Potato Leaf Disease Classification Using Deep Learning

Course Code: **PGDDS 203**
Course Name: **Data Science Project**

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Introduction

Potato crops are highly vulnerable to diseases like Early Blight and Late Blight, which can cause severe yield loss if not detected early. Traditional diagnosis through manual inspection is slow, subjective, and often inaccurate.

To solve this, we developed an automated disease detection system using a Custom Convolutional Neural Network (CNN) that classifies potato leaves into Early Blight, Late Blight, or Healthy.

Problem & Objectives

Problem Statement

- Potato blights spread rapidly and severely impact global crop yield.
- Manual diagnosis is slow, subjective, and error-prone.
- Need for fast, automated, accurate disease detection using images.

Objectives

- Build a Custom CNN without pretrained models
- Achieve high classification accuracy
- Develop a Tkinter GUI for real-time testing
- Provide a portable solution for farmers & researchers

Dataset Overview

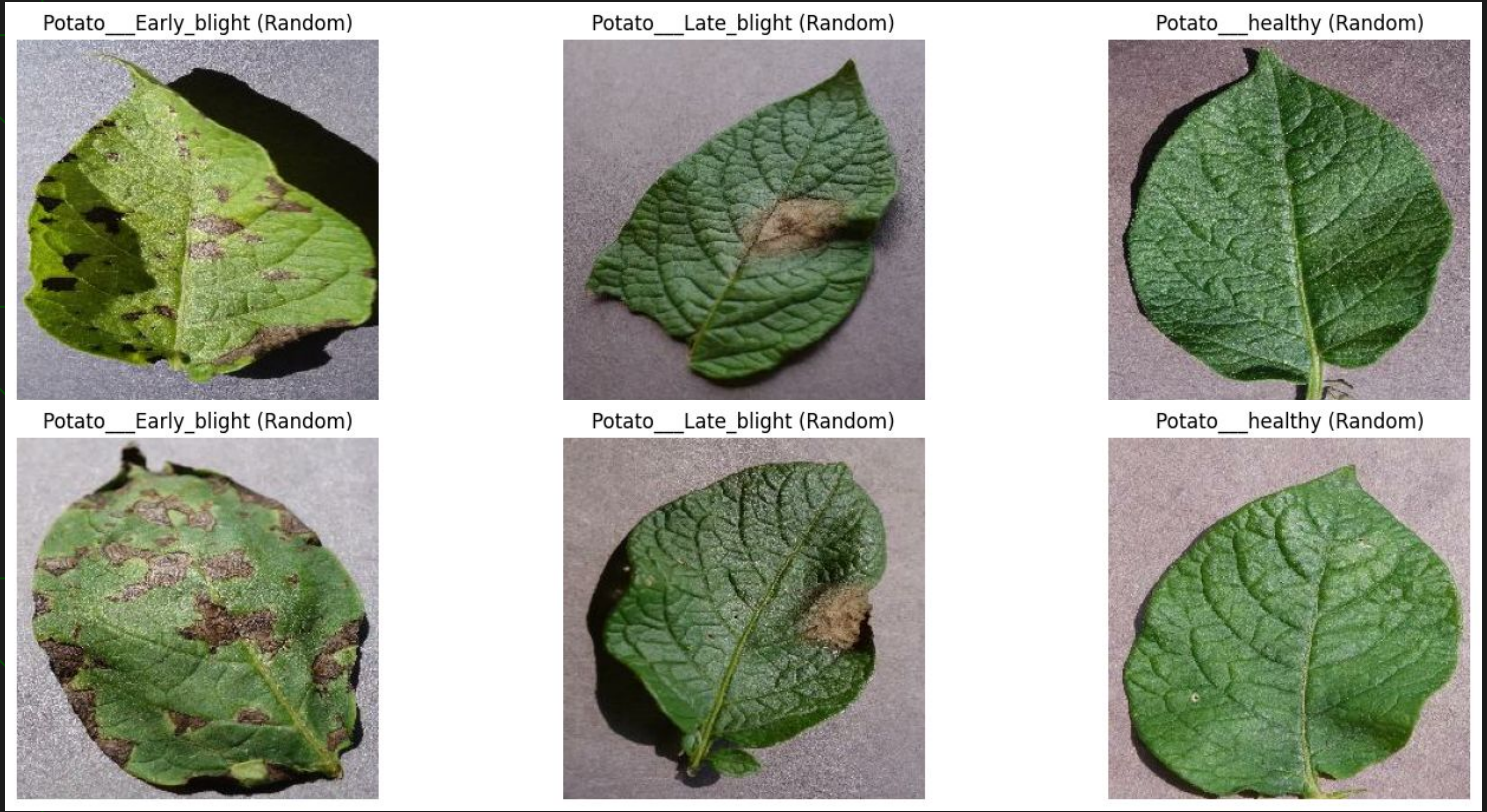
Dataset Description

- Dataset from PlantVillage
- 3 Classes:
  - Potato_Early_Blight
  - Potato_Late_Blight
  - Potato_Healthy

Preprocessing

- Image resizing (256×256)
- Pixel normalization
- One-hot encoding
- Shuffle + train/val/test split

Dataset Overview



System Workflow

End-to-End Pipeline

- Load dataset
- Preprocess images
- Train Custom CNN
- Evaluate model
- Save model → potato_model.h5
- Build Tkinter frontend
- User uploads image → Model predicts disease

Custom CNN Architecture

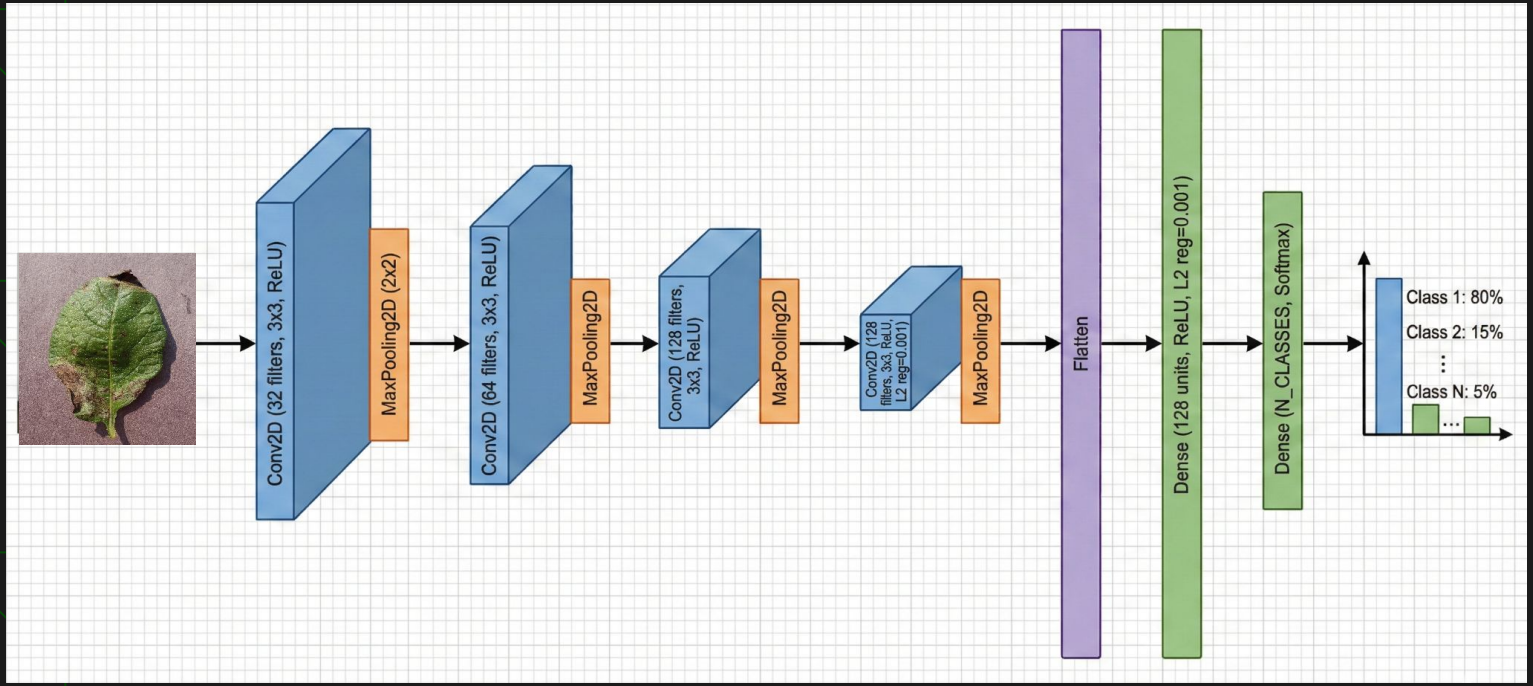
Architecture Overview

- Conv2D (32 filters) + MaxPool
- Conv2D (64 filters) + MaxPool
- Conv2D (128 filters) + MaxPool
- Conv2D (128 filters + L2 Reg.) + MaxPool
- Flatten
- Dense (128, L2 Regularization)
- Dense Output (Softmax, 3 classes)

Purpose

- Extract low-level → high-level features
- Reduce overfitting using L2 regularization
- Produce class probability distribution

Custom CNN Architecture



Model Training Details

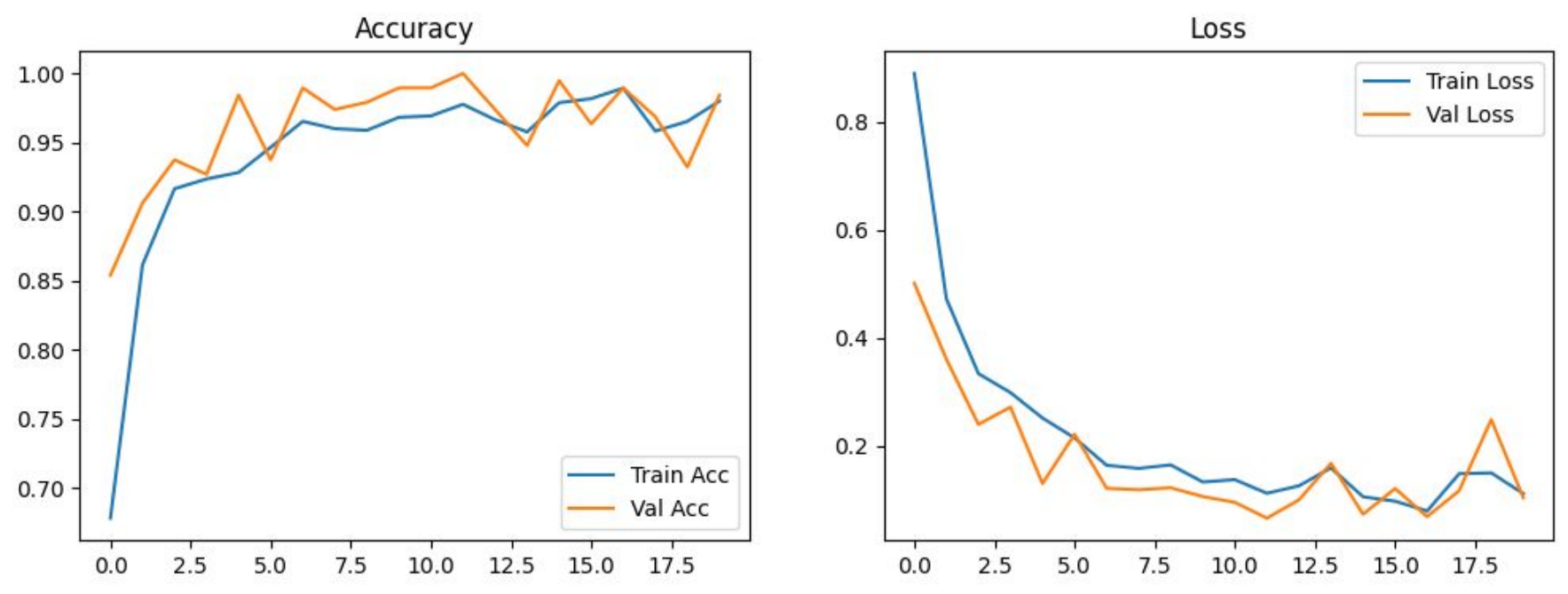
Training Setup

- Optimizer: Adam
- Loss: Categorical Cross Entropy
- Metrics: Accuracy
- Batch size: 32
- Epochs: Based on validation convergence

Key Notes

- Stable training
- No overfitting due to regularization
- Strong train–validation consistency

Model Training Details



Classification Report

Overall Test Accuracy: 98%

Class	Precision	Recall	F1-Score
Early Blight	1.00	0.96	0.98
Late Blight	0.97	0.99	0.98
Healthy	0.94	1.00	0.97

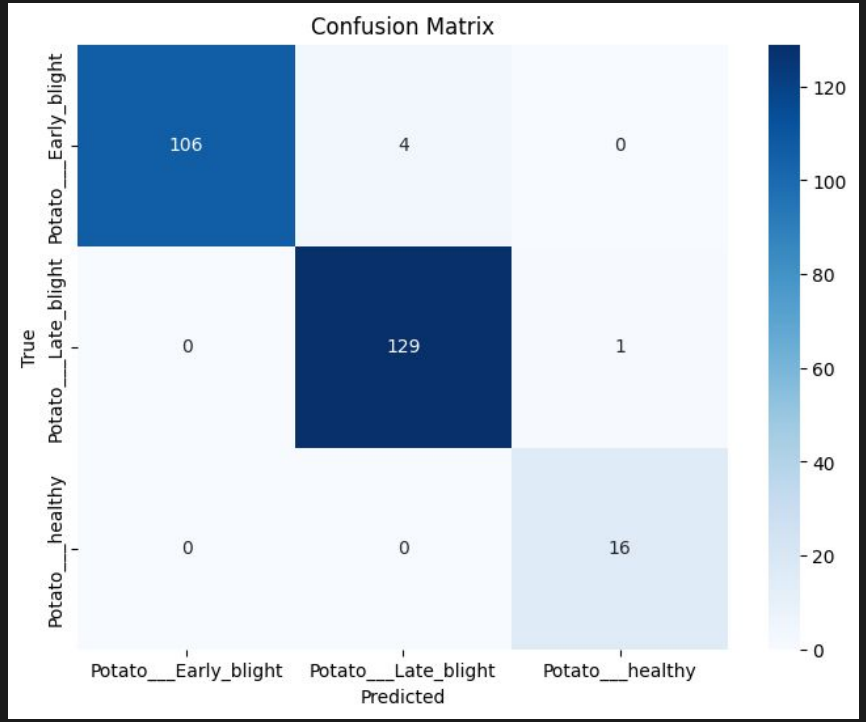
Key Insights

- Perfect precision for Early Blight
- Strong model generalization
- Excellent performance despite class imbalance

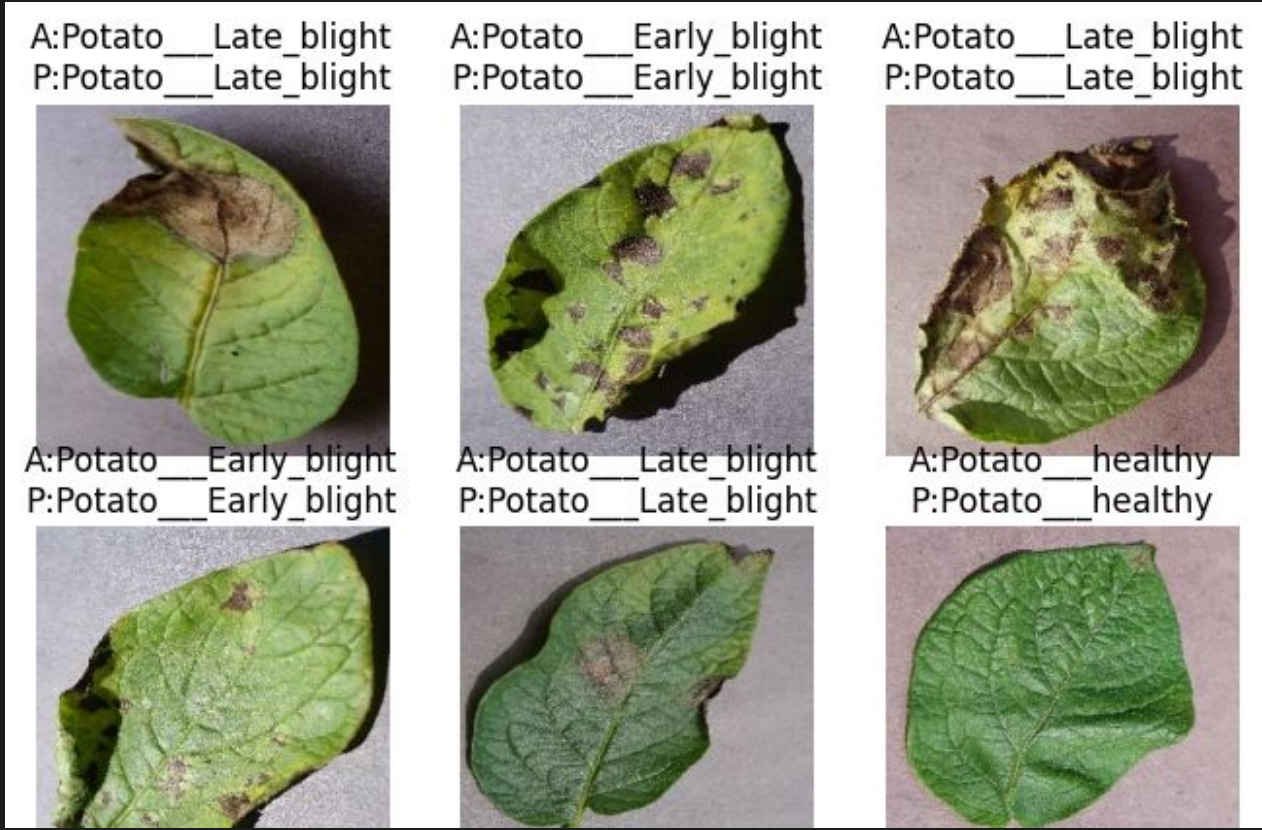
Confusion Matrix

Observations

- Strong diagonal → high correct predictions
- Minor confusion between Early & Late Blight
- All healthy leaves predicted correctly (100% recall)
- Errors caused by visual similarities in advanced infection



Sample Predictions



Conclusion

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- Custom CNN achieved 98% test accuracy
- Successfully differentiates Early Blight, Late Blight, Healthy
- Tkinter GUI enables real-world usability
- Lightweight model without pretrained networks

Thank You