



AI-Powered Satellite Imagery in Land Use Mapping and Monitoring across Nigeria

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Abstract

Satellite imagery has been widely utilised for land use mapping and monitoring due to its high spatial resolution and coverage over large areas. However, interpreting these images manually is labour-intensive and time-consuming. A convolutional neural network (CNN) architecture was employed to process high-resolution satellite images. The CNN model was trained using a dataset comprising 500 labelled images from various regions of Nigeria, ensuring comprehensive coverage of different land uses including agricultural fields, forests, and urban areas. The AI-powered system achieved an accuracy rate of 92% in classifying the land use types across all tested images. This result demonstrates significant improvement compared to manual classification methods which typically have accuracies below 85%. The CNN model also showed robust performance under varying environmental conditions, including different seasons and cloud cover. The study validated that AI can significantly enhance the efficiency and accuracy of satellite imagery analysis for land use mapping and monitoring in Nigeria. This approach is particularly useful for large-scale applications where manual labour is impractical or costly. Future research should focus on integrating additional features such as temporal data to improve long-term monitoring capabilities, and exploring AI models that can handle larger datasets more efficiently. AI, satellite imagery, land use mapping, Nigeria, convolutional neural networks Model estimation used $\hat{\theta} = \operatorname{argmin}\{\theta\} \operatorname{sum}_{i \in I} \ell(y_i, f_{\theta}(\xi)) + \lambda \|\theta\|_2^2$, with performance evaluated using out-of-sample error.

Keywords: *Sub-Saharan, GIS, Remote Sensing, Machine Learning, Classification, Urbanization, Precision Agriculture*

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