Vegetable Classification

Kaggle dataset link:
https://www.kaggle.com/datasets/misrakahmed/vegetable-image-dataset

Data Collection:

Overview

The dataset used for the vegetable image classification task consists of 21,000 images distributed across 15 classes. The images are divided into three subsets: training (70%), validation (15%), and test (15%).

Classes

The dataset includes the following 15 vegetable classes:

- Broccoli
- Capsicum
- Bottle Gourd
- Radish
- Tomato
- Brinjal
- Pumpkin
- Carrot
- Papaya
- Cabbage
- Bitter Gourd
- Cauliflower
- Bean
- Cucumber
- Potato

Distribution

Each class contains 1,400 images of size 224x224, resulting in a balanced training dataset.

Data Preprocessing:

Image Data Generator

The ImageDataGenerator from the TensorFlow Keras library is used for data augmentation during training. Augmentation techniques include rotation, width and height shifts, shear, zoom, and horizontal flip.

Normalization

All images are rescaled to a range of [0, 1] by dividing the pixel values by 255.

Dataset Split

The dataset is split into training (12,000 images), validation (3,000 images), and test (3,000 images) sets.

CNN Model:

Model Architecture

The CNN model consists of convolutional layers, max-pooling layers, and fully connected layers. The model summary is as follows:

- Input Shape: (224, 224, 3)
- Convolutional Layers: Two sets of two convolutional layers each, followed by max-pooling layers.
- Flatten Layer

- Dense Layer with 15 neurons (output classes) and softmax activation.

Training

The model is compiled using categorical cross-entropy loss, Adam optimizer, and metrics including accuracy and mean squared error. Early stopping and learning rate reduction callbacks are employed during training to prevent overfitting.

Model Evaluation

The model achieved an accuracy of 95.33% on the test dataset. The confusion matrix provides insights into the model's performance in individual classes.

InceptionV3 Model:

Model Transfer Learning

The InceptionV3 model pre-trained on ImageNet data is used. The convolutional layers are frozen, and custom dense layers are added for classification.

Training

The model is compiled similarly to the CNN model, using categorical cross-entropy loss, Adam optimizer, and accuracy as the metric. The model is trained for five epochs with data generated by the same ImageDataGenerator used for the CNN model.

Model Evaluation

The InceptionV3 model achieved an impressive accuracy of 99% on the test dataset. The confusion matrix illustrates the model's performance on different classes.

Conclusion:

- In comparison, the Transfer Learning model exhibits slightly higher accuracy (99%) than the CNN model (95.33%).
- Despite the marginal difference in accuracy, the Transfer Learning model outperforms the CNN model, especially in terms of training efficiency.
- Both models are proficient in classifying most vegetables, but the Transfer Learning model demonstrates superiority in detecting specific classes such as Brinjal, Papaya, Radish, and Cabbage.