision-making. The AeroSense project is a major step toward smarter and more efficient environmental monitoring in cities and industrial areas.

Acknowledgment

We sincerely thank everyone who helped make the AeroSense project a success. First, we deeply appreciate our guide and faculty members Thank you for your support, encouragement, and technical guidance throughout the project. Their knowledge was essential in shaping our ideas and improving our approach.

We also thank our institution for giving us the resources and a platform to develop and apply innovative solutions. A heartfelt thank you to our team for their hard work, collaboration, and dedication in overcoming challenges to make this project successful.

Finally, we sincerely thank our family and friends for their unwavering support and encouragement, which kept us motivated and focused on our goal. This project has been a great learning experience, and we look forward to improving our work in air quality monitoring and protecting the environment.

REFERENCES :

1 Books:

1. Rao, C. Environmental Pollution and Monitoring Techniques.
2. Sharma, R. Internet of Things for Smart Cities: Concepts and Applications.

2 Web Resources:

1. World Health Organization (WHO) – Global Air Quality Guidelines (https://www.who.int/health-topics/air-pollution)
2. Environmental Protection Agency (EPA) – Air Quality Monitoring Standards (https://www.epa.gov/air-research)

3 Software & Tools:

1. Programming Languages: Python, PHP, JavaScript
2. IoT Platforms: Arduino, Raspberry Pi, ESP8266 for sensor integration
3. Cloud Services: Firebase, AWS IoT Core for real-time data analytics