Fruits and Vegetables Recognition System

Overview

The Fruits and Vegetables Recognition System is a deep learning-based image classification project designed to automatically identify different types of fruits and vegetables from images. The system utilizes a Convolutional Neural Network (CNN) model trained on a custom dataset to achieve accurate recognition for real-world applications such as smart retail, automated sorting, and agricultural monitoring.

Objective

The objective of this project is to build an intelligent recognition model capable of classifying multiple categories of fruits and vegetables with high accuracy using image data. The system aims to provide a robust and efficient solution for visual recognition tasks involving diverse fruit and vegetable images.

Methodology

Dataset Preparation

The dataset was divided into training, validation, and test sets, stored in Google Drive, and loaded using TensorFlow's `image_dataset_from_directory()` function. Each image was resized to 64×64 pixels, converted to RGB format, and normalized to ensure consistency in input data. This preprocessing ensured uniformity across the dataset and improved the model's ability to generalize across different categories.

Model Architecture

The CNN model was developed using TensorFlow and Keras to perform efficient image-based classification. It consists of multiple convolutional layers that extract essential spatial features using the ReLU activation function, followed by max pooling layers that reduce spatial dimensions while retaining key information. Dropout layers were incorporated to minimize overfitting and improve generalization. After feature extraction, the data was flattened and passed through fully connected dense layers. The final output layer used a Softmax activation **function** with 36 output units to predict the probability of each fruit or vegetable class.

Training and Optimization

The model was compiled using the Adam optimizer with categorical cross-entropy as the loss function. Training was carried out over multiple epochs with batch normalization and dropout layers to enhance performance and prevent overfitting. The model was trained on the prepared dataset until stable convergence was achieved.

Evaluation

After training, the model's performance was evaluated using separate datasets. The CNN achieved a training accuracy of 0.8501, a validation accuracy of 0.8632, and a test accuracy of 0.8579. These results demonstrate that the system performs reliably across unseen data, maintaining consistent and balanced performance without significant overfitting.

Tools and Libraries

Python, TensorFlow, Keras, NumPy, Matplotlib, and Google Colab were used for model development, training, and evaluation.

Conclusion

The project successfully developed a CNN-based model for fruit and vegetable classification with strong performance and generalization capability. Future improvements could include expanding the dataset to include more categories, implementing transfer learning using advanced models such as MobileNet or ResNet, and deploying the trained model as a web or mobile application for real-time recognition.