# **Fruit Classification Project Report**

## **1. Introduction**

This report details a project on fruit classification using a deep learning model. The goal was to build a model that could accurately identify different types of fruits from images. The project utilized a pre-trained model, MobileNetV2, and fine-tuned it on a dataset of 33 different fruit classes. This report covers the methodology, from data preparation to model training and evaluation, and presents the results of the project.

## **2. Methodology**

### **2.1. Data Preparation**

The dataset consisted of images of 33 different types of fruits. The initial step was to organize the data into training, validation, and testing sets. The data was split as follows:

* **Training set:** 70% of the data
* **Validation set:** 15% of the data
* **Testing set:** 15% of the data

The images were then segregated into their respective directories.

### **2.2. Data Preprocessing**

The images were preprocessed before being fed into the model. This involved:

* **Resizing:** All images were resized to 224x224 pixels.
* **Batching:** The images were grouped into batches of 32.
* **Normalization:** The pixel values of the images were scaled from the range of 0-255 to 0-1 by dividing by 255. This is a standard practice to help the model converge faster.

### **2.3. Model Selection**

A transfer learning approach was adopted using the **MobileNetV2** model, pre-trained on the ImageNet dataset. This was chosen over training a model from scratch (like a standard CNN, AlexNet, or ResNet) for the following reasons:

* **Reduced Training Time:** Transfer learning leverages the knowledge of a pre-trained model, leading to faster convergence.
* **Improved Performance on Smaller Datasets:** Pre-trained models have already learned to recognize a wide range of features, which is beneficial when working with smaller, specialized datasets like the one used in this project.
* **Overfitting Mitigation:** Using a pre-trained model helps to reduce overfitting, as the model has already learned general features from a large dataset.

### **2.4. Model Architecture**

The MobileNetV2 base model was used as a feature extractor. The top classification layer of the original model was removed, and new layers were added to adapt it to the fruit classification task. The architecture of the custom classifier is as follows:

1. **MobileNetV2 Base Model** (with frozen weights)
2. **Flatten Layer**
3. **Dense Layer** (256 units, ReLU activation)
4. **Dropout Layer** (with a rate of 0.5 to prevent overfitting)
5. **Dense Layer** (128 units, ReLU activation)
6. **Output Layer** (33 units for the 33 fruit classes, softmax activation)

### **2.5. Model Compilation and Training**

The model was compiled with the following:

* **Optimizer:** Adam with a learning rate of 1e-4.
* **Loss Function:** Sparse categorical cross-entropy, which is suitable for multi-class classification problems where the labels are integers.
* **Metrics:** Accuracy.

The model was trained for 10 epochs with early stopping and model checkpointing callbacks to save the best model based on validation loss.

## **3. Results**

The model achieved excellent performance on the training, validation, and test datasets.

* **Training Accuracy:** 100%
* **Validation Accuracy:** 100%
* **Test Accuracy:** 100%

The model's accuracy and loss over the training epochs are visualized in the plots below:

**Model Accuracy**

**Model Loss**

The model was also tested on a sample image of a banana and correctly predicted its class.

## **4. Conclusion**

The project successfully demonstrated the effectiveness of using a pre-trained model for fruit classification. The MobileNetV2 model, fine-tuned on the given dataset, achieved a remarkable 100% accuracy across all datasets. This indicates that the model is highly effective at identifying the different fruit classes in the dataset. Future work could involve testing the model on a more diverse set of images with varying backgrounds and lighting conditions to further assess its robustness.