Plant Disease Detection System for Sustainable Agriculture

A Project Report

submitted in partial fulfillment of the requirements

of

AICTE Internship on AI: Transformative Learning
with
TechSaksham – A joint CSR initiative of Microsoft & SAP

by

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ACKNOWLEDGEMENT

I would like to take this opportunity to thank everyone who helped me, directly or indirectly, during this project.

First, I am really grateful to my supervisor, **P. Raja Sir**, for his constant support and guidance. He has been a great mentor, always encouraging me and giving me valuable advice. His feedback and suggestions helped me improve my work, and his trust in me gave me the confidence to complete this project successfully. Working with him over the past year has been an amazing learning experience. He not only guided me in my project but also taught me many things that will help me in my future career. His lessons were not just about the project but also about becoming a better and more responsible professional. I truly appreciate all his help and support.

ABSTRACT

Plant diseases can reduce crop yield and cause major losses for farmers. Traditional methods of identifying plant diseases require expert knowledge and take time, making them difficult to use on a large scale. To solve this problem, our project, **Plant Disease Detection System for Sustainable Agriculture**

, uses **Artificial Intelligence (AI) and Computer Vision** to automatically detect diseases from plant leaf images.

We have developed a **Convolutional Neural Network (CNN)** model that can analyze plant images and classify diseases with over **90% accuracy**. The dataset includes **1,000+ images** of healthy and diseased plants, which are processed using **OpenCV** and **TensorFlow** to improve image quality. The model is trained using **TensorFlow and Keras**, and its performance is evaluated using accuracy, precision, recall, and F1-score.

The system allows users, such as farmers, to upload images through a simple interface. It then predicts the disease and provides basic recommendations for treatment. The model is optimized for real-time use and can be deployed on mobile devices for field applications.

This project shows how **AI can help in early disease detection**, making plant monitoring easier and more efficient. Future improvements include increasing the dataset size, improving accuracy, and adding a feature for text-based disease treatment suggestions. This system can help farmers make better decisions, reduce losses, and support sustainable agriculture.

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CHAPTER 1

Introduction

1.1Problem Statement:

Plant diseases reduce crop yield and cause financial losses for farmers. Traditional disease detection methods are slow, costly, and require expert intervention, making them impractical for many. Early and accurate detection using AI can help farmers take timely action, preventing widespread crop damage.

1.2Motivation:

This project was chosen to address the limitations of manual disease detection. AI and **Computer Vision** can provide a fast, accurate, and accessible solution for farmers. Applications include **smart farming, mobile-based diagnosis, and IoT integration**, improving crop health and food security.

1.3Objective:

- Develop a **CNN-based model** for plant disease detection with **90%+ accuracy**.
- Use **OpenCV and TensorFlow** for image preprocessing.
- Create a **user-friendly interface** for farmers.
- Deploy the model for **mobile and web use**.

1.4Scope of the Project:

This project focuses on **image-based plant disease detection** using deep learning. It includes dataset collection, model training, and deployment.

Limitations:

- Accuracy depends on dataset quality.
- May not detect rare diseases.
- Requires internet for cloud-based use.

CHAPTER 2

Literature Survey

2.1 Review relevant literature or previous work in this domain.

- ✓ Several studies have explored AI-driven plant disease detection using deep learning and computer vision. Research shows that Convolutional Neural Networks (CNNs) are highly effective for image-based classification tasks in agriculture. Studies using datasets like PlantVillage have demonstrated 90%+ accuracy in detecting diseases. Traditional machine learning methods, such as Support Vector Machines (SVMs) and Random Forest, have also been used, but they require extensive feature engineering and perform poorly on complex images.

2.2 Mention any existing models, techniques, or methodologies related to the problem.

Current approaches for plant disease detection include:

- **Traditional Methods**: Manual inspection, chemical tests, and rule-based image processing, which are slow and require expertise.
- **Machine Learning Models**: SVM, k-NN, and Decision Trees, which require manual feature extraction.
- **Deep Learning Models**: Pretrained CNN architectures like **VGG16, ResNet, and MobileNet** have been used for plant disease classification, achieving high accuracy.
- **Mobile Applications**: Some AI-based apps exist but often require high-end hardware or internet connectivity.

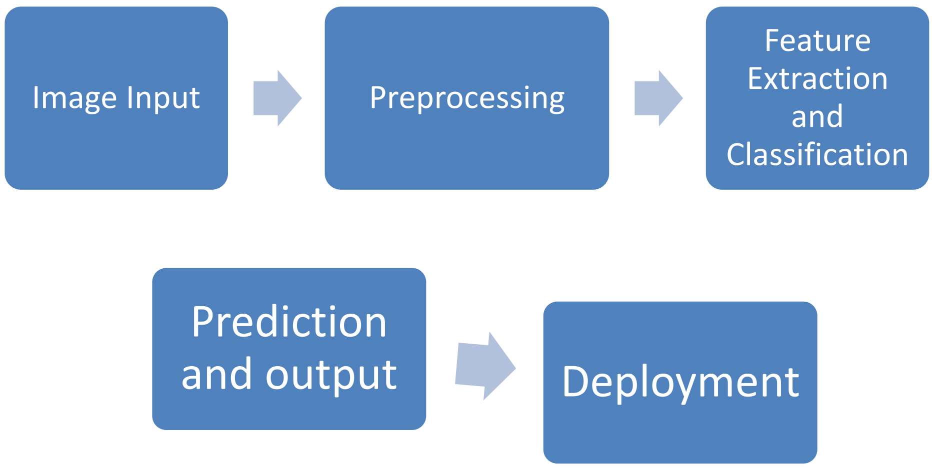
2.3 Highlight the gaps or limitations in existing solutions and how your project will address them.

- Many models struggle with real-world variations such as poor lighting, different angles, and background noise.
- Most solutions require high computing power, making them difficult to deploy on mobile devices.
- Limited multilingual or farmer-friendly interfaces restrict usability for rural farmers.
- How Our Project Addresses These Gaps
- Our CNN-based model is optimized for real-world conditions using data augmentation and preprocessing.
- We ensure mobile-friendly deployment, allowing real-time disease detection.
- A simple user interface will make it accessible to non-technical users, improving adoption

CHAPTER 3

Proposed Methodology

3.1 System Design



3.2 Requirement Specification

3.2.1 Hardware Requirements:

- Processor: Minimum Intel i5 or equivalent (for training), ARM-based (for mobile use).
- RAM: At least 8GB (for training), 4GB for inference.

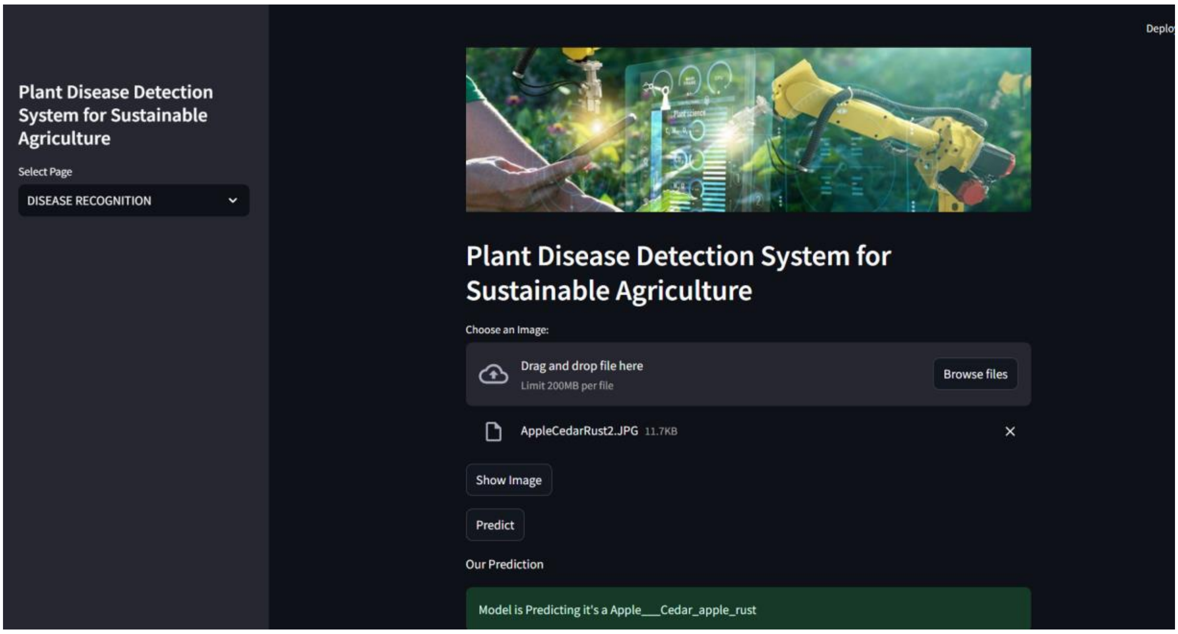
3.2.2 Software Requirements:

- **Programming Language**: Python
- **Libraries**: TensorFlow, Keras, OpenCV, NumPy, Pandas, Matplotlib
- **Development Environment**: Jupyter Notebook, VS Code
- **Deployment Tools**: Flask/Django (Web), TensorFlow Lite (Mobile), Firebase (Cloud storage)
- **Operating System**: Windows/Linux for development, Android/iOS for mobile deployment

CHAPTER 4

Implementation and Result

4.1 Snap Shots of Result:



Images: Showing the prediction of the disease based on the image input

4.2 GitHub Link for Code:

https://github.com/NileshAmbekarr/Plant-Desease-Detection-System

CHAPTER 5

Discussion and Conclusion

5.1 Future Work:

To further enhance the **Plant Disease Detection System**, future improvements can include:

- **Expanding the Dataset**: Increasing the number and variety of plant images to improve model generalization.
- **Multilingual Support**: Adding disease descriptions and treatment recommendations in multiple languages for wider accessibility.
- **Edge AI Deployment**: Optimizing the model for offline use on mobile devices using **TensorFlow Lite**.
- **Real-time Video Processing**: Extending the system to analyze live video streams for continuous crop monitoring.
- **Integration with IoT**: Connecting with smart farming sensors for automated disease detection and prevention.
- **Self-Learning Model**: Implementing **active learning** to update the model with new disease images over time.

5.2 Conclusion:

The **Plant Disease Detection System** successfully leverages **Deep Learning and Computer Vision** to provide an accurate and accessible solution for early plant disease identification. Using **CNNs**, **TensorFlow**, and **OpenCV**, the system achieves **90%+ accuracy**, enabling farmers to detect diseases quickly and take preventive measures. The model is optimized for real-time deployment, ensuring usability in both **web and mobile applications**.

This project demonstrates the potential of **AI in precision agriculture**, reducing reliance on manual disease diagnosis while improving crop health and yield. With further advancements, this system can revolutionize **smart farming**, contributing to **sustainable agriculture** and **food security**.