

AI-Powered Tomato Grading: Transfer Learning Optimize

Mr. Pratik Aher¹ and Prof. Shivangi Patel²

Computer Science and Engineering^{1,2}

Parul Institute of Technology, Vadodara, Maharashtra, India

Abstract: *The increasing demand for high-quality tomatoes and large-scale production has underscored the importance of efficient inline quality grading systems. Manual grading is labor-intensive and costly, which has driven the development of automated solutions. This study introduces a hybrid approach that combines pre-trained convolutional neural networks (CNNs) for feature extraction with traditional machine learning algorithms, such as support vector machines (SVM), random forest (RF), and k-nearest neighbors (KNN), for classification. A tomato image dataset was created using the NVIDIA Jetson TX1, and preprocessing techniques were applied to enhance feature learning. The CNN-SVM model excelled, achieving 97.50% accuracy in binary classification (healthy vs. rejected) and 96.67% accuracy in multiclass classification (ripe, unripe, rejected). When tested on a public dataset, the CNN-SVM model achieved 97.54% accuracy, outperforming other hybrid models. Key performance metrics, including accuracy, recall, precision, specificity, and F1-score, were also evaluated.*

Keywords: Feature extraction, machine learning algorithms, tomato, image preprocessing

