The Air Pollution AQI Website

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Abstract

The Air Pollution AQI Website is an interactive, actual-time net software designed to offer complete air nice statistics throughout a couple of places. Using reliable public APIs together with OpenWeatherMap and IQAir, the system can provide real-time statistics on most important air pollutants together with PM2.Five, PM10, Carbon Monoxide (CO), Nitrogen Dioxide (NO₂), and Ozone (O₃). The platform functions dynamic visualizations along with charts, interactive maps, and coloration-coded AQI indicators, allowing customers to effortlessly interpret air great conditions. Users can carry out town-based totally searches, examine pollutant-specific records, and access health advisories based totally on real-time AQI values. The responsive and user-pleasant interface ensures accessibility across diverse gadgets, assisting knowledgeable choice-making concerning out of doors sports. Beyond statistics presentation, the machine goals to raise public attention approximately the fitness influences of air pollution and inspire environmentally accountable conduct. The scalable layout permits future improvements including GPS-based tracking, historical fashion evaluation, and integration with IoT-enabled air first-class sensors. Overall, the application serves as a powerful virtual tool for environmental recognition and proactive air first-class management.
Keywords: Air quality index; Environmental awareness; Pollution monitoring system; Real-time data; Web application.

1. Introduction

One of the largest problems with the surroundings and public health today is air pollution. Every day, thousands and thousands of humans breathe in dangerous air without even knowing it. Pollutants like PM2.5, PM10, carbon monoxide, nitrogen dioxide, and ozone can purpose serious fitness troubles like bronchial asthma, lung infections, heart disorder, or even respiratory issues that last for a long term [1,2]. A lot of humans don't know while the air round them is risky due to the fact these pollutants are regularly hard to look. Because of this, there may be a strong need for a reliable device which can tell humans approximately the air great in actual time. The motivation at the back of the Air Pollution AQI Website assignment is to assist bridge this information hole and protect public health. The undertaking ambitions to provide users with speedy, accurate, and easy-to-recognize air quality information for any city they look for. People could make better alternatives approximately what to do outdoor and a way to live secure by means of being capable of see pollutants levels all of the time. For instance, mother and father can test the AQI before letting their youngsters play outside, and people with breathing troubles can stay far from polluted regions at certain times. This website gathers real-time AQI statistics from diverse monitoring stations the use of dependable public APIs like OpenWeatherMap and IQAir. The platform uses React.Js to display this data in a modern-day, interactive inter-face that features perfectly across all systems, inclusive of cell phones [3-5]. The machine suggests whether or not the air is hazardous or secure the use of colour-coded signs. This gets rid of the need for technical understanding and permits users to quickly assess the degree of danger. The following pollutants are critical components of the AQI:

- PM2.5 & PM10: Particulate matter that poses significant respiratory risks.
- NO2: A gas linked to respiratory issues.
- Ozone (O3): Harmful at ground level, contributing to respiratory problems.

- CO: A toxic gas from incomplete fuel combustion.
- SO2: A gas contributing to respiratory issues and acid rain.
- NH3: A compound from agricultural and industrial sources affecting air quality.

The website offers useful statistics approximately major pollution and their fitness outcomes similarly to showing AQI values. Users can more effortlessly discover statistics visually with interactive charts, graphs, and maps. Another useful characteristic is the capability to view ancient information, which permits users to peer patterns in pollutants, such as seasonal variations or abrupt will increase introduced on with the aid of climate or human pastime. In order to maintain users knowledgeable for the duration of emergencies like business smog or pollutants from fires, customers can also receive indicators whilst the first class of the air deteriorates. Increasing environmental cognizance is a key motivation for this task. Many people are ignorant of how pollutants is a result of ordinary human hobby. Users are encouraged to assist cleaner environmental practices in their groups and adopt green behavior via gaining knowledge of more approximately air satisfactory. Additionally, the gadget is built to extend in the destiny. Future capabilities ought to encompass deeper ancient forecasting, GPS-based totally automated region detection, and integration with IoT-enabled air sensors for neighbourhood-level monitoring. The device would turn out to be even more accurate and useful with these improvements. The standard intention of this Air Pollution AQI Website is to offer a beneficial and instructive platform that allows individuals to shield their health and the surroundings. The venture objectives to enhance every person's satisfactory of life and encourage safer existence and purifier air by presenting real-time data on air pleasant.

2. Method

To guarantee that air quality data is processed, displayed, and updated seamlessly in real time, the proposed Air Pollution AQI Website employs a clear and modular design. The system is simpler to construct, maintain, and grow thanks to its modular design. The website has a three-layer architecture: a data integration layer that links the system to external AQI sources, a backend layer that controls data flow, and a frontend layer that users interact with. Several system design models, including Use Case Diagrams, Sequence Diagrams, DFDs, ER diagrams, and Class Diagrams, aided in the understanding of how various system components interacted during development. A sequence diagram, for instance, illustrates the sequential process from the moment a user inputs the name of a city until the AQI appears on the screen. This methodical approach guarantees that the system functions effectively and is simple for future developers to update.

2.1. System Architecture

There are three main layers in the architecture:

User Interface Layer (Frontend – React.js)

- Manages user interactions and AQI data visualization in real time.
- Uses color-coded pollution level indicators in a responsive user interface.

Middleware Layer (Backend – Express.js)

- Serves as a conduit for communication between external APIs and the frontend.
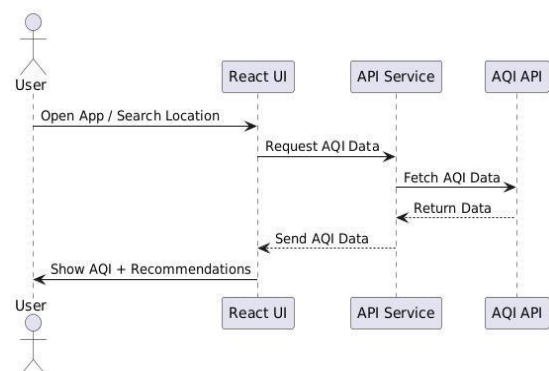- Uses CORS and validation methods to guarantee safe data handling.


Figure 1 UML Sequence Diagram

Data Integration Layer (External AQI APIs)

- Retrieves current pollution levels from reliable API sources like IQAir and OpenWeatherMap. Figure 1 shows UML Sequence Diagram

The area of the system that users see and interact with directly is called the User Interface Layer. It guarantees quick updates and a seamless

experience even when data changes every few seconds because it is built with React.js. To assist users in rapidly comprehending air quality levels, the interface makes use of color-coded indicators that resemble traffic signals. For example, hazardous levels are indicated by red, while green indicates good air quality. This is particularly useful for individuals with asthma organizing outdoor activities or for parents determining whether it is safe for their kids to play outside. The website's responsive design guarantees that users can easily view, comprehend, and interact with the content whether they are using a laptop at home or a mobile phone while traveling. The Middleware Layer serves as the system's "middleman." After receiving requests from the frontend and interacting with external APIs, it processes the data and returns it in a clear, usable format. Express.js, which is renowned for being quick and lightweight, is used to create this layer. Additionally, it makes use of CORS to guarantee secure communication and stop illegal data access. Before sending the data to the user, validation methods make sure it is accurate and complete. A real-world example would resemble a restaurant kitchen: the waiter (backend) retrieves the ingredients from suppliers (APIs), verifies their quality, prepares the dish (formats data), and then serves it to the customer after a customer (user) places an order (AQI request). This preserves the security and accuracy of the data. Accurate real-time pollution data is gathered by the Data Integration Layer from reliable APIs like OpenWeatherMap and IQAir. Similar to weather stations, these APIs continuously track the pollution levels in various cities [6-8]. Similar to checking Google Maps for traffic updates prior to making travel plans, the system retrieves the most recent AQI when a user searches for a city. Users will always receive current readings for pollutants such as PM2.5, PM10, CO, NO_2, and O_3 thanks to this layer. When someone visits the website prior to their morning jog, for instance, the system instantly retrieves new data from these APIs to assist them in determining whether it is safe to go outside or if they should wait until pollution levels decrease. Figure 2 shows Use-Case Diagram of the Website
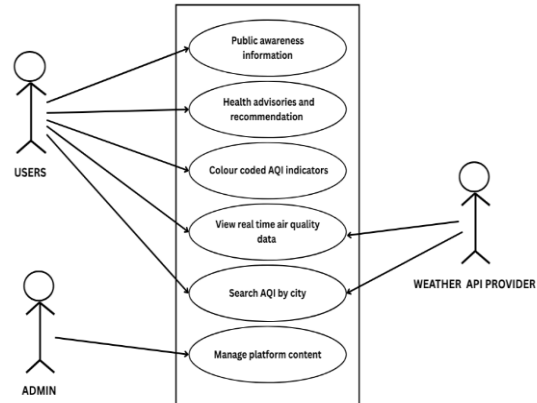
Figure 2 Use-Case Diagram of the Website

2.2. Implementation

User Module

Through an easy-to-use dashboard, this module gives end users interactive functionality. Among the main functions are:

- Choosing or altering a geographic location
- AQI and pollutant values (PM2.5, PM10, CO, NO_2, and O_3) in real time
- Using visual colour standards to understand the AQI category (Good → Hazardous)
- Obtaining recommendations for health precautions
- Examining AQI trends and history over time

Server Module

Reliable data processing, storage, and transmission are guaranteed by the backend server. Principal duties:

- Obtain current AQI data from APIs and transform it into a common format
- To improve performance, keep temporary AQI/cache records.
- Verify API responses and handle errors
- Control the location history and preferences of users
- For safe frontend-backend communication, turn on CORS.
- Keep the user interface and data repository in sync.

Table 1 AQI Pollution Concentration Levels

AQI Range	Air Quality Level	Meaning
0–50	Good	Safe air quality
51–100	Moderate	Acceptable; minor risk for sensitive people
101–150	Unhealthy for Sensitive Groups	Some health risks for children, elderly, etc.
151–200	Unhealthy	Everyone may experience health effects
201–300	Very Unhealthy	Health warning; avoid outdoor activities
301–500	Hazardous	Dangerous; serious health effects

Admin Module

- Operational management and system monitoring are supported by the admin panel:
- Configuring API keys and tracking usage
- Examining system logs to enhance performance
- Export pollutant and AQI datasets in CSV and Excel formats for analysis.
- Modify the AQI category classification thresholds

Visualization Module

- uses Chart.js to render the AQI index and breakdown of pollutants.
- provides interactive graphs and pollutant visualization to improve user comprehension. Table 1 shows the AQI Pollution Concentration Levels

The AQI monitoring system's workflow starts when a user uses the interface to select a particular location, like a city or region. The frontend sends a structured request for the pertinent air quality data as soon as the selection is made. The backend server receives this request and is essential to connecting the application to outside data providers. The server then retrieves the most recent AQI and pollutant concentration data for the selected location by interacting with reliable third-party APIs like OpenWeatherMap or IQAir. During this stage, the system ensures that the request is properly formatted and securely transferred, enabling reliable and consistent communication between components [9, 10]. The backend starts processing and verifying the data to make sure it is accurate, comprehensive, and consistent after the external APIs return the requested air quality data. To ensure dependability, any irregularities, missing fields, or invalid values are examined and dealt with. After passing validation, the data is sent to the user interface, where it is presented visually in an understandable and accessible way. The AQI level, pollutant breakdown, and real-time health-based recommendations based on the severity of the air quality are displayed by the user interface. Automated alerts are set off to notify users right away if the system detects hazardous or quickly deteriorating conditions. This guarantees prompt awareness, assisting people in taking preventative measures to safeguard their health. The system uses intelligent data interpretation techniques to further improve the workflow by converting unprocessed numerical values into insights that users can understand. Based on international AQI guidelines, the platform classifies air quality into standard ranges like Good, Moderate, Unhealthy, or Hazardous rather than just displaying AQI numbers. To assist users in rapidly comprehending the degree of environmental risk, each category is accompanied by brief advisory notes and color-coded indicators. By periodically updating data without requiring user input, the workflow also facilitates continuous updates [11, 12]. Figure 3 shows the AQI Data Visualization and Health Tips

3. Results and Discussion

3.1. Results

The modules that were put in place work together to make it possible to monitor air quality in real time in a way that is accurate, quick, and easy to use. They also help raise public awareness of environmental issues and protect public health. Figure 4 shows the AQI Data Graphical Representation
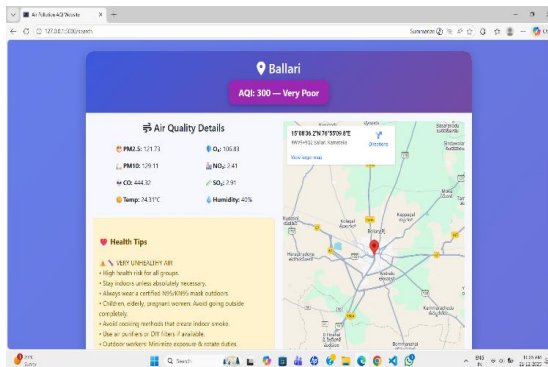
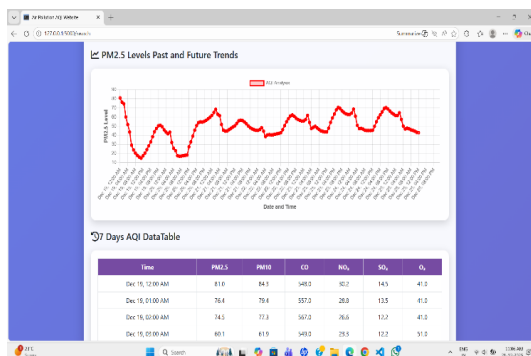**Figure 3** AQI Data Visualization and Health Tips

Figure 4 AQI Data Graphical Representation

3.2. Discussion

Website effectively offers real-time air first-class information throughout different locations. The effects spotlight full-size variations in pollutant ranges amongst towns, indicating ability environmental and fitness risks [13, 14]. The inclusion of interactive visualizations complements consumer understanding by way of simplifying complicated AQI information into intuitive graphical formats. These visible factors aid knowledgeable choice-making by allowing users to assess air nice conditions speedy [15]. Overall, the gadget contributes to accelerated public cognizance of air pollutants influences and promotes accountable conduct towards environmental and private health protection.

Conclusion

The Air Pollution AQI Website addresses the urgent need for accessible, real-time air quality data by integrating reliable APIs like OpenWeatherMap and IQAir to provide accurate, pollutant-specific information ($PM2.5$, $PM10$, CO, NO_2, O_3) through an interactive, user-friendly, and responsive platform.

Unlike traditional government sites, this scalable solution offers personalized features such as real-time alerts, health advisories, and an intuitive AQI dashboard, fostering public engagement and environmental awareness. With plans for enhancements including GPS tracking and historical data visualization, the website empowers users to monitor air quality, make informed health decisions, and actively support sustain-ability efforts, marking a significant step toward a healthier and more informed community.

Acknowledgements

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