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TITLE PAGE

- **Problem Statement ID:** 1734
- **Problem Statement Title:** Downscaling of Satellite based air quality map using AI/ML
- **Theme:** Clean & Green Technology
- **PS Category:** Software
- **Team ID:**
- **Team Name:** Tech Titans

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IDEA TITLE

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Proposed Solution:

1. Data Collection & Preprocessing:

- Acquiring NO2 data from satellites (e.g., Sentinel-5P) and handle gaps with imputation techniques.

2. Model Development:

- Training a Machine Learning model (e.g., Random Forest) to downscale satellite data to fine resolution.

3. Validation:

- Apply cross-validation and test with independent data to ensure accuracy.

4. Deployment:

- Deploy as a web tool for real-time NO2 monitoring with a user-friendly interface for researchers and government bodies.

How it Addresses the Problem: Provides detailed local NO2 maps, improving air quality assessments.

Innovation & Uniqueness: Combines satellite and ground data with advanced ML for accurate, real-time air quality mapping and no comprehensive solution exists like this.

Fig 1. Snap of dataset

Data Acquisition

•**API**: Accessed via Sentinel Hub using specific coordinates and date range.

•**Token**: Used for API authentication.

Data Processing

•**Script**: Extracted NO2 levels in floating-point format.

•**Request**: Retrieved NO2 data for the region.

Visualization

•**Output Grid**: Displays NO2 levels per pixel, with a color bar indicating concentration levels (dark = low, light = high).

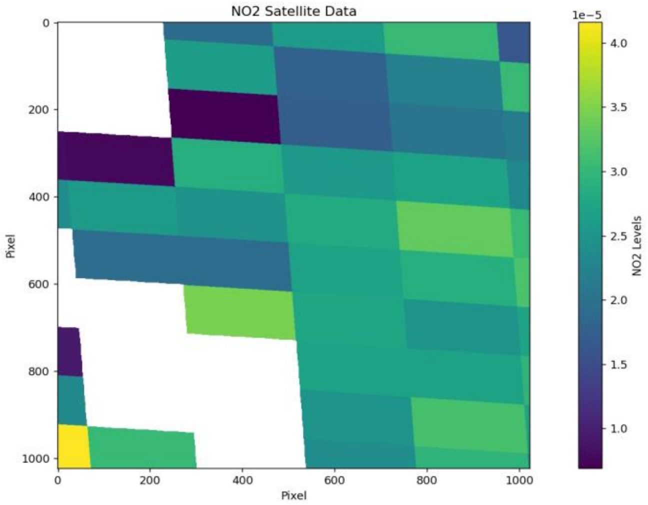

Fig 2. Outcome

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TECHNICAL APPROACH

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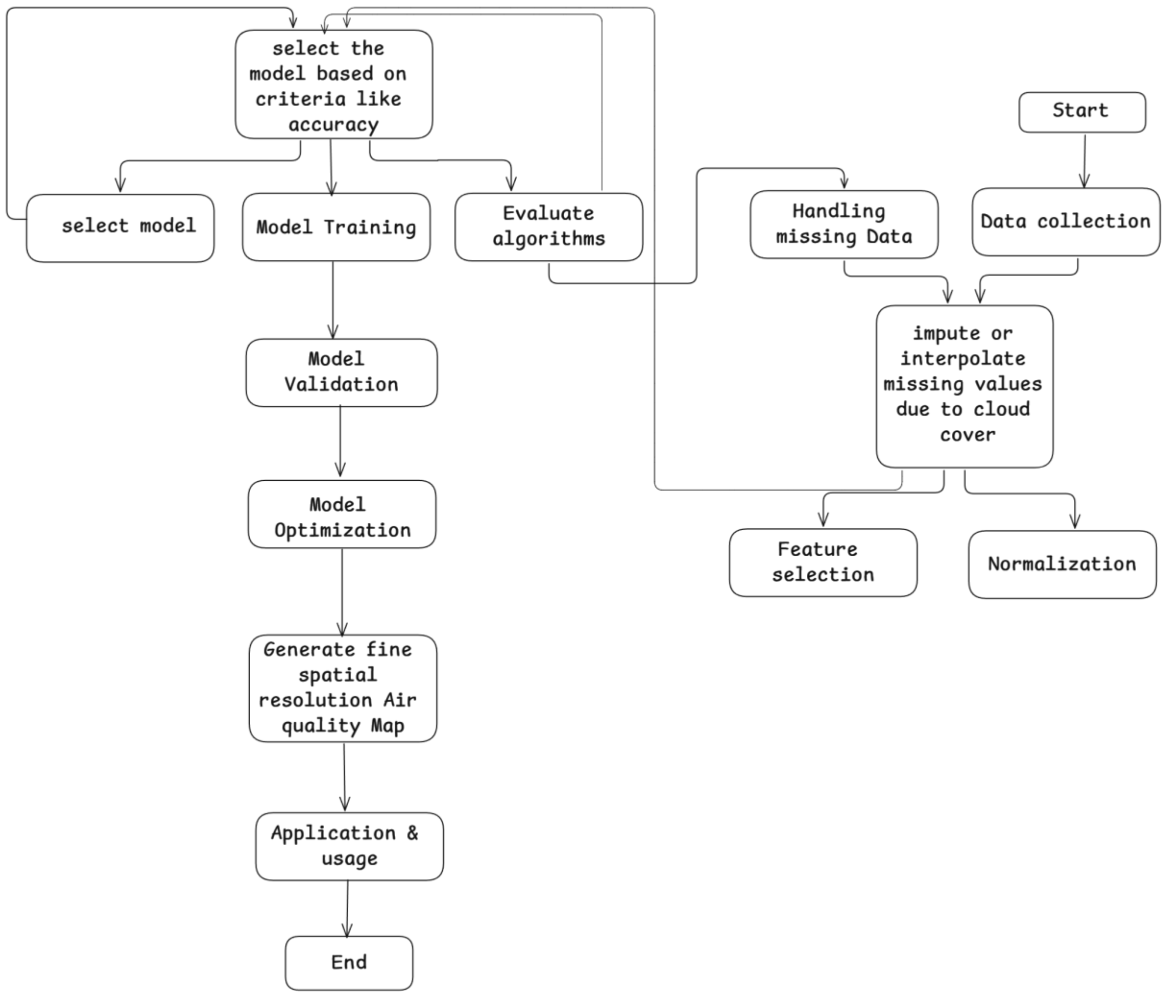
❖ Technologies to be Used

Programming Languages: Python
Database: MongoDB
Frameworks & Libraries: TensorFlow, PyTorch, Scikit-Learn, GeoPandas, Matplotlib, Pandas

❖ Methodology & Process for Implementation

Data Collection: Satellite data ,data from air quality monitoring stations
Data Preprocessing: Handling gaps in data, Extracting relevant environmental features
Algorithm Selection: Random Forest, CNN, GBM
Training: data to train the model
Validation: Independent dataset validation, cross-validation

Block Diagram



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FEASIBILITY AND VIABILITY

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Feasibility

- **Data Availability**: Abundant satellite and ground data, though preprocessing is needed.
- **Technical Maturity**: Reliable AI/ML algorithms and robust libraries are available.
- **Computational Resources**: Requires high-performance computing or cloud solutions.

Challenges & Risks

- **Data Gaps**: Missing or noisy data could lead to inaccurate maps.
- **Model Complexity**: Balancing model sophistication with risk of overfitting or underfitting.
- **Scalability**: Managing large datasets might cause performance slowdowns.
- **Validation**: Ensuring the model works well across different regions.
- **Interpretability**: Complex models might be difficult for stakeholders to understand.

Strategies

- **Data Gaps**: Implement cloud masking, interpolation, and data augmentation.
- **Model Complexity**: Start with simpler models, use cross-validation, and combine model for better accuracy.
- **Scalability**: Leverage cloud computing and parallel processing to handle big data efficiently.
- **Validation**: Use diverse and independent datasets to ensure the model generalizes well.

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IMPACT AND BENEFITS

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Target Audience:

•**Researchers:** Access to high-resolution data improves the quality and scope of environmental research.

•**Government Bodies:** Enhanced capabilities for real-time air quality monitoring and rapid response to pollution events.

•**Public:** Better access to localized air quality information empowers individuals to make informed health and lifestyle decisions.

Benefits:

•**Health Improvements:** Facilitates early warning systems for air pollution, reducing health risks and chronic diseases.

•**Community Engagement:** Fosters community involvement in environmental issues through accessible data and visualization tools.

•**Targeted Pollution Control:** Enables precise targeting of pollution sources, leading to more effective cleanup and mitigation efforts.

•**Enhanced Environmental Policies:** Provides data-driven evidence to support stringent air quality regulations and compliance with environmental standards.

•**Sustainable Development:** Supports green initiatives and sustainable practices by offering insights into pollution trends and impacts.

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RESEARCH AND REFERENCES

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RESEARCH

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