Team Name : **VishSa**

Team Leader Name : **Sahin Nayak**

Problem Statement : **Monitoring Air Pollution from Space, by an integrated approach using satellite observations, ground-based measurements, reanalysis data, and AI/ML techniques.**

Team Members:

Team Leader:

Name: Sahin Nayak
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Team Member-1:

Name: Vishal Parui
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Team Member-2:

Name: Sudip Bakuli
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Team Member-3:

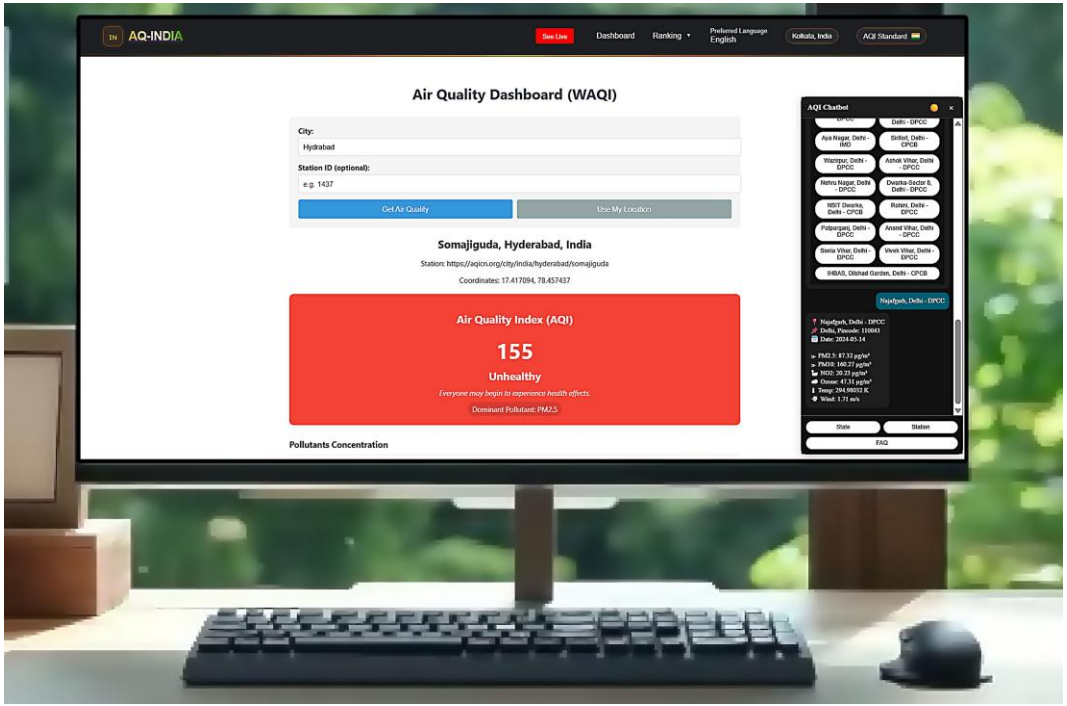
Name: Soumen Mishra
College: West Bengal State Council of Technical & Vocational Education and Skill Development

Problem Statement:

India faces a severe air pollution crisis, with an average PM2.5 of 95 µg/m³ (2024 data), exceeding the WHO limit of 15 µg/m³. This impacts 1.67 billion people, causing health issues and economic losses. AQ-INDIA addresses this by providing real-time, actionable insights.

Brief about the Idea:

AQ-INDIA is a web platform integrating satellite radiance (INSAT-3DR), CPCB PM data, MERRA reanalysis parameters, and AI/ML models. It offers real-time AQI monitoring, predictions, and policy simulations across India, empowering citizens and policymakers with localized, data-driven solutions.

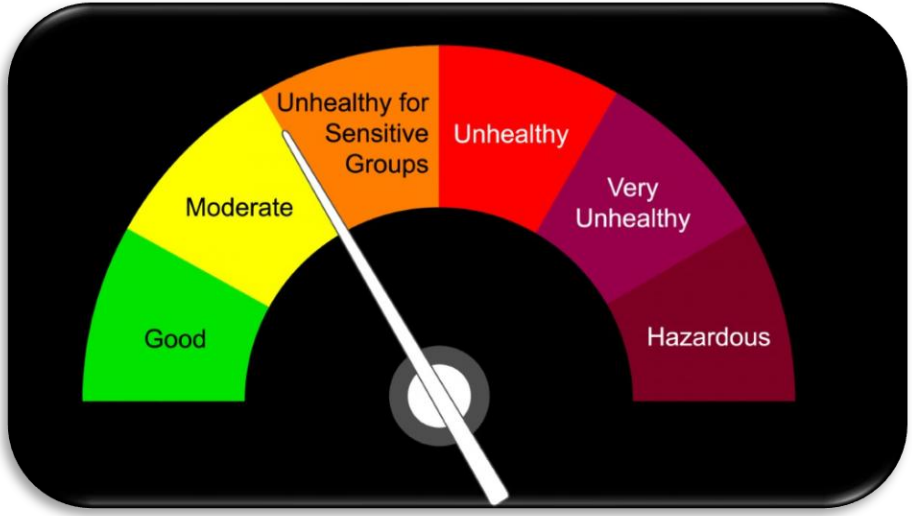


Advantages:

- Global & real-time monitoring (unlike ground-only networks).
- Higher accuracy by merging satellite, ground, and model data.
- Early warning systems for policymakers and public health.

Applications:

- Urban air quality management
- Tracking transboundary pollution
- Climate change studies
- Health impact assessments



Opportunity should be able to explain the following:

- How different is it from any of the other existing ideas?

  AQ-INDIA uniquely combines satellite-validated, Ground Based data with AI-driven forecasts, unlike generic AQI apps, offering a holistic pollution view.

- How will it be able to solve the problem?

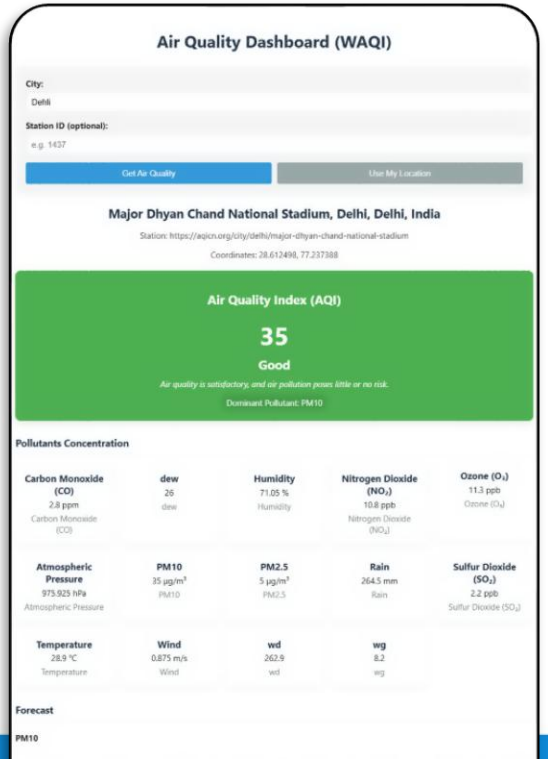
  The use of K-means clustering for generating cluster of particles on Map and used Random Forest Regression for real time predictions this can provide us insights about harmful air quality even for Real-time monitoring, future predictions, and CPCB simulations enables proactive pollution control and public awareness.

- USP of the proposed solution:

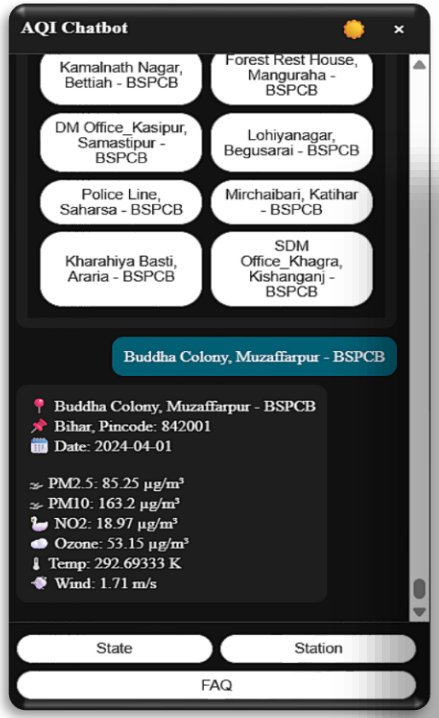
  Satellite Data-AI Model integration, Chat BOT Supported with an Unique, Responsive & Indian-centric design is an Unique Selling Proposition.

List of features offered by the solution:

- Real-time AQI monitoring with Station search.
- Interactive map with clustered AQI zones (green, yellow, orange, red).
- Monthly and yearly pollution graphs with previous year data Representation.
- AI/ML-based PM2.5, PM10, NO2, CO, SO2 & Ozone predictions.
- Real time ChatBot support for new user with a User friendly attractive interface.

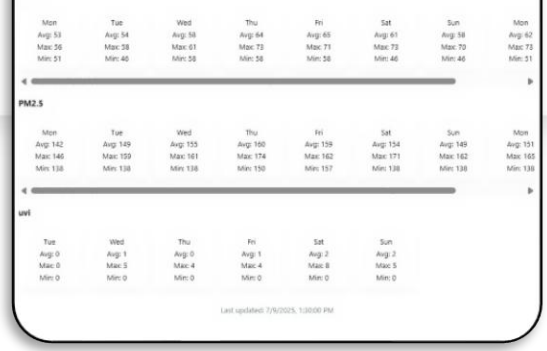


Visual Representation:



ChatBot Support

User-Friendly Interface



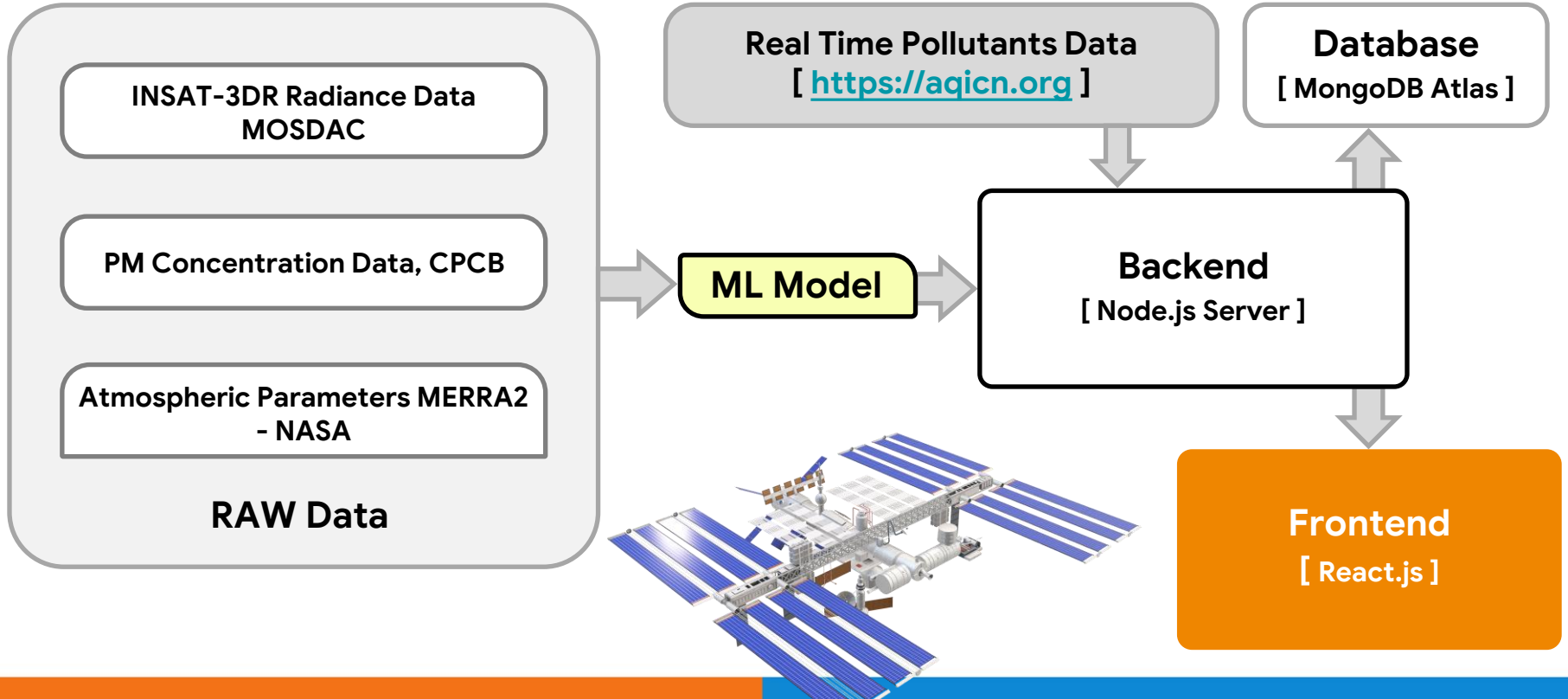
Real-time AQI monitoring

India's AQI Rankings 2024 Based on PM 2.5

2024 air quality monitoring across major Indian cities.

Rank	City	2024 Avg	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	IN New Delhi, India	95	217	104	76	68	84	47	35	25	39	102	202	134
2	IN Ghaziabad, India	88	199	106	76	67	68	40	32	25	43	103	178	116
3	IN Greater Noida, India	88	242	122	74	69	90	57	33	26	42	83	130	91
4	IN Noida, India	88	221	120	69	69	83	46	27	26	40	94	152	109
5	IN Faridabad, India	84	201	106	80	87	114	55	41	29	36	62	109	85
6	IN Bhiwadi, India	82	199	102	74	70	98	61	41	33	40	82	115	71
7	IN Gurgaon, India	81	180	91	71	91	81	48	37	32	37	73	132	100
9	IN Sonipat, India	75	185	92	57	49	67	43	30	23	31	81	151	92
11	IN Rohtak, India	74	178	85	65	60	76	44	27	20	32	81	144	80
12	IN Hapur, India	73	171	131	54	56	62	29	23	19	32	88	130	83

Process flow diagram or Use-case diagram:



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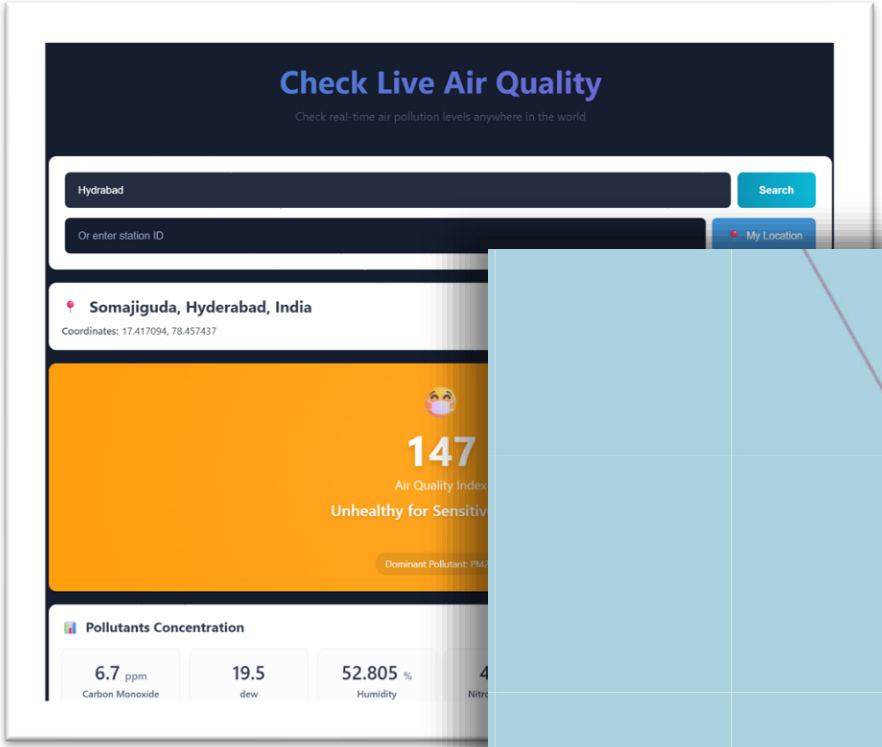
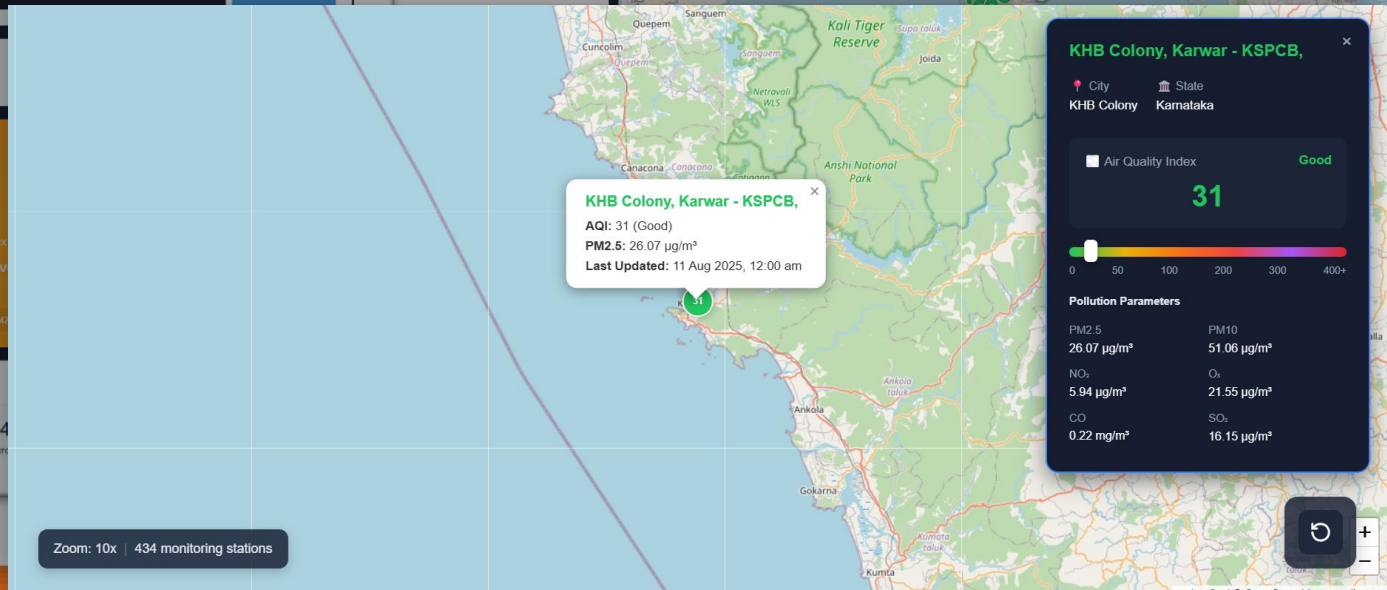
Layouts:





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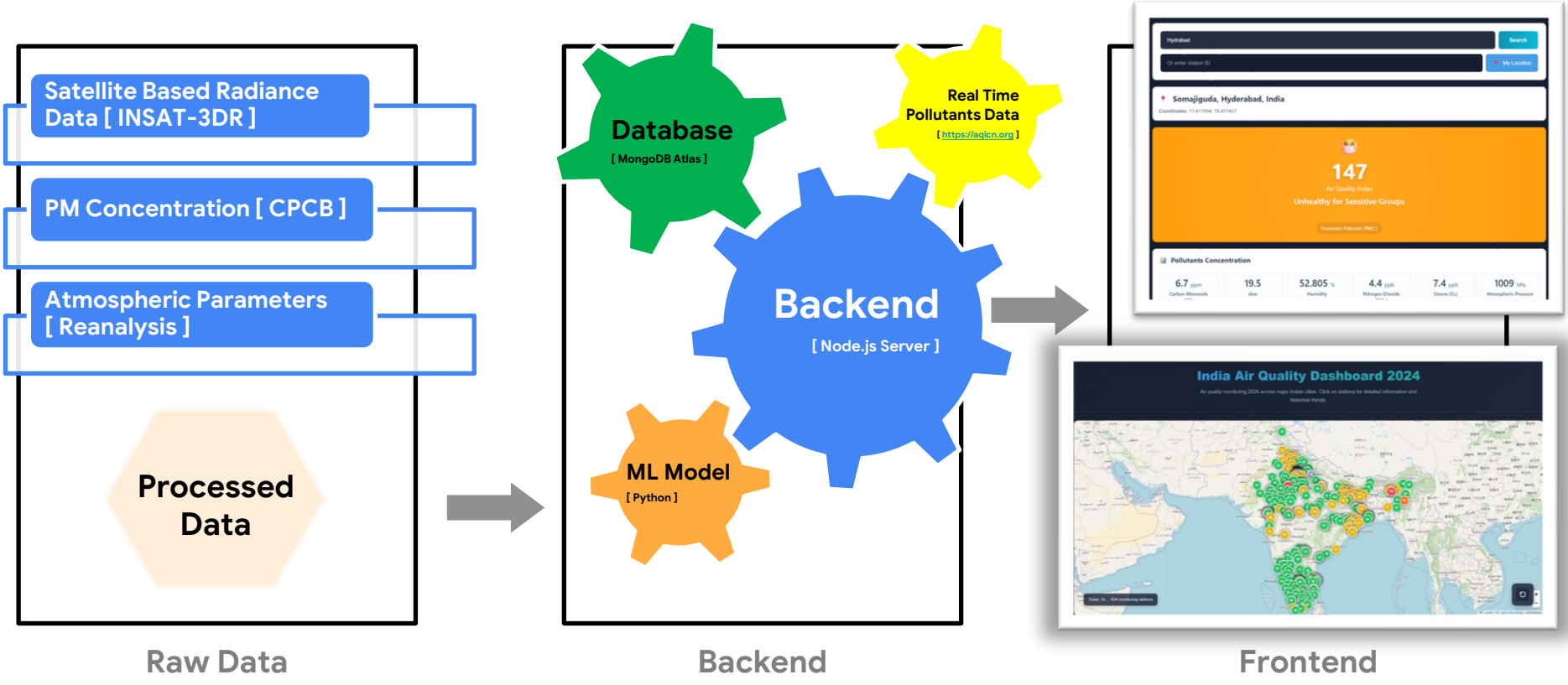
Architecture diagram of the proposed solution:



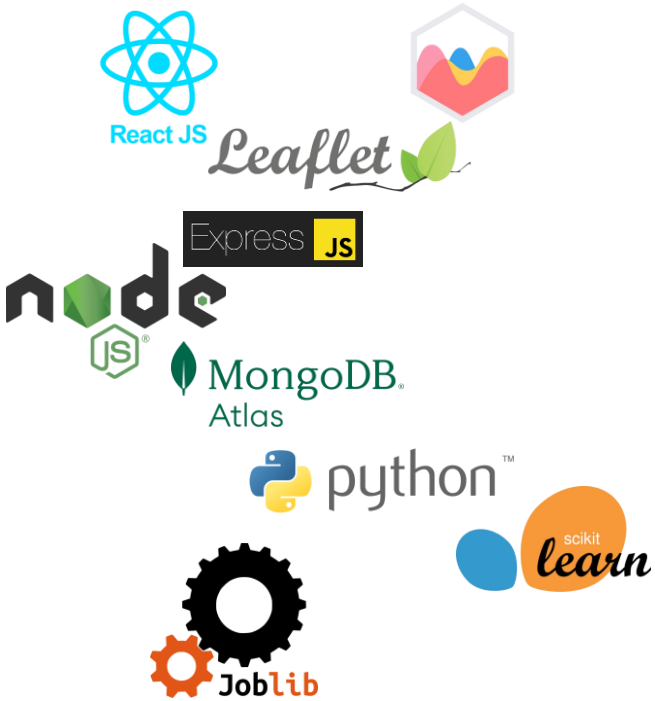
Technologies to be used in the solution:

Frontend:
React, Leaflet, Chart.js (for responsive user-friendly interface).

Backend:
Node.js, Express.js, MongoDB Atlas (For responsive user-friendly Interface).

AI/ML:
Python, Scikit-learn, Joblib (Used K- Means Clustering Algorithm for clustering similar data and Random Forest Regression for real time prediction).

Data:
INSAT-3DR Radiance [MOSDEC]
PM Concentration, [CPCB]
Atmospheric Parameters Reanalysis Data [MERRA-2, NASA]



References:

1. Atmospheric Parameters Reanalysis **[MERRA2 - NASA]** - [https://search.earthdata.nasa.gov/]
2. Satellite Based Radiance Data **[INSAT-3DR, MOSDAC]** - [https://www.mosdac.gov.in/]
3. PM Concentration **[CPCB]** - [https://cpcb.nic.in/]
4. Real Time Pollutants data - [https://waqi.info/]

Live Intial Demonstration - [https://isro-hackathon.onrender.com/]

Github Repository - [https://github.com/Sahin-Nayak/ISRO_HACKATHON/]

Conclusion:

The proposed Integrated Air Pollution Monitoring System leverages satellite observations, ground-based sensors, reanalysis data, and AI/ML techniques to deliver a comprehensive, real-time solution for tracking and analyzing air pollution. By combining multi-source data fusion, machine learning-driven analytics, and interactive visualization tools, this system enables:

Accurate, high-resolution pollution mapping (global to hyperlocal scales)

Early warning systems for public health and policy interventions

Source attribution to identify industrial, vehicular, and natural emission hotspots

Scalable deployment from research prototypes to city-wide monitoring networks

With technologies like INSAT 3DR AOD data, MOSDAC and real-time dashboards, this approach bridges gaps between environmental science, policymaking, and public awareness. Future enhancements could integrate IoT sensor networks, blockchain for data transparency, and climate modeling for long-term impact assessments.

This solution not only advances smart environmental monitoring but also empowers stakeholders to take data-driven actions for cleaner air and healthier communities.

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