A

Mini Project Report on

Plant Disease Prediction using Deep Learning

Submitted in partial fulfillment of the requirements
for the degree of
BACHELOR OF ENGINEERING
IN
Computer Science & Engineering
Artificial Intelligence & Machine Learning

by

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Parshvanath Charitable Trust's

A. P. SHAH INSTITUTE OF TECHNOLOGY

(Approved by AICTE New Delhi & Govt. of Maharashtra, Affiliated to University of Mumbai)

(Religious Jain Minority)

CERTIFICATE

This is to certify that the project entitled "**Plant Disease Prediction using Deep Learning"** is a bonafide work of Soham Shelke (23106044), Atharva Tawde (23106122), Atharva Samant (23106057), Raunak Panigrahi (23106092) submitted to the University of Mumbai in partial fulfillment of the requirement for the award of **Bachelor of Engineering** in **Computer Science & Engineering (Artificial Intelligence & Machine Learning).**

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Project Report Approval

This Mini project report entitled "**Plant Disease Prediction using Deep Learning**" by **Soham Shelke, Atharva Tawde, Atharva Samant and Raunak Panigrahi** is approved for the degree of ***Bachelor of Engineering*** in ***Computer Science &Engineering***, (AI & ML) ***2024-25***.

External Examiner: ____________________

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Date:

Declaration

We declare that this written submission represents my ideas in my own words and whereothers' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission hasnot been taken when needed.

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ABSTRACT

This project explores the application of deep learning techniques for plant disease prediction, a critical aspect of modern agriculture. The primary objective is to develop a web-based system that accurately detects plant diseases from leaf images, assisting farmers and agricultural professionals in early disease identification and management. Our system integrates three TensorFlow models: Leaf Detection, Plant Classification, and Disease Classification, with the latter leveraging the ResNet50 architecture to predict diseases based on both image features and real-time weather data. The model provides the top three disease predictions for a given leaf image. To enhance the reliability of predictions, we incorporate live weather data using the Weather API and provide disease-specific recommendations via the Gemini API. Our findings highlight the effectiveness of ResNet50 in plant disease classification and the added value of integrating real-time environmental factors and AI-driven recommendations. Future work will focus on expanding the dataset, optimizing model performance, and refining recommendation strategies to enhance user guidance.

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CHAPTER 1

INTRODUCTION

INTRODUCTION

Plant disease identification is a crucial aspect of modern agriculture, as early detection can prevent crop loss and ensure food security. Accurate disease diagnosis enables farmers to take timely action, improving crop yield and reducing reliance on excessive pesticide use. However, traditional methods of disease identification rely on expert knowledge, manual inspection, and visual symptoms, making the process time-consuming and prone to errors.

In recent years, machine learning and deep learning have emerged as powerful tools for plant disease detection. By leveraging image-based data and recognizing patterns in leaf structures, deep learning models can provide highly accurate disease predictions. These models can analyze subtle visual differences that might not be easily identifiable to the human eye, leading to better disease classification and management.

This project aims to develop a web-based system that predicts plant diseases based on leaf images using three TensorFlow models:

- Leaf Detection Model – Identifies whether the uploaded image contains a valid leaf.
- Plant Classification Model – Classifies the plant species.
- Disease Classification Model – Uses ResNet50 to predict plant diseases based on image features and real-time weather data.

The top three disease predictions are presented to the user along with AI-driven recommendations obtained via the Gemini API. Additionally, live weather data from the Weather API is integrated to improve prediction reliability, as environmental factors significantly influence disease occurrence.

Objectives:

- To develop a web-based system for automated plant disease detection.
- To integrate three deep learning models for leaf detection, plant classification, and disease classification.
- To enhance disease predictions by incorporating real-time weather data.
- To provide personalized disease management recommendations using the Gemini API.
- To evaluate model performance and improve classification accuracy.

Motivation:

The motivation behind this project stems from the growing need for AI-driven solutions in agriculture. Early detection of plant diseases can:

- Prevent crop losses and improve food security.
- Reduce excessive pesticide use, minimizing environmental impact.
- Support farmers with automated, accessible, and real-time disease insights.
- By leveraging deep learning and AI-driven recommendations, this project aims to empower farmers with reliable and efficient disease detection tools.

Key Challenges in Plant Disease Prediction:

- Data Quality and Availability – The accuracy of deep learning models depends on a diverse and well-labelled dataset. Poor-quality images can reduce prediction performance.
- Environmental Variability – Disease symptoms may vary due to lighting, weather, and soil conditions, making classification more complex.
- Overfitting – Models may perform well on training data but struggle with new, unseen images.
- Generalization Across Plant Species – Some diseases have similar symptoms across different plants, requiring a robust classification system.

CHAPTER 2
LITERATURE SURVEY

LITERATURE SURVEY

2.1-HISTORY

Plant disease detection has traditionally relied on manual observation by farmers and agricultural experts. However, this approach is often time-consuming, subjective, and dependent on human expertise. Early methods for automated disease detection used traditional image processing techniques, but these approaches struggled to generalize across diverse plant species, lighting conditions, and environmental variations.

With the advancement of deep learning and AI, researchers have developed computer vision-based techniques that significantly improve disease identification accuracy. Convolutional Neural Networks (CNNs) have emerged as a dominant approach for image-based plant disease classification, enabling real-time and automated disease detection.

Deep Learning Approaches Used

To enhance prediction accuracy, this project employs three deep learning models trained on plant disease datasets. These models leverage state-of-the-art architectures in computer vision and transfer learning:

1. Leaf Detection Model

   The first step in the disease prediction pipeline is to determine whether the uploaded image contains a valid leaf. This prevents misclassification caused by irrelevant images. A CNN-based classifier is used for this purpose, trained on a dataset containing images of leaves and non-leaf objects.

2. Plant Classification Model

   After detecting a valid leaf, the system classifies the plant species before diagnosing potential diseases. This step ensures that disease classification is contextually accurate, as different plants may exhibit similar symptoms for different diseases. A deep learning model trained on plant species identification is used for this task.

3. Disease Classification Model (ResNet50)
For disease prediction, we use ResNet50, a deep learning model well-suited for extracting detailed features from images. ResNet50's residual connections allow it to efficiently learn complex plant disease patterns, improving classification accuracy.

This model is trained on a dataset containing various plant diseases and generates the top three disease predictions for a given leaf image. Additionally, it integrates real-time weather data to enhance prediction accuracy. Since environmental factors like temperature, humidity, and rainfall significantly influence disease occurrence, incorporating live weather data ensures more reliable predictions.

Integration of External APIs

To improve disease diagnosis and provide data-driven recommendations, our project integrates two external APIs:

- **Weather API** – Retrieves real-time weather conditions, which are used to refine disease predictions based on environmental factors.
- **Gemini API** – An AI-powered recommendation system that suggests treatment strategies for the predicted diseases, assisting users in taking preventive and corrective measures.

Summary

This literature survey highlights the deep learning techniques and external APIs utilized in this project for accurate plant disease detection. The combination of CNN models (including ResNet50), real-time weather data, and AI-driven recommendations ensures an effective and reliable web-based plant disease diagnosis system.

2.2-LITERATURE REVIEW:

1.**Plant Disease Detection Using Deep Learning**

Publisher: IEEE

Authors : Ebrahim Hirani; Varun Magotra; Jainam Jain; Pramod Bide

Published in: 2021 6th International Conference for Convergence in Technology (I2CT)

In recent years, use of Convolutional neural networks has been explored in a wide range of applications whether its image classification, feature extraction or image segmentation. One of those applications is plant disease detection, since plant disease is one of the most significant factors that leads to poor yield in the agricultural sector. Over the period of time various deep learning approaches have been used to solve this problem of identification and classification of plant disease. But then to there are some limitation to these approaches. The recent application of transformer networks in computer vision tasks has shown great promise. This paper compares these approaches with traditional CNN approaches in the task of plant disease detection. The best validation accuracy that our transformer model achieves is 97.98%.

2. Plant Disease Classification Using Deep Learning

Publisher: IEEE

Authors : Ebrahim Hirani; Varun Magotra; Jainam Jain; Pramod Bide

Published in: 2021 3rd International Conference on Signal Processing and Communication (ICPSC)

Agriculture is vital to the Indian economy, and early detection of plant diseases is crucial to prevent crop loss. Many plants, including apples, tomatoes, cherries, and grapes, show disease symptoms on their leaves, which can be identified using deep learning. This project utilizes a CNN model for plant disease classification, offering faster and more accurate predictions than manual observation. Pre-trained models like VGG, ResNet, and DenseNet were evaluated, with DenseNet achieving the highest accuracy.

CHAPTER 3

PROBLEM STATEMENT

PROBLEM STATEMENT

3.1 Problem Overview

Plant diseases pose a significant threat to global agriculture, leading to reduced crop yield, economic losses, and food insecurity. Early and accurate detection of plant diseases is essential for implementing timely interventions and preventing large-scale crop damage.

Traditional disease diagnosis methods rely on manual inspection by farmers or agricultural experts, which can be:

Time-consuming – Visual inspection across large farms is impractical.
Error-prone – Similar symptoms may appear in different diseases, leading to misdiagnosis.
Limited by expertise – Not all farmers have access to expert guidance.
To address these challenges, AI-based automated plant disease detection provides a faster, more reliable, and scalable solution.

3.2 Problem Definition

This project aims to develop a web-based AI application that allows users to upload leaf images and receive disease predictions based on deep learning models. The system consists of three key TensorFlow models:

Leaf Detection Model – Ensures that the uploaded image contains a valid leaf before processing.
Plant Classification Model – Identifies the plant species before diagnosing diseases.
Disease Classification Model (ResNet50) – Predicts plant diseases based on leaf images and real-time weather data.
To enhance prediction accuracy and provide actionable insights, the system integrates:

Weather API – Fetches live weather data to improve disease prediction based on environmental factors.
Gemini API – Provides AI-driven recommendations for disease treatment and prevention.

CHAPTER 4

EXPERIMENTAL SETUP

EXPERIMENTAL SETUP

4.1 Software Setup

This section outlines the tools and methodologies used to develop, train, and evaluate the deep learning models for plant disease prediction, including data acquisition, preprocessing, model training, and evaluation.

1. Data Acquisition

- **Dataset Source:** Publicly available dataset (PlantVillage) containing ~54,305 images of healthy and diseased leaves across 11 crop species.
- **Weather Dataset :** Generated synthetic dataset according to the diseases.
- **Target Variable:** Identifying plant species and predicting possible diseases from leaf images.

2. Data Preprocessing

- **Image Preprocessing:**
  - Resizing images for consistency.
  - Normalizing pixel values for model convergence.
  - Data augmentation (rotation, flipping, etc.) to enhance dataset variability.
- **Data Splitting:**
  - 80% for training, 20% for testing.

3. Model Development

- **Leaf Detection Model**: CNN-based classifier to filter valid leaf images.
- **Plant Classification Model:** Custom CNN model for plant species identification.
- **Disease Classification Model (ResNet50):** Uses ResNet50 with real-time weather data integration for disease prediction.

4. Model Training

- **Hyperparameter Tuning:** Batch size, learning rate, layers, and dropout rate optimized.
- **Training Process:** Adam optimizer and categorical cross-entropy loss were used.

5. Model Evaluation

- **Metrics:**
  - Leaf Detection Model: Achieved 98.2% accuracy on the test dataset.
  - Plant Classification Model: Achieved 94.5% accuracy across 11 plant species.
  - Disease Classification Model (ResNet50): Achieved 79.8% accuracy with weather data integration.

6. Tools and Technologies

- **Programming Language:** Python
- **Libraries:** TensorFlow Keras, Flask, Pandas, NumPy, Matplotlib
- **APIs:** Weather API for live data, Gemini API for treatment recommendations.

4.2 Hardware Setup

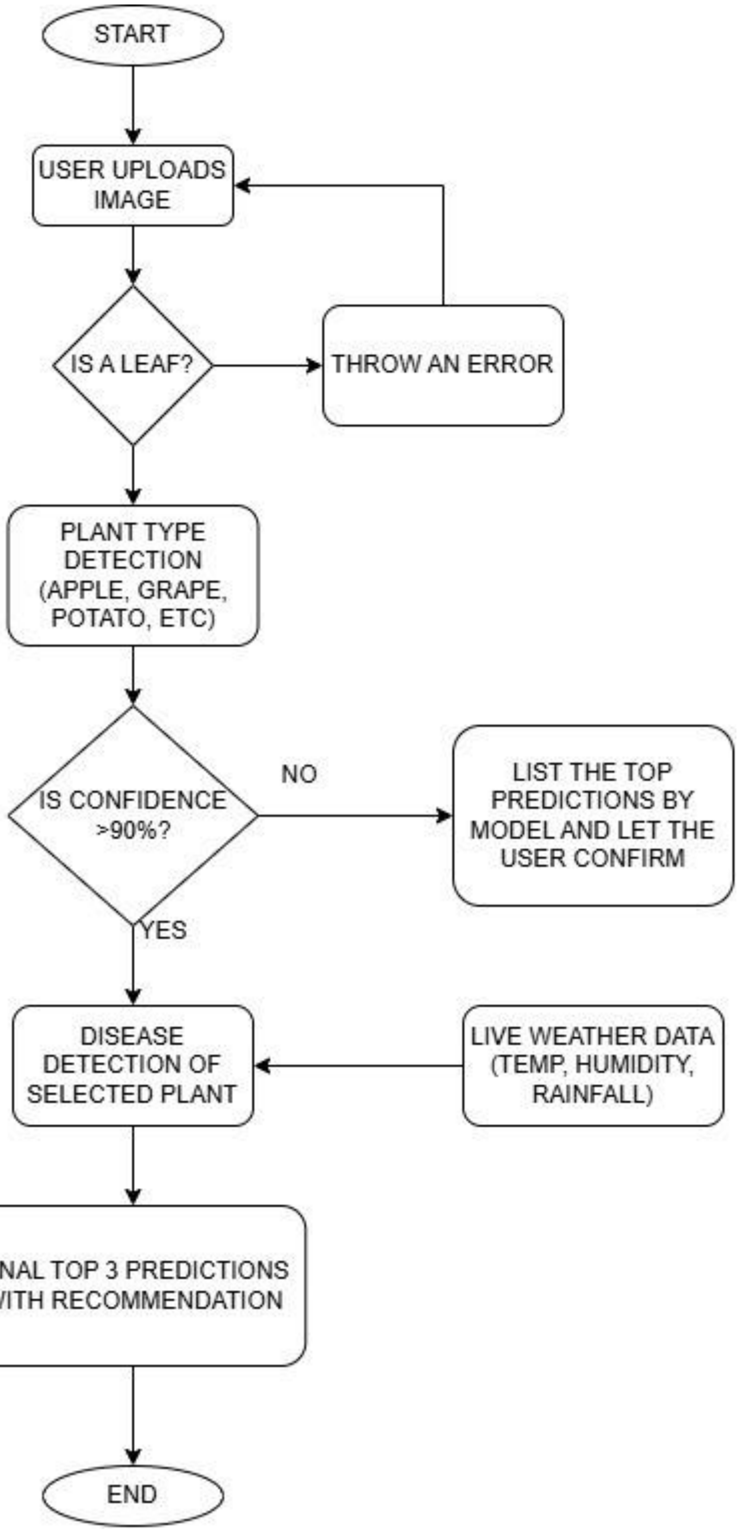
- **Training Resources:** Google Colab's GPU, Kaggle acceleration for faster model training.
- **Storage:** Cloud-based storage for dataset handling.
- **Deployment Requirements:** Runs on a standard PC or cloud server with moderate processing power.
- **Accessibility:** Web-based interface accessible from desktops, laptops, and mobile devices.

CHAPTER 5

PROPOSED SYSTEM AND BLOCK DIAGRAM

PROPOSED SYSTEM AND IMPLEMENTATION

5.1 Block diagram of proposed system



5.2 Description of block diagram

1. **Start:**

- The process begins when the user uploads an image of a plant leaf.

❖ **Is it a Leaf?**

- The system checks if the uploaded image contains a valid leaf using a Leaf Detection Model.
- If not, it throws an error and prompts the user to upload a valid image.

2. **Plant Type Detection:**

- Once a valid leaf image is detected, the Plant Classification Model identifies the plant species (e.g., Apple, Grape, Potato).

3. **Confidence Check:**

- The system evaluates its confidence level in the classification.
- If Confidence > 90%: It proceeds with disease detection.
- If Confidence ≤ 90%: The system lists the top predictions and asks the user to confirm the correct plant species.

4. **Disease Detection:**

- Using a Disease Prediction Model (ResNet50), the system detects possible diseases affecting the plant based on the confirmed plant species.

5. **Live Weather Data:**

- The system integrates real-time weather data (e.g., temperature, humidity, rainfall) using external APIs to refine the disease prediction.

6. **Final Prediction and Recommendation:**

- The system provides the top 3 disease predictions along with AI-generated treatment recommendations using the Gemini API.

7. **End:**

- The process concludes with the display of results to the user.

5.3 Implementation :

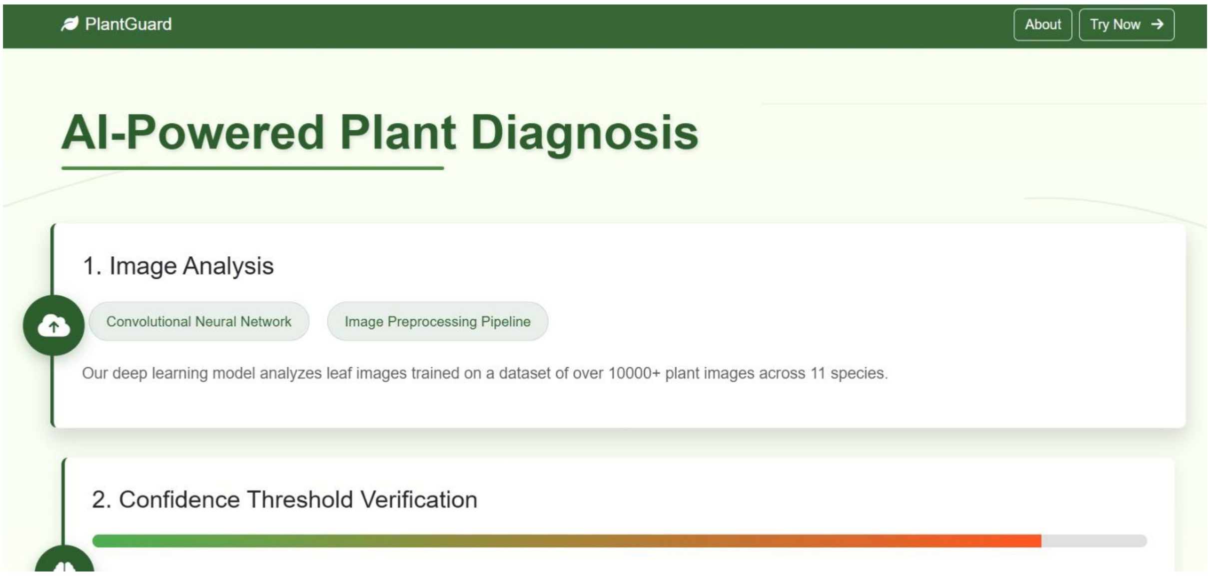


Figure 5.1 Home Page

Figure 5.2 Result Page

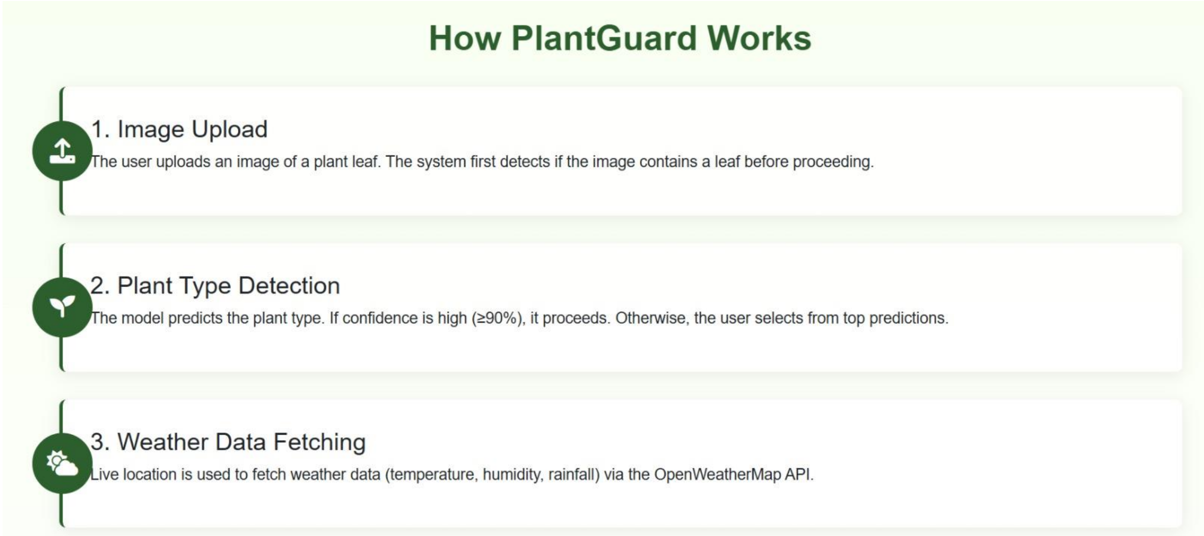


Figure 5.3 About Page

5.4 Advantages:

- **Early Disease Detection –** Helps in identifying plant diseases at an early stage, preventing crop loss.
- **High Accuracy –** Uses deep learning models like CNN and Transfer Learning for precise classification.
- **Automated Process –** Reduces the need for manual disease detection, saving time and effort.
- **User-Friendly Interface** – A simple web application allows easy image uploads and predictions.

5.5 Disadvantages:

- **Limited to Trained Diseases –** Can only detect diseases that are present in the training dataset.
- **Dependence on Image Quality –** Poor-quality images or improper lighting can lead to inaccurate predictions.
- **Misclassification Risk –** Similar-looking diseases might be confused, affecting treatment decisions.
- **Computational Requirements –** Deep learning models require high processing power for training and inference.

CHAPTER 6

CONCLUSION

CONCLUSION

The web-based plant disease prediction system using deep learning is a major advancement in agricultural technology. It automates disease detection through image analysis, providing farmers with instant and accurate predictions by simply uploading a leaf image. The integration of OpenWeather API for real-time weather data and Gemini API for AI-powered treatment recommendations further enhances decision-making.

Compared to traditional manual inspections, this system is faster, more accurate, and reduces human error. While deep learning ensures high accuracy, ongoing challenges like dataset quality, model generalization, and environmental variations need continuous improvement. Expanding datasets and refining models can further enhance performance.

In summary, this AI-driven solution bridges the gap between technology and agriculture, offering farmers a scalable, cost-effective, and accessible tool for better crop health management and sustainable farming practices.

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