Second Year Mini Project Report

Submitted in partial fulfillment of the requirements of the degree
BACHELOR OF ENGINEERING IN COMPUTER ENGINEERING

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CERTIFICATE

This is to certify that the Mini Project entitled **" AirAware "** is a bonafide work of **Aadil Shah(57), Jennifer Cheriyan(63), Anusha Gonal(24), Mayuresh Gujare(25), Vedant Navani(71)** submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of **"Bachelor of Engineering"** in **"Computer Engineering" .**

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Mini Project Approval

This Mini Project entitled "AirAware**"** by **Aadil Shah(57), Jennifer Cheriyan(63), Anusha Gonal(24), Mayuresh Gujare(25), Vedant Navani(71)** is approved for the degree of **Bachelor of Engineering** in **Computer Engineering.**

Examiners

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(Internal Examiner Name & Sign)

2……
(External Examiner name & Sign)

Date:

Place:

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Abstract

In a world where pollution is a growing threat to our well-being, our website AirAware offers valuable assistance for medical purposes, aiding individuals with respiratory diseases, those considering relocation, and those seeking pure air environments. Our dynamic website utilizes real-time data of Air Quality Index (AQI) -a standardized measure used worldwide to assess air quality levels, to provide up-to-the-minute environmental insights for cities across India.

Beyond just data, our platform goes the extra mile. Users can input the city they want to search and respiratory condition (if any), enabling them to access information on whether the city is safe for them in terms of air quality. This helps the user to make informed decisions about their health and well-being. This user-friendly feature empowers individuals to determine if it's safe to travel or relocate based on prevailing air quality conditions. By emphasizing the application of AQI information for medical purposes and catering to individuals with respiratory diseases, our platform ensures that health remains a top priority. Whether it's for medical concerns, relocation plans, or simply seeking cleaner air, our project offers a valuable resource for individuals navigating India's environmental landscape.

Acknowledgments

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We would like to express our deep gratitude to all the teaching and non-teaching staff for their unwavering encouragement, support, and selfless assistance throughout the project. Their contributions were indispensable to our project's success.

List Of Abbreviations

AQI	Air Quality Index
API	Application programming interface
GIS	Geographic Information System
AOT	Aerosol Optical Thickness
AI	Artificial Intelligence
DOE	Department of Environment
IDW	Inverse Distance Weighted

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AirAware

Chapter 1: Introduction

1.1 Introduction

Air pollution is a big problem worldwide, affecting our health and the environment. Certain pollutants like PM2.5, NO2, SO2, O3, and CO can cause serious harm to our lungs and heart. To help people understand how bad the air is, we use something called the Air Quality Index (AQI). It's like a scale that tells us if the air is safe to breathe or not. Knowing this helps us make smarter choices about going outside and protecting ourselves. With more people caring about the environment, having up-to-date air quality info is really important. Bad air quality isn't just annoying – it can be dangerous and even life-threatening, especially for those who are more sensitive. So, it's crucial for us to work together to reduce air pollution and keep everyone healthy.

1.2 Motivation

The project is driven by a strong dedication to public health, the environment, and sharing knowledge. We want to give communities the means to make smart choices that keep them healthy and protect the environment. This motivation comes from a sense of duty, and we're determined to make sure information reaches the public, so everyone can help make the air cleaner and the planet healthier.

1.3 Problem Statement and Objectives

The project aims to develop a real-time, user-friendly platform to inform individuals about the safety of their surroundings based on Air Quality Index (AQI) and pollutant levels, mitigating health risks associated with air pollution.

1.4 Organization of the report

Chapter 1: Introduction

The first chapter of the report introduces the core concept of the project, focusing on the development of an innovative "AirAware" website. This chapter comprises a thorough examination of the project's introduction, the driving factors behind its initiation, a clearly defined problem statement, and specific objectives that steer the project's path.

Chapter 2: Literature Review

In this chapter, a thorough review of existing systems and relevant literature is conducted. Research papers, studies, and current trends related to air quality index, other pollutants, and pollution monitoring are explored. By critically examining the current landscape, areas for potential improvements and innovations are identified.

Chapter 3: Project Implementation

In the subsequent chapter of the report, the focus shifts to the implementation of the Air Quality and Pollutants Information Website. The chapter details the project's architectural framework, delves into the algorithms and design procedures utilized, and offers an overview of the hardware and software components responsible for the website's operation. Additionally, the chapter showcases the findings of conducted experiments and concludes by presenting future prospects and directions, providing a comprehensive perspective on the project's design and development journey.

Chapter 2: Literature Survey

2.1 Survey of Existing System

Existing systems include websites where the AQI is calculated based on the concentration of multiple pollutants, and the platforms often include color-coding and health advisories to inform the public. Few websites offer platforms that collect data from a network of air quality monitoring stations. They use artificial intelligence and machine learning to calibrate and validate the data, providing real-time AQI information for specific locations. These platforms may also offer additional features such as AQI forecasts and historical data. Some research projects and methods focus on using satellite data to estimate AQI. By analyzing satellite-recorded data such as aerosol optical thickness (AOT), researchers can calculate AQI values using regression models. This approach can provide a broader view of air quality on a regional or global scale. Projects that combine AQI data with GIS technology aim to visualize and analyze air quality on maps. These systems can provide spatial information on air pollution levels and help identify areas with high pollutant concentrations. GIS tools like ArcGIS are used to create maps and aid in decision-making for environmental management.

2.2 Existing resources and its description :

- Design and Analysis of IoT based Air Quality Monitoring System

This research focuses on the persistent problem of yearly haze in Malaysia and employs Geographic Information System (GIS) technology and the Air Pollutant Index (API) data from the Department of Environment (DOE) to monitor and visualize air quality. By utilizing Inverse Distance Weighted (IDW) interpolation within ArcGIS 10.1, the study aims to analyze and identify areas with differing levels of air pollutants, offering insights for addressing and mitigating air quality issues in Malaysia.

- National Air Quality Index

The AQI is calculated using a sub-index for each pollutant and then aggregating them into a single value using a maximum operator approach2. The AQI ranges from 0 to 500, with lower values indicating better air quality and higher values indicating worse air quality. The AQI is also color-coded and assigned a remark to help the public understand the possible health impacts of the air quality1. [1]

- Mumbai Air Pollution

The methodology for the website 1 is based on IQAir's air quality information platform, which uses artificial intelligence (AI) to calibrate and validate thousands of governmental and non-governmental air quality monitoring stations. The platform also uses deep machine learning to forecast the air pollution levels based on historical data, weather data, and other interrelated signals. [2]

- Haze monitoring based on air pollution index (API) and geographic information system (GIS)

The paper presents the design and implementation of a mobile, IoT-enabled air quality monitoring system that measures real-time data for Carbon Monoxide, Smoke, and PM levels, offering a cost-effective and low-power solution. The system analyzes local air quality and uses a buzzer for alerting users when air quality reaches critical levels. It utilizes

an Android application for data transmission and a cloud server for data storage and visualization, facilitating accessibility and awareness of air quality conditions. [3]

Aspect	Mobile IoT Air Quality Monitoring	GIS-based Air Quality Monitoring	National Air Quality Index	Mumbai Air Pollution
Components	Mobile, IoT-enabled air quality monitoring system with Android app, cloud server, buzzer alert.	GIS technology, Air Pollutant Index (API) data, Inverse Distance Weighted (IDW) interpolation.	Sub-indices for individual pollutants (e.g., CO, Smoke, PM) aggregated using a maximum operator.	AI-based platform with data from various monitoring stations, historical data, and weather data.
Data Sources	Real-time data for Carbon Monoxide, Smoke, and PM levels, and API data.	API data from the Department of Environment (DOE) in Malaysia.	Data from various air quality monitoring stations.	Governmental and non-governmental air quality monitoring stations, historical data, and weather data.
Analysis Techniques	Real-time data analysis.	GIS-based spatial analysis using IDW interpolation.	Sub-index calculation for individual pollutants.	AI-based calibration, validation, and forecasting.
Geographic Visualization	Utilizes an Android app and cloud server for data storage and visualization.	Uses GIS technology to create visualizations of air quality in Malaysia.	Provides color-coded AQI and health impact remarks.	Utilizes AI for calibration and forecasting, likely with visualizations.

Table No. 2.2.1 : Comparison of Existing Systems

2.3 Limitations of Existing System or Research Gap

One big problem is that many websites are not easy to use, which makes it tough for people, especially those who aren't good with technology, to get important information. Also, when they show numbers about air quality, they often don't explain what those numbers mean for your health and the environment. There's not enough easy-to-understand information to help people learn about what causes pollution and how to stop it. To fix this, we need to give people better education so they can make choices for cleaner air. Apart from informing people about the measure of air quality index at a specific place, no existing websites use this information and apply it for the wellbeing of people facing respiratory problems. Lastly, these websites don't do a good job of getting people excited about fighting pollution. They show data but don't encourage people to get involved and take action to make the air cleaner. [1][2]

2.4 Mini Project Contribution

The mini project, "Air Aware," aims to make a substantial contribution to addressing critical environmental and public health challenges. By providing real-time access to air quality data and weather information, individuals are empowered to make informed decisions that directly impact their well-being. The project offers a user-friendly design, clear explanations of the Air Quality Index (AQI), educational content on pollution causes and solutions, and active promotion of pollution awareness. Through these features, existing limitations and research gaps in the field are sought to be bridged.

Chapter 3 : Proposed System

3.1 Introduction:

In a world where pollution is becoming a bigger concern, our website AirAware is here to help. We focus on providing useful information for people with respiratory problems, those thinking about moving to a new place, and anyone who wants to know about air quality. Our website uses real-time data from the Air Quality Index (AQI), which is a measure used to check how clean the air is. We cover cities all across India, giving you the latest updates on air quality. But we don't stop there – our website lets you enter the city you're interested in and any respiratory issues you might have. This helps you find out if the air there is safe for you. It's all about helping you make smart choices for your health. Whether you're thinking about traveling or moving somewhere new, our website gives you the information you need to stay safe and healthy in India's changing environment.

AQI Category	Associated Health Impact
Good (0 to 50)	Minimal impact
Satisfactory (51 to 100)	May cause minor breathing discomfort to sensitive people
Moderately Polluted (101 to 200)	May cause breathing discomfort to the people with lung disease such as asthma and discomfort to people with heart disease, children and older adults
Poor (201 to 300)	May cause breathing discomfort to people on prolonged exposure and discomfort to people with heart disease
Very Poor (301 to 400)	May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases
Severe (401 to 500)	May cause respiratory effects even on healthy people and serious health impacts on people with lung/heart diseases. The health impacts may be experienced even during light physical activity

Table No. 3.1.1 : AQI category and associated health impacts for India [6]

AQI Category	AQI	Concentration range*							
		PM_{10}	$PM_{2.5}$	NO_2	O_3	CO	SO_2	NH_3	Pb
Good	0 - 50	0 - 50	0 - 30	0 - 40	0 - 50	0 - 1.0	0 - 40	0 - 200	0 - 0.5
Satisfactory	51 - 100	51 - 100	31 - 60	41 - 80	51 - 100	1.1 - 2.0	41 - 80	201 - 400	0.5 - 1.0
Moderately polluted	101 - 200	101 - 250	61 - 90	81 - 180	101 - 168	2.1 - 10	81 - 380	401 - 800	1.1 - 2.0
Poor	201 - 300	251 - 350	91 - 120	181 - 280	169 - 208	10 - 17	381 - 800	801 - 1200	2.1 - 3.0
Very poor	301 – 400	351 - 430	121 - 250	281 - 400	209 - 748*	17 - 34	801 - 1600	1200 -1800	3.1 - 3.5
Severe	401 - 500	430+	250+	400+	748+*	34+	1600+	1800+	3.5+

Table No. 3.1.2 : Concentration range of pollutants[10]

AQI chart as a yardstick that runs from 0 to 500. The higher the AQI value, the greater the level of air pollution and the greater the health concern.An AQI value of 50 or below represents good air quality, while an AQI value over 300 represents hazardous air quality.[3]

3.2 Architecture/ Framework:

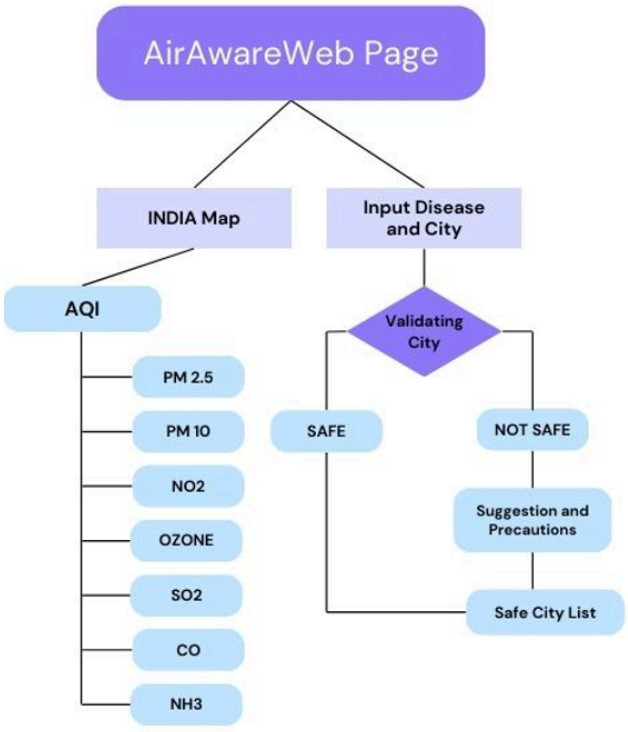


Figure No. 3.2.1 : Block diagram of AirAware[4][5][6]

When a user interacts with the platform, they can input specific locations or areas of interest via the search bar. Upon receiving the user's input, it retrieves the corresponding air quality data and displays it on an interactive map of India. Additionally, if the user provides information about their health condition, the platform cross-references this data with the air quality information to generate personalized health recommendations. These recommendations are tailored to the user's specific health condition and the severity of air pollution in their area, advising them on appropriate precautions to take if the air quality is deemed unsafe for their condition. Overall, "AirAware" serves as a comprehensive tool for raising awareness about air pollution, protecting public health, and empowering individuals to make informed decisions about their well-being in India's diverse environmental landscape.[7]

3.3 Algorithm and Process Design:

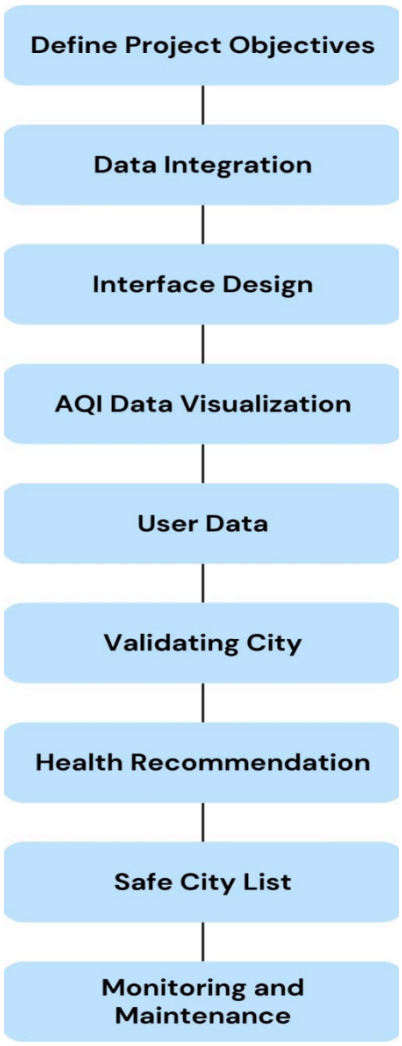


Figure no. 3.3.1 : Process followed for AirAware [8][9][10]

Our website operates through a multi-step process to provide users with real-time air quality information and personalised health recommendations. First, the platform collects data from

monitoring stations and sensors distributed across India, which continuously measure various pollutants in the air. This data is then processed using advanced algorithms to calculate the Air Quality Index (AQI) for each location, as well as to analyse the concentration of individual pollutants such as PM2.5, PM10, NO2, SO2, CO, and O3.

Upon accessing the website users are greeted with an interactive map of India, overlaid with color-coded indicators representing the Air Quality Index (AQI) for different regions. This visual representation enables users to easily identify areas of concern and make informed decisions about their outdoor activities and travel routes. The platform's search bar functionality further enhances user experience, allowing individuals to pinpoint specific locations and retrieve detailed air quality data tailored to their needs.[11]

3.4 Details of Hardware & Software:

HARDWARE

- Device: Computer, laptop, tablet, or smartphone
- Connectivity: Access to a stable internet connection
- Web Browser: Installed web browser (e.g., Chrome, Firefox, Safari)

SOFTWARE

- HTML, CSS, and JavaScript (for UI interaction)
- Weather Api (to get required data)
- AJAX, Fetch API libraries (to control fetched data).
- LeafLet (to use and control maps)
- Chart.js , React.js, etc. (to show data in the form of charts)
- Git/ GitHub (to control versions and collaborate)

3.5 Experiment and Results:

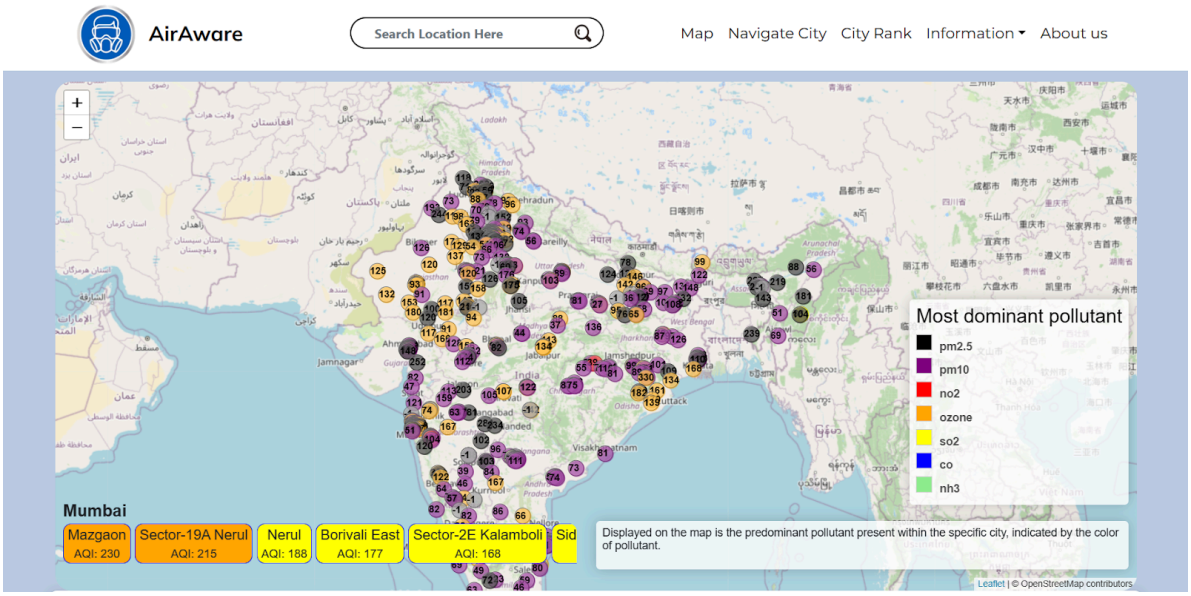


Figure no. 3.5.1: Home page of website

The homepage of our website features an interactive map of India, meticulously marked with city and station-specific indicators, representing various pollutants such as PM 2.5, PM 10, NO2, Ozone, SO2, NH3, etc. Each marker on the map is color-coded based on the corresponding pollutant and the AQI value of that particular location. The search functionality allows users to easily locate and explore detailed information about specific cities. Additionally, users can click on individual cities to access comprehensive data about pollutant levels, contributing factors, and real-time AQI measurements. To facilitate user engagement, a suggestion list of cities is provided for quick access. Complementing the map, a chart illustrates the correlation between colors and specific pollutants, offering users a quick reference guide for interpreting the displayed information.

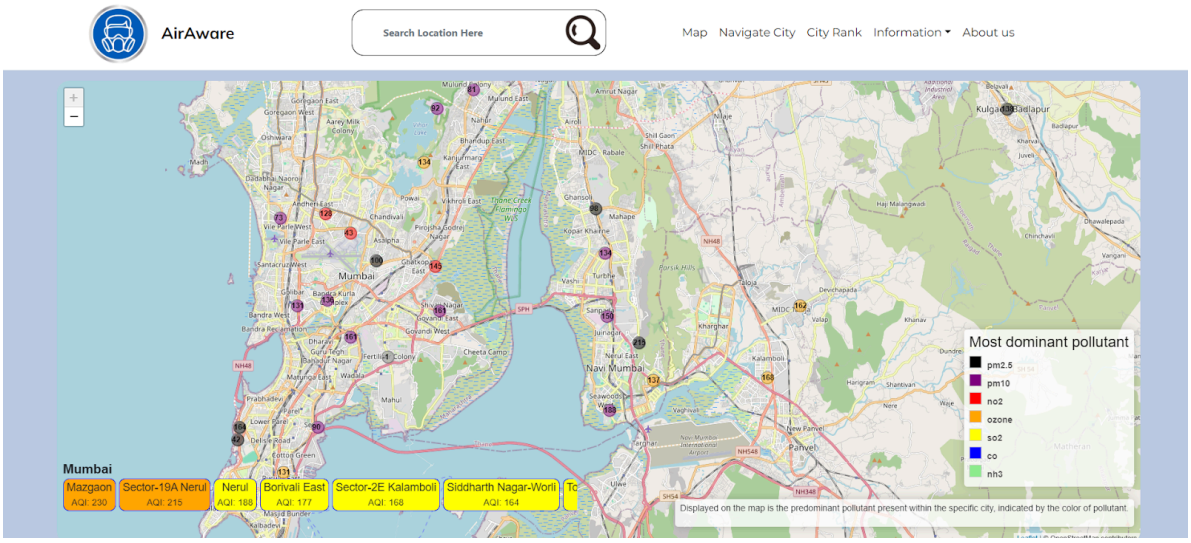


Figure no. 3.5.2 : Granularity of map.

The concept of granularity is exemplified in our map system, where we have the capability to zoom in up to a specific city or area. This feature proves beneficial as it allows users to closely examine the surrounding areas of their searched location, providing a more detailed and comprehensive view. This fine level of control enhances the user experience, ensuring that individuals can navigate and explore geographical information with precision, focusing on areas of interest while maintaining a clear understanding of the broader context.

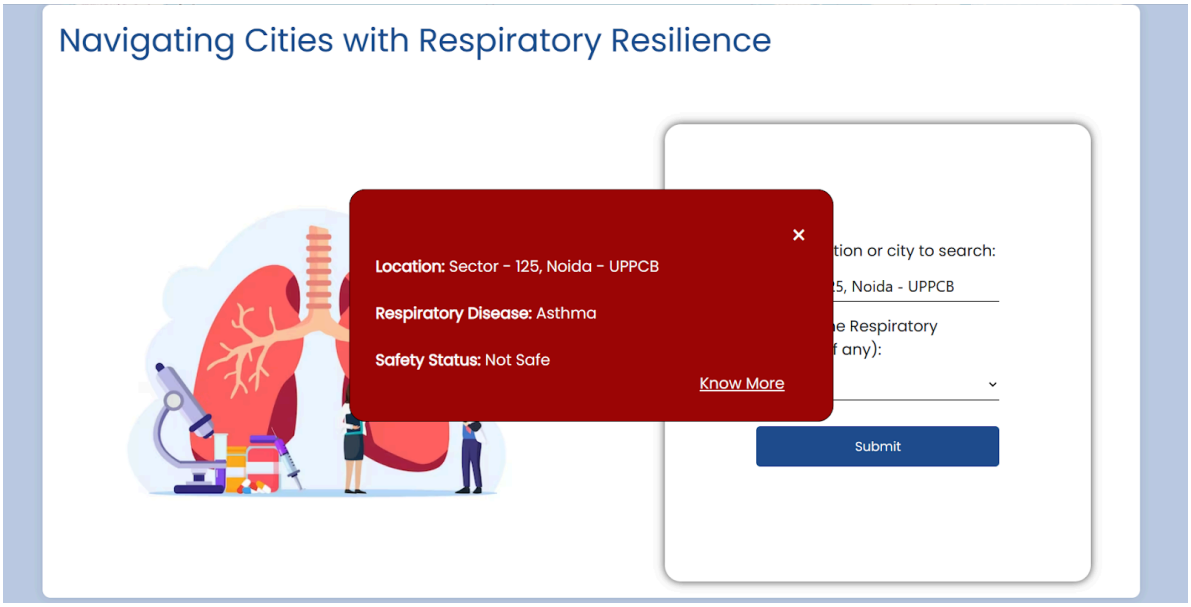
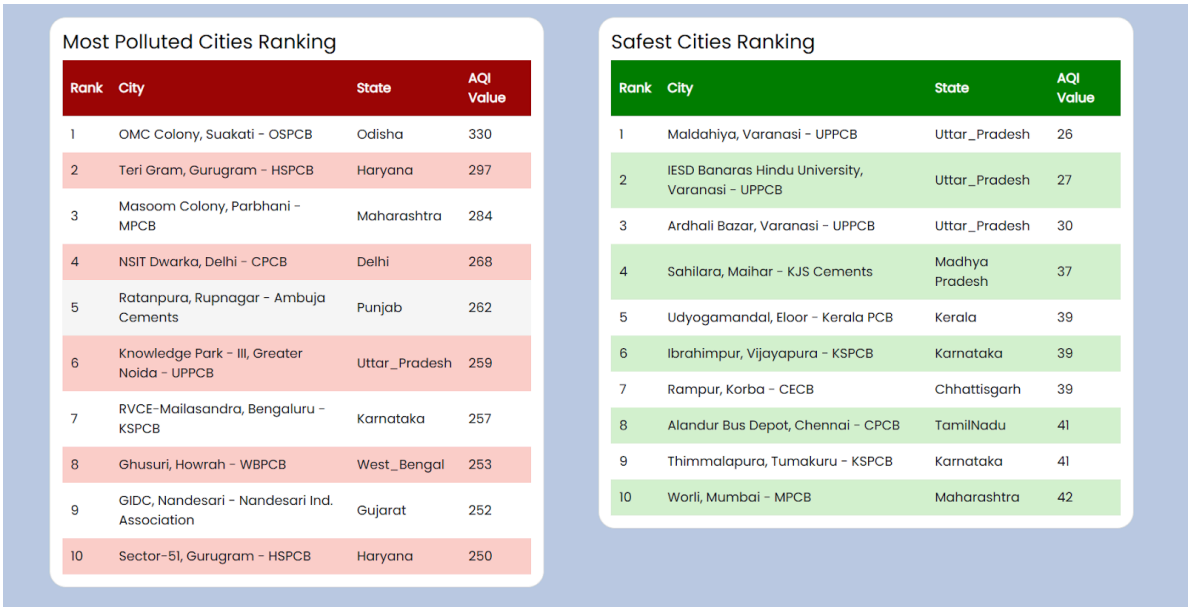


Figure no. 3.5.3 : User Interface for navigating cities with respiratory resilience.

In this website section, users input their location for searching, along with information about respiratory conditions such as asthma, COPD, Bronchitis, Emphysema, Lung Cancer, Influenza, Pleural Effusion and Bronchiectasis etc. The system then employs algorithms to calculate and compare pollutant levels in that city. Specifically tailored recommendations are provided to individuals with respiratory diseases, indicating whether the air quality is safe for them. Additionally, clicking on the "show more" button redirects users to a more detailed presentation of pollutants specific to the selected city, enhancing their understanding of the environmental conditions and ensuring informed decision-making for individuals with respiratory concerns.



Most Polluted Cities Ranking

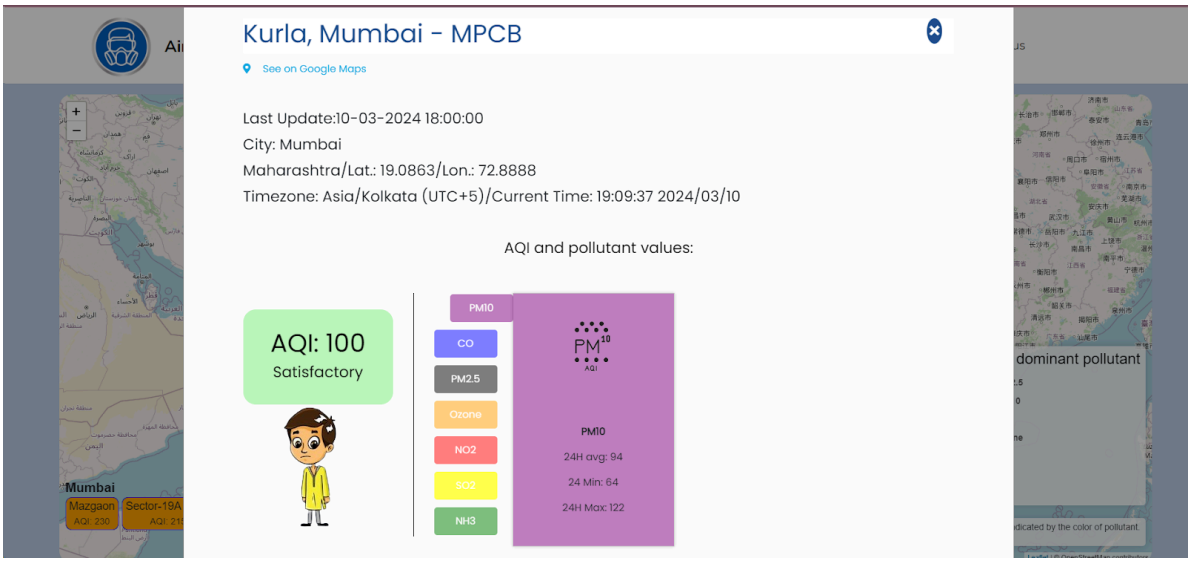
Rank	City	State	AQI Value
1	OMC Colony, Suakati - OSPCB	Odisha	330
2	Teri Gram, Gurugram - HSPCB	Haryana	297
3	Masoom Colony, Parbhani - MPCB	Maharashtra	284
4	NSIT Dwarka, Delhi - CPCB	Delhi	268
5	Ratanpura, Rupnagar - Ambuja Cements	Punjab	262
6	Knowledge Park - III, Greater Noida - UPPCB	Uttar_Pradesh	259
7	RVCE-Mailasandra, Bengaluru - KSPCB	Karnataka	257
8	Ghusuri, Howrah - WBPCB	West_Bengal	253
9	GIDC, Nandesari - Nandesari Ind. Association	Gujarat	252
10	Sector-51, Gurugram - HSPCB	Haryana	250

Safest Cities Ranking

Rank	City	State	AQI Value
1	Maldahiya, Varanasi - UPPCB	Uttar_Pradesh	26
2	IESD Banaras Hindu University, Varanasi - UPPCB	Uttar_Pradesh	27
3	Ardhali Bazar, Varanasi - UPPCB	Uttar_Pradesh	30
4	Sahilara, Maihar - KJS Cements	Madhya Pradesh	37
5	Udyogamandal, Eloor - Kerala PCB	Kerala	39
6	Ibrahimpur, Vijayapura - KSPCB	Karnataka	39
7	Rampur, Korba - CECB	Chhattisgarh	39
8	Alandur Bus Depot, Chennai - CPCB	TamilNadu	41
9	Thimmalapura, Tumakuru - KSPCB	Karnataka	41
10	Worli, Mumbai - MPCB	Maharashtra	42

Figure no. 3.5.4 : Ranking of cities according to AQI

The website displays real-time data showcasing the top 10 cities in India with the highest Air Quality Index (AQI) values, as well as the bottom 10 cities with lower AQI values. This information is dynamically updated using live data on pollutants and AQI values for each city. By offering insights into both the most and least favourable air quality conditions, users gain a comprehensive understanding of the current environmental status across various locations in India. This feature enables individuals to make informed decisions and promotes awareness regarding air quality variations in different cities.



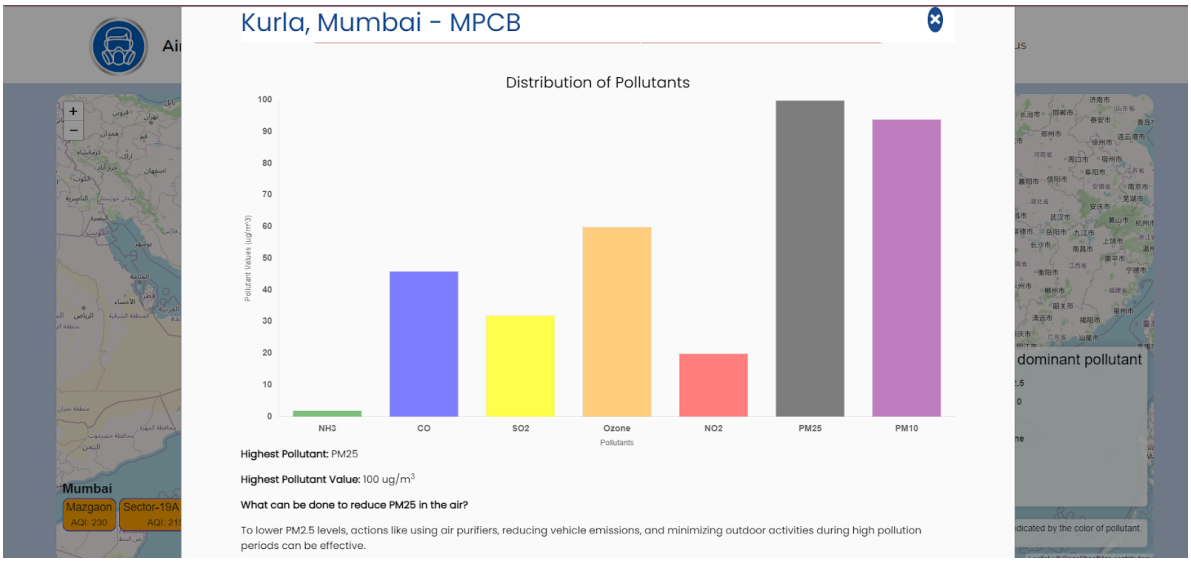


Figure no. 3.5.5 : Searching cities and calculating AQI and distribution of pollutants.

Upon selecting or searching for a particular city, a detailed pop-up screen appears, providing a thorough overview of the city's environmental conditions. This screen includes geographical coordinates, graphs, and tables showing how pollutants are spread. It shows the 24 hours average, minimum and maximum value of each pollutant. The Air Quality Index (AQI) is clearly shown, giving a fast evaluation within a safety range. Also, the pop-up offers advice on precautions based on the current air quality, helping people protect their health. This combined method ensures users understand the environmental conditions and get practical tips to reduce health risks.

3.6 Conclusion and Future work

In conclusion, AirAware represents a vital step forward in addressing the critical environmental and public health challenges posed by air pollution. By prioritizing user-friendliness, accessibility, and education, our platform aims to bridge existing gaps in understanding and engagement surrounding air quality issues.

Through intuitive design, clear explanations of the Air Quality Index (AQI), and accessible educational content on pollution causes and solutions, AirAware empowers users to make informed decisions about their health and environment. Importantly, the platform integrates features to assist individuals with respiratory diseases, providing personalized alerts and recommendations to ensure their safety.

Beyond providing information, it inspires action and community involvement through active promotion of pollution awareness and engagement initiatives. By fostering a sense of empowerment and collective responsibility, the platform encourages users to take tangible steps toward cleaner air and a healthier future for all.

In essence, it represents not just a tool for monitoring air quality but a catalyst for positive change, driving awareness, education, and action to combat air pollution and safeguard public health and the environment.

In the future, we will be adding the capability to store and display data from past years, enabling users to gain insight into historical trends. Additionally, we will be implementing smart algorithms to predict future Air Quality Index (AQI) values. This enhancement will enable our system not only to showcase past occurrences but also to anticipate air quality conditions, thereby offering valuable insights for better decision-making aimed at maintaining a healthy environment.

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