Case Study 3 Hook Document – Wildfire Detection

Alexandra Vesselinov

DS 4002

Spring 2025

Stop the Spread: Early Wildfire Detection

You're working on a newly formed wildfire surveillance team operating with an environmental protection agency. With extreme heat and dry seasons on the rise due to climate change, your team is piloting a new AI-assisted tool to help detect wildfires in real time using satellite data. In recent years, wildfires have grown more unpredictable and destructive, burning millions of acres and threatening ecosystems and communities. Timely identification of wildfire outbreaks has become critical. Your job is to help build and evaluate a machine learning model that can classify satellite images into two categories ("fire" or "no fire") to support decision-making in wildfire response planning [2].

To do this, you will work with a labeled dataset of forest landscape images. Each image is classified as either containing active fire or not. You'll train a Convolutional Neural Network (CNN), a type of deep learning model known for its strength in image recognition tasks [1],[3]. You'll be responsible for processing the images, applying data augmentation techniques to increase robustness, building the CNN architecture, and training your model to reach a high accuracy threshold. You'll then evaluate its performance using metrics like precision, recall, F1-score, and a confusion matrix [4],[5].

Your model's performance will determine how confidently the team can rely on your outputs for early detection. Can your model detect the signal through the noise? Can it distinguish false positives (like clouds, fog, or smoke) from actual fires? Your goal is to build a high-performing wildfire classification model that reaches at least 90% accuracy. Your deliverable will include not just code, but also visualizations and a short written summary that assesses your model's effectiveness and proposes future improvements.

This case study simulates a real-world applied machine learning task. You will be able to build technical proficiency with CNNs, deepen your understanding of image classification challenges, and reflect on the broader impact of these types of models.

References

[1] F. Chollet, “Image classification from scratch,” *Keras*, 2020. [Online]. Available: https://keras.io/examples/vision/image_classification_from_scratch/

[2] National Aeronautics and Space Administration, “Fire Information for Resource Management System (FIRMS),” NASA, 2024. [Online]. Available: https://firms.modaps.eosdis.nasa.gov/

[3] M. Brownlee, “How to Develop a Convolutional Neural Network to Classify Photos,” *Machine Learning Mastery*, Jan. 2020. [Online]. Available: https://machinelearningmastery.com/how-to-develop-a-convolutional-neural-network-from-scratch-for-mnist-handwritten-digit-classification/

[4] D. Zhang et al., “A deep learning framework for identifying wildfire from satellite images,” *Remote Sensing*, vol. 12, no. 5, pp. 873–890, 2020. [Online]. Available: https://www.mdpi.com/2072-4292/12/5/873

[5] GeeksforGeeks, “Image Classification using CNN in Keras,” GeeksforGeeks, 2023. [Online]. Available: https://www.geeksforgeeks.org/python-image-classification-using-keras/