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Plant Disease Detector with Image Upload and Machine Learning

Ponvannan.M*, J. Savitha**
*(Department Of Information Technology, Dr. N.G.P Arts and Science College, Coimbatore, Tamil Nadu, India
Email: ponvannan707@gmail.com)
** (Department Of Information Technology, Dr. N.G.P Arts and Science College, Coimbatore, Tamil Nadu, India
Email: savithaj@drngpasc.ac.in)

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Abstract:

Plant diseases have become a major concern in agriculture due to changing climatic conditions, pest attacks, and improper crop management practices. Early detection of plant diseases is essential to prevent yield loss, reduce excessive pesticide usage, and maintain crop health. Traditional disease identification methods rely on manual inspection by farmers or experts, which can be time-consuming, subjective, and difficult to perform at scale. This paper presents a Plant Disease Detector, a software system designed to identify plant leaf diseases using image processing and machine learning techniques. The system analyzes uploaded or captured leaf images and extracts important visual features such as color statistics, texture patterns, and Gray Level Co-occurrence Matrix (GLCM) characteristics. A Support Vector Machine (SVM) classifier trained on labeled leaf image datasets predicts disease categories efficiently and classifies leaves as healthy or diseased, identifying the specific disease type with treatment recommendations..

Keywords: ***Plant Leaf Disease Detection, Computer Vision, GLCM Texture Analysis, Support Vector Machine, Feature Extraction, Precision Agriculture***

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I. INTRODUCTION

Plants play a vital role in sustaining human life, supporting agriculture, food production, and ecological balance. Healthy crops are essential for ensuring food security, economic stability for farmers, and environmental sustainability. However, plant diseases caused by fungi, bacteria, viruses, and environmental stress have significantly affected crop productivity in many regions. The spread of plant diseases leads to reduced yield, lower crop quality, and increased financial loss for farmers.

Plant diseases often appear on leaves in the form of discoloration, spots, texture changes, or abnormal growth patterns. If these symptoms are not detected at an early stage, the infection can spread rapidly and damage large areas of cultivation. Timely monitoring and analysis of plant health is necessary to prevent disease spread and maintain agricultural productivity.

This paper presents the Plant Disease Detector, a software-based system that analyzes plant leaf images and detects diseases automatically using image processing and machine learning, providing an affordable and accessible solution for farmers and agricultural researchers.

II. LITERATURE SURVEY

Plant disease detection has become an important research area due to increasing crop losses and the need for sustainable agricultural practices. Several researchers have applied supervised learning algorithms such as Support Vector Machine (SVM), Decision Tree, Random Forest, and Convolutional Neural Networks (CNN) for plant disease classification. Studies show that machine learning models can effectively analyze leaf images and detect disease symptoms based on color and texture features.

Image processing plays a crucial role in automated disease detection systems. Researchers commonly use preprocessing techniques such as image resizing, grayscale conversion, noise filtering, and segmentation to enhance leaf images. Feature extraction methods including color histogram analysis, statistical features, and Gray Level Co-occurrence Matrix (GLCM) texture analysis are widely used to capture disease patterns.

Research emphasizes that preprocessing steps such as normalization, background removal, and feature scaling significantly improve machine learning model performance. The proposed system builds on these findings by integrating a complete preprocessing pipeline with GLCM-based feature extraction and SVM classification for robust and reliable disease detection.

III. PROBLEM STATEMENT

Plant diseases are increasing due to climate change, fungal, bacterial, and viral infections, and lack of early monitoring in large farmlands. Manual inspection is time-consuming and subjective, requiring expert knowledge for accurate diagnosis. No simple digital tool currently exists for quick, accurate disease detection accessible to farmers without technical expertise.

A software-based solution is required to analyze plant leaf images automatically, detect diseases at an early stage, provide fast and accurate classification results, and support real-time detection using camera input at minimal cost.

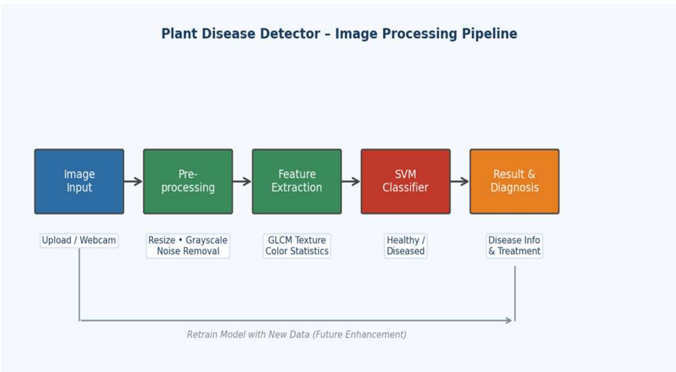


Fig. 1: Image Processing Pipeline

IV. PROPOSED SYSTEM – PLANT DISEASE DETECTOR

Plant Disease Detector is an image-based plant disease identification system designed to assist farmers, agricultural students, and researchers in monitoring crop health. The system processes uploaded or captured leaf images using a complete pipeline from preprocessing through classification and disease information retrieval.

Users upload plant leaf images or capture them using a webcam. The preprocessing module resizes images, converts them to grayscale, and removes noise to improve feature extraction accuracy. The feature extraction module computes GLCM texture features and statistical color features capturing disease-related patterns. A Support Vector Machine (SVM) model trained on labeled datasets classifies the leaf and identifies the specific disease type.

The disease information module retrieves related symptoms, causes, and suggested treatments from a structured database. The complete system is delivered through a user-friendly web interface displaying prediction results and disease information in a clear, accessible format.

V. SYSTEM ARCHITECTURE

The architecture consists of six modules: image acquisition, preprocessing, feature extraction, machine learning classification, disease information retrieval, and web interface. The image acquisition module accepts uploaded images in JPG or PNG format and supports real-time webcam capture. The preprocessing pipeline applies resizing, grayscale conversion, and noise removal for consistent feature extraction.

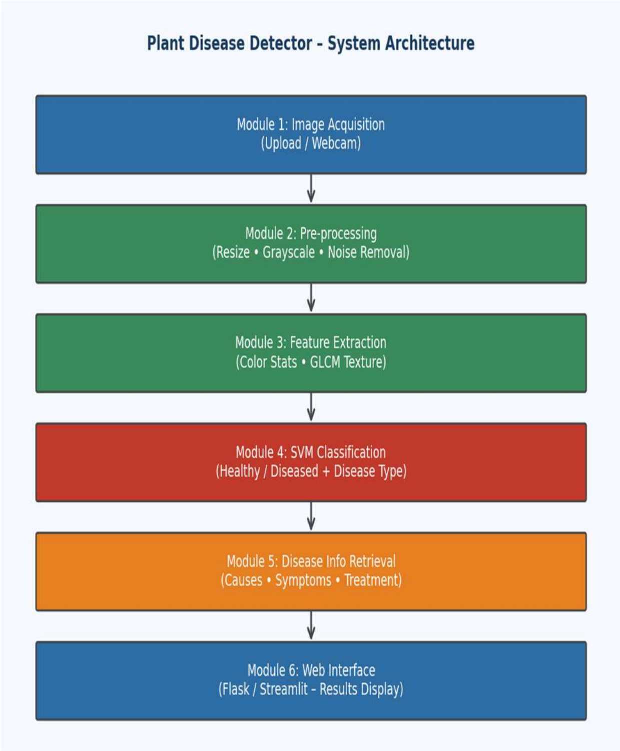
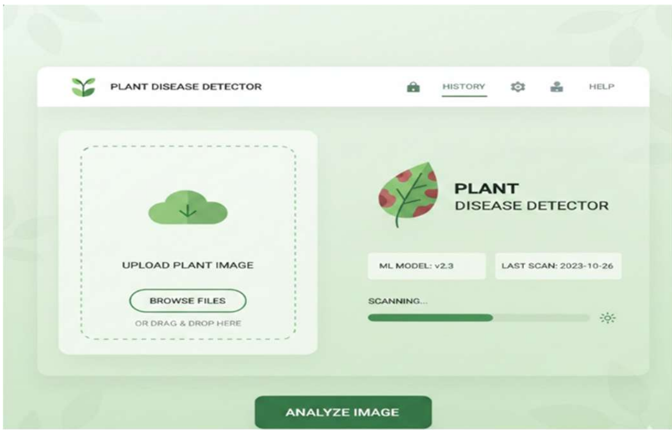


Fig. 2: System Architecture Modules

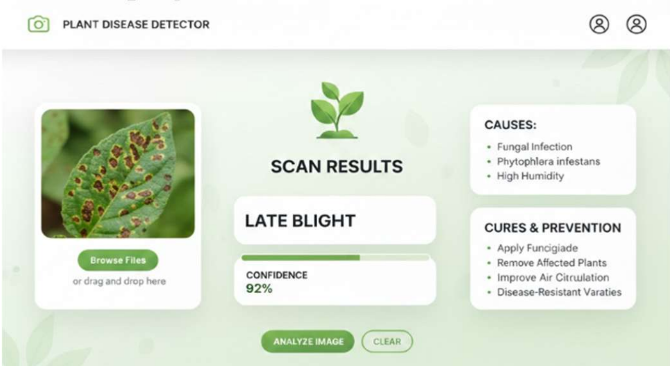
The feature extraction module converts images into numerical feature vectors using GLCM texture analysis and statistical color feature computation. The SVM classification module processes these vectors and outputs disease predictions. Software requirements include Python 3.x, OpenCV, scikit-learn, and Flask. The system operates on standard hardware with minimal resource requirements.

VI. RESULTS AND DISCUSSION

The developed Plant Disease Detector successfully analyzes uploaded leaf images and predicts plant disease categories in real time. Testing across a dataset of plant leaf images containing both healthy and diseased samples confirmed accurate classification performance. The system accepts uploaded images, performs preprocessing and feature extraction, and classifies them using the trained SVM model with consistent results.



Key outcomes include accurate classification of leaves into healthy and multiple disease categories, stable SVM model performance, and clear visual output displaying predictions. The preprocessing pipeline significantly improved classification accuracy compared to using raw image features. The system proved to be cost-effective, efficient, and suitable for smart agriculture and early disease detection programs.



VII. CONCLUSION

The Plant Disease Detector provides an efficient and reliable software-based solution for identifying plant leaf diseases. The system integrates image preprocessing, GLCM feature extraction, SVM classification, and disease information retrieval into a single user-friendly application. By accurately classifying leaves as healthy or diseased and providing treatment recommendations, the system offers a fast, low-cost, and practical solution for plant health monitoring in smart agriculture contexts.

VIII. FUTURE SCOPE

Future improvements include deploying the application on cloud platforms and enhancing the system with Convolutional Neural Networks (CNN) to improve detection accuracy for complex disease patterns. Extending the system to cover more plant species, developing a mobile-compatible version for Android and iOS, and integrating real-time field detection through smartphone cameras would further improve practical usability and agricultural impact.

IX. REFERENCES

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