Project Report Fruit Classification Using Transfer Learning

By Somia Noor

Introduction & Objective

Image classification is an important application of computer vision with real-world use cases in agriculture, retail, and food quality inspection. Manual identification of fruits can be slow and can have errors, especially when dealing with large volumes of images.

The objective of this project is to build an automated fruit classification system using deep learning. The model is trained to recognize ten different fruit categories using images from the Roboflow Fruit dataset. Transfer learning is applied to improve performance while reducing training time and computational cost.

Methodology

Dataset

The dataset was obtained from Roboflow and consists of ten fruit classes: Apple, Avocado, Banana, Cherry, Kiwi, Mango, Orange, Pineapple, Strawberries, and Watermelon.
The data is divided into training, validation, and test sets.

Preprocessing & Augmentation

- Images were resized to **224 × 224 pixels**.
- Pixel values were normalized to a **0–1 range**.
- Data augmentation was applied only to the training set using rotation, zoom, shifting, and horizontal flipping to reduce overfitting.

Model Selection

MobileNetV2 was selected as the base model because:

- It is lightweight and efficient.
- It is pre-trained on ImageNet, providing strong feature extraction.
- It performs well on image classification tasks with limited data.

The pre-trained layers were frozen initially, and a custom classification head with dense and dropout layers was added. Softmax activation was used in the output layer to classify the ten fruit categories.

Training

- Optimizer: Adam
- Loss Function: Categorical Cross-Entropy
- Early stopping was used to prevent overfitting.
- Optional fine-tuning was performed with a very low learning rate.

Results

The model showed strong performance on the test dataset.

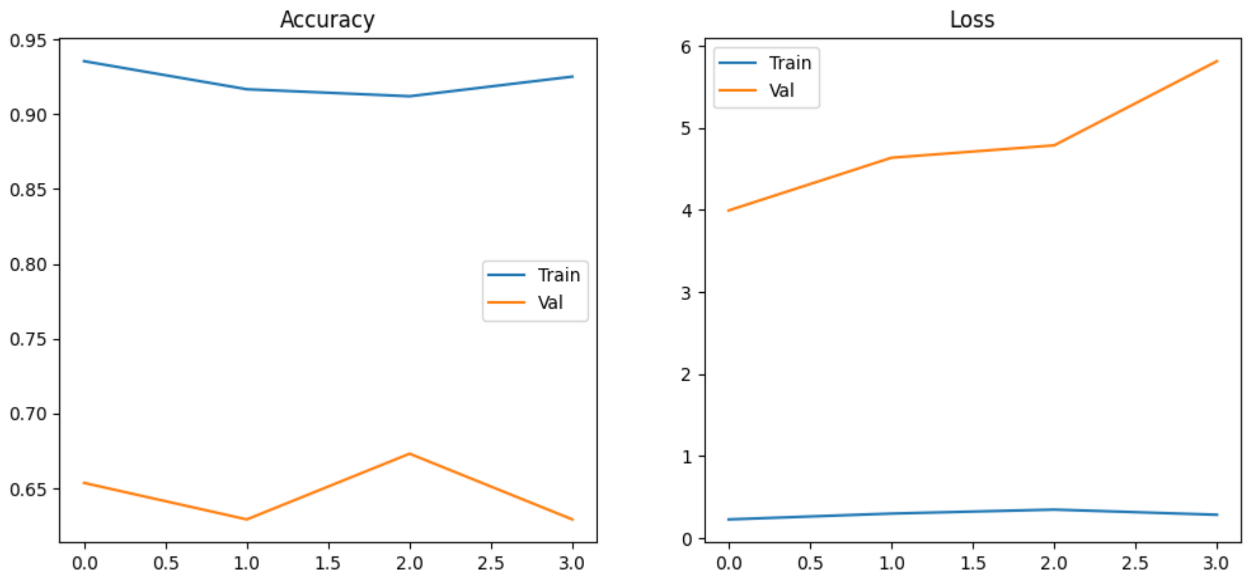
Results

- High test accuracy was achieved.
- Precision, recall, and F1-score were balanced for most classes.

Classes/Names	precision	recall	f1-score	support
apple	0.52	1.00	0.69	11
avocado	1.00	0.83	0.91	12
banana	1.00	0.50	0.67	12
cherry	0.83	0.83	0.83	6
kiwi	1.00	1.00	1.00	8
mango	0.86	0.67	0.75	9
orange	0.75	0.82	0.78	11
pinenapple	0.89	0.80	0.84	10
strawberries	0.67	0.75	0.71	8
watermelon	0.71	0.67	0.69	15
accuracy			0.77	102
macro avg	0.82	0.79	0.79	102
weighted avg	0.82	0.77	0.78	102

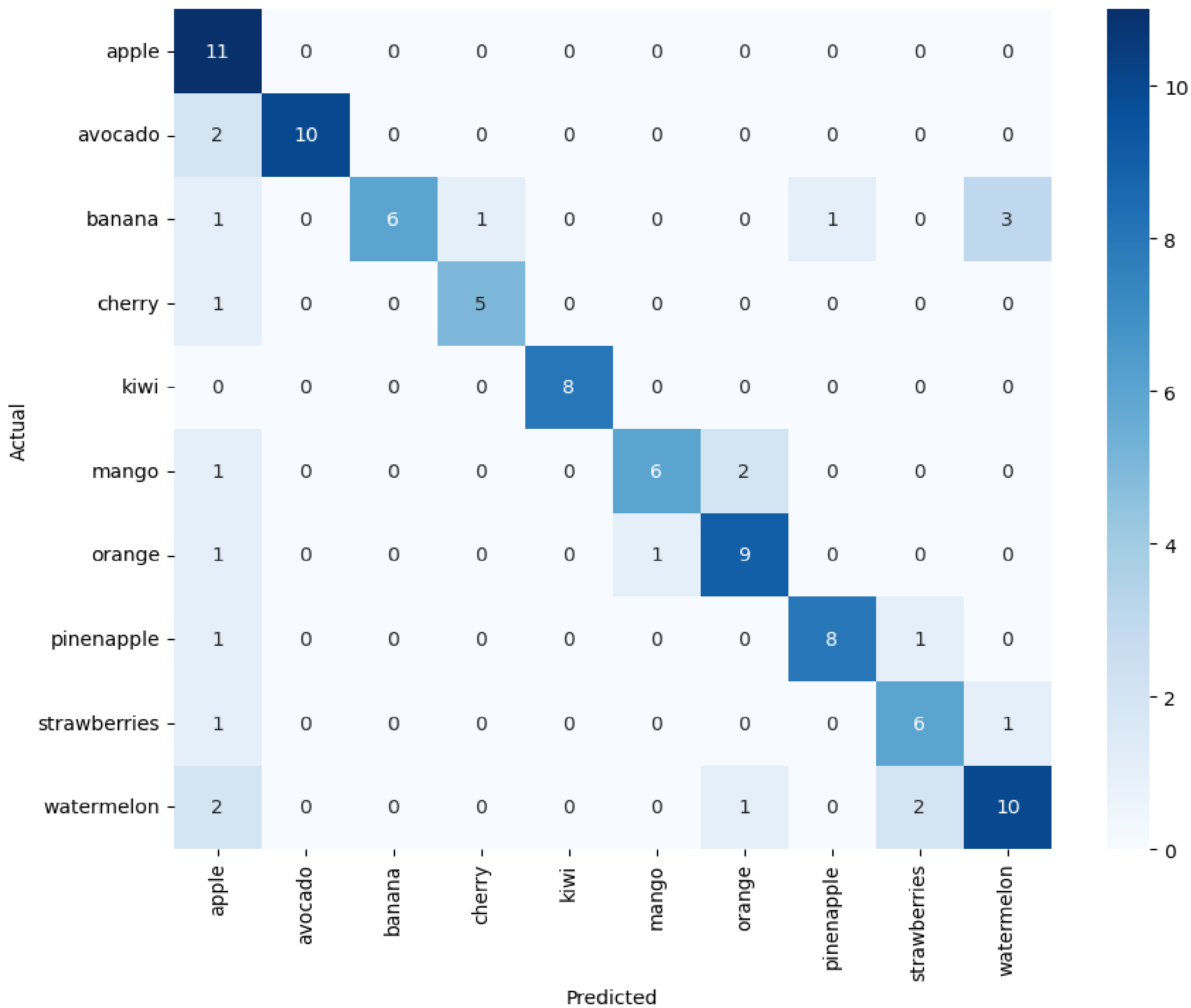
Training Performance

Training and validation accuracy and loss curves show stable learning and minimal overfitting.



Confusion Matrix

The confusion matrix indicates that most classes were correctly classified. Some confusion occurred between visually similar fruits.



Conclusion

This project successfully implemented a fruit classification system using transfer learning. MobileNetV2 proved to be an effective choice due to its efficiency and strong feature extraction. Data augmentation helped improve generalization and reduce overfitting.

The model performed well overall; however, some misclassifications occurred between fruits with similar color and shape, such as apples and cherries. These errors are mainly due to visual similarity and limited data variation.

Overall, the approach worked well and can be further improved by using more data, higher-resolution images, or deeper models(good trained).