Chapter 8
Deforestation and Forest Monitoring With CNN and RNN

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ABSTRACT

Deforestation poses a significant threat to global biodiversity and climate stability, necessitating effective monitoring and management strategies. It is highly necessary for an effective monitoring strategy to mitigate deforestation as it possesses a potential threat to climate stability and global biodiversity. A novel deep learning technique with Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) is proposed to identify the deforestation and monitoring the forest. CNN is deployed to identify the deforested areas by extracting spatial features and RNN are used to capture the patterns of forest dynamics processing the time series satellite data. This is a novel mechanism where the spatial and temporal analysis is done for the prediction.

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1. INTRODUCTION

One of the most urgent environmental issues of our day is deforestation, which is the quick and frequently careless removal of forests (Masolele et al., 2021). It not only has a major impact on climate change but also causes habitat damage, biodiversity loss, and societal unrest. Deforestation, the irreversible destruction of forests for a variety of reasons, presents serious global environmental, social, and economic problems (Sree, Babu, & Devi, 2010). It causes ecosystems to be disturbed, biodiversity to disappear, and it accelerates climate change by releasing carbon that has been stored in trees (Jamshed et al., 2022). Assessing deforestation rates, locating sensitive regions, and putting conservation measures into action all depend on efficient forest monitoring (Ball et al., 2022).

The scalability, cost-effectiveness, and real-time analysis of traditional forest monitoring techniques, like satellite imaging and field surveys, are constrained (Rao et al., 2024). However, there are potential solutions available when cutting-edge technology like recurrent neural networks (RNN) and convolutional neural networks (CNN) are integrated. RNNs are skilled at examining temporal patterns (Mangalampalli et al., 2023) in deforestation rates, whereas CNNs are excellent at detecting changes in land cover, including deforestation, from satellite data. Innovative methods are needed to address this complicated problem, and convolutional neural networks (CNNs) offer a promising one. Deep learning algorithms such as CNNs, which are mainly used for image analysis, have shown impressive ability to identify patterns and features in visual data (Subhahan & Kumar, preprint). CNNs are able to analyses enormous amounts of satellite imagery with previously unheard-of speed and precision when used to address the issue of deforestation. CNNs can recognize important markers of deforestation, like clearings, logging roads, and changes in vegetation cover, by learning from labelled datasets. With their critical functions in environment protection, carbon sequestration, and climate regulation, forests are vital parts of Earth's ecology (Sree, Babu, & Devi, 2009). However, millions of hectares of forest cover have been lost due to deforestation, which is mostly caused by logging, urbanization, infrastructural development, and agricultural expansion (Chintalapati et al., 2023). Deforestation causes a variety of negative effects, such as soil erosion, disturbed water cycles, biodiversity loss, and higher greenhouse gas emissions that exacerbate climate change. Hybrid models can offer thorough insights into the dynamics of deforestation by integrating CNNs for spatial analysis and RNNs for temporal analysis (Ortega Adarme et al., 2020). These models are able to precisely locate areas that have been cleared of trees, forecast hotspots for future deforestation, and evaluate the long-term efficacy of conservation measures. In addition, the combination of CNN and RNN makes it possible to create prediction models that, using historical data, project future risks of deforestation (Sharmila,

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