# FRESH AI : Lightweight Machine Learning for Avocado Ripeness Prediction

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## INTRODUCTION

This project introduces an innovative machine learning application that classifies avocado images and predicts their ripeness with high precision. As part of a broader research initiative, our solution brings together deep learning and mobile deployment, enabling users to assess avocado ripeness in real time using a lightweight CNN model embedded in a mobile app.

## METHODOLOGY

- Data augmentation was employed given the limited size of the original image dataset.
- For the classification task, three lightweight Convolutional Neural Network (CNN) architectures were evaluated: Efficient Net, MobileNetV2, and UNet. These models were trained to classify avocado images into distinct ripeness categories.
- For the regression task, we adapted three architectures MobileNetV2, Efficient Net, and SqueezeNet to predict continuous ripeness values. This was achieved by replacing the fully connected classification layer with a linear layer, transforming the models for regression output.
- All models were initially trained in PyTorch, then converted to ONNX and subsequently to TensorFlow Lite (TFLite) format for mobile deployment. The TFLite models were integrated into a Flutter-based mobile application, enabling efficient, real-time avocado ripeness prediction through live camera input.
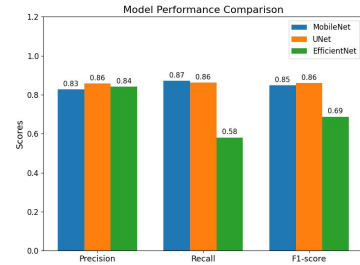
## RESULTS

### CLASSIFICATION



Figure 1. Comparison between MobileNetV2,Efficient Net and Unet for classification..
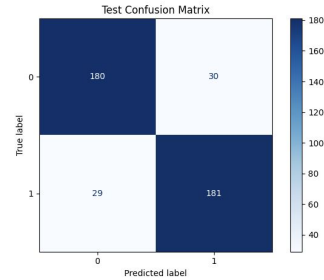


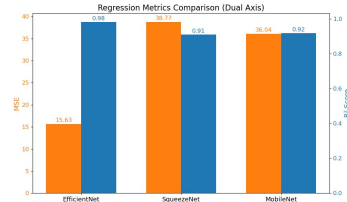Figure 2. Confusion Matrix illustrating classification performance of Unet.

### REGRESSION



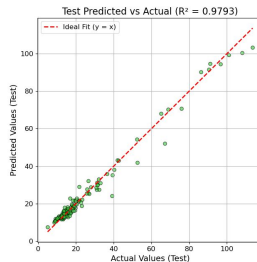Figure 3. Comparison between MobileNetV2, Efficient Net and Squeezenet for regression.



Figure 4. Efficient Net Regression Performance. Plot of Predicted vs. Actual Ripeness Values.

## CONCLUSION

- Fresh AI demonstrates the feasibility of deploying lightweight deep learning models for real-time avocado ripeness detection on mobile devices.
- Classification Findings:UNet outperformed other models with the highest F1-score (0.86), precision (0.86), and balanced recall (0.86), making it the most reliable model for ripeness classification.
- Regression Insights:Efficient Net emerged as the top performer with the lowest MSE (15.63) and the highest R² score (0.96), demonstrating strong accuracy and predictive consistency.
- Mobile Deployment:All models were converted to TFLite for mobile compatibility.The current prototype lays a strong foundation for future development, where scalable, lightweight AI can support healthier lifestyles and sustainable consumption. *FreshAI* is not just a tech solution it's a step toward building a more informed, food-conscious future through responsible AI innovation.

## ACKNOWLEDGEMENTS