Integrated Air Quality and Weather Prediction System with Real-Time Dashboard

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***Abstract*—In modern urban environments, air pollution and unpredictable weather conditions have become major concerns affecting human health and daily life. Traditional environmental monitoring systems mainly depend on separate platforms and manual observation methods, which often create limitations in accessibility, real-time monitoring, data visualization, and public awareness. Due to rapid industrialization, increasing vehicle emissions, and climate changes, it becomes difficult for users to obtain accurate and combined environmental information efficiently using conventional methods [1]. The lack of integrated monitoring systems also affects decision-making and environmental awareness among people.**

Recent advancements in web technologies, API integration systems, and real-time data visualization techniques have enabled the development of intelligent environmental monitoring platforms [2]. Modern dashboards allow users to monitor air quality parameters such as AQI, PM2.5, PM10, temperature, humidity, and weather conditions through responsive web interfaces. These systems improve accessibility, reduce manual effort, and provide efficient real-time environmental monitoring [3]. However, many existing systems mainly focus on either weather forecasting or air quality monitoring separately and do not provide a centralized platform with interactive visualization, responsive UI, and efficient real-time integration.

The proposed Integrated Air Quality and Weather Prediction System with Real-Time Dashboard is designed as a centralized web-based platform that integrates real-time weather monitoring, air quality analysis, interactive visualization, and API-based environmental data management into one system. The platform provides responsive environmental monitoring and dynamic visualization facilities using modern web technologies. It also includes centralized dashboard functionalities for displaying AQI levels, weather conditions, pollutant values, temperature, humidity, and graphical analysis in a simple and user-friendly interface.

Keywords— Air Quality Monitoring, Weather Prediction, Real-Time Dashboard, AQI, API Integration, Node.js, Environmental Monitoring, Web Application

I. INTRODUCTION

A. Background

Air pollution and changing weather conditions have become major concerns in modern urban environments. Real-time monitoring and visualization of environmental data are essential for increasing public awareness and enabling informed decision-making. Traditional environmental monitoring systems mainly depend on separate platforms and manual observation methods, which often create limitations in accessibility, real-time monitoring, and data visualization. Due to rapid industrialization, increasing vehicle emissions, and environmental changes, it becomes difficult for people to access accurate and combined environmental information efficiently using conventional methods.

Recent advancements in web technologies, API integration systems, and real-time data visualization techniques have enabled the development of intelligent environmental monitoring systems. Modern dashboards allow users to monitor air quality parameters such as AQI, PM2.5, PM10, temperature, humidity, and weather conditions through responsive web interfaces. These systems improve accessibility, reduce manual effort, and provide efficient real-time environmental monitoring.

Modern environmental monitoring applications also support advanced functionalities such as dynamic visualization, centralized dashboard systems, API-based live data fetching, and responsive user interfaces. These technologies improve operational efficiency and help users monitor environmental conditions effectively.

B. Problem Statement

Many traditional environmental monitoring systems and existing platforms still face challenges related to real-time data integration, interactive visualization, and centralized monitoring facilities. Users often need to access multiple platforms separately for weather information and air quality monitoring, which reduces efficiency and user convenience. Some existing systems also lack responsive interfaces, real-time updates, and proper graphical representation of environmental data.

The absence of a centralized platform for monitoring both weather conditions and air quality affects public awareness and environmental decision-making. Many systems fail to provide accurate real-time visualization, efficient API integration, and smooth user interaction. In addition, some applications are difficult to maintain and scale due to inefficient backend architecture and complex data handling mechanisms.

Therefore, there is a need for a modern, lightweight, scalable, and user-friendly environmental monitoring system capable of integrating real-time weather and air quality information into a single dashboard efficiently.

C. Objectives

The major objective of the proposed Integrated Air Quality and Weather Prediction System with Real-Time Dashboard is to develop a lightweight, scalable, and user-friendly web platform using modern web technologies. The system aims to provide efficient environmental monitoring through real-time weather and air quality data visualization.

The application is designed to improve environmental awareness through responsive interfaces, real-time API integration, and interactive graphical visualization. It also aims to simplify environmental monitoring operations by integrating weather information and AQI monitoring into a centralized dashboard system.

Another important objective of the proposed system is to reduce manual monitoring effort, improve accessibility to environmental data, and support efficient real-time visualization. The system also focuses on maintaining smooth communication between frontend, backend, and external APIs to improve overall system reliability and performance.

D. Scope of the Project

The proposed Integrated Air Quality and Weather Prediction System with Real-Time Dashboard is designed as a centralized web-based platform that integrates weather monitoring, air quality analysis, API-based data collection, and graphical visualization into one system. The platform allows users to search for cities and monitor environmental conditions efficiently through an interactive dashboard.

The system supports responsive web interfaces for accessing the platform across different devices such as desktops, laptops, tablets, and smartphones. It is suitable for smart city monitoring, public environmental awareness systems, educational purposes, and modern environmental monitoring applications requiring real-time data analysis and visualization.

The architecture also supports future enhancements such as AI-based weather prediction, machine learning analytics, IoT sensor integration, mobile application support, cloud deployment, and advanced visualization techniques. The modular design of the application improves scalability, maintainability, and future adaptability for evolving technological requirements.

II. LITERATURE REVIEW

A. Existing Air Quality and Weather Monitoring Systems

Modern environmental monitoring systems have significantly improved real-time monitoring of air quality and weather conditions through digital platforms and API-based technologies. Many existing systems allow users to monitor environmental parameters such as Air Quality Index (AQI), temperature, humidity, PM2.5, PM10, and weather conditions efficiently. These systems improve public awareness and reduce manual effort in environmental monitoring operations.

Many existing applications also provide functionalities such as weather forecasting, pollutant analysis, real-time alerts, graphical visualization, and location-based monitoring services. Popular platforms such as OpenWeatherMap, IQAir, and AirVisual have demonstrated the effectiveness of real-time environmental monitoring systems in handling large-scale weather and pollution data efficiently. These systems support environmental awareness and improve accessibility for users across different geographical regions.

However, several existing systems still face limitations related to data integration, user experience, visualization efficiency, and centralized monitoring facilities. Some platforms become difficult to maintain due to complex backend structures and inefficient data management techniques. In certain cases, users experience issues related to delayed data updates, poor graphical representation, and limited accessibility across different devices. Security challenges and dependency on multiple external services also remain important concerns in modern environmental monitoring systems.

Traditional environmental monitoring platforms also depend heavily on separate infrastructures for weather forecasting and air quality analysis, which creates operational complexity and reduces user convenience. Therefore, researchers and developers continuously focus on improving system architecture, real-time visualization, and user interaction within modern environmental monitoring applications.

B. Modern Web Technologies

Recent advancements in modern web technologies have enabled the development of scalable, responsive, and interactive environmental monitoring systems. Technologies such as HTML, CSS, JavaScript, Node.js, Express.js, and Chart.js are widely used for building real-time web applications because of their flexibility, efficiency, and scalability.

Modern frontend technologies provide responsive and dynamic user interfaces that improve user interaction and application performance. Component-based and modular frontend development simplifies dashboard management and enhances maintainability for large-scale applications. Backend technologies such as Node.js and Express.js support efficient API handling and server-side operations, enabling fast communication between frontend interfaces and external environmental APIs.

Real-time APIs such as OpenWeatherMap and Open-Meteo provide flexible and efficient environmental data management for handling weather details, AQI values, and pollutant information dynamically. Unlike traditional static systems, API-based architectures improve scalability and support efficient real-time data communication. Data visualization libraries such as Chart.js further improve system usability by transforming complex environmental data into graphical and interactive representations.

Modern web technologies also support responsive web design, cross-platform accessibility, real-time communication, and lightweight application development. These advancements enable developers to build scalable, efficient, and user-friendly environmental monitoring systems capable of supporting future technological enhancements.

C. Research Gap

Although many existing environmental monitoring systems provide weather forecasting or air quality monitoring functionalities, several platforms still lack efficient real-time integration, responsive interfaces, centralized dashboards, and interactive visualization mechanisms. Some traditional systems are difficult to maintain and scale due to inefficient backend architectures and poor data handling mechanisms.

Many platforms mainly focus on either weather monitoring or air quality analysis separately without providing a complete integrated environmental monitoring solution. Existing systems also face limitations in handling real-time visualization, responsive dashboard management, and efficient API communication within a single scalable platform.

Several applications fail to provide seamless integration between frontend interfaces, backend servers, and external environmental APIs, which affects overall system performance and user experience. Some systems also lack responsive design support for different devices and screen sizes, limiting accessibility for users.

Therefore, there is a need for a lightweight, scalable, and user-friendly environmental monitoring system that integrates modern web technologies for efficient real-time weather and air quality monitoring. The proposed system aims to address these limitations by providing responsive frontend interfaces, efficient backend communication, centralized dashboard facilities, and interactive graphical visualization within a single scalable architecture.

III. SYSTEM OVERVIEW

A. Proposed System

The proposed Integrated Air Quality and Weather Prediction System with Real-Time Dashboard is designed as a centralized web-based platform that provides real-time environmental monitoring services for users through interactive dashboard visualization. The system integrates frontend interfaces, backend APIs, external environmental APIs, and graphical visualization technologies into a single platform. The primary objective of the proposed system is to simplify environmental monitoring operations while improving accessibility, visualization efficiency, and public awareness.

The application allows users to search for cities, monitor weather conditions, view Air Quality Index (AQI) levels, and analyse environmental parameters such as PM2.5, PM10, temperature, humidity, CO, NO_2, and SO_2 efficiently. The proposed system also provides responsive dashboard visualization and real-time API-based environmental monitoring facilities to improve user convenience and operational efficiency. Users can access the platform through responsive web interfaces from different devices such as desktops, laptops, tablets, and smartphones.

The system also supports centralized management of environmental data visualization, API communication, and dynamic graphical analysis through the dashboard interface. Automated real-time data fetching and interactive visualization reduce manual monitoring effort and improve overall environmental awareness. The proposed platform is designed to support future scalability and advanced feature integration in modern environmental monitoring environments.

B. System Architecture

The proposed system follows a lightweight web-based architecture consisting of frontend technologies for dashboard visualization, backend technologies for API communication, and external APIs for environmental data collection. The architecture follows a client-server structure including presentation layer, application layer, and API integration layer. This layered architecture improves maintainability, scalability, and system performance.

The frontend layer provides responsive dashboard interfaces for users. HTML, CSS, and JavaScript are used for developing dynamic and interactive interfaces that improve user interaction and application responsiveness. The frontend communicates with backend services through HTTP requests for handling user operations such as city-based search, dashboard updates, and environmental data visualization.

The backend layer handles API communication, data processing, and environmental data management operations. Node.js and Express.js are used to develop server-side functionalities and API handling mechanisms efficiently. The backend acts as an intermediary between frontend interfaces and external environmental APIs.

The external API layer provides real-time weather and air quality data for the application. APIs such as OpenWeatherMap and Open-Meteo are used for retrieving temperature, humidity, AQI values, pollutant levels, and weather conditions dynamically. Secure API communication and structured data handling improve overall system reliability and operational efficiency.

C. Key Features

The Integrated Air Quality and Weather Prediction System provides several important features that improve environmental monitoring efficiency and user experience. The system supports responsive dashboard visualization, city-based search functionality, real-time weather monitoring, AQI analysis, pollutant tracking, and graphical environmental data representation.

Users can monitor environmental conditions efficiently through interactive charts, visual cards, and responsive dashboard interfaces. Real-time API integration allows users to access accurate environmental information dynamically through graphical visualization techniques.

The application also includes centralized dashboard functionalities for monitoring AQI levels, temperature, humidity, PM2.5, PM10, CO, NO_2, and SO_2 values efficiently. Additional features such as responsive design, lightweight architecture, secure API communication, scalable system design, and dynamic graphical visualization improve application performance and reliability.

These functionalities make the proposed system suitable for smart environmental monitoring, educational analysis, public awareness systems, and modern real-time environmental management applications.

D. User Modules

The system mainly consists of user and system monitoring modules. The user module allows users to search for cities, monitor weather conditions, analyse AQI levels, view pollutant values, and access graphical environmental reports through the dashboard interface. Users can also interact with charts and visualization components for better environmental analysis.

The system monitoring module handles API communication, environmental data fetching, backend processing, and dashboard visualization operations efficiently. It manages real-time environmental data processing and graphical representation through the centralized dashboard interface.

Structured communication between frontend interfaces, backend services, and external APIs ensures smooth system operations and efficient environmental monitoring. The separation of user interaction and backend processing modules improves operational management and overall system performance within the application.

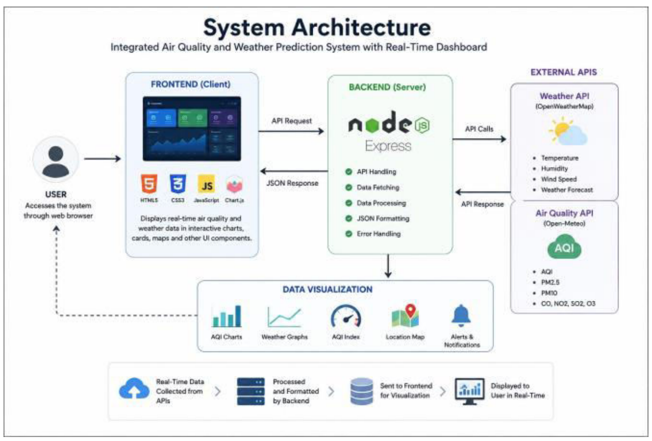

Fig. 1. System Architecture Diagram

IV. METHODOLOGY

A. Workflow of the System

The proposed E-Commerce Web Application follows a structured workflow for handling product browsing, user authentication, shopping cart management, order processing, and payment integration. The workflow begins when users access the platform, browse products, and search for required items. After selecting products, users can add items to the shopping cart and proceed to checkout for order confirmation.

The system verifies user authentication before processing sensitive operations such as order placement and payment transactions. Once payment verification is completed successfully, the order details are stored in the database, and the administrator can monitor transaction activities through the admin dashboard. The workflow ensures smooth communication between frontend interfaces, backend APIs, payment gateways, and the MongoDB database.

The structured workflow improves operational efficiency, reduces manual effort, and enhances the overall shopping experience for customers. The integration of automated processes also improves transaction reliability and order management within the platform.

B. Authentication Process

The authentication process ensures secure access to the platform by validating user credentials during registration and login. Secure authentication mechanisms are implemented to protect user accounts and transaction information. The system also supports role-based access control for customers and administrators.

During registration, user details are securely stored in the MongoDB database after validation. During login, the system verifies credentials and grants authorized access to application functionalities. Authentication tokens and secure session management techniques are used to improve security and prevent unauthorized access.

The authentication module also supports password encryption and secure API communication for protecting customer information and transaction records. These security mechanisms improve overall system reliability and customer trust within the platform.

C. Product Management Process

The product management process allows administrators to add, update, delete, and organize products efficiently through the admin dashboard. Product details such as category, pricing, stock information, descriptions, and images are stored securely in the MongoDB database for efficient retrieval and management.

D. Payment Processing Methodology

The payment processing methodology integrates secure online payment gateways for handling customer transactions. During checkout, users can complete payments securely through integrated payment services such as Razorpay. The system verifies payment status and updates order records automatically after successful transactions.

E. Use Case Diagram

The Use Case Diagram represents the interaction between users and the E-Commerce Web Application. It describes how customers and administrators interact with different functionalities such as product browsing, authentication, cart management, order processing, payment handling, and admin management.

The customer entity interacts with the system for registration, login, product searching, shopping cart management, and online transactions. The administrator entity manages products, users, inventory records, orders, and overall business operations through the admin dashboard. The use case model helps in understanding system functionalities and operational workflows efficiently.

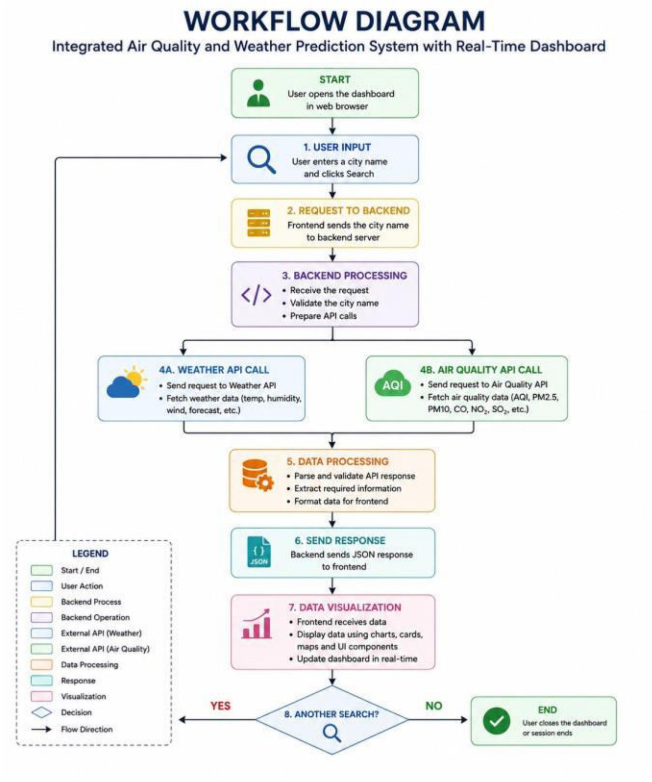

Fig. 2. Workflow Diagram

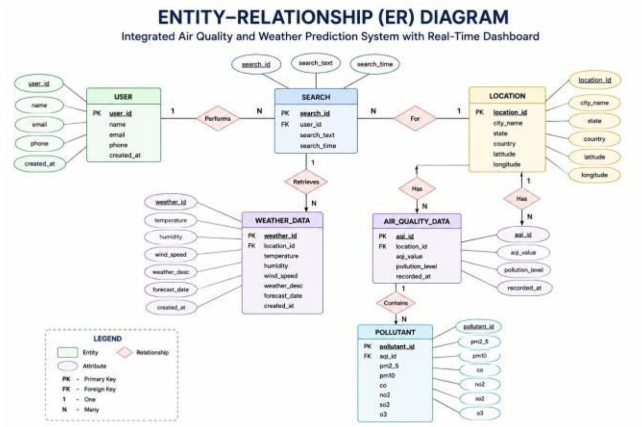

Fig. 3. ER Diagram

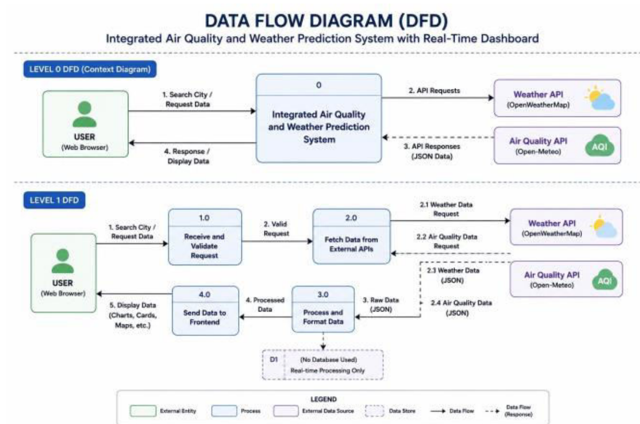

Fig. 4. DFD Diagram

V. System Design

A. Use Case Diagram

The Use Case Diagram represents the interaction between users and the Integrated Air Quality and Weather Prediction System with Real-Time Dashboard. It describes how users interact with different functionalities such as city search, weather monitoring, AQI analysis, pollutant visualization, and dashboard interaction.

The use case design improves system understanding by representing user interactions and environmental monitoring operations graphically. It simplifies requirement analysis and supports efficient dashboard development processes.

B. System Design

The system design manages environmental data collection, API communication, backend processing, and dashboard visualization efficiently. The application uses frontend technologies, backend services, and external APIs to provide real-time environmental monitoring operations.

C. Data Flow Diagram

The Data Flow Diagram (DFD) represents the flow of information between users, frontend interfaces, backend services, external APIs, and dashboard visualization modules. It explains how environmental data such as AQI levels, weather conditions, pollutant values, and temperature information are processed within the system.

D. Class Diagram

The Class Diagram represents the structure of the system and relationships between different classes such as User, WeatherData, AQIData, APIHandler, Dashboard, and Visualization modules. It helps in understanding the object-oriented structure of the application.

The class diagram simplifies application development and improves maintainability through modular object-oriented design principles.

VI. Implementation

A. Frontend Implementation

The frontend of the Integrated Air Quality and Weather Prediction System with Real-Time Dashboard is developed using HTML, CSS, and JavaScript to provide responsive and interactive dashboard interfaces. The frontend handles city-based search functionality, environmental data visualization, AQI monitoring, weather analysis, and graphical dashboard operations efficiently.

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Fig. 5. Homepage Interface

B. Backend Implementation

The backend is implemented using Node.js and Express.js. It manages API communication, environmental data processing, dashboard updates, and real-time data handling functionalities efficiently.

C. API Integration Implementation

The system uses external APIs for collecting real-time environmental data such as AQI values, temperature, humidity, weather conditions, PM2.5, PM10, CO, NO_2, and SO_2 levels. API responses are received in JSON format and processed before being displayed on the dashboard interface.

Secure API communication mechanisms are implemented to ensure smooth environmental data retrieval and efficient dashboard updates. Error-handling techniques are also used to manage invalid responses and failed API requests effectively.

D. Visualization Implementation

The system integrates Chart.js and graphical dashboard components for representing environmental data visually. Interactive charts and visual cards are used to display AQI trends, pollutant levels, temperature analysis, and weather information dynamically.

E. Dashboard Interface

The dashboard interface provides centralized visualization for monitoring environmental conditions efficiently. Users can search for cities, monitor AQI levels, analyse weather conditions, and view pollutant information through graphical components and responsive dashboard cards.

VII. RESULTS AND ANALYSIS

A. Dashboard Results

The developed Integrated Air Quality and Weather Prediction System successfully displays real-time environmental information through an interactive dashboard interface. The system efficiently presents AQI levels, weather conditions, temperature, humidity, PM2.5, PM10, CO, NO_2, and SO_2 values dynamically for different cities.

The implemented dashboard interface ensures responsive visualization, real-time updates, and smooth user interaction within the platform. Users can monitor environmental conditions efficiently through graphical charts, visual cards, and interactive dashboard components.

B. Environmental Data Monitoring Results

The environmental monitoring module successfully handles real-time API communication, environmental data retrieval, pollutant analysis, and weather monitoring operations. The backend efficiently processes API responses and updates dashboard visualization dynamically.

The system allows efficient monitoring of AQI levels, weather conditions, and pollutant values through centralized dashboard functionalities. Real-time environmental monitoring improves operational efficiency and public awareness regarding environmental conditions.

C. Visualization Analysis

The visualization module successfully represents environmental information through interactive charts and graphical dashboard components using Chart.js integration. The system dynamically updates graphical representations based on user search operations and API responses.

Graphical visualization improves readability of complex environmental data and enhances user understanding of AQI trends, pollutant analysis, and weather conditions. Interactive dashboard interfaces also improve user engagement and operational accessibility within the application.

D. Performance Analysis

The developed Integrated Air Quality and Weather Prediction System provides responsive user interaction, efficient backend communication, and lightweight API-based environmental monitoring operations. The web-based architecture improves scalability, dashboard performance, and overall system reliability.

The frontend provides smooth graphical visualization while the backend ensures efficient API communication and structured environmental data processing. The lightweight system architecture also reduces operational complexity and improves real-time dashboard efficiency.

Feature	Traditional System	Proposed System
Environmental Monitoring	Separate Platforms	Integrated Dashboard
Data Updates	Delayed	Real-Time Updates
Visualization Method	Basic Text Format	Interactive Charts
User Experience	Limited	Responsive Interface
Accessibility	Limited Devices	Multi-Device Support
Data Handling	Manual Monitoring	Automated API Integration
System Architecture	Complex	Lightweight Architecture

Table 1. Performance Comparison

Table I shows the comparison between traditional environmental monitoring systems and the proposed Integrated Air Quality and Weather Prediction System. The proposed system provides integrated environmental monitoring, real-time API-based updates, interactive graphical visualization, lightweight architecture, responsive dashboard interfaces, and efficient environmental data handling compared to traditional monitoring methods.

VIII. DISCUSSIONS

A. Advantages of the System

The proposed Integrated Air Quality and Weather Prediction System with Real-Time Dashboard provides several advantages over traditional environmental monitoring systems and existing monitoring platforms. The system offers a responsive and user-friendly dashboard interface that allows users to monitor AQI levels, weather conditions, pollutant values, and environmental parameters efficiently. Real-time API integration and interactive graphical visualization improve environmental awareness and enhance user experience.

The centralized dashboard simplifies environmental monitoring, data visualization, and API communication processes. The use of modern web technologies improves application scalability, performance, and maintainability. Automated real-time data fetching and graphical analysis also reduce manual monitoring effort and operational complexity for users.

The platform supports efficient environmental data processing and secure API communication, which improves overall system reliability. Responsive frontend implementation ensures compatibility across multiple devices and screen sizes, providing better accessibility for users.

B. Limitations

Although the proposed system provides several advantages, certain limitations still exist. The application depends heavily on internet connectivity for accessing environmental data, performing API communication, and updating dashboard visualization. Poor internet connectivity may affect real-time monitoring efficiency and overall user experience.

The current system mainly focuses on real-time environmental monitoring functionalities and does not include advanced AI-based prediction systems or machine learning analytics features. Large-scale deployment may also require advanced cloud infrastructure and additional optimization mechanisms to handle high-frequency API requests and large volumes of environmental data efficiently.

The system currently supports limited external API integrations and may require additional improvements for enterprise-level environmental monitoring operations. Future enhancements in scalability, predictive analytics, and advanced visualization can further improve overall system performance.

C. Real-world Applicability

The proposed Integrated Air Quality and Weather Prediction System can be used effectively in various real-world environments such as smart cities, educational institutions, environmental monitoring centers, research organizations, and public awareness systems. The platform provides an efficient solution for monitoring air quality and weather conditions through centralized dashboard visualization and real-time environmental data analysis.

The application is suitable for organizations and users that require real-time environmental monitoring, pollutant analysis, and weather visualization for improving environmental awareness and operational decision-making. The scalable architecture also makes the system adaptable for future technological expansion and advanced feature integration.

D. Scalability and Future Improvements

The lightweight web-based architecture used in the proposed system provides high scalability and flexibility for future enhancements. Additional features such as AI-based weather prediction systems, machine learning analytics, cloud deployment, IoT sensor integration, mobile application support, and advanced environmental visualization can be integrated into the platform without affecting the existing architecture.

Future improvements may also include advanced analytics dashboards, heatmap visualization, real-time environmental alerts, multilingual support, enhanced API optimization mechanisms, and predictive environmental analysis systems. These enhancements will improve user experience, operational efficiency, and overall platform reliability in large-scale environmental monitoring environments.

IX. FUTURE SCOPE

A. AI-Based Environmental Prediction

Future improvements of the proposed Integrated Air Quality and Weather Prediction System may include AI-based environmental prediction systems for providing advanced forecasting and intelligent environmental analysis. Machine learning algorithms can analyse historical AQI data, weather conditions, pollutant levels, and environmental patterns to predict future air quality and weather conditions automatically.

Advanced AI technologies may also support predictive analytics for identifying pollution trends, climate variations, and environmental risk conditions. These features can help improve public awareness, environmental planning, and smart city management operations efficiently.

B. Mobile Application Support

The current system is implemented as a web-based application; however, future development may include dedicated mobile applications for Android and iOS platforms. Mobile application support will improve accessibility and allow users to monitor AQI levels, weather conditions, pollutant values, and environmental alerts directly from smartphones and tablets.

Mobile integration can also provide push notifications, real-time environmental updates, personalized monitoring facilities, and improved user interaction. A mobile-friendly ecosystem will further increase platform usability and public accessibility in modern environmental monitoring environments.

C. Cloud Deployment

Future deployment of the proposed system on cloud platforms can improve scalability, availability, security, and performance. Cloud-based infrastructure can support large numbers of users, high-frequency API requests, and real-time environmental data synchronization efficiently.

Cloud deployment technologies such as AWS, Microsoft Azure, or Google Cloud Platform can provide better resource management, automated backups, distributed storage, and improved system reliability. Cloud hosting can also simplify maintenance processes and enhance application performance for large-scale environmental monitoring operations.

D. IoT Sensor Integration

The proposed system can be further extended through IoT sensor integration for collecting highly accurate and localized environmental data. IoT devices can monitor environmental parameters such as AQI, PM2.5, PM10, humidity, temperature, and gas concentrations directly from physical locations in real time.

The integration of IoT-based monitoring systems can improve environmental data accuracy and support smart city environmental management operations. Future enhancements may also include sensor analytics dashboards, real-time environmental alert systems, location-based monitoring services, and intelligent environmental control mechanisms.

Additional future enhancements may include chatbot integration, multilingual support, heatmap visualization, real-time environmental alerts, advanced cybersecurity mechanisms, machine learning analytics, augmented reality-based environmental visualization, and predictive environmental monitoring systems. These technologies can further improve public awareness, operational efficiency, and environmental monitoring capabilities in future smart environments.

X. CONCLUSION

The proposed Integrated Air Quality and Weather Prediction System with Real-Time Dashboard provides a modern, lightweight, and scalable solution for real-time environmental monitoring environments. The system successfully integrates weather monitoring, AQI analysis, environmental data visualization, API communication, and interactive dashboard functionalities into a single platform. The implementation of modern web technologies improves system performance, flexibility, maintainability, and scalability for real-time environmental monitoring operations.

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