

EcoScepter- **Satellite based Vegetation Health Assessment and** **Deforestation Detection using CNN**

Project Synopsis

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1. Introduction

EcoScepter is a project aimed at studying forest and vegetation health using satellite images. Traditional methods rely on simple vegetation indices, which often become inaccurate due to seasonal changes, weather conditions, and cloud cover. EcoScepter improves this by using an AI model (CNN) that learns patterns directly from satellite data and adapts to different seasons.

The system uses multiple satellite bands to understand land conditions and classify areas into categories such as healthy forest, normal forest, possible deforestation, water bodies, and built-up regions. By including seasonal information in the analysis, EcoScepter reduces false alarms caused by natural seasonal changes.

This project can help in monitoring forest health, detecting illegal logging activities, studying land-use changes, and supporting environmental research related to climate and wildlife. EcoScepter presents a modern and adaptable approach to satellite-based environmental monitoring that is not commonly used today.

2. Project Category

1. **Category:** AI-Based Geospatial Analysis System
2. **Hardware Components:** Laptop / Desktop Computer
3. **Software Components:** Google Earth Engine, Python, TensorFlow / PyTorch
4. **Programming Languages:**
 - **Frontend:** Streamlit / Web Interface (optional)
 - **Backend:** Python
 - **Geospatial:** GEE with its JavaScript code editor (for data extraction)

3. Objective of the Project

1. To create an AI-based system that can identify the health of forests and vegetation using satellite images.
2. To improve accuracy by going beyond traditional index-based methods and using patterns learned directly from the data.
3. To include seasonal variations so the system can avoid mistaking natural seasonal changes for damage or deforestation.
4. To detect important land features such as healthy forests, degraded areas, water bodies, and built-up regions.
5. To build a clear process for collecting, preparing, and analyzing satellite images.
6. To support environmental studies related to forest health, climate change, and wildlife conservation.

4. System Requirements

A. Hardware Requirements

Optional because this project can also be implemented in cloud platform such as Google Colab.

- Operating System: Windows 10/11, Linux, or macOS
- RAM: Minimum 8 GB (16 GB recommended for model training)
- Storage: At least 5–10 GB for datasets
- Processor: Intel i5/i7 or equivalent multi-core processor
- GPU (Optional but recommended): NVIDIA GPU with CUDA support for faster training

B. Software Requirements

- Python 3.9+
- TensorFlow or PyTorch
- GDAL / Rasterio (for GeoTIFF operations)
- NumPy, Pandas, Matplotlib
- Streamlit (optional UI)
- Google Earth Engine (for data collection)
- OpenCV / PIL (for patch processing)

5. Scope of the Project

1. Collect satellite images of different regions and prepare them for analysis.
2. Study important environmental patterns such as vegetation health, water presence, and built-up areas.
3. Organize the data into seasonal groups so the system can understand natural changes throughout the year.
4. Train an AI model to identify forest health conditions and detect signs of possible deforestation or land degradation.
5. Produce visual maps and summaries that clearly show the condition of forests and surrounding areas.
6. Provide a general framework that can support climate studies, ecological monitoring, and other environmental research.
7. Offer a modern tool that can help researchers, forest departments, and environmental agencies make informed decisions.

6. Result

EcoScepter is expected to function as an intelligent, season-aware satellite analysis system capable of identifying vegetation health, water bodies, built-up areas, and early signs of possible deforestation. By learning patterns across different seasons, the model is likely to perform more reliably than traditional index-based methods, especially in regions affected by weather changes or natural seasonal shifts.

The system may generate easy-to-understand maps and summaries that highlight forest conditions and potential areas of concern. Since the pipeline is designed to be reusable, it can be applied to different regions with minimal changes, making it practical for large-scale environmental studies. If successful, EcoScepter could support forest management, conservation efforts, climate-related research, and early warning systems by providing accurate, automated, and scalable satellite-based insights.