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TOMATO POST-HARVEST MANAGEMENT: AI-POWERED APPROACH FOR TRACKING TOMATO MATURATION AND DETERIORATION WITH SIX VISUAL CLASSES



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Abstract:

To maintain freshness, minimize waste, and preserve the quality of the tomato, it is essential to accurately determine its usable shelf-life, which typically varies between 3 and 14 days depending on the storage conditions. An intelligent post-harvest management scheme needs a powerful classifier using machine learning. This paper proposes an improved classifier and usable shelf-life estimation approach using a 6-class dataset. A dataset is developed in a way to track six different stages of the maturation and deterioration of tomatoes in terms of their visual difference: Immature Green, Mature Green, Half Ripe, Ripe, Old, and Rotten, unlike stages based on time intervals. The proposed approach uses deep learning models such as EfficientNet B-7, ResNet-50, and Vision Transformers, implemented using fine-tuning and transfer learning based on a large-scale dataset designed to improve the model's performance. A hybrid mode is developed by fusing features of ViT and ResNet-50, enabling the extraction of both localized features (i.e., texture and blemishes) and global contextual information. The experimental results show that EfficientNet B-7 achieved 92.78% accuracy, ResNet-50 achieved 96.33% accuracy, ViT achieved 97.11% accuracy, and the hybrid model achieved an accuracy of 98%.

Keywords:

Transfer Learning, Feature-level Fusion, Maturity Stage Classification, Fine-grained Visual Recognition, Deep Feature Extraction, Agricultural Automation, Smart Sorting Systems, Artificial Intelligence

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