Multiscale Landslide Detection using Remote Sensing Imagery

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MOTIVATION / INTRODUCTION

- Landslides pose a major threat to human life, infrastructure, and the environment—traditional detection methods are time-consuming and limited in scope.
- Conventional ground-based surveys are time-consuming, labor-intensive, and geographically restricted, making them unsuitable for large-scale, real-time monitoring.
- The availability of high-resolution satellite imagery and deep learning models like CNNs and YOLO has made automated, large-scale landslide detection more feasible and accurate.
- Designed for real-time deployment and scalability, the system aims to support disaster management agencies by enabling early alerts, informed decision-making, and efficient risk mitigation strategies in vulnerable regions.

OBJECTIVES

- Develop an automated system that accurately distinguishes between landslide-affected and stable terrains using remote sensing imagery.
- To implement VGG16 for classification and YOLOv8 for localization of landslide regions.
- Evaluate and validate the detection framework using key performance metrics (accuracy, precision, recall, F1-score, and Intersection over Union) to ensure reliability and real-world applicability.
- Contribute to disaster preparedness and risk mitigation by providing a scalable, real-time monitoring tool that supports early detection and rapid response strategies.

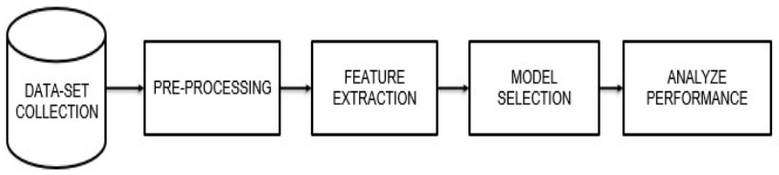
SCOPE OF THE PROJECT

Develop a scalable, real-time landslide detection system using remote sensing imagery that integrates seamlessly with disaster management frameworks for early warning and mitigation.

METHODOLOGY

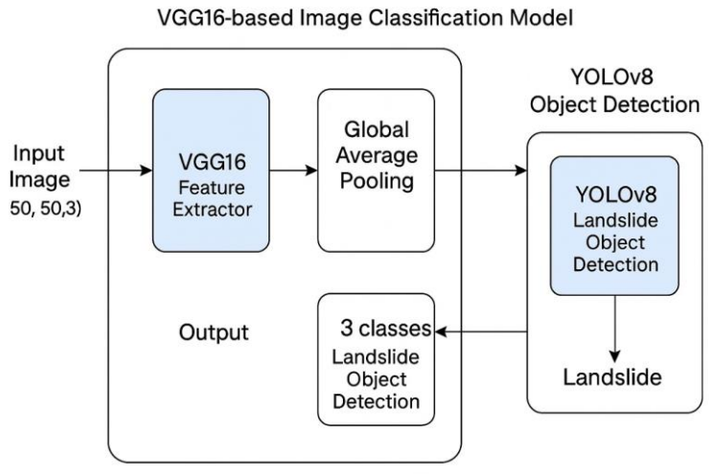
Preprocessing

The proposed system begins with preprocessing satellite images by resizing them to a uniform resolution, converting them to grayscale to simplify computation, and normalizing pixel values to enhance consistency. Statistical features such as mean, median, and variance are extracted to capture global intensity characteristics. Texture features are computed using the Gray Level Co-occurrence Matrix (GLCM), which helps differentiate landslide-affected regions based on surface patterns like roughness and homogeneity. Contours are derived from ground truth annotation masks to delineate landslide boundaries for accurate labeling. These processed images and features are used to train a VGG16 model for classification and a YOLOv8 model for object detection, which together detect and localize landslide-prone areas with bounding boxes and segmented mask overlays.



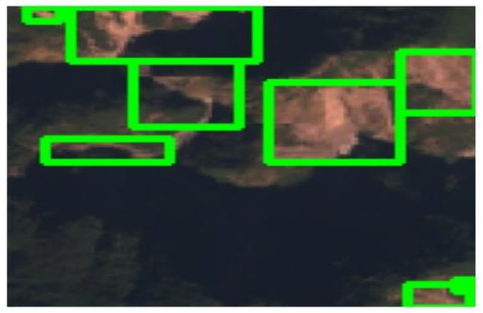
ARCHITECTURE

Train VGG16 for classification and YOLO for object detection on the processed data and highlight detected landslide areas with bounding boxes and validate against ground truth masks.



RESULTS

Algorithm	Accuracy
Accuracy	99.58
Precision	85.71
Recall	92.30
F1-score	88.88



CONCLUSION

A deep learning-based approach leveraging **VGG16** for classification and **YOLO** for object detection was implemented to identify landslides from remote sensing imagery. The system achieved a high **accuracy of 99.58%**, with a **precision of 85.71%**, **recall of 92.30%**, and an **F1-score of 88.88%**, showcasing its strong capability in accurately detecting landslide-affected areas.

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REFERENCES

W. Zhang et al. 'LS-YOLO: A Novel Model for Detecting Multiscale Landslides With Remote Sensing Images.' IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 2024.

Chandra N, Vaidya H. 'Automated detection of landslide events from multi-source remote sensing imagery: Performance evaluation and analysis of YOLO algorithms.' J Earth Syst Sci 133, 2024.