Team Name : **Dark Knight**

Team Leader Name : **Sumit Kundu**

Problem Statement : AI/ML-driven automated feature detection and change analysis of glacial lakes, road networks, and urban drainage systems from multi-source satellite imagery.

Team Members

Team Leader: **Sumit Kundu**

Name: Sumit Kundu **(Individual)**
College: Haldia Institute Of Technology

Team Member-1:

Name: NA
College: NA

Team Member-2:

Name: NA
College: NA

Team Member-3:

Name: NA
College: NA

Brief about the Idea:

Our methodology is to design a AI/ML-based platform for automatic feature detection and temporal changes analysis by multi-sensor satellite data. Particularly, it focuses on the detection and tracking of:

- Glacial lakes – to forecast potential disasters such as GLOFs (Glacial Lake Outburst Floods)
- Transportation systems monitoring for degradation or expansion in remote or disaster-stricken regions
- Urban drainage systems as tools for risk assessment and sustainable planning at urban areas

The solution will exploit state-of-the-art deep learning models (CNNs, e.g., U-Net, Mask R-CNN) for feature segmentation and change detection (change detection networks; e.g., Siamese Networks) for the study of temporal transformations. Through merging data from Indian and foreign satellites (Satellite-2, Cartosat, Landsat) it is set to provide information via an easy to use dashboard for authorities, planners, and disaster response teams.

Opportunity should be able to explain the following:

- How does it compare with previous ideas?

  Most current satellite analytics software offers only single-feature analysis (e.g., only road networks or only glacial lakes) which of- ten relies on human intervention or theregion-specific tuning. Our approach is multi-feature, fully automatic and designed to operate over various geographic regions from multi-source satellite data with little human involvement.

- How will it address the problem?

  Our system will use state-of-the-art AI/ML models to automatically detect, segment and track changes of glacial lakes, roads and drainage systems in the satellite images over time. It can help early warning, rapid response, and better planning by providing in-time actionable insights to the relevant departments.

USP (Unique Selling Proposition):

- Integrated AI-driven framework for the detection and characterization of crucial metrics
- Covers multi-temporal and multi-resolution satellite data
- Extensible and deployable over large disaster-management, infrastructure-monitoring and urban-resilience systems
- Supports Make in India and other space-tech innovation IOT with ISRO compatible data usage.

List of features offered by the solution

1. Multi-Source Satellite Support: Compatible with Sentinel-2, Cartosat, Landsat & more (multi-resolution, multi-temporal)

2. AI/ML-Powered Feature Detection: Automated mapping of glacial lakes, road networks and urban drainage system by using deep learning models (e.g., U-Net, Mask-RCNN)

3. Change Detection & Temporal Analysis: Tracks evolution over time to detect growth, decay or changes in infrastructure

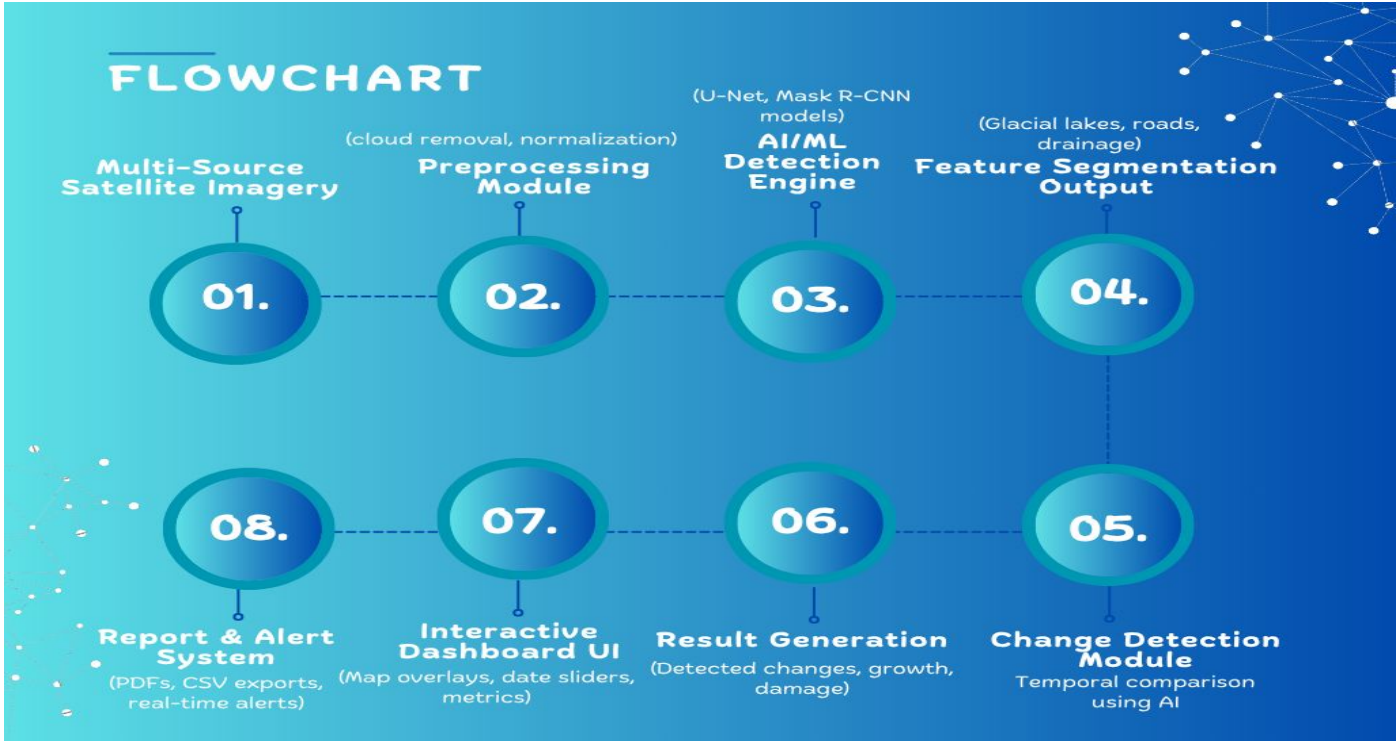
4. Interactive Dashboard: Visual map overlay and date sliders and feature comparison for decision makers

5. Real-Time / Scheduled Processing: An adaptable analysis pipeline that is conducive to regular updates and alerts

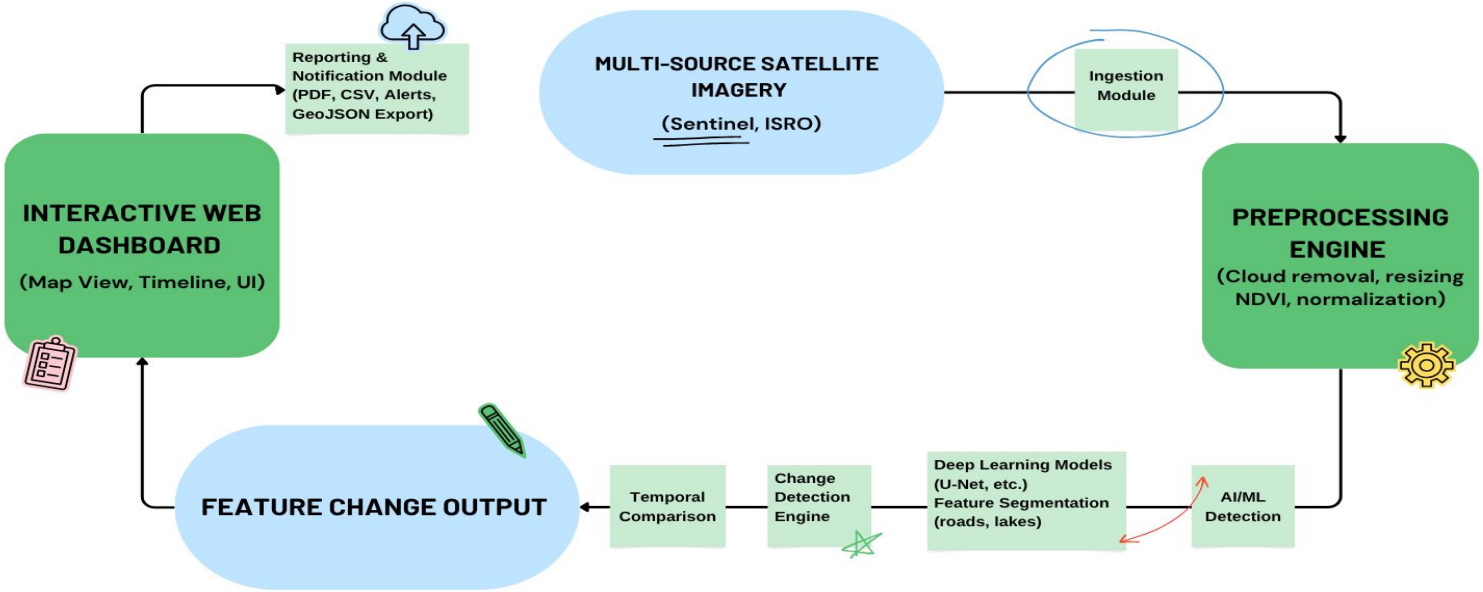
6. Automate & Export your Reports: Summarized insights can be downloaded as PDFs, CSVs, GeoJSON, etc.

7. Scalable, Secure Architecture: Cloud-enabled API-based and made for institutional/government use.

Process flow diagram or Use-case diagram



Architecture diagram of the proposed solution



Technologies to be used in the solution:

Satellite Data Sources	Preprocessing & Remote Sensing Tools	AI/ML Frameworks	Backend Development	Frontend & Visualization	Cloud & Deployment
1. Sentinel-2 (ESA) **2. Cartosat**, **RESOURCESAT** (ISRO) **3. Landsat-8/9** (NASA-USGS)	**1. GDAL, Rasterio** – Geospatial raster processing **2. NumPy**, **Pandas** – Numerical data manipulation **3. OpenCV** – Image processing (resizing, filtering) **4. Fmask** or **SCL Band** – Cloud detection and masking **5. QGIS** (optional) – Manual validation and visualization	**1. TensorFlow / PyTorch – Model training & inference** **2. Keras – High-level neural network APIs** **3. Scikit-learn – Classical ML models (if needed)** **4. U-Net, Mask R-CNN, Siamese Networks – Feature detection & change analysis models**	**1. Flask** / **FastAPI** – API server for model integration **2. Celery** – For background job processing (optional) **3. PostgreSQL + PostGIS** – Geospatial database	**1. React.js** – Frontend UI **2. Leaflet.js** or **Mapbox GL JS** – Map rendering & overlays **3. Chart.js**, **D3.js** – For metrics and timelines	**1. AWS EC2 / Lambda / S3** – Scalable hosting and storage **2. Docker** – Containerization **3. GitHub Actions** – CI/CD integration **4. Bhuvan API** – For ISRO-compatible integration (if applicable)

Estimated implementation cost (optional):

Category	Estimated Cost (INR)	Details
Cloud Infrastructure	₹30,000 – ₹50,000	AWS EC2/S3 for compute and storage, depending on scale and usage hours
Satellite Data Access	₹0 – ₹10,000	Free data from Sentinel, Landsat, Bhuvan; minor costs for high-res datasets
Model Training & Compute	₹20,000 – ₹40,000	GPU-based instances or local workstation power consumption
Software Tools & Licenses	₹0	Open-source libraries (TensorFlow, Flask, React, etc.)

Development & Testing	₹0 – ₹50,000	If outsourced or additional workforce is used
Deployment & Monitoring	₹10,000 – ₹20,000	Domain, CI/CD, uptime, monitoring tools
Total Estimated Cost	**₹60,000 – ₹1,50,000**	Based on prototyping and pilot deployment

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THANK YOU