Team Name : **DAMP Vision**

Team Leader Name : Patel Deep B.

Problem Statement : **Monitoring Air Pollution from Space**

Team Members

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Team Member-3:

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Brief about the Idea:

This project aims to improve air pollution monitoring by combining satellite data, ground-based measurements, and reanalysis datasets with **Artificial Intelligence and Machine Learning (AI/ML)**. Satellite sensors such as **INSAT-3D/3DR, EOS-06 OCM-3, Sentinel-5P, and MODIS provide data on pollutants including AOD, NO_2, and SO_2.** Ground-level data from CPCB monitoring stations and reanalysis datasets like ERA5 and CAMS contribute weather and contextual information.

AI and ML techniques are used to combine these different data sources. Models estimate **ground-level pollutant levels, such as PM2.5**. They also downscale satellite data to finer resolutions and fill in gaps caused by cloud cover. This combination improves the coverage of air quality monitoring in both space and time.

The processed data helps identify pollution hotspots, detect trends, and predict future air quality. Findings are shown through easy-to-understand visualizations like dashboards or interactive maps. This approach increases accuracy, broadens monitoring coverage, and aids in making better environmental decisions.

It's about creating a powerful tool that brings together vast amounts of space and ground data to give a clearer, more complete picture of air quality.

Opportunity should be able to explain the following:

- How is it different?

Combines satellite, ground, and AI data.
Covers rural & urban areas, not just cities.
Includes source identification, forecasting, and uncertainty — features missing in most systems.

- How does it solve the problem?

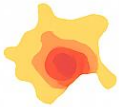
Predicts air quality ahead of time.
Offers personalized exposure insights.
Helps policymakers act on pollution sources effectively.

- USP of the Solution

AI-powered satellite integration
Hyperlocal forecasts
Uncertainty-aware predictions
Citizen-focused design

List of features offered by the solution

Key Features



Interactive PM2.5 Heatmap

View real-time predicted pollution across India

Personalized Exposure Calculator

Calculates risk based on user's location & time

Historical: Trends & Data Download

Time-series graphs and CSV/GeoTIFP export

Personalized Exposure Calculator

Calculates risk based on user's location & time

Source Apportionment Module

Detects pollution sources (*e.g.*, traffic, fire, Industry)

User-Friendly Web Dashboard

Built with interaactive maps, charts and simole UI

Cloud-Based & Scalable Architecture

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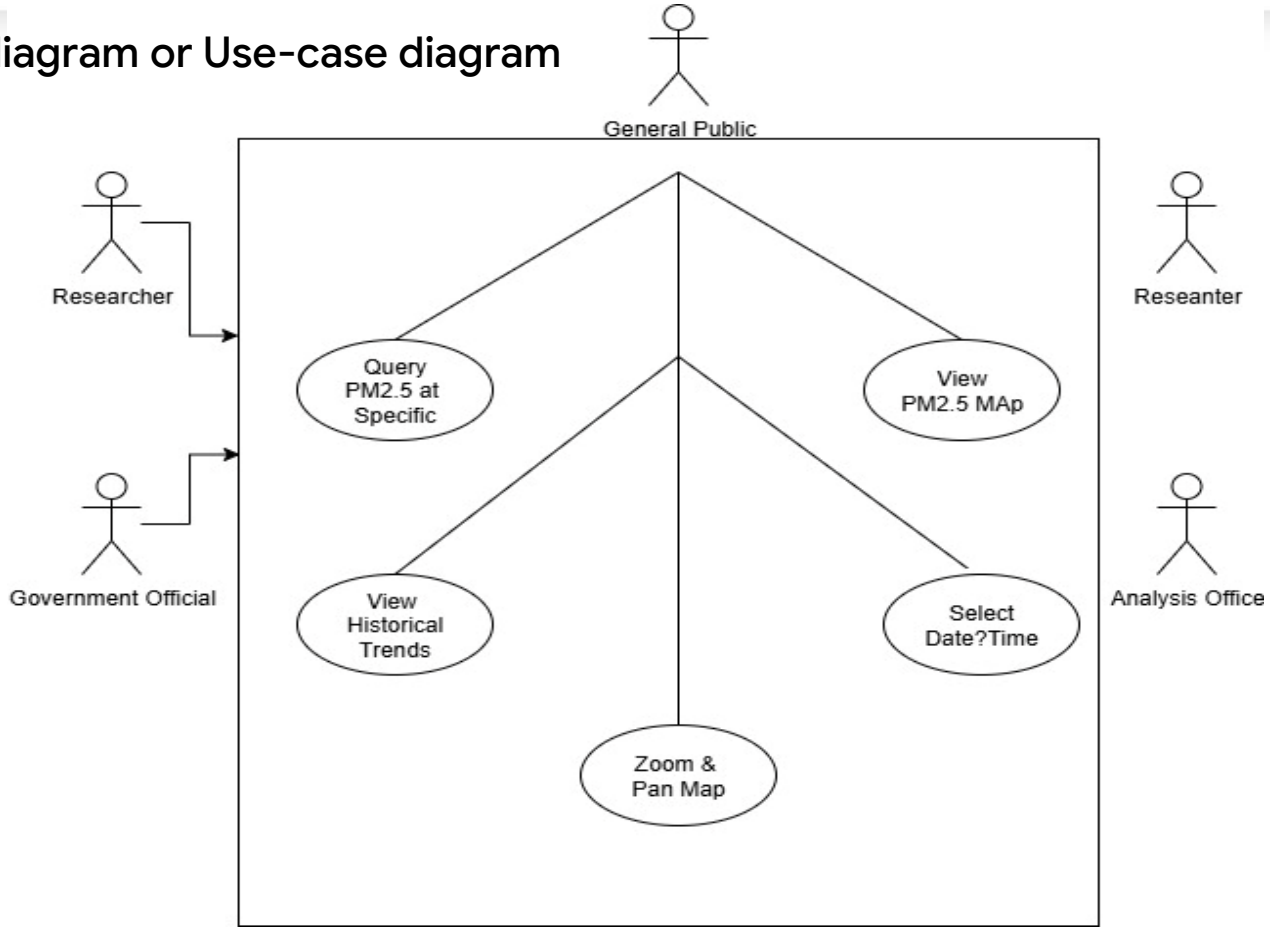
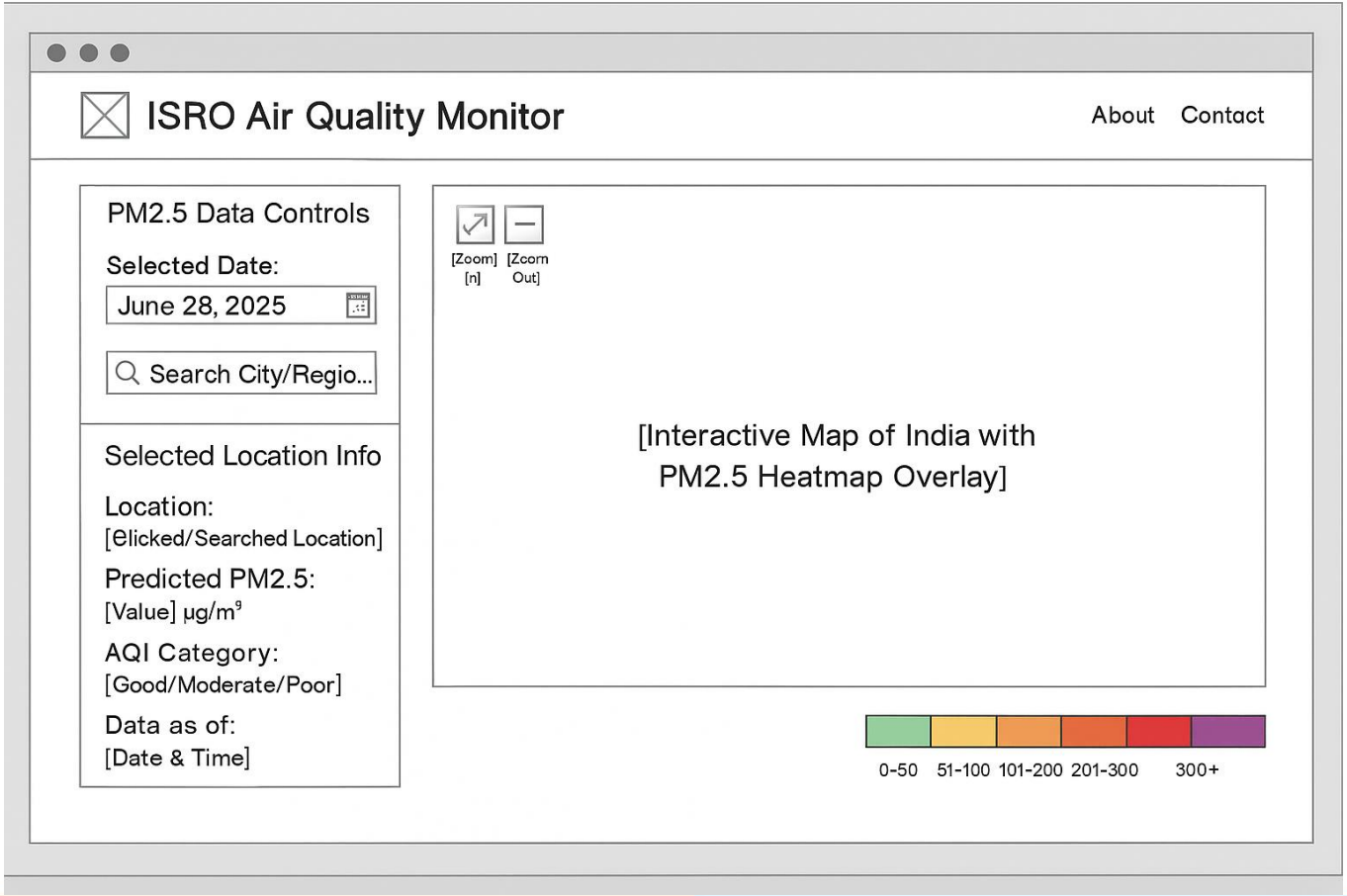
Process flow diagram or Use-case diagram



Wireframes/Mock diagrams of the proposed solution (optional)



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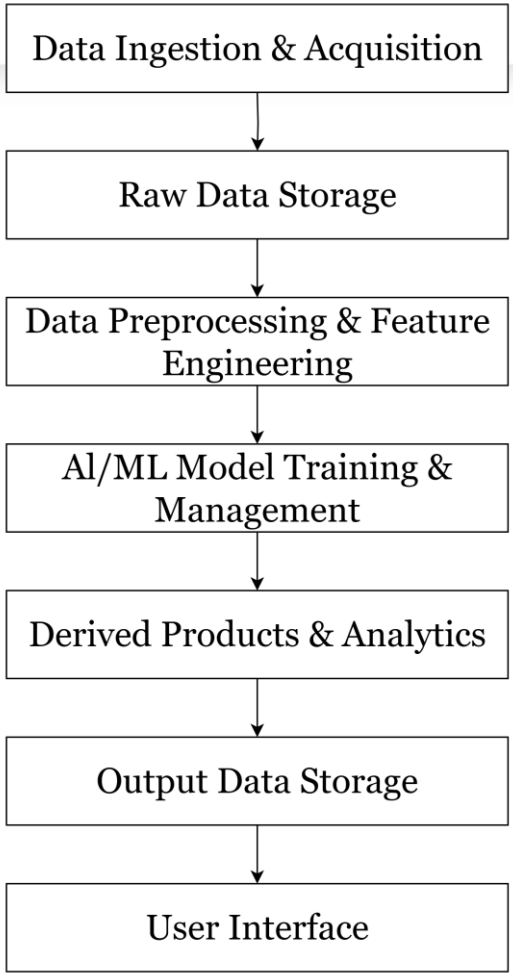
Architecture diagram of the proposed solution



Technologies to be used in the solution:

1. **Satellite Data Sources:** INSAT-3D/3DR/3DS, Sentinel-5P, MODIS, VIIRS
2. **Ground Monitoring:** CPCB APIs, ENVIS, OpenAQ
3. **AI/ML Frameworks:** TensorFlow
4. **Data Processing Tools:** Python, pandas, NumPy, netCDF4
5. **Geospatial Tools:** PostGIS, GeoTIFF, OpenStreetMap, QGIS
6. **Cloud & Infrastructure:** AWS / GCP / Azure, Docker, Kubernetes, Apache Airflow
7. **Frontend Technologies:** React.js, Leaflet.js, Mapbox GL JS, Chart.js, Tailwind CSS
8. **Backend/API Services:** Flask, FastAPI, Node.js (Express)
9. **Workflow & Model Management:** MLflow, Prefect

Estimated implementation cost (optional):

Component	Service/Tool	Purpose	Estimated Monthly Cost (INR)
Cloud Storage	AWS S3 / GCP Cloud Storage	Store raw and processed data (e.g., satellite, CSV, GeoTIFF)	₹165 – ₹415
Model Training Compute	AWS EC2 / GCP VM with GPU	Train ML models (CNN, LSTM, etc.)	₹4,150 – ₹8,300
Web/API Hosting	t3.small / f1-micro VM	Host backend API and dashboard	₹830 – ₹1,245
Database	PostgreSQL / BigQuery (small instance)	Store processed features and results	₹830 – ₹1,660
Workflow Management	Apache Airflow (cloud or self-hosted)	Schedule data ingestion and model runs	₹830 – ₹1,245

Component	Service/Tool	Purpose	Estimated Monthly Cost (INR)
Monitoring & Logging	GCP/AWS Monitoring tools	Track app health and performance	₹0 – ₹415
Model Management	MLflow (self-hosted)	Track model versions and performance	Free
Map Tiles & Visualization	Mapbox / Leaflet.js (up to 50k loads)	Render interactive PM2.5 maps	₹0 – ₹4,150
Geospatial Data & Tools	OpenStreetMap / static datasets	LULC, population density, road networks	Free
Development Tools	GitHub, VSCode, CI/CD tools	Version control and code deployment	Free (basic tier)

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