# IMAGE-BASED PLANT DISEASE DETECTION USING DEEP LEARNING MODELS

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## ABSTRACT

Plant disease can drastically affect agricultural productivity and crop health. Early identification of plant diseases is crucial for mitigating these effects. This research proposes a plant disease detection system based on deep learning using convolutional neural networks (CNNs), specifically EfficientNet-B0, trained on a diverse dataset of plant leaf images. The model classifies 30+ disease classes and provides confidence scores along with precautionary measures. The system is integrated into a web-based application with an intuitive UI, allowing users to upload or capture images for real-time diagnosis. The results demonstrate high accuracy and robust performance, contributing to smart agriculture practices.

**Keywords:** Plant Disease Detection, Deep Learning, CNN, EfficientNet, Image Classification, Smart Agriculture

## 1. INTRODUCTION

In agriculture, plant diseases present a significant challenge to food security and crop quality. Traditional methods of disease identification are manual, time-consuming, and require expert knowledge. To address this, AI-based automated systems have emerged. Recent advancements in computer vision, especially deep learning, have made it possible to detect diseases using plant leaf images with high accuracy. This study aims to develop a system that leverages deep learning models for plant disease detection and deploys them in a web app to assist farmers and agriculturists.

## 2. METHODOLOGY

The system uses a deep learning approach for image classification of plant diseases. The dataset consists of thousands of labeled images of diseased and healthy plant leaves. The preprocessing steps involve resizing, normalization, and data augmentation. A pre-trained EfficientNet-B0 model was fine-tuned on the dataset. The trained model was exported in `.pt` format and deployed in a Flask-based web application. The app allows users to upload images, which are then processed to predict the disease class along with its confidence level and show related precautions.

2.1 Data Collection & Preprocessing

Images were sourced from public datasets and cleaned for quality. Techniques like rotation, flipping, and brightness adjustment were applied for augmentation.

2.2 Model Selection & Training

EfficientNet-B0 was chosen for its balance between performance and efficiency. The model was trained using PyTorch with categorical cross-entropy loss and Adam optimizer.

## 3. MODELING AND ANALYSIS

The model architecture includes convolutional layers, batch normalization, ReLU activation, and dense layers for classification. Training achieved over 95% accuracy on validation data. The system was analyzed for confusion matrix, precision, recall, and F1-score. The model was optimized for performance on both desktop and mobile web browsers.

## 4. RESULTS AND DISCUSSION

The system successfully classified plant diseases across more than 30 categories. The model achieved a test accuracy of 94.2% and a precision of 92.5%. The web interface is responsive and user-friendly. Users receive real-time predictions with visual feedback and recommendations categorized by budget for treatment. This facilitates faster and more informed decisions in plant healthcare.

| Class | Accuracy (%) | Sample Count |
| --- | --- | --- |
| Apple Scab | 96.1 | 500 |
| Tomato Mosaic Virus | 93.7 | 650 |
| Corn Blight | 92.3 | 720 |

## 5. CONCLUSION

This research showcases the potential of deep learning for real-time plant disease detection using leaf images. The proposed model demonstrates high accuracy and is deployed in a practical, accessible format for end users. The system has the potential to assist farmers in early diagnosis, reducing yield loss and promoting efficient plant care.

## ACKNOWLEDGEMENT

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