SMART INDIA HACKATHON 2025

- **Problem Statement ID –** 25232
- **Problem Statement Title-** Detection of Open Crust Mining and 3D Visualization
- **Theme-** Smart Automation
- **PS Category-** Software
- **Team ID-** 295
- **Team Name-** OreNexus

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Automated Mining Detection

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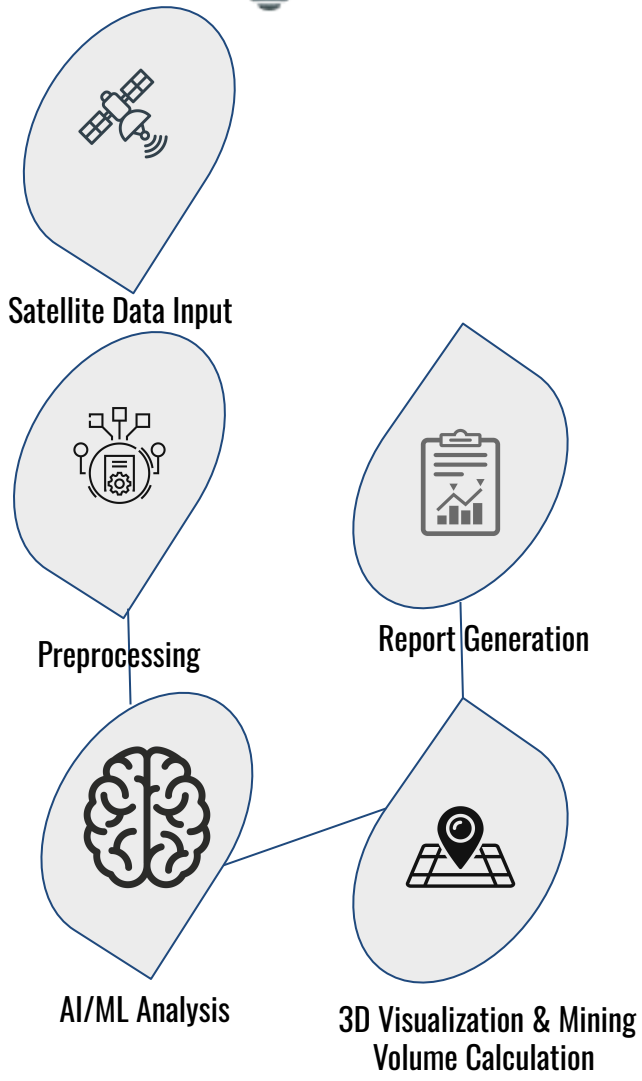
Explanation of Problem statement:

- Use of **satellite imagery** to detect open crust mining activity automatically.
- Displaying this with both **2d** and **3d** visualizations
- Identification of **illegal mining area** by comparing with provided authorised mining area

Unique Value Proposition (UVP)

- **Compare Mines Side-by-Side:** Easily compare different mines both visually on the map and with their key stats. See side-by-side numbers for things like the **total area mined**, **ore volume**, **ore quality** and even the **percentage of illegal mining**.
- Use of an **in-house AI Model** trained on historical data specifically to detect mined area accurately
- **Predict Environmental Damage:** Estimate future environmental impact, like how your work might pollute nearby rivers, so you can plan ahead to protect the area.



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TECHNICAL APPROACH

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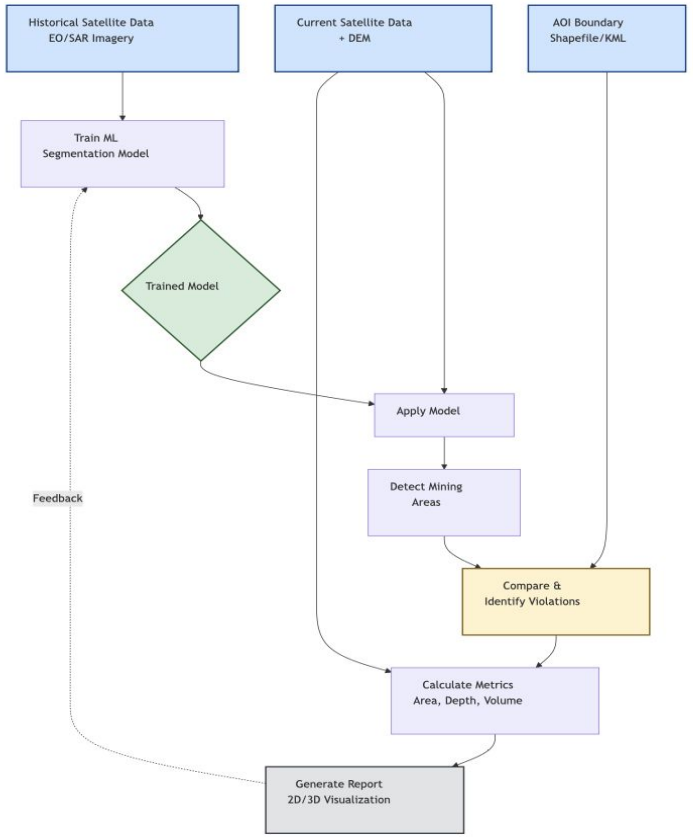
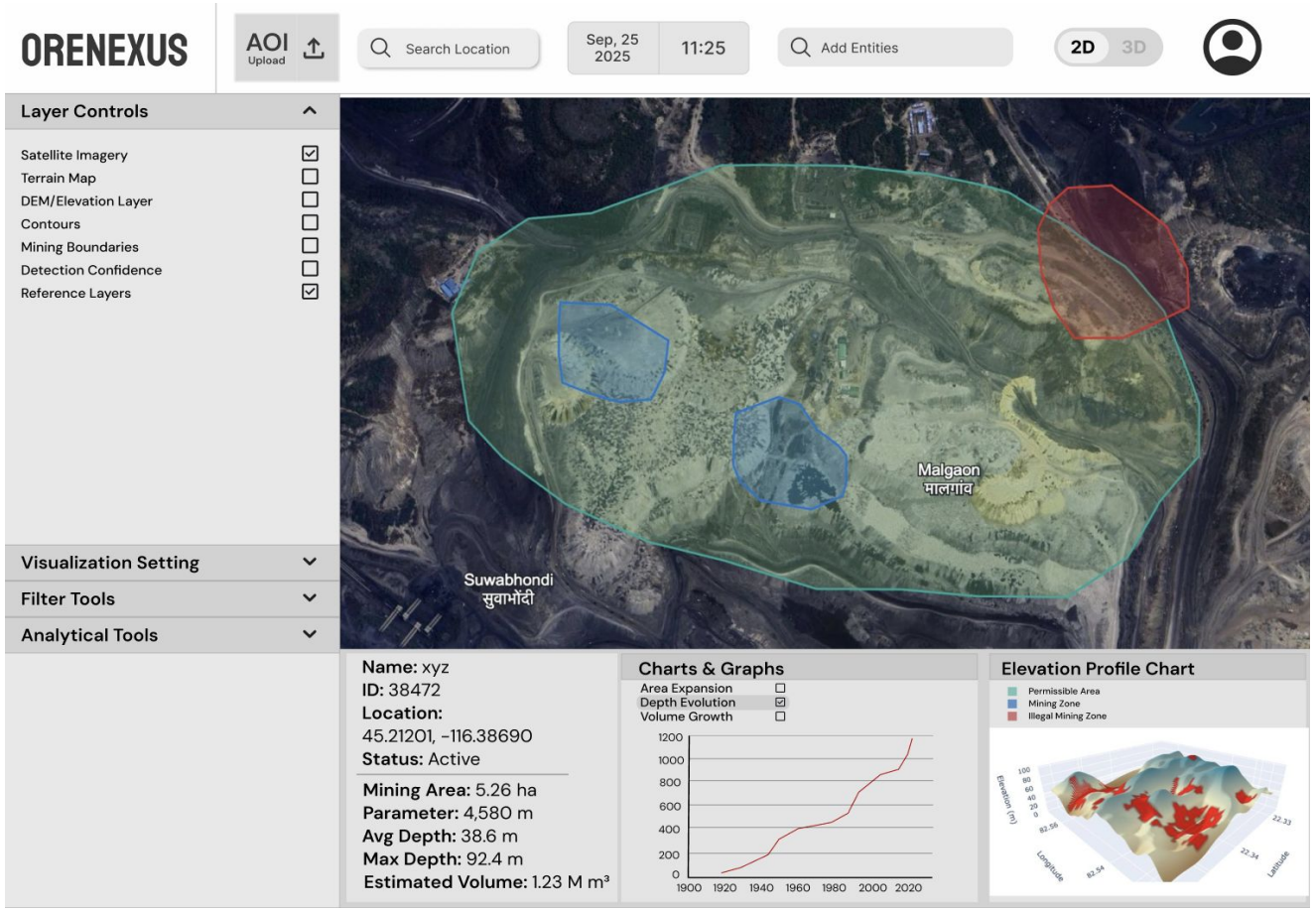
Detailed Workflow Diagram



Prototype



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FEASIBILITY AND VIABILITY

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Feasibility:

- **Proven Tech:** AI/ML, DEM, and satellite data using open-source tools.
- **High Adoption:** Easily integrates with government GIS platforms.
- **Low Maintenance:** Automation reduces manual checks and costs.

Challenges & Risks:

- **High Setup Costs:** Integrating satellite and DEM data is expensive.
- **Data Accuracy:** Clouds, noise, or low-res data can cause errors.
- **Resistance to Change:** Officials may prefer manual monitoring.
- **Privacy Concerns:** Sensitive mining data must be secured.

Strategies to Overcome Challenges:

- **Government Partnerships:** Seek support and funding.
- **Cost Reduction:** Use cloud-based open DEM data.
- **Accuracy Improvement:** Implement AI/ML validation pipelines.
- **Build Trust:** Transparent dashboards and notifications.

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IMPACT AND BENEFITS

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Positive Impact:

- **Prevents illegal mining** by providing real-time data for policy enforcement.
- **Limits long-term ecological degradation** by identifying and addressing violations before major harm occurs.
- Builds public trust with open data and real-time updates.

Potential negative impact:

- **Increased operational costs** for smaller mining enterprises that must adapt to stricter monitoring or digital compliance systems.
- **Privacy and data** concerns if community or land-use data are shared publicly without safeguards.

Social Benefits:

- Helps identify illegal mining quickly, preventing unauthorized extraction of resources
- Builds public trust through real-time updates and open dashboards.

Economic Benefits:

- Enables real-time monitoring of mining costs, profits, and output for enterprises.
- Improves decision-making and resource allocation across regions.

Environmental Benefits:

- Detects and prevents large-scale environmental damage early
- Supports better planning and regulation with digital evidence.

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RESEARCH AND REFERENCES

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- ## Sentinel-1,2—Copernicus/ Copernicus documentation:
  Provides radar imaging data useful for detecting changes in land surface, identifying illegal mining activities, and monitoring mining-related environmental hazards like subsidence.
  https://documentation.dataspace.copernicus.eu/Data/SentinelMissions/Sentinel1.html
  https://dataspace.copernicus.eu/data-collections/copernicus-sentinel-data/sentinel-2

- ## Copernicus DEM—Global and European Digital Elevation Model(DSM):
  ELevation data critical for detecting landform changes due to mining activities, assessing erosion risks, and planning rehabilitation strategies.
  https://dataspace.copernicus.eu/explore-data/data-collections/copernicus-contributing-missions/collections-description/COP-DEM

- ## Sentinel Hub EO Browser(Visualize & Download TIFFs):
  Enables visualization and downloading of satellite imagery to study active mining zones, tailings storage fasciitis and surrounding ecosystems.
  https://www.sentinel-hub.com/explore/eobrowser/

- ## EuroSAT Dataset(Sentinel-2 Land Use Classification):
  Provides training data for AI/ML models to classify land use and detect illegal or unreported mining sites using sentinel-2 images.
  https://arxiv.org/abs/1709.00029