ABSTRACT

Tomato quality grading plays a crucial role in ensuring high standards in agricultural production. Traditional manual grading methods are often inefficient, labor-intensive, and prone to errors, resulting in increased operational costs and reduced quality control. This research proposes an automated tomato quality grading system that integrates pre-trained convolutional neural networks (CNNs) for feature extraction with traditional machine learning classifiers for classification. The system utilizes both binary and multi-class classification techniques to assess tomato quality, categorizing them into healthy or rejected (binary), and ripe, unripe, old, and damaged (multi-class).

The hybrid approach leverages CNNs such as InceptionV3, DenseNet121, and MobileNetV2 for extracting intricate features from tomato images, which are then classified using machine learning models like Support Vector Machines (SVM), k-Nearest Neighbors (KNN), and Decision Trees (DT). Experimental results show that the combination of DenseNet121 with a Support Vector Classifier (SVC) and a linear kernel achieves 96% accuracy in multi-class classification, while InceptionV3 with an SVC and an RBF kernel reaches 94% accuracy in binary classification. This study demonstrates the potential of deep learning and machine learning hybrid models in automating and enhancing the accuracy, efficiency, and scalability of tomato quality grading, ultimately offering a cost-effective and reliable solution for modern agricultural practices.

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