

Geospatial Landslide detection using deep learning

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▲ About

Landslides are mostly triggered by earthquakes or heavy rainfall and are increasingly damaging due to unplanned urbanization. So, **detecting them early** is crucial for **effective response**, providing vital information on their impact.

Our project aims to **analyze satellite images**, which contain geospatial data to detect whether landsliding is present in a specific region. Our project strives to achieve this by performing pixel-wise binary classification and semantic segmentation.



Data Set



Landslide4Sense

Landslide mapping from Sentinel2 dataset.

Details

The **Sentinel-2 dataset**, part of the European Space Agency's (ESA) Copernicus program, provides high-resolution optical imagery from the Sentinel-2 satellites.

- 1600 labeled multispectral images (each 256x256 pixels) across 8 spectral bands
- Over 47,000 landslide and non-landslide patches, ideal for training deep learning models.

▲ Different Features

● Historical Vs Recent Landslide Satellite image

We plan to incorporate a comparative analysis of recent and historical landslides to enhance our understanding of their patterns, impact & evolution over time.

- **New landslides** show up as areas with spatial & temporal changes in texture in optical images, and hence they can be easily identified from Google Earth images.
- **Old landslides** have certain geomorphological features (e.g., scarps, flanks, cracks, and ridges) and they can be identified based on these geomorphological features

▲ Reference for Concept

- **Research Article:** Deep Learning for Landslide Detection & Segmentation in High Resolution Optical Images (Sichuan-Tibet Transportation Corridor)

<https://www.mdpi.com/2072-4292/14/21/5490>

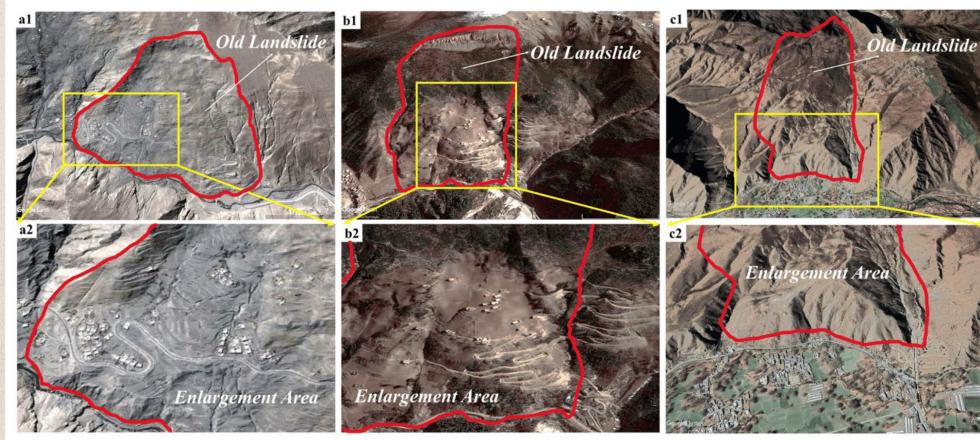


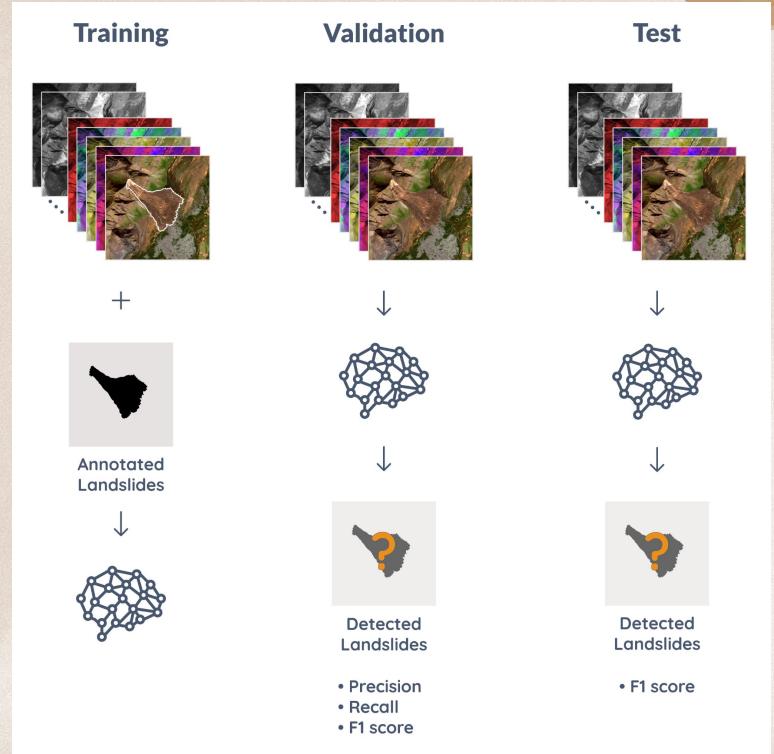
Figure: identify old landslides and ice avalanches based on the trained model

Project Reference

Uses dataset: Landslide4sense

Difference: No distinction between old & new landslides

<https://github.com/iamtekson/landslide4sense-solution/blob/main/Landslide4Sense%20solution.ipynb>



METHODOLOGY

Data Set

- Satellite images with RGB, NIR, and other channels.
- Data is normalized and cleaned
- The dataset is split into training and validation sets using scikit-learn.

Model Selection & Dev

- UNet model, a convolutional neural network (CNN) architecture designed for **pixel-wise segmentation tasks**.
- It will be trained on the preprocessed satellite images, with the output being a binary classification.
- Loss function: **Binary Cross-Entropy** combined with **Dice Loss**.

IMPLEMENTATION

- Compare historical and recent landslide data to identify patterns by training separate models.
- Use IoU, accuracy, precision, recall, F1-score, and cross-validation for performance assessment.
- Predict on unseen images; compare historical and recent landslide outcomes.

▲ Methodology for different period

Historical Vs Recent Landslide Satellite image

We intend to enhance our landslide detection model using **temporal analysis**. By comparing satellite images from different periods, we'll identify changes indicating new landslides. We'll modify the UNet model to include **new input** channels representing differences between old and new images for RGB, NDVI, Slope, and Elevation. This will involve adjusting the model to accept these additional channels, training it with this enriched dataset, and evaluating its performance in detecting newly occurred landslides.

Thank you

