**PROJECT REPORT**

**FRUIT CLASSIFICATION**

**1. Project Objective**

The primary goal of this project is to develop and train a robust Convolutional Neural Network (CNN) to accurately classify a wide variety of fruit images from the "Fruit Recognition" dataset available on Kaggle.

**2. Dataset**

**Source:** Fruit Recognition dataset from Kaggle.

**Classes:** The model was trained to classify 33 different types of fruits.

**Structure:** The dataset contains a large collection of images, organized into training and testing directories, with each subdirectory corresponding to a specific fruit class.

**3. Data Preprocessing**

To ensure the model trains effectively, the following preprocessing steps were applied to the image data:

**Image Resizing:** All images were standardized to a uniform size of 100x100 pixels.

**Normalization:** Pixel values were scaled from the original 0-255 range to a 0-1 range by dividing by 255. This normalization step is crucial for optimizing the model's performance.

**Data Splitting:** The data was divided into training and testing sets for model training and subsequent evaluation.

**4. Model Architecture**

A Sequential Convolutional Neural Network (CNN) was constructed with the following layers:

**Convolutional Layer 1:** A Conv2D layer with 32 filters and a (3,3) kernel, using ReLU activation.

**Pooling Layer 1:** A MaxPooling2D layer for downsampling.

**Convolutional Layer 2:** A second Conv2D layer with 32 filters and a (3,3) kernel, also with ReLU activation.

**Pooling Layer 2:** Another MaxPooling2D layer.

**Flatten Layer:** Converts the 2D feature maps into a 1D vector.

**Dense Layer:** A fully connected layer with 64 neurons and ReLU activation.

**Output Layer:** A final Dense layer with 33 neurons (one for each fruit class) and a softmax activation function to generate class probabilities.

**5. Training and Evaluation**

**Compilation:** The model was compiled using the Adam optimizer and the sparse\_categorical\_crossentropy loss function, which is ideal for multi-class classification tasks with integer-based labels.

**Training:** The model was trained for 10 epochs.

**Performance:** The model achieved a high level of accuracy on both the training and validation datasets, demonstrating its ability to effectively learn the distinguishing features of the 33 different fruit classes. The training history plots showed consistent learning and good convergence.

**6. Conclusion**

The CNN model developed in this project successfully classifies images across 33 different fruit categories with high accuracy. The project confirms that CNNs are a powerful and effective tool for complex, multi-class image recognition tasks.