Comparing the Effectiveness of Novel Vision Transformers to Convolutional Neural Networks in Real Time Detection of Citrus Diseases With Integration on Drone Platform, Year II

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The citrus industry in Florida has been devastated with multiple diseases - greening, canker, and blackspot - leading to tree death, orchard closure, and lost orange production. Traditional manual inspection methods are time-consuming, expensive, and inefficient. This project explores the use of real-time computer vision systems powered by artificial intelligence (AI) to autonomously detect citrus diseases using RGB imagery. Two object detection models were compared: YOLOv8, a Convolutional Neural Network (CNN), and RT-DETR, a Vision Transformer (ViT). Both models were trained on a custom benchmark dataset which features over 6,000 citrus images augmented by difficulty level to simulate real-world conditions such as lighting and motion blur. Five-fold cross validation, hyperparameter tuning, and performance analysis across the dataset revealed that YOLOv8 outperformed RT-DETR in accuracy and real-time speed. Grad-CAM visualizations were generated to compare model attention and interpret failure cases. YOLOv8 achieved 92.5% mAP versus RT-DETR's 87.07%. The models' architecture were also optimized via neural architecture search and ablation study, and hyperparameters via bayesian optimization. The optimized YOLOv8 model was deployed on a Raspberry Pi 5 with a camera module, mounted on a consumer-grade drone. This lightweight system successfully performed live disease detection with geo-tagging in a field test over a citrus grove, showcasing accurate classification of diseased leaves / fruits using only RGB data. A real-time dashboard demonstrated detections while the drone flew through the farm. This work demonstrates the viability of low-cost drone platforms for disease detection and introduces a novel data framework for future research in AI implementation on drones.

Awards Won: