AirAware – Air Quality Monitoring

INFOSYS VIRTUAL INTERNSHIP 6.0 BATCH -3

By

PRANATI RAO PINISETTI

Purpose of the Project

To monitor real-time AQI of Indian cities

To forecast pollution levels using Machine Learning

To contribute toward environmental improvement

Tech Tools & Technologies

Frontend: React.js

Backend: Node.js, Express.js

Database: MongoDB

ML Models: Python (XGBoost, ARIMA, Prophet)

Others: CSV Parser, Axios, Recharts

AQI (Air quality index)

The Air Quality Index (AQI) measures air pollution levels.

Common pollutants include:

- Ozone (O3)
- Particulate Matter (PM2.5 and PM10)
- Carbon Monoxide (CO)
- Sulfur Dioxide (SO2)
- Nitrogen Dioxide (NO2)

The Air Quality Index	
Index Values	AQI Category
0 - 50	Good
51 - 100	Moderate
101 – 150	Unhealthy for Sensitive Groups
151 – 200	Unhealthy
201 – 300	Very Unhealthy
301 –500	Hazardous

How Are AQI Factors Measured?

- CO: Measured using electrochemical sensors
- SO_2 & NO_2: Measured using UV fluorescence & chemiluminescence analyzers
- PM2.5 & PM10: Measured using laser scattering instruments
- Ozone: Measured using UV photometry
- Lead: Detected through high-volume air samplers
- Ammonia: Measured using chemiluminescence detectors

The Air Quality Index	
Index Values	AQI Category
0 - 50	Good
51 - 100	Moderate
101 – 150	Unhealthy for Sensitive Groups
151 – 200	Unhealthy
201 – 300	Very Unhealthy
301 –500	Hazardous

Drawbacks in Existing Systems

- Many apps do not show 7-day pollutant-wise forecasts
- Limited graphical visualization
- Slow or outdated data due to delayed sensors
- Some apps show AQI but not exact pollutant levels
- No combined dashboard for trends + alerts + forecasts
- Lack of personalization or alerts for sensitive groups

Common AQI Apps/Systems:

- CPCB Portal
- SAFAR
- AQI.in
- IQAir
- AirNow
- Google Weather AQI

Major Contributors to Air Pollution

Primary Pollution Sources

- Vehicle emissions (cars, bikes, trucks)
- Industrial smoke & chemical release
- Construction dust & road dust
- Brick kilns near Delhi
- Stubble burning in Punjab & Haryana
- Diesel generator sets
- Wood burning & biomass
- Household solid fuels (coal, cow dung, waste)

Regulated Pollutants in India

PM10, PM2.5, NO_2, SO_2, CO, Ozone, Lead, Ammonia

How Air Pollution Harms Humans & Earth

Impact on Humans

- Causes breathing issues & asthma
- Leads to chronic lung diseases
- Triggers heart attacks & blood pressure
- Irritates eyes, throat & skin
- Reduces immunity & overall health

Impact on Environment

- Increases global warming
- Reduces visibility (smog)
- Causes acid rain
- Damages crops & soil health
- Harms wildlife & ecosystems

Solutions

Practical Solutions to Reduce Air Pollution

Air Purifiers: Reduce indoor pollutants

Green Transportation: Electric vehicles, cycling, public transport

Better Fuels: Adoption of CNG, LPG, PNG over diesel

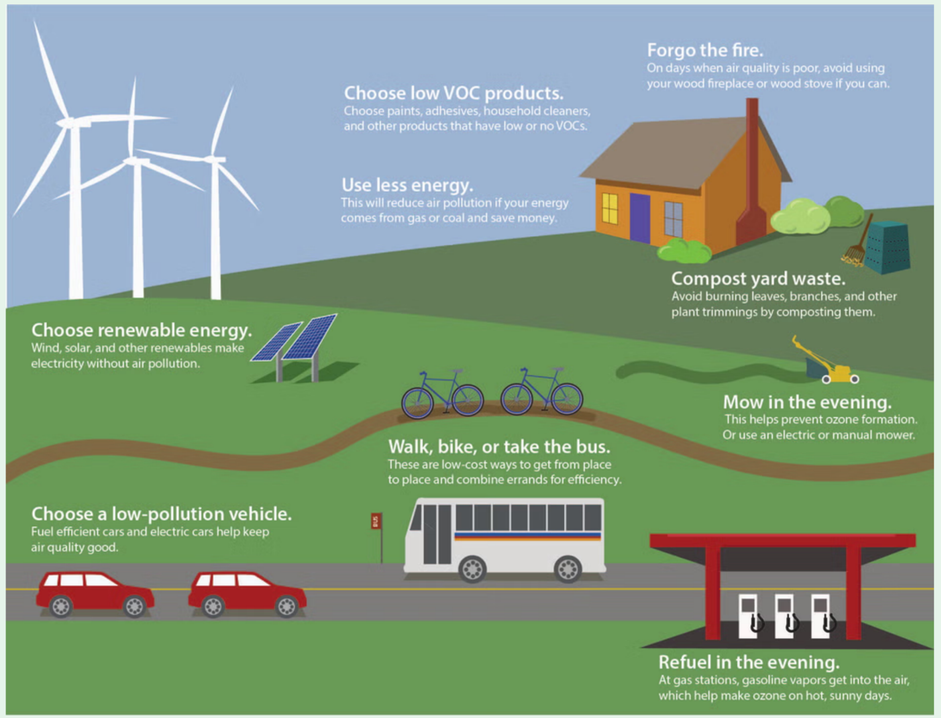
More Trees: Increase green cover around cities

Dust Control: Water spraying at construction sites

Proper Waste Management: Reduce burning of trash

Regulated Industrial Emissions: Use scrubbers & filters

Public Awareness: Encouraging eco-friendly habits



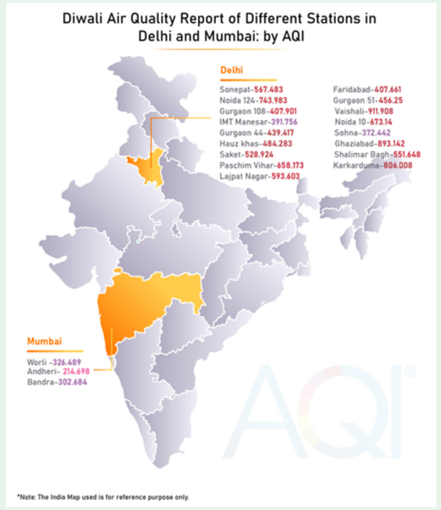
Impact of our project

How AirAware Helps Society

- Provides real-time AQI for 26 Indian cities
- Shows 10 pollutant levels in detail
- Gives 7-day forecast to prepare early
- Helps people avoid outdoor exposure on bad days
- Supports students, researchers & govt agencies
- Encourages awareness about environmental safety

Technical Strengths

- Data-driven Machine Learning
- Fast & interactive dashboard
- Dynamic charts for trends
- Real-time alerts system
- Clean UI for understanding AQI easily



How Our System Solves Real-World Problems

- Faster and smarter than traditional AQI apps
- Highlights pollutant-wise trends clearly
- Predicts upcoming pollution levels
- Sends alerts to sensitive groups
- Helps authorities respond early
- Supports multiple languages
- Connects with real IoT air-quality sensors

Future Enhancements

- Mobile app (Android/iOS)
- Voice-enabled AQI updates
- Live location-based AQI alerts
- SMS/Email alert feature
- Multiple-language support
- Deep-learning-based predictions (LSTM/GRU)
- Integration with real IoT sensors

Tools, Software, Languages Used

Frontend:
React.js – for building the interactive user interface
HTML5, CSS3, JavaScript – for structure and styling
Recharts / Chart.js – for pollutant-wise AQI graphs

Backend:
Node.js + Express.js – to handle API calls and data routing
Axios / Fetch API – to fetch AQI data

Database:
MongoDB Atlas (Cloud DB) – to store historical AQI and trend data

Machine Learning Service:
Python – core ML logic
Pandas, NumPy – data preprocessing
XGBoost / ARIMA / Prophet – AQI forecasting
Matplotlib / Seaborn – pollutant trend plots

Frontend (React)

```
cd frontend
npm install
npm start
Runs at: http://localhost:3000
```

Run Backend (Node.js + Express)

```
cd backend
npm install
node server.js
Backend runs at: http://localhost:5000
```

Air Quality Data Explorer

Analyze and visualize air quality trends across India

Data Controls

LOCATION

Bengaluru

TIME RANGE

Last 7 Days

2020-06-24 to 2020-07-01

POLLUTANTS

PM2.5	NO	NO2
NOx	NH3	CO
SO2	O3	Benzene

APPLY FILTERS

Data Quality

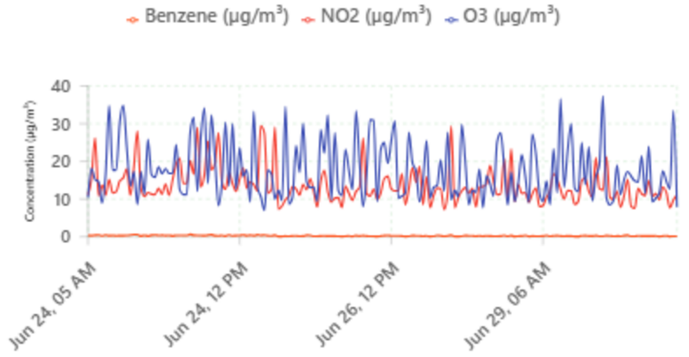
Completeness: 100.0%

Validity: 100.0%

Total Records: 168

Time Series Analysis

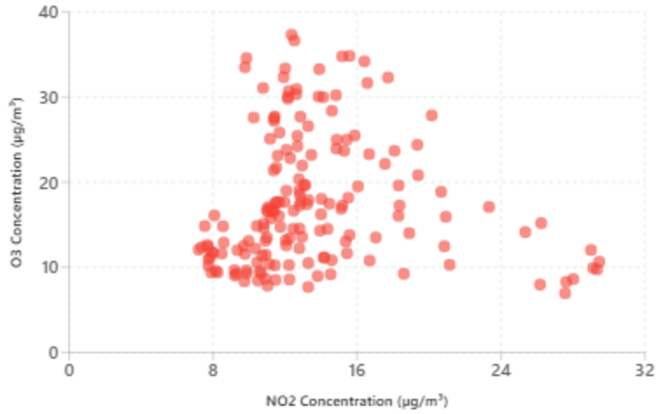
Fullscreen



Pollutant Correlations

NO2 vs O3

Fullscreen



Statistical Summary

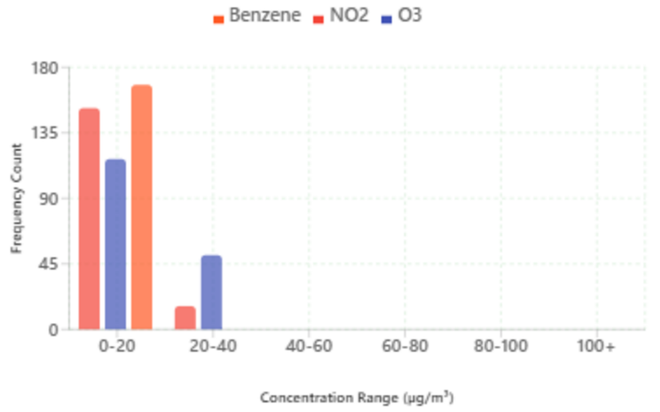
NO2

Fullscreen

13.63 MEAN	12.48 MEDIAN	29.46 MAX
7.20 MIN	4.73 STD DEV	168 COUNT

Distribution Analysis

Fullscreen

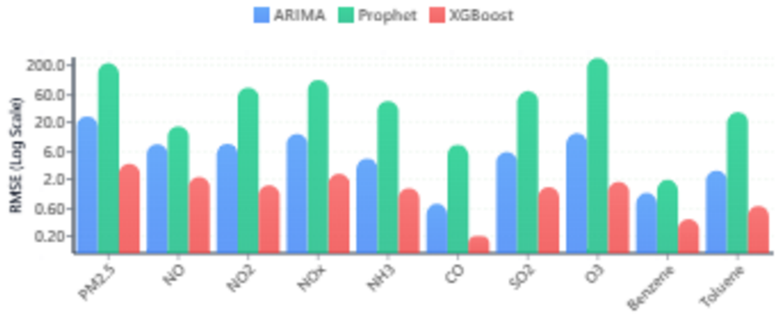


Air Quality Forecast Engine

ML-powered predictions using ARIMA, Prophet, LSTM & XGBoost models

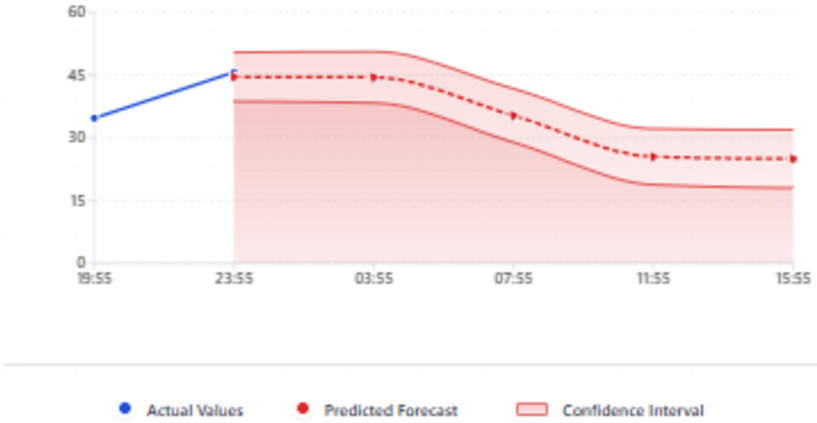
Model Performance

RMSE | MAE | Fullscreen



PM2.5 Forecast

PM2.5 | XGBoost | 24h | Fullscreen



Best Model by Pollutant

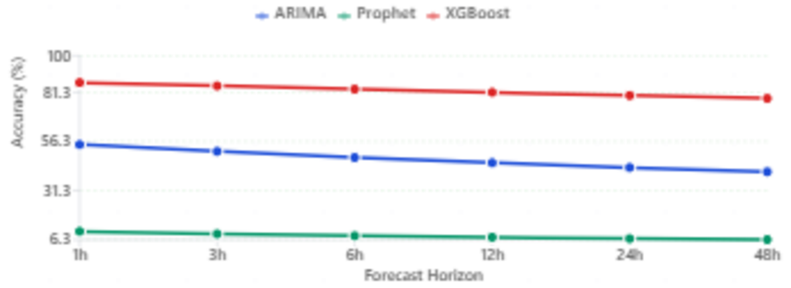
Fullscreen

POLLUTANT	BEST MODEL	RMSE	STATUS
PM2.5	XGBOOST	3.7173	• Active
NO	XGBOOST	2.1830	• Active
NO2	XGBOOST	1.5617	• Active
NOx	XGBOOST	2.4556	• Active
NH3	XGBOOST	1.4015	• Active
CO	XGBOOST	0.2014	• Active
SO2	XGBOOST	1.4643	• Active

Forecast Accuracy Over Time

Model performance across different forecast horizons

Fullscreen



Air Quality Alert System

Current Air Quality

Delhi

Delhi City

7-Day Forecast

7-Day Forecast

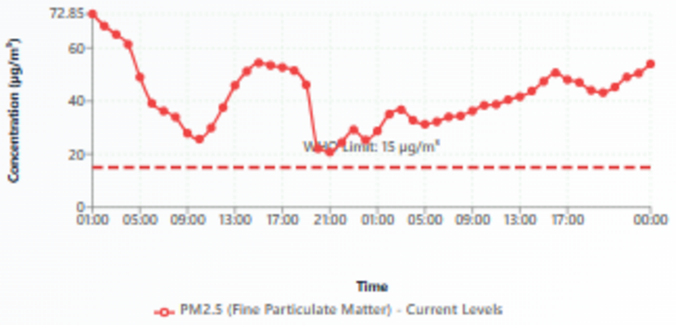
TUE	WED	THU	FRI	SAT	SUN	MON
AQI	AQI	AQI	AQI	AQI	AQI	AQI
124	94	100	98	126	169	109

- 0-50 Good
- 50-100 Satisfactory
- 100-200 Moderate
- 200-300 Poor
- 300-400 Very Poor
- >400 Severe

Pollutant Concentrations

Select Pollutant: PM2.5 (Fine Particulate Matter)

Delhi



Active Alerts

Active Alerts

- **Unhealthy for Sensitive Groups**
  AQI 124 expected on Tue
- **Unhealthy for Sensitive Groups**
  AQI 126 expected on Sat
- **Unhealthy for Sensitive Groups**
  AQI 169 expected on Sun

Interactive Dashboard

Controls

STATE

Amritsar

TIME RANGE

Last 24 Hours

POLLUTANT

PM2.5

FORECAST HORIZON

7 Days

Update Dashboard

Admin Mode

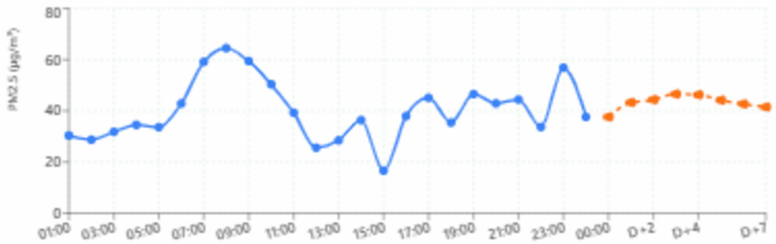
Last Updated: 7:56:44 PM

Current Air Quality

Amritsar City

0-50 Good
50-100 Satisfactory
100-200 Moderate
200-300 Poor
300-400 Very Poor
>400 Severe

PM2.5 Forecast

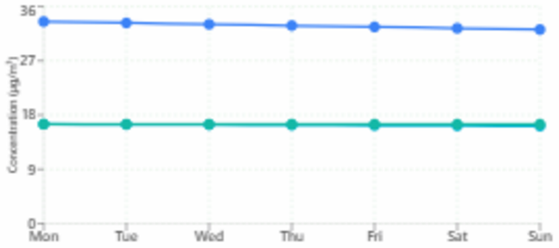


Forecast Historical

Min Forecast	Avg Forecast	Max Forecast
37.6	43.3	46.6

Pollutant Trends

Select Pollutants: PM2.5 NO NO2 NOx NH3 CO SO2 O3 Benzene Toluene



NO2 O3 PM2.5

PM2.5	NO2	O3
32.8 avg µg/m³	16.3 avg µg/m³	16.5 avg µg/m³

Alert Notifications

Satisfactory air quality - AQI 83 LOW

PM2.5 at 37.6 µg/m³ - Above recommended level MEDIUM

Admin Controls

Upload new datasets and retrain forecasting models

Upload New Dataset

Choose CSV file

Click to browse or drag and drop

Upload Dataset

Retrain ML Models

Select Model Type

Prophet

Model Information:

- Prophet: Best for seasonal patterns
- ARIMA: Classical time series
- XGBoost: Machine learning approach

Start Retraining

Important: Retraining models can take several minutes depending on dataset size. The dashboard will continue to use existing models until retraining completes successfully.


THANK YOU !!!
PTI