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BHARATIYA ANTARIKSH HACKATHON 2025

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Team Name : SVNIT Coders

Team Leader Name : Deep Hitesh Das

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

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Team Leader
Name: Deep Hitesh Das
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Team Member-1
Name: Bodhini Jain
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Team Member-2
Name: Swapna Kondapuram
College: Sardar Vallabhbhai National Institute of Technology

Brief about Idea

Bridging the Data Gap: We tackle the scarcity of ground sensors by using our ML models to virtually sense PM levels from space, enabling pan-India air quality estimation.

AI for Environmental Equity: By predicting pollution in underserved regions, we ensure informed action even where sensors don’t exist, a step towards environmental justice.

Dynamic Pollution Mapping: Our pipeline creates near-real-time, high-resolution PM maps, empowering decision-makers with spatial intelligence for rapid response.

Scalable & Indigenous Solution: Using INSAT data and open-source AI, we present a cost-effective, scalable, and India-specific solution for national air quality monitoring.

Smart Data Fusion: Unlike traditional models, we fuse satellite AOD, CPCB data, and meteorological reanalysis to enhance prediction accuracy across diverse terrains

What we bring to the table

How is it Different from Existing Ideas?

Combines three diverse data sources (Satellite + Ground + Reanalysis) in one ML pipeline

Uses AI models to estimate surface-level PM from atmospheric indicators, not just AOD directly

Focuses on real-time mapping at a national scale, unlike traditional city-level monitoring

How Will It Solve the Problem?

Predicts PM levels even in sensor-absent regions, solving data scarcity

Enhances accuracy using contextual meteorological variables (e.g., humidity, wind)

Generates a continuous pollution heatmap, useful for planning, alerts, and health advisories

Unique Selling Proposition

AI-based virtual sensing grid - zero infrastructure, full coverage

Scalable, adaptive, and open-source - ready for rapid deployment and future expansion

INSAT-powered and India-specific, unlike generic global tools

Key Capabilities of the solution

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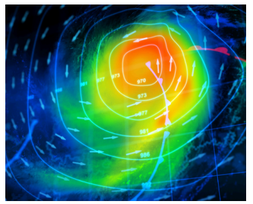
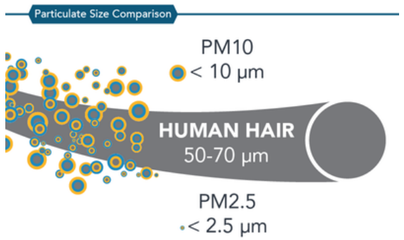
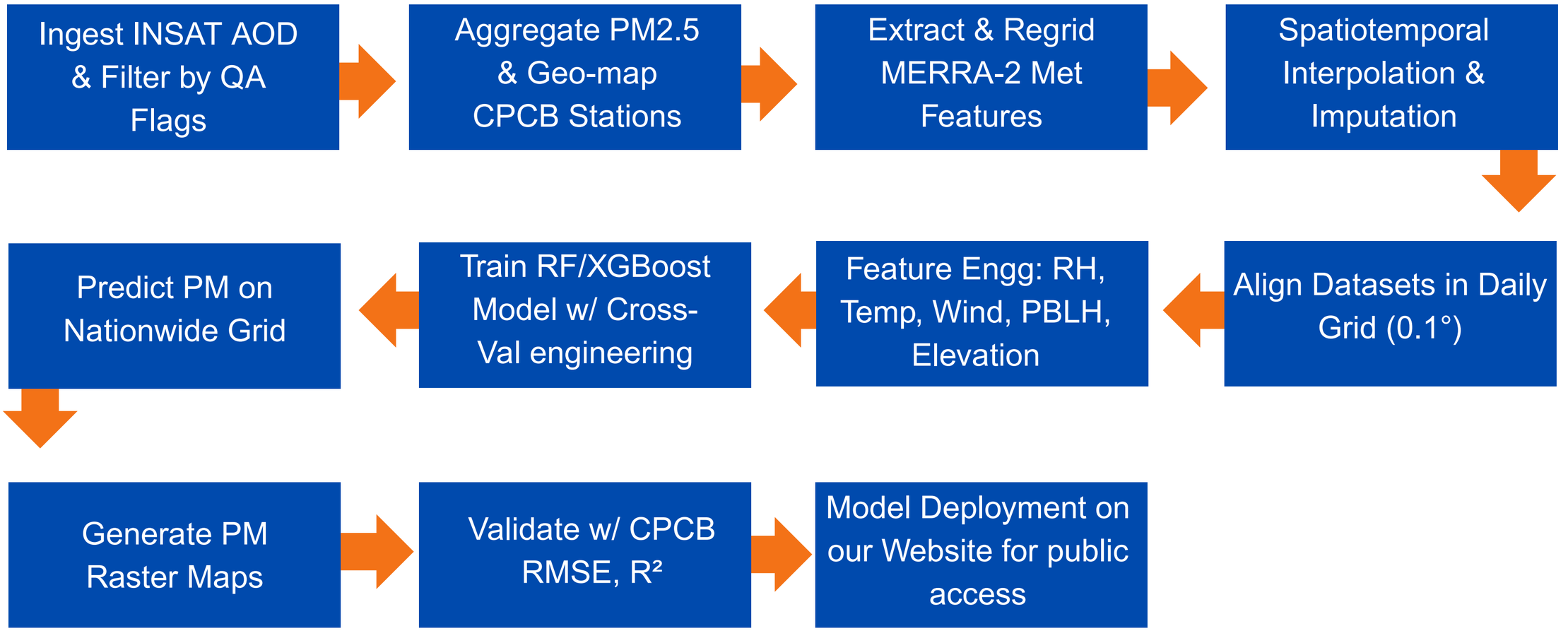
- Daily PM2.5 concentration maps across India using fused satellite and ML-based predictions
- Real-time visualization of air pollution levels with interactive, zoomable maps
- Historical PM2.5 trends viewable by location, date range.
- Ground-truth comparisons with CPCB monitoring stations for model validation
- Downloadable PM2.5 datasets in CSV and GeoTIFF format for research
- Location-based PM forecasts using recent AOD and meteorological data
- City-wise air quality dashboards with pollution statistics and visual summaries
- Animated pollution heatmaps to track temporal changes across India
- Alert system for high PM2.5 days in selected regions (email/SMS notifications optional)
- Developer API access for programmatic retrieval of pollution estimates
- Supports environmental planning and data-driven policy decisions using AI insights



CPCB



Process flow diagram



Wireframes

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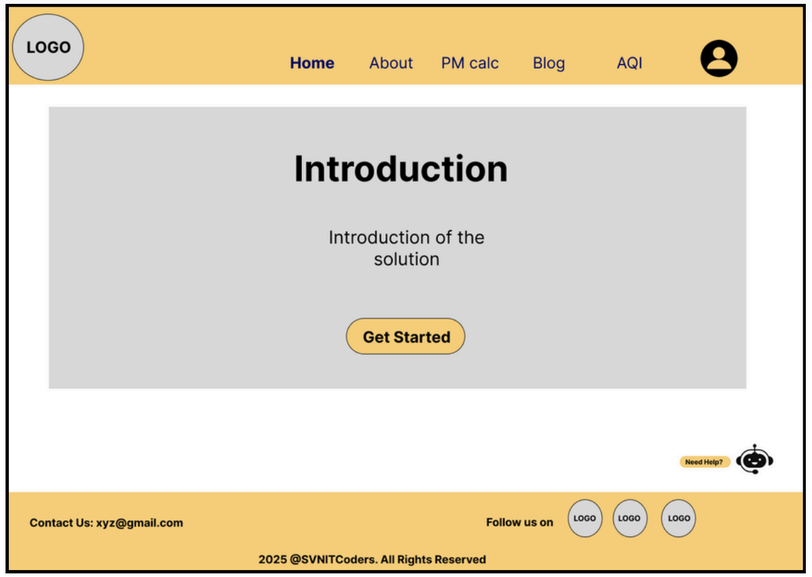
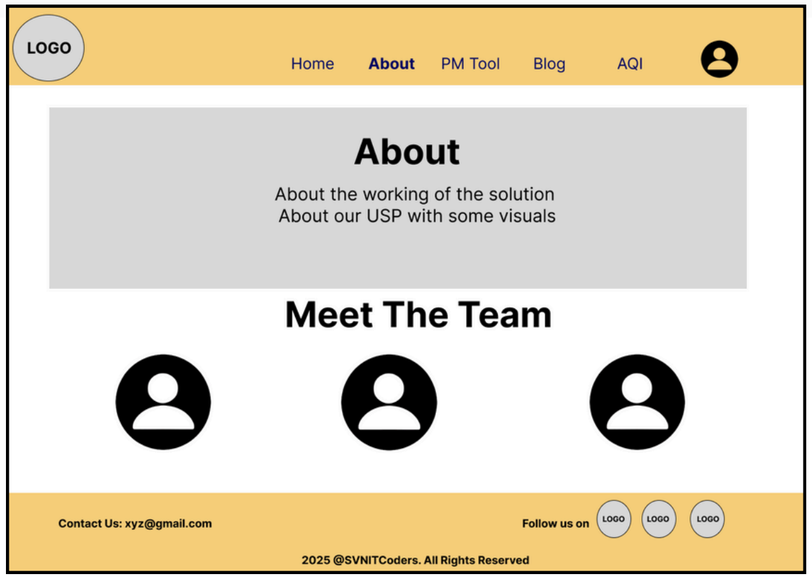
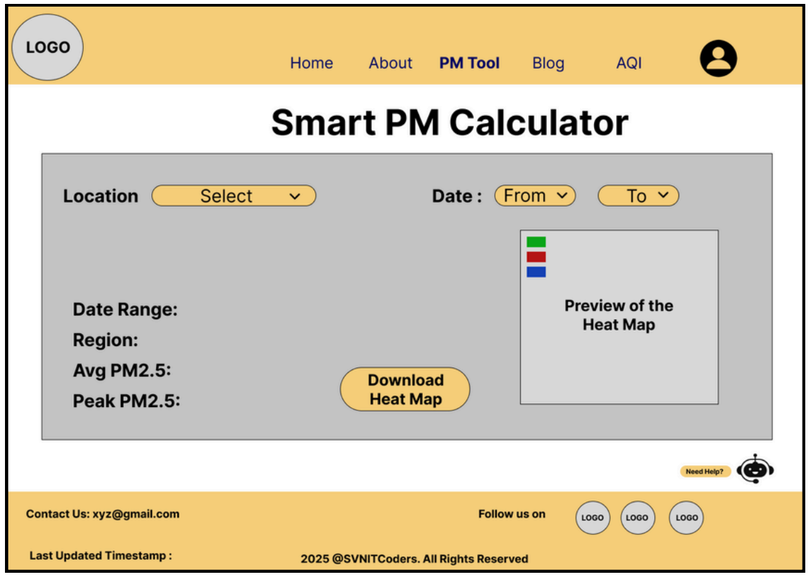
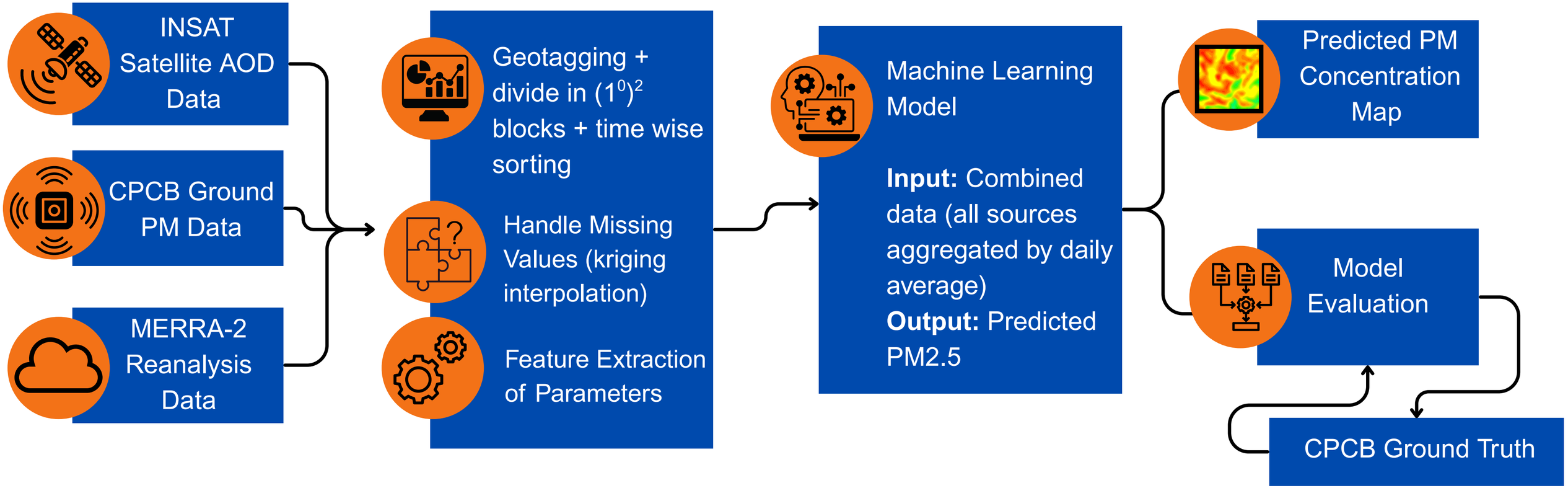






Architecture Diagram



Tech Stack

AI/ML Techniques

- Random Forest Regression for Robust, interpretable baseline model
- XGBoost / LightGBM for high-accuracy, ensemble-based predictions
- Neural Networks (if time permits) for learning nonlinear AOD-PM relationships
- Grid Search / Cross-validation for model tuning and evaluation

Tools & Platforms

- Python language for data processing and modeling
- Pandas, NumPy, SciPy for Data manipulation and analysis
- Scikit-learn, XGBoost, LightGBM, TensorFlow/PyTorch – ML frameworks
- Matplotlib, Seaborn, Plotly for Visualization of PM maps and model outputs

Time Cost

Task	Estimated Time
Data collection and parsing	2 Weeks
Data preprocessing, cleaning, interpolation, merging	2 Weeks
Feature engineering and model development	1 Week
Training and validation	5 days
PM mapping and visualization	5 days
Final evaluation + documentation	1 Week

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THANK YOU