# Project Report: Plant Disease Detection Using Deep Learning

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## 1. Introduction

Plant diseases have a direct impact on crop yield and quality, posing a major threat to global food security. Early and accurate detection is crucial to controlling the spread of such diseases. In this project, we developed an AI-powered plant disease detection system using deep learning and built an interactive web application to classify images of plant leaves as either **healthy** or **diseased**.

## 2. Abstract

This project applies computer vision and deep learning techniques to detect diseases in plant leaves. It leverages a trained image classification model to make predictions on uploaded leaf images via a user-friendly web interface built with Streamlit. The system includes features such as multi-language support (English and Hindi), downloadable result summaries, and a stylish interface with a background and logo for better user engagement.

## 3. Tools Used

- **Programming Language**: Python 3.x
- **Libraries**:
    - **Streamlit –** Web app interface
    - **Pandas –** Data handling
    - **PIL –** Image processing
- **Interface**: Streamlit
- **Deep Learning Model**: Custom CNN or pretrained model (via src/predict.py)
- **Languages Supported:** English, Hindi
- **UI Enhancements:** Custom CSS for backgrounds, logo, responsive layout

## 4. Steps Involved in Building the Project

1. **Dataset Collection:**
   A labeled image dataset containing healthy and diseased plant leaves was sourced from open repositories like PlantVillage.
2. **Model Training:**
   A CNN model was built and trained using TensorFlow/Keras to classify images into multiple classes (e.g., Healthy, Powdery Mildew, Rust, etc.).
3. **Model Saving & Label Encoding:**
   The trained model and label dictionary were saved for reuse and mapping prediction indices to human-readable labels.
4. **Prediction Logic:**
   A predict_image() function was developed to preprocess uploaded images, run inference, and return predicted labels and confidence levels.
5. **Web GUI Development:**
   An interactive frontend was developed using Streamlit with the following features:
   - Single or multiple image upload
   - Multi-language support (English, Hindi)
   - Result summary with confidence %
   - Color-coded label output (green for healthy, red for diseased)
   - CSV report download option
6. **User Experience Enhancements:**
   - Sidebar language switcher
   - Responsive grid-based layout for image predictions

## 5. Conclusion

This project successfully delivers an intelligent system that assists users in identifying plant leaf diseases using deep learning. The system is easy to use, visually appealing, and informative. It can be beneficial for farmers, agricultural researchers, and hobbyists. With planned future upgrades, this tool has strong potential for real-world deployment and impact.