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Plant Disease Detection using CNN

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Abstract

Agriculture plays a significant role in the economic development of many countries. Plant diseases severely affect crop productivity and quality, leading to economic loss for farmers. Early and accurate disease detection is essential to improve yield and ensure food security. This paper proposes a deep learning-based plant disease detection system using Convolutional Neural Network (CNN). The system classifies leaf images into healthy and diseased categories. The proposed model performs image preprocessing, feature extraction, and classification to provide accurate predictions. Experimental results show that the model achieves high accuracy across multiple plant species. The system can be deployed as a web-based application for real-time disease prediction.

Keywords— CNN, Deep Learning, Image Classification, Plant Disease Detection, Agriculture.

I. INTRODUCTION

Agriculture is the backbone of many developing nations. However, plant diseases pose a serious threat to crop production. Traditional disease identification methods rely on visual inspection by agricultural experts, which is time-consuming and error-prone. With advancements in Artificial Intelligence and Deep Learning, automated plant disease detection systems have gained importance. Convolutional Neural Networks (CNN) are highly effective in image classification tasks due to their ability to automatically extract spatial features.

The proposed system uses a CNN model to detect plant diseases from leaf images. The system workflow is illustrated in **Fig. 1**, which shows the overall process from image upload to prediction result display.

II. SYSTEM ARCHITECTURE

The system architecture consists of image acquisition, preprocessing, CNN-based classification, and result generation modules. The complete architecture diagram is shown in **Fig. 1**.

A. Overall System Architecture

The architecture includes the following components:

1. User Image Upload
2. Image Preprocessing
3. CNN Model Training and Testing
4. Disease Prediction
5. Remedy Suggestion

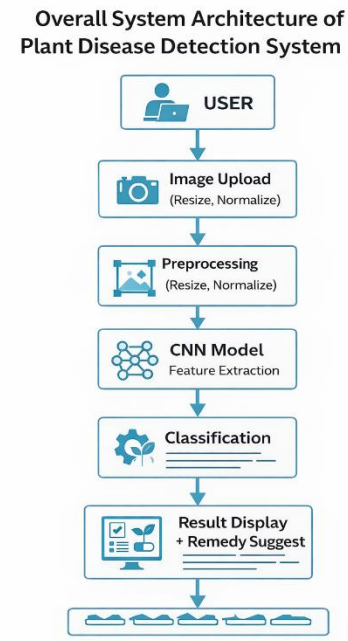
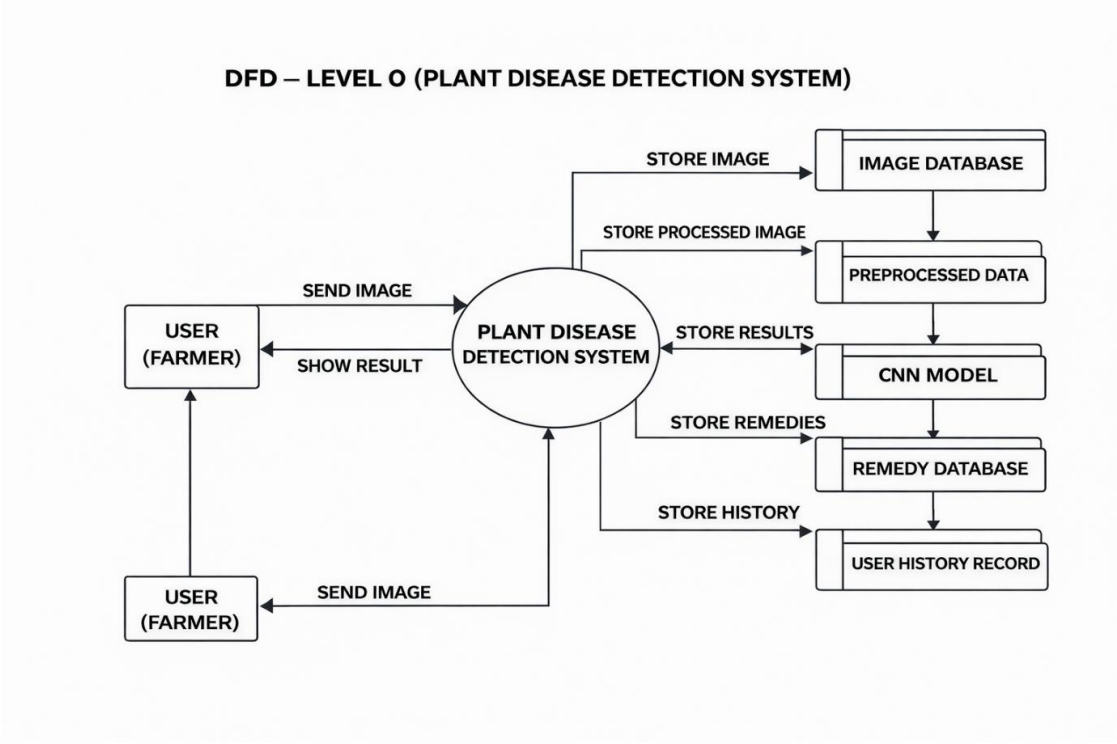


Fig. 1. Overall System Architecture of Plant Disease Detection System

III. DATA FLOW DIAGRAM (DFD LEVEL 0)

The Level 0 Data Flow Diagram represents the interaction between the user and the plant disease detection system. The user uploads a leaf image, and the system processes it to generate prediction results. The DFD Level 0 diagram is shown in **Fig. 2**.

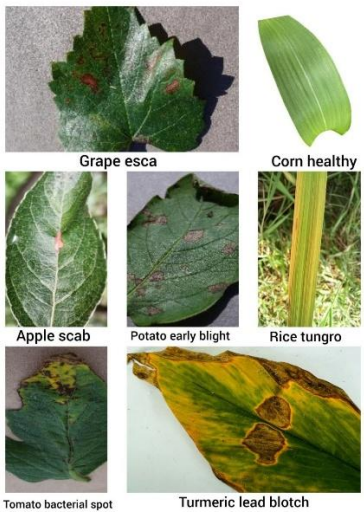


IV. METHODOLOGY

The dataset consists of images of potato, tomato, and rice leaves, including healthy and diseased samples. The images are resized and normalized before feeding into the CNN model. Data augmentation techniques such as rotation and flipping are applied to improve generalization.

The CNN architecture includes convolutional layers for feature extraction, pooling layers for dimensionality reduction, fully connected layers for classification, and a softmax layer for final output probability distribution. The model is trained using a training dataset and validated using a testing dataset. Performance metrics such as accuracy, precision, recall, and F1-score are used for evaluation.

Image Dataset Sample



V. RESULTS AND ANALYSIS

The proposed CNN model achieved high accuracy in detecting plant diseases. The system successfully classified diseases such as Early Blight, Late Blight, Bacterial Spot, Leaf Mold, and Brown Spot. The experimental results demonstrate that CNN provides better feature extraction compared to traditional machine learning methods. The performance graph and confusion matrix are illustrated in **Fig. 3** and **Fig. 4**, respectively.

Fig. 3. Model Accuracy Graph

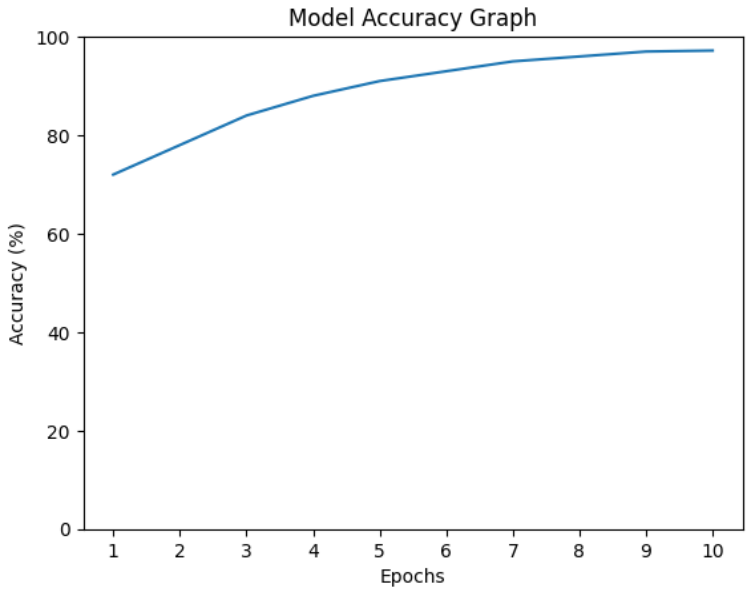
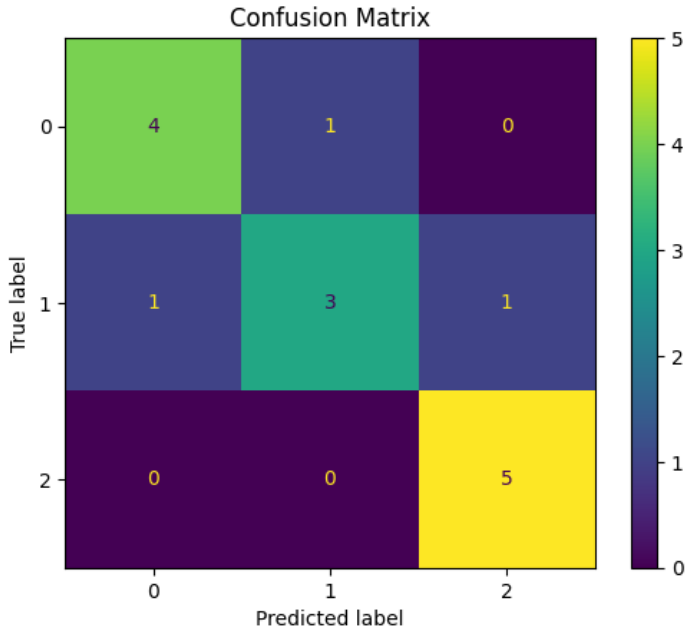


Fig. 4. Confusion Matrix



VI. CONCLUSION

This paper presents a CNN-based plant disease detection system that accurately identifies diseases from leaf images. The system reduces manual inspection effort and provides faster results. The experimental evaluation proves that deep learning models are effective for agricultural disease classification. Future enhancements include expanding the dataset, improving model performance using advanced architectures, and developing a mobile application for real-time detection.

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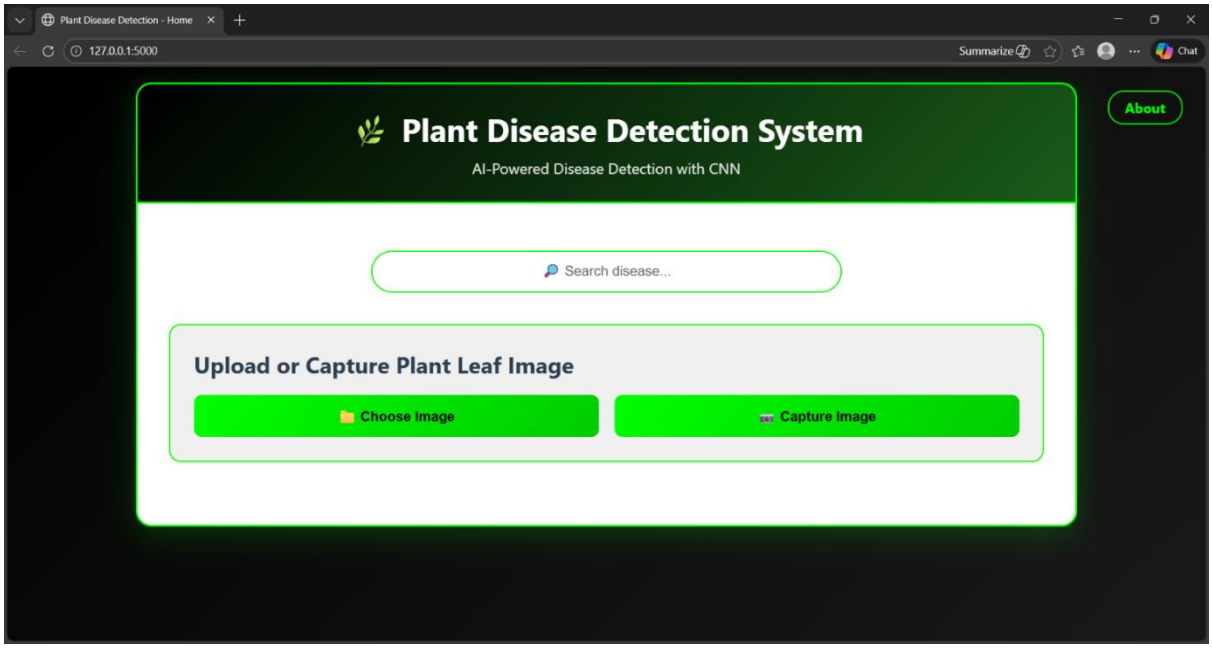
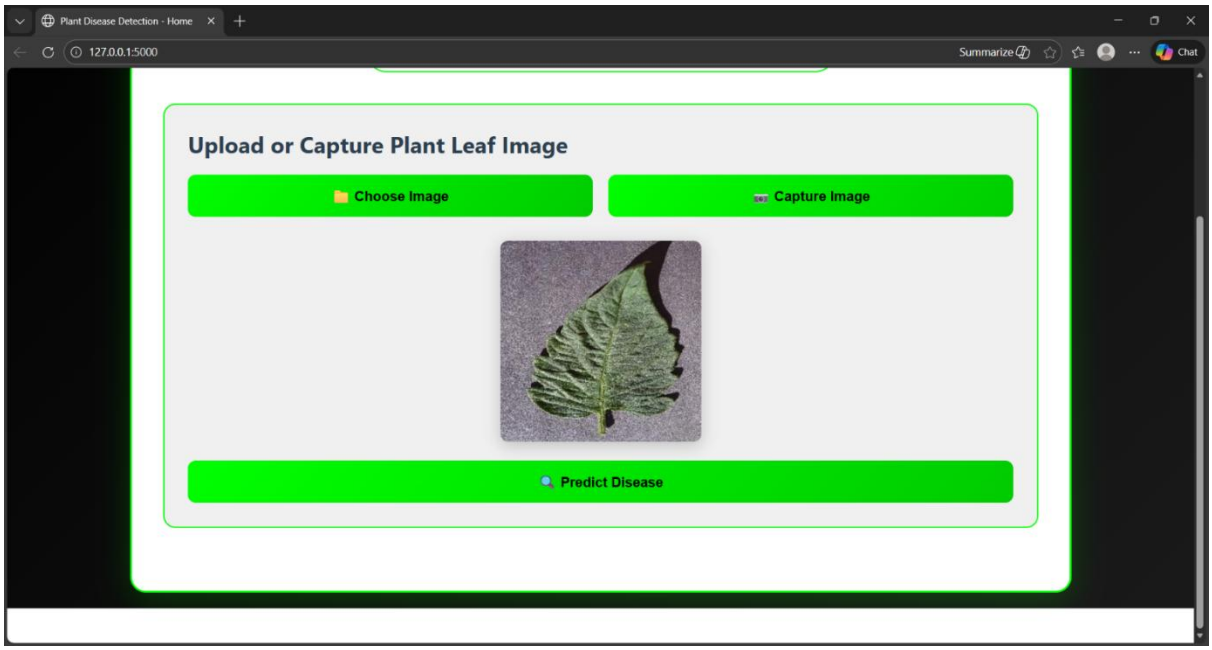
SAMPLE SCREEN





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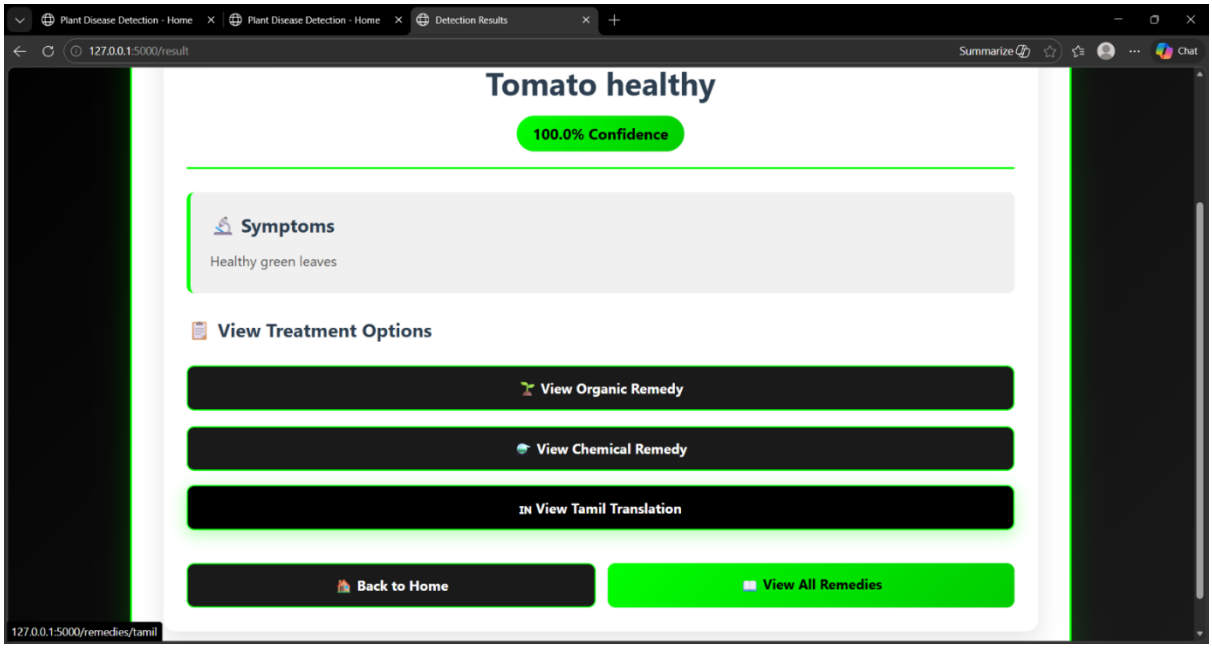

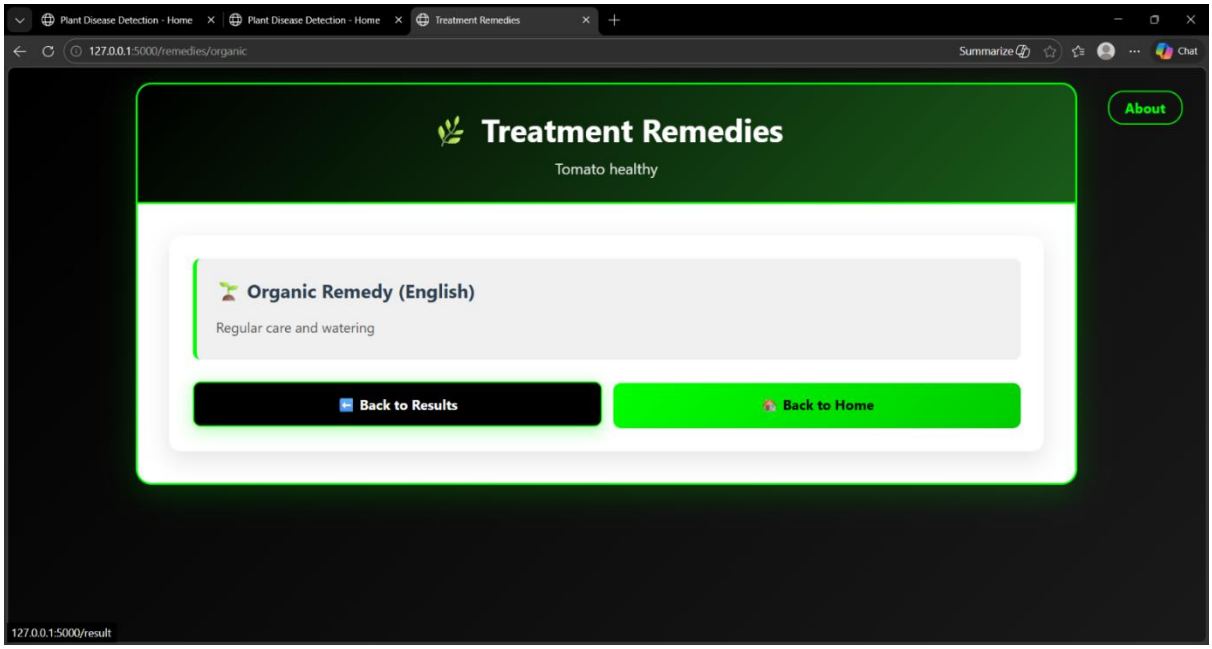

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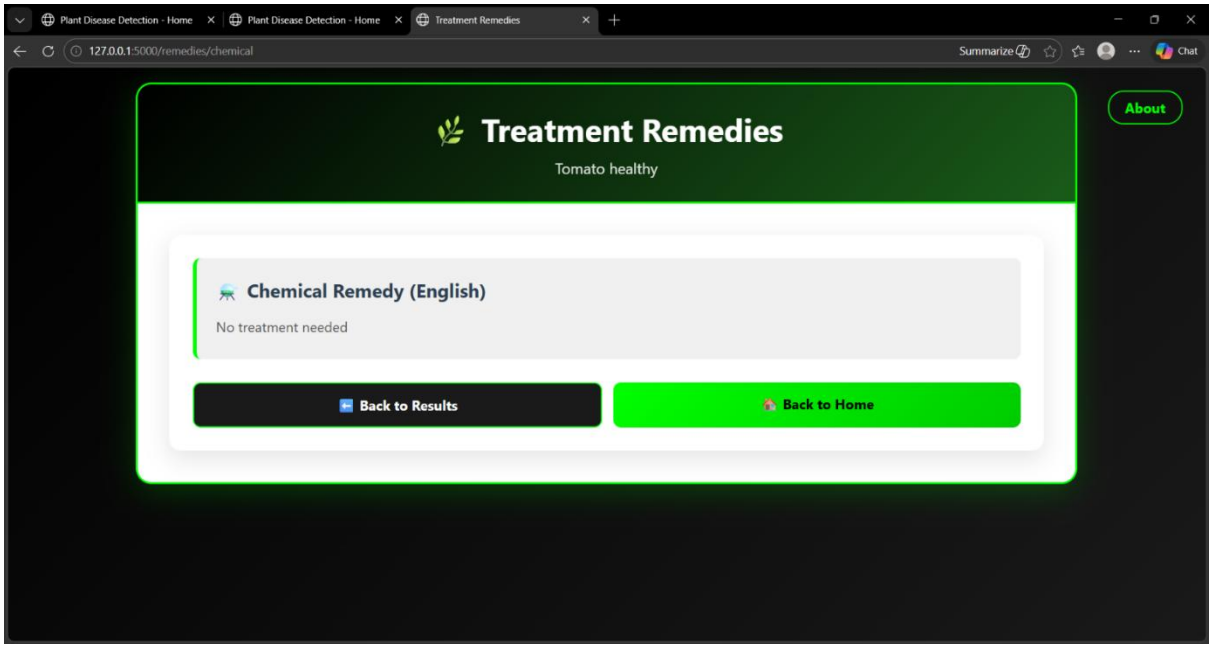

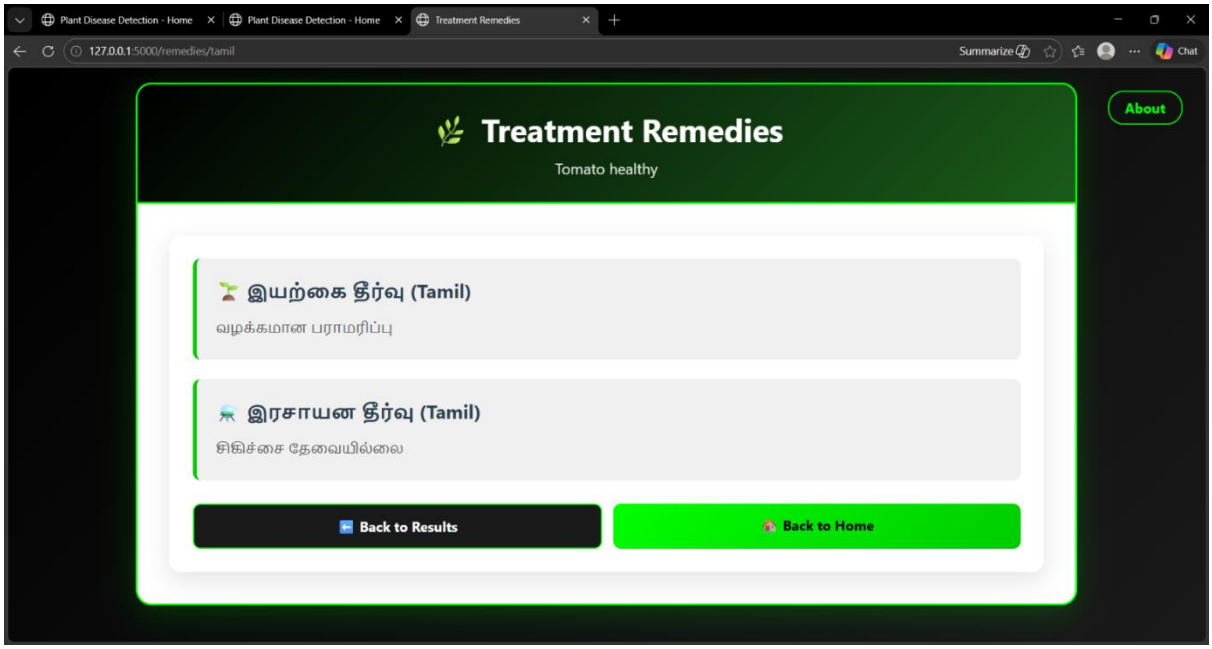

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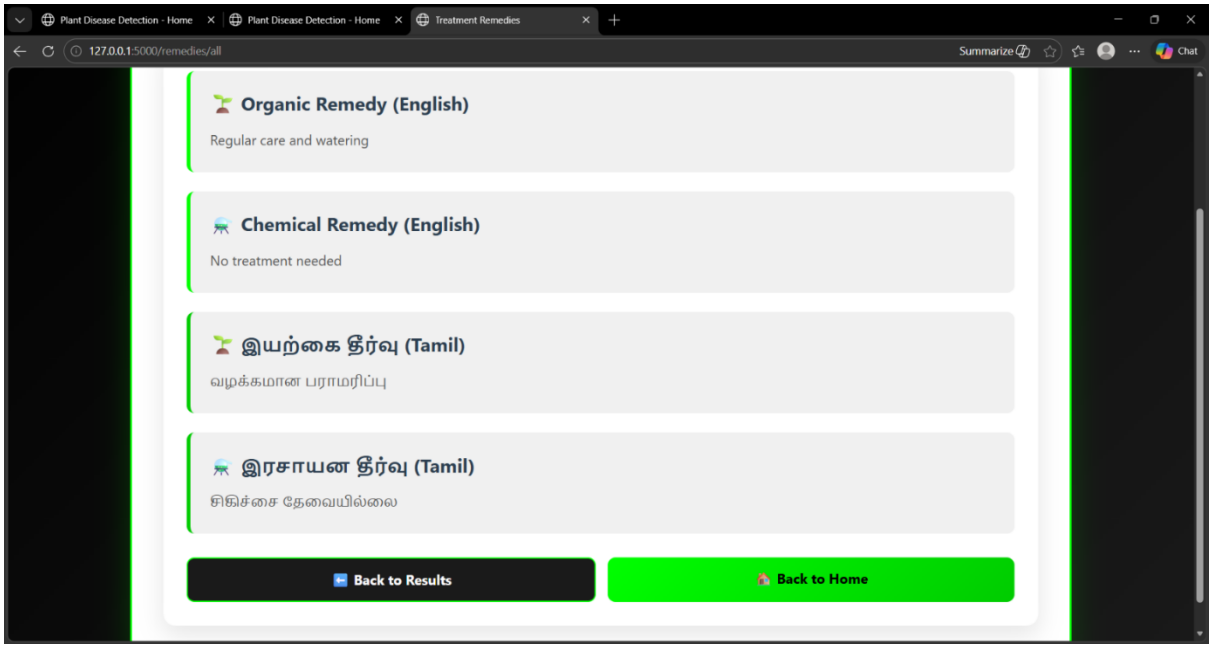

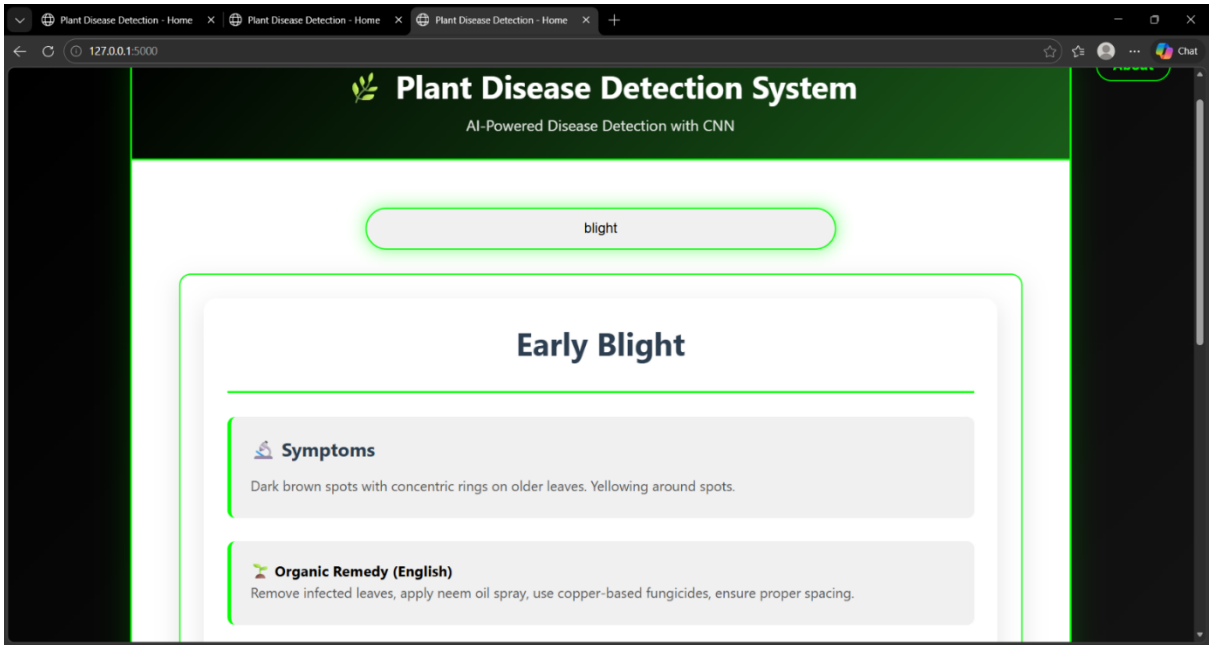

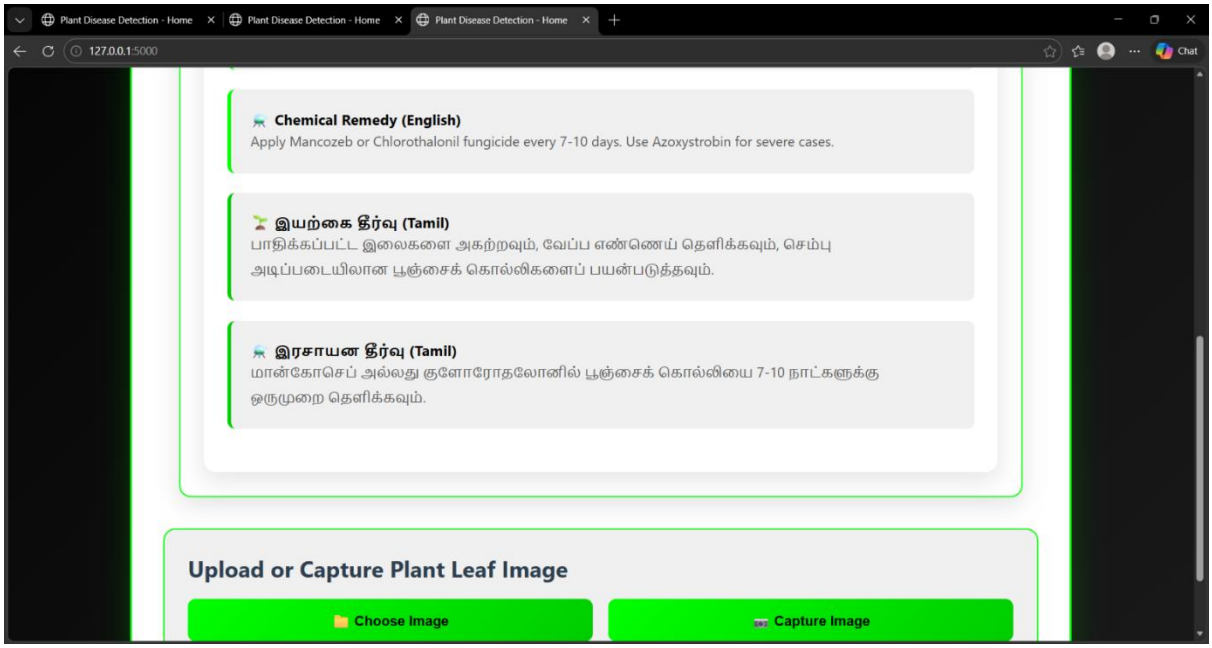

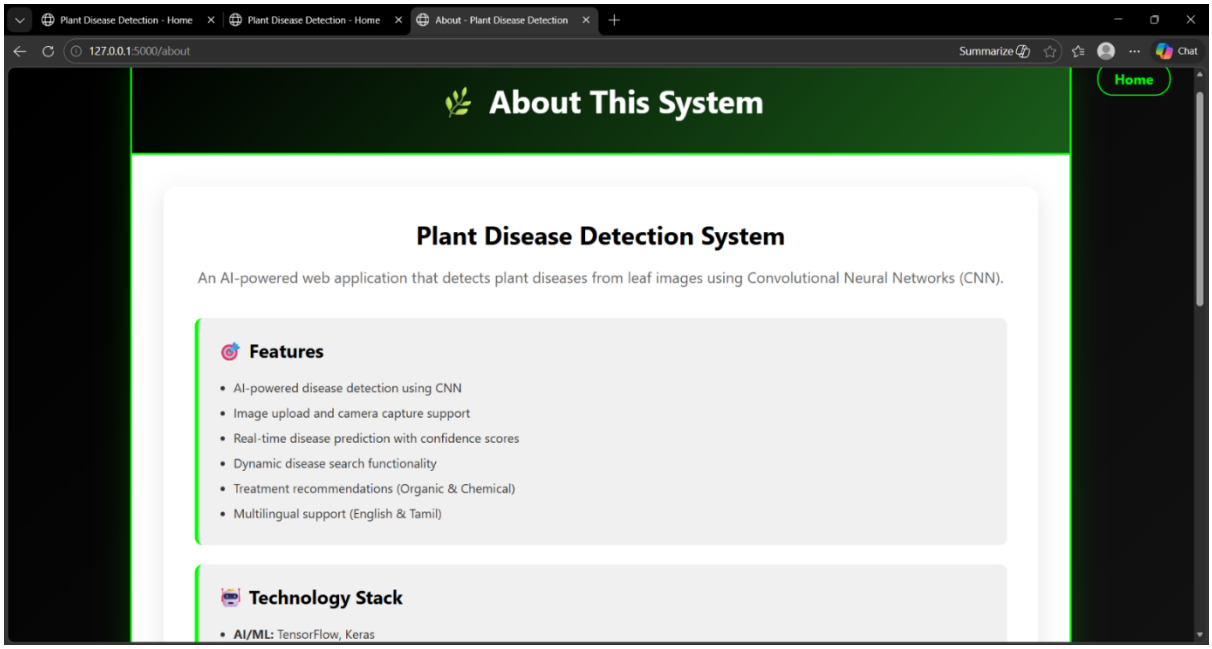

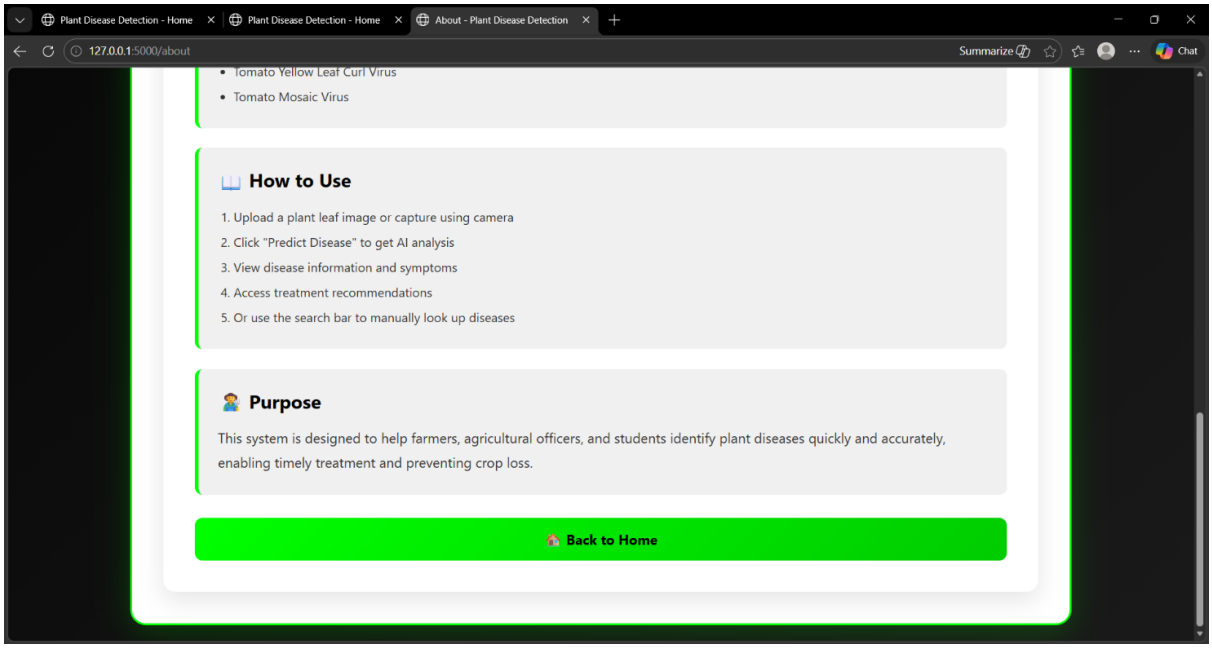

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