Chapter 2
AI-Based Deep Memory Alex Neural Network for Early Detection of Forest and Land Fires

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ABSTRACT

In recent years, the National Institute of Aeronautics and Space (LAPAN) has used hotspot data derived from satellite imagery to identify and detect forest and land

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fires at an early stage. Hotspot data has greatly facilitated firefighting operations and enhanced enforcement activities. Nevertheless, the system has certain limitations, mostly stemming from its incapacity to differentiate between forest and land fires and other sources of heat or fires produced by typical human actions. In addition, this approach requires time-consuming verification and significantly depends on human elements for sophisticated analysis and validation. Lately, the field of deep learning has been implementing a novel strategy by making progress in the field of artificial intelligence. The algorithm has been trained to identify burnt areas by analyzing satellite images recorded between 2017 and 2019. It recognizes the pattern and tone of the image in these areas. To validate the presence of burnt areas, it compares the current imagery from the past week with the historical Sentinel-2 imagery for each cluster, specifically for forest and land fire identification. Initially, the satellite images are obtained and the noise is eliminated using a median Butterworth filter. Next, the characteristics of the area of interest may be grouped using a K-density-based agglomerative method. The hotspot may now be accurately detected utilizing the advanced deep memory Alex neural network. The outcomes of the hotspot identification procedure, which has an accuracy rate of 99.7%, may aid firefighters in promptly extinguishing flames and help law enforcement authorities in identifying the optimal target area. Hence, the recommended technology has the potential to enhance the efficacy and productivity of resources assigned by law enforcement agents, resulting in improved and more prompt public services.

1. INTRODUCTION

Forest fires exist worldwide and threaten various life forms and the environment. To reduce the impact and loss of lives as a result of these fires, it is very crucial to identify such fires at the initial stage [1]. Old-fashioned ways of fire detection such as manual checking and through satellite there is something to learn about the reliability of the means, the speed at which the checking is done, and the coverage done. With the advancement in artificial intelligence and deep learning, it is possible to design more enhanced fire detection systems without these disadvantages. One of them includes the use of a deep memory neural network architecture that can be derived from AlexNet, a CNN that marked a significant progression of deep learning study. The architecture that we referred to as Deep Memory Alex Neural Network (DMANN) combines deep learning, memory, and learning from patterns that help in the early identification of forest and land fires.