

ABSTRACT

Banana ripeness is an important factor that affects quality, taste, and consumer acceptance; however, manual assessment is still subjective, time-consuming, and less consistent. This study developed a digital image-based banana ripeness classification model using deep learning with the Convolutional Neural Network InceptionV3 architecture through transfer learning and fine-tuning. The model was designed to classify four ripeness classes, namely overripe, ripe, rotten, and unripe. The dataset consisted of 13.478 banana images obtained from the Kaggle platform. The dataset was divided into 80% for training, 10% for validation, and 10% for testing. Before training, all images underwent preprocessing, including resizing and normalization. The model was then trained using 18 experimental scenarios with different hyperparameter combinations, consisting of learning rates of 0,001; 0,0001; and 0,00001, batch sizes of 16 and 32, and dropout rates of 0,3; 0,4; and 0,5. The experimental results showed that the best performance was achieved using a learning rate of 0,00001, a batch size of 16, and a dropout rate of 0,4, resulting in a validation accuracy of 0,9978 and a training accuracy of 0,9948. In the final evaluation using a confusion matrix, the model achieved a testing accuracy of 0,9911, with a precision of 0,9907, a recall of 0,9910, and an F1-score of 0,9908. This study is expected to contribute to the development of artificial intelligence-based inspection systems to support digital transformation in the agricultural sector.

Keywords : *Convolutional Neural Network, hyperparameter tuning, InceptionV3, banana classification, transfer learning*