



Project Details:

Project Title - Forecasting Air Quality Using Historical Pollution Data

Project Purpose -

- Predict air quality index (AQI) and pollutant levels using historical pollution data.
- Help authorities, planners, and the public take preventive actions and make healthier decisions.
- Provide alerts, dashboards, and trend analysis for better environmental management.

Tools and Technologies - Python, Streamlit

Mentor - Ms. Umme Asma S

Batch Number – 3

Start Date - 22-September-2025

Intern Name - R Doondi Gangadhar

GitHub Repository -

https://github.com/doondi30/AirAware_SmartAirQuality_September2025_RDGangadhar

AQI and Factors

- AQI (Air Quality Index) is a numerical scale (0–500) indicating **how clean** or **polluted** the air is.
- It combines multiple pollutants into a single index.

AQI Range	Category	AQI Range	Category
0 – 50	Low Risk	201 – 300	Poor
51 – 100	Satisfactory	301 – 400	Very Poor
101 – 200	Moderate	401 – 500	Severe

Factors Affecting AQI:

- **Carbon Monoxide (CO):** Emitted from vehicle exhaust and incomplete combustion.
- **Sulphur Dioxide (SO₂):** Comes from coal burning and industrial processes.
- **Lead (Pb):** Released from smelting, batteries, and old paints.
- **Ammonia (NH₃):** Agricultural fertilizers and livestock waste.
- **Nitrogen Dioxide (NO₂):** Traffic emissions and power plants.

→ These pollutants degrade air quality and pose serious health risks

Source:

Traveller

Measurement of Air Pollutants

- **CAAQMS Stations:** India runs ~1,500 stations that check air quality 24/7.
 - **Automatic Monitoring:** These stations measure key pollutants like CO, SO₂, NO₂, Pb, NH₃, PM10, PM2.5.
 - **AQI Calculation:** Data is converted into the Air Quality Index (AQI).
 - **Validation:** Results are checked against NAAQS standards before being shared publicly.
- **Techniques include:**

Pollutant	Technique	Instrument
Particulate Matter (PM _{2.5} / PM ₁₀)	Gravimetric / Beta-attenuation	High Volume Sampler
Carbon Monoxide (CO)	Non-dispersive infrared absorption	CO Analyzer
Sulphur Dioxide (SO ₂)	UV Fluorescence	SO ₂ Analyzer
Nitrogen Dioxide (NO ₂)	Chemiluminescence	NO ₂ Analyzer
Lead (Pb)	Atomic absorption spectrophotometry	Lead Analyzer
Ammonia (NH ₃)	Chemiluminescence	NH ₃ Analyzer

AQI Evaluation Agencies

Agencies

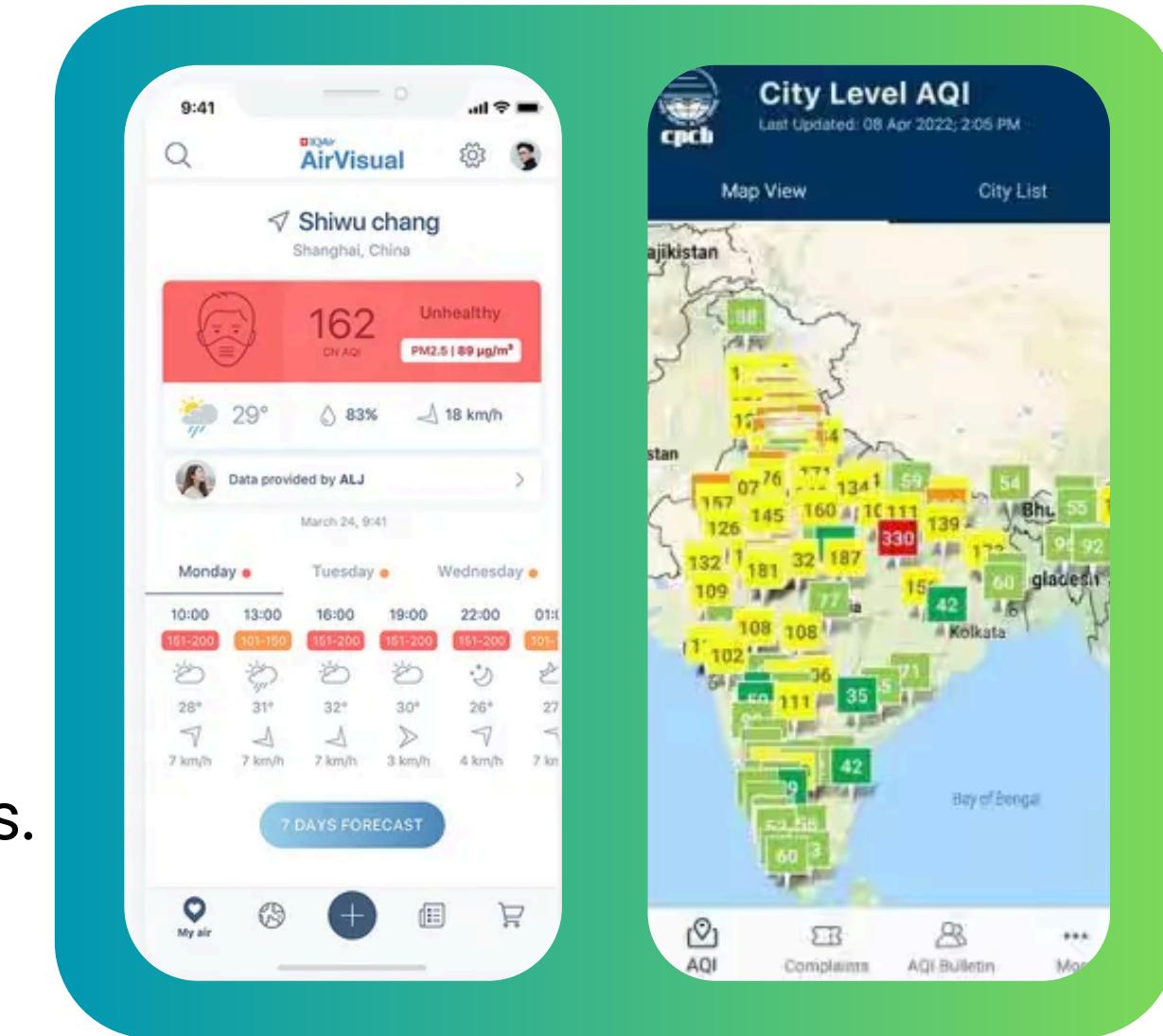
- **CPCB (Central Pollution Control Board)**: Runs the National AQI since 2014, sets standards, shares real-time data.
- **SPCBs (State Boards)**: Monitor and enforce AQI locally in each state.

How They Evaluate

- Measure pollutants like CO, SO₂, NO₂, Pb, NH₃, PM10, PM2.5.
- Compare with NAAQS standards to calculate AQI levels.
- Share results in real time through apps and websites.

Real-Time AQI Apps

- **SAMEER (Official CPCB App)**: Alerts + live AQI data.
- **AirVisual**: Detailed pollutant breakdown and global coverage.



AirVisual App interface

SAMEER App interface

Major Contributors to Air Pollution

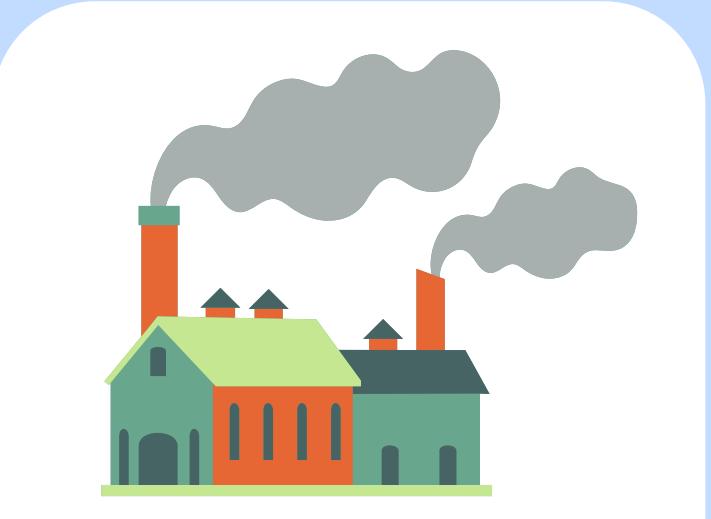
Seasonal factors:

- Firecrackers during New Year and Diwali add smoke.
- Delhi: Brick kilns release dust and smoke into the air.
- Punjab: Stubble burning creates heavy smog in the season.

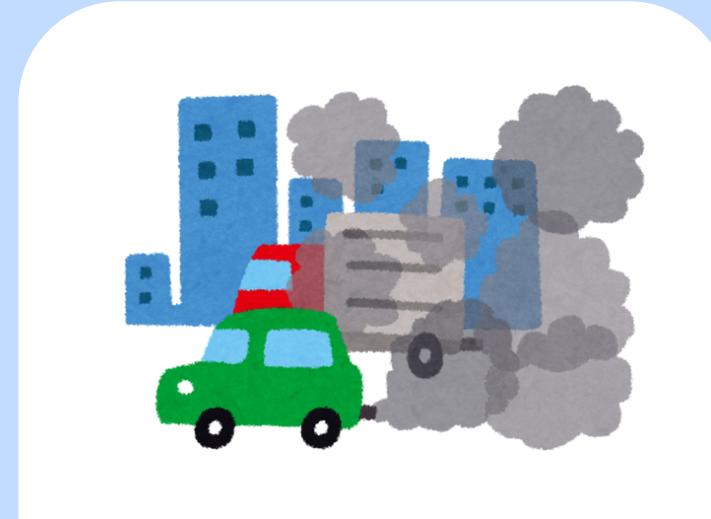
Sources:

WIKIPEDIA

Hindustan Times
THE HINDU



Industrial activities
51%



Vehicle emissions
27%



waste and
crop burning
17%



Dust and
Construction
2%



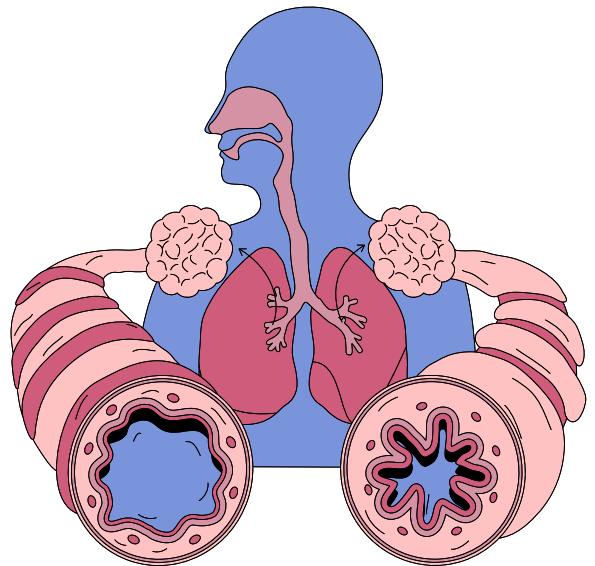
Residential heating
and cooking
2%



Biomass and waste
1%

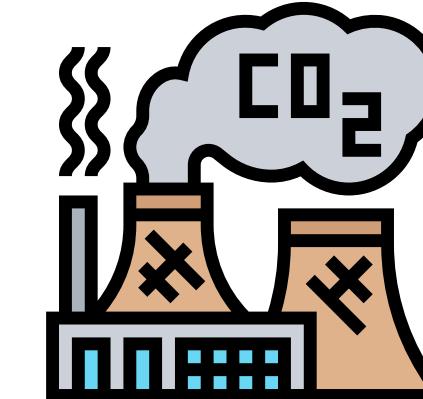
How is harmful to Humans and Earth

Effects on Humans



- Respiratory diseases
- Cardiovascular stress
- Eye and skin irritation
- Reduced life expectancy

Effects on Earth



Global warming due to greenhouse gases



Acid rain damaging soil and water bodies

Studies (University of Chicago, Air Quality Life Index 2024) estimate **Indians lose 5.3 years of life expectancy** on average due to **air pollution**, while **Japanese citizens lose less than 0.2 years** due to stringent **pollution control** and **cleaner energy systems**.

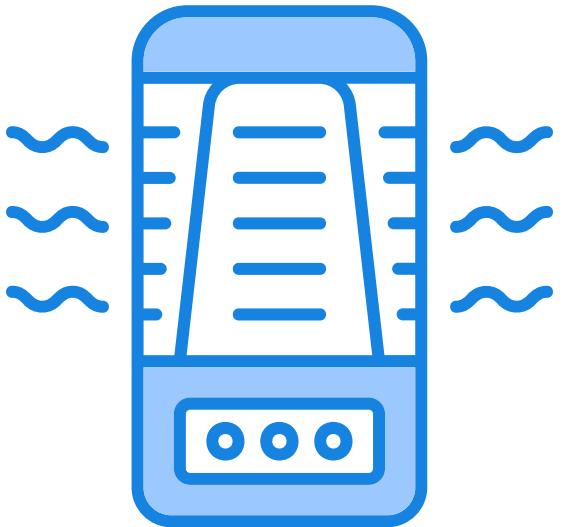
Sources:



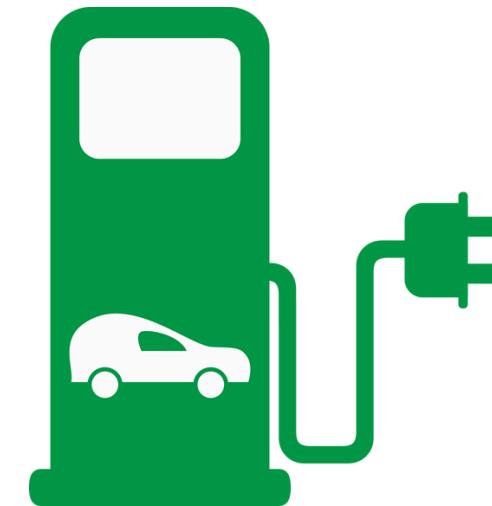
THE UNIVERSITY OF CHICAGO
EPIC ENERGY POLICY INSTITUTE

The Indian **EXPRESS**

Solutions to Reduce Air Pollution



Clean indoor air with purifiers and outdoor air with plants, trees, and green roofs.



Replace fossil fuels by adopting electric vehicles and renewable energy sources.



Promote sustainable habits through public awareness campaigns and strict policy enforcement.



Predict AQI trends with smart software to alert authorities and visualize pollution patterns.

Project Impact and its Contribution

- Helps governments and citizens **predict poor air quality days in advance**.
- Supports **policymaking, urban planning**, and **public health preparedness**.

Case: Cyclone Montha (Oct 2025) – Andhra Pradesh and West Bengal

- **After the cyclone, air pollution got worse** (AQI 250–350 = very poor).
- **Dust and moisture raised PM2.5 by 30–50%**.

Farmers' Risk: **1.58 lakh hectares of crops in Andhra Pradesh and areas in West Bengal** were at risk.

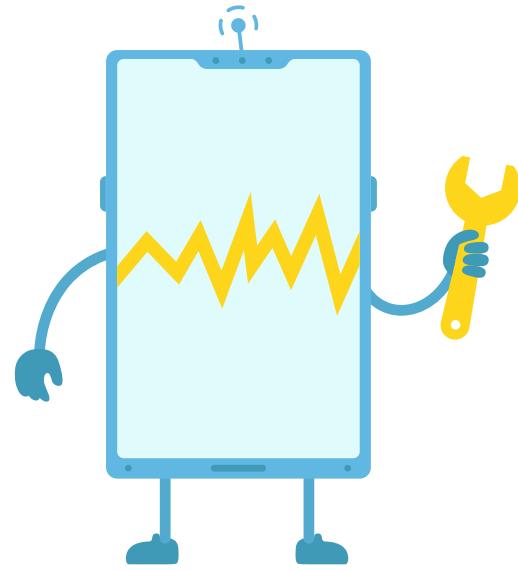
Govt Warning: **Avoid nitrogen fertilizers during high AQI to protect crops.**

Forecasts Helped: Farmers paused fertilizer use when AQI >200, covered crops, and resumed only when AQI <150.

Tech Stack

Component	Tools / Technologies Used
Language	Python
Data Handling	Pandas, NumPy
Visualization	Matplotlib, Seaborn
Forecasting Models	ARIMA, Prophet, LSTM, XGBoost
Web Interface	Streamlit
Data Sources	Kaggle
Version Control	GitHub

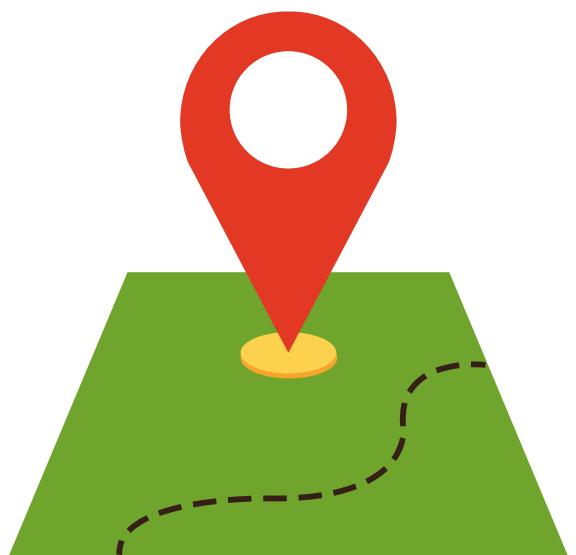
Future Enhancements



Launch a mobile app for real-time AQI alerts and pollution awareness.



Reward citizens for contributing to clean air like planting trees or following pollution control rules.



Integrate satellite and IoT sensor data for realtime, citywide air quality monitoring.



Adopt advanced deep learning models for more accurate forecasting.

Execution Steps

Steps to Run the Project

1. Load Data:

- Import historical AQI datasets from Kaggle.

2. Data Cleaning & Preprocessing:

- Handle missing values, normalize features, and resample time series.

3. Model Training:

- Train forecasting models (XG Boost, ARIMA, Prophet and LSTM).

4. Model Evaluation:

- Compare accuracy using RMSE/MAE metrics.

5. Model Saving:

- Store best performing model for inference.

6. Run Web App:

- Execute streamlit run app.py.
- Access the dashboard for predictions and alerts.

7. Upload New Data:

- Admin can upload new CSVs to retrain and update forecasts.



**THANK
YOU**