InceptionV3 Plant Disease Classification

AI Skills Project – Deep Learning & Transfer Learning

Project Overview

This document presents the implementation of a plant disease classification system using a Convolutional Neural Network based on the InceptionV3 architecture and transfer learning. The objective is to classify plant leaf diseases from images and support agricultural diagnosis.

Dataset Description

The PlantVillage dataset was used. Five disease classes were selected: Tomato Target Spot, Pepper Bell Bacterial Spot, Grape Black Rot, Corn Common Rust, and Cherry Powdery Mildew.

Data Preprocessing

Images were resized to 299x299 pixels and preprocessed using InceptionV3 preprocessing. Data augmentation techniques were applied to improve generalization.

Model Architecture

InceptionV3 pretrained on ImageNet was used as a backbone. A custom classification head with Global Average Pooling and a softmax output layer was added.

Training Strategy

The model was trained using Adam optimizer and categorical cross-entropy loss. Early stopping and model checkpointing were applied to save the best model.

Model Evaluation

Performance was evaluated using accuracy, precision, recall, F1-score, and confusion matrix to ensure reliable assessment.

Explainability Using Grad-CAM

Grad-CAM was implemented to visualize regions of interest that influenced predictions, improving transparency and trust in the model.

Comparison with Other Models

Results were compared with other CNN architectures implemented by the team to analyze performance differences.

GUI Integration

The trained model is prepared for GUI integration, allowing image upload, prediction visualization, and Grad-CAM display.

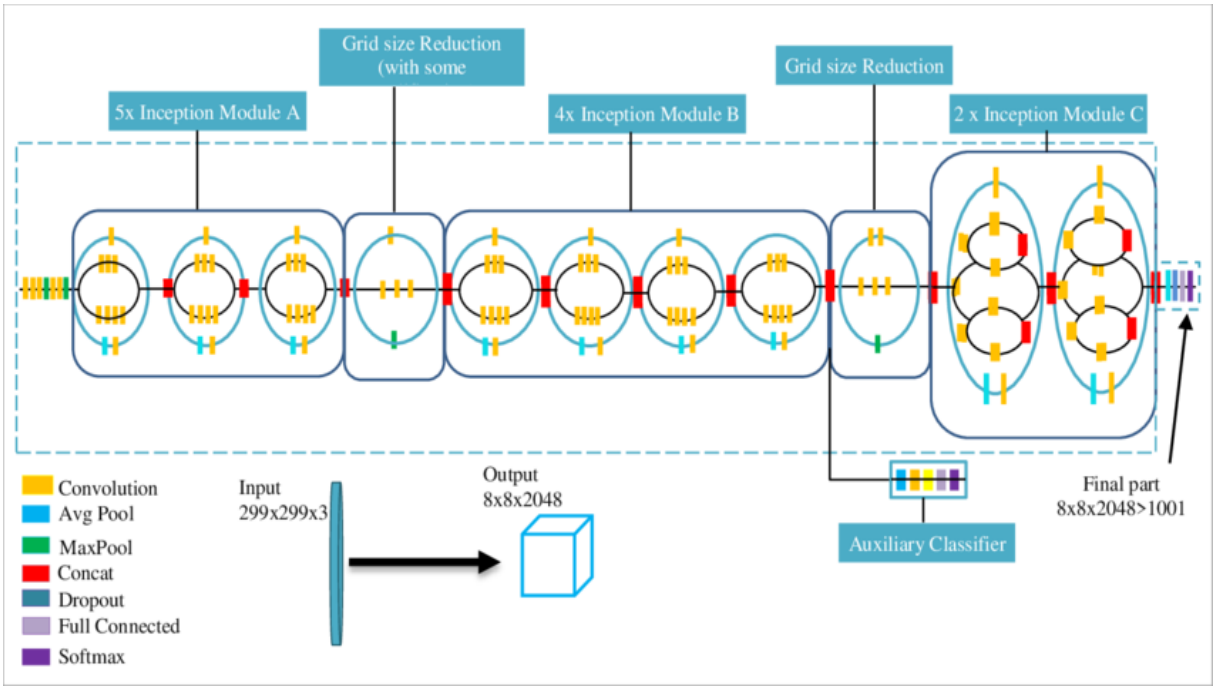
Individual Contribution (Patrick)

I implemented the InceptionV3 model, handled training, evaluation, explainability, and documentation for this part of the project.

Conclusion

This project demonstrates the effectiveness of transfer learning using InceptionV3 for plant disease classification with strong accuracy and explainability.

InceptionV3 Architecture Explanation



Input Layer

The InceptionV3 network takes an input image of size 299×299×3. This resolution allows the model to capture fine visual details such as texture variations and disease patterns on plant leaves.

Initial Convolution and Pooling Layers

Early convolution and pooling layers extract low-level features like edges and textures while reducing the spatial dimensions of the input to improve computational efficiency.

Inception Module A

Inception Module A applies multiple convolution filters in parallel, including 1×1, 3×3, and factorized 5×5 convolutions. The outputs are concatenated to capture multi-scale features.

Grid Size Reduction

Grid size reduction blocks decrease the spatial resolution of feature maps while increasing the number of channels, balancing performance and efficiency.

Inception Module B

This module uses factorized convolutions such as 1×7 followed by 7×1 to reduce computational cost while enabling deeper feature learning.

Inception Module C

Inception Module C focuses on extracting high-level semantic features, helping the network distinguish between visually similar plant diseases.

Auxiliary Classifier

An auxiliary classifier is used during training to improve gradient flow and act as a regularizer. It is disabled during inference.

Global Average Pooling

Global average pooling replaces large fully connected layers, reducing overfitting and converting feature maps into a compact feature vector.

Final Classification Layer

A custom dense layer with softmax activation is added to classify images into the five selected plant disease categories.