ABSTRACT

This study introduces an enhanced deep learning approach for accurately classifying tomato ripeness levels using a modified Inception-V3 model, with applications in large-scale agricultural environments. Leveraging a dataset of 7,224 RGB images of tomatoes in varying ripeness stages, the modified model achieved a validation accuracy of 98.42%, with precision, recall, and F1-score values exceeding 98%. These results outperform the base Inception-V3 model and other commonly used architectures such as ResNet and VGG, showcasing the model's superior classification accuracy and computational efficiency. Key modifications include adjustments to filter sizes and the configuration of inception blocks, which significantly reduce the parameter count, thereby optimizing computational resources and enhancing feature extraction for multi-scale image analysis. The model was tested under three lighting conditions, achieving over 97% accuracy across all categories. Confusion matrices validate its effectiveness, highlighting adaptability to real-world agricultural environments and suitability for IoT-based systems offering real-time automated ripeness assessments. This optimized model is well-suited for implementation in IoT-based systems, offering real-time, automated ripeness assessments via mobile or web applications. By automating ripeness classification, this model supports improved harvest quality, reduces manual labor, and potentially increases profitability by ensuring timely crop collection. Experimental evaluations demonstrated that the modified model achieved faster convergence and lower training loss compared to its counterparts, underscoring its robustness and adaptability for various agricultural applications.

Keywords: *Inception-v3, deep learning, tomato ripeness detection, image classification*