

Abstract

Many countries' economies are heavily reliant on the agricultural sector. Smart agriculture, which integrates artificial intelligence, offers an innovative solution to enhance production efficiency. Manual classification of banana ripeness is often subjective and labor-intensive, posing challenges in maintaining quality and consistency during post-harvest processes. This study proposes an automated banana ripeness classification system using the NASNetMobile deep learning architecture enhanced with the Convolutional Block Attention Module (CBAM). A lightweight convolutional neural network (CNN) was implemented to classify bananas into four ripeness stages: unripe/green, yellowish-green, half-ripe, and overripe, utilizing a real-world dataset with data augmentation techniques. Experimental results demonstrate that the NASNetMobile+CBAM model outperforms the baseline model, achieving an accuracy of 89.27%, precision of 89.27%, recall of 87.56%, and an F1-score of 87.67%. The integration of CBAM effectively mitigated class imbalance, especially in difficult categories like Class B, and improved accuracy from 59.5% to 70.6% at epoch 100. Moreover, CBAM contributed to better learning stability and generalization capability. This research contributes to the advancement of smart agriculture by enabling accurate and efficient automated fruit ripeness classification.

Keywords: classification banana ripeness, NASNetMobile, CBAM, smart agriculture
