A Formative Assessment-II Report on
"AI-Powered Early Detection of Forest Fires using Satellite Image Processing"

Submitted towards the fulfilment of the requirement of
Fundamentals of Digital Image Processing
Bachelor of Technology (B-Tech)
Academic year 2024-25
(Third Year)

Submitted by :

Amit Mali 123B1F058

Under the Guidance

Dr. Harsha Bhute

1.Problem Statement

Wildfires are becoming more frequent and severe. Early and accurate detection of ignition from satellite data will reduce environmental, social and economic impacts. The difficulty lies in constructing an AI based system that can deal with multisensor satellite information (e.g., thermal bands, multispectral, geostationary high-temporal data, land-cover products, etc.) to provide the lowest false alarm rate possible, detect ignitions under a variety of atmospheric conditions and landscapes, and to detect fires (and separate other false hotspots) as early as possible.

2.Aim

The aim is to build an efficient system for detecting wildfires accurately from satellite images.

3.Motivation

- Forest fires are becoming more frequent and intense around the world; early detection could dramatically reduce damage and spread.
- Satellite imagery will cover large, inaccessible, and remote areas where it is impractical to detect fires from the ground.
- AI can learn complex patterns, as opposed to traditional threshold algorithms (MODIS/VIIRS) which will often produce false positives, or fail to detect small fires.

4.Objectives

- To preprocess satellite images by enhancing quality, resizing, and augmenting to improve feature extraction for fire detection.
- To build and train a deep learning model that learns important visual features from processed images to classify wildfire presence accurately.
- To validate the model's performance across diverse satellite images to ensure reliable wildfire detection in various real-world scenarios.

5. Literature Survey

Author & Year	Features	Methodology Used	Limitations
Ali & Kurnaz (2025)	Multi-sensor satellite wildfire data.	CNN, U-Net, Autoencoder models	Needs large data; affected by clouds, delays
Yu & Singh (2025)	Real-time remote sensing, GANs	U-Net, ConvLSTM, Attention ConvLSTM	Data gaps; risks of overfitting; regional
Urbanelli et al. (2023)	Multi-satellite thermal hotspot data	Multimodal supervised ML	Small fires and real-time detection hard
Ghali & Akhloufi (2024)	RGB & thermal aerial wildfire images	Ensemble CNN and transformer models	Dataset narrow; may confuse smoke & others
Kang et al. (2022)	Geo-stationary satellite temporal data	CNN with spatial and temporal info	Low spatial detail; false alarms; cloudy areas

6.Methodology

- Data Preprocessing: Resize images, normalize pixels, and apply augmentations like rotation and flipping
- Build Model: Use pretrained ResNet18, modify final layer for wildfire classification (fire/no fire)
- Train Model: Train using cross-entropy loss and Adam optimizer with learning rate scheduling
- Test Model: Evaluate accuracy and loss on validation and test datasets
- Deploy Model: Use the trained model for real-time wildfire detection on new images

7.Conclusion

The model demonstrated high accuracy in detecting wildfires from satellite images, effectively distinguishing fire and non-fire areas. Using a pretrained ResNet18 and with proper data preprocessing and augmentation helped the model generalize well despite limited training data.This method can help detect wildfires faster to protect people and the environment.