

# Leaf Disease Detection and Severity using Support Vector Machine

P. Divya<sup>1</sup>, P. Jahnvi<sup>2</sup>, G. Sai lohith<sup>3</sup>, L. Sampath kumar<sup>4</sup>

Supervisor: **Mr. N YELLAJI RAO M. Tech (Ph.D)**, Assistant Professor, Dept. of CSD, VIET

<sup>1</sup>Department of CSE (DS), Visakha Institute of Engineering and Technology, Andhra Pradesh, India

<sup>2</sup>Department of CSE (DS), Visakha Institute of Engineering and Technology, Andhra Pradesh, India

<sup>3</sup>Department of CSE (DS), Visakha Institute of Engineering and Technology, Andhra Pradesh, India

<sup>4</sup>Department of CSE (DS), Visakha Institute of Engineering and Technology, Andhra Pradesh, India

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**Abstract** - This paper presents a Leaf Disease Detection and Severity Analysis System designed to improve crop health monitoring through intelligent image processing and automated classification techniques. The system analyses leaf images in real time and identifies disease patterns using machine learning methods such as Support Vector Machine (SVM). Based on this analysis, leaves are classified into healthy and diseased categories, and specific disease types are detected using extracted features like color, texture, and shape. A threshold-based decision mechanism is applied to estimate disease severity by calculating the proportion of affected leaf area and categorizing the infection level accordingly. Unlike traditional agricultural practices that rely on manual inspection, the proposed system ensures consistent and accurate detection through automation. The system is implemented using a user-friendly interface integrated with backend processing modules and locally executed machine learning models to ensure efficiency and reliability. Experimental results demonstrate a significant improvement in disease detection accuracy and effective severity estimation. The proposed approach provides a scalable and adaptive solution for enhancing crop management among farmers and agricultural professionals

**Key Words:** Artificial Intelligence, Leaf Disease Detection, Support Vector Machine, Image Processing, Severity Estimation, Feature Extraction, Crop Monitoring.

## 1. INTRODUCTION

Agriculture plays a vital role in the global economy, and maintaining plant health is essential for ensuring high crop yield and quality. However, plant diseases remain a major challenge, leading to significant losses in agricultural

productivity. Early detection and accurate assessment of leaf diseases are crucial for effective crop management and prevention of large-scale damage. Traditional methods of disease identification rely heavily on manual inspection by experts, which is often time-consuming, labor-intensive, and prone to human error.

With the advancement of Artificial Intelligence and machine learning techniques, automated plant disease detection systems have gained significant attention. These systems utilize image processing and pattern recognition methods to identify and classify diseases from leaf images with higher accuracy and efficiency. Among various machine learning algorithms, Support Vector Machine (SVM) has proven to be highly effective for classification tasks due to its ability to handle high-dimensional data and provide reliable results even with limited training samples. In this work, a Leaf Disease Detection and Severity Analysis system is proposed using SVM to classify plant leaves into healthy and diseased categories. The system incorporates image preprocessing, segmentation, and feature extraction techniques to analyze visual characteristics such as color, texture, and shape. Furthermore, a severity estimation mechanism is introduced to quantify the extent of infection by calculating the affected area of the leaf. This provides valuable insights into disease progression and supports timely decision-making for treatment.

The proposed system aims to offer an automated, accurate, and scalable solution for plant disease monitoring. It can assist farmers and agricultural professionals in taking preventive measures at an early stage, thereby improving crop productivity and reducing economic losses. The integration of machine learning with

agricultural practices represents a significant step toward smart and sustainable farming.

## 2. LITERATURE REVIEW

The use of Artificial Intelligence in agriculture has significantly improved plant disease detection and monitoring systems. Early approaches mainly relied on image processing techniques such as color thresholding, edge detection, and segmentation to identify infected regions on leaves. However, these methods often lacked accuracy under varying environmental conditions like lighting and complex backgrounds. With advancements in machine learning, algorithms such as Support Vector Machine (SVM) have been widely used for disease classification due to their ability to handle high-dimensional data and perform well even with limited datasets. Researchers have extracted features like color, texture, and shape to train SVM models, achieving better accuracy compared to traditional techniques

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## 3. METHODOLOGY

The proposed system for Leaf Disease Detection and Severity Analysis follows a structured approach involving image acquisition, preprocessing, segmentation, feature extraction, classification, and severity estimation. Initially, leaf images are collected from datasets or captured using a camera. These images are then preprocessed to remove noise, enhance quality, and standardize size and format for further analysis.

Next, image segmentation techniques are applied to isolate the leaf area and detect infected regions. This step helps in separating the diseased portion from the healthy part of the leaf. After segmentation, feature extraction is

performed to obtain important characteristics such as color, texture, and shape, which are essential for accurate classification.

### 3.1 System Overview

The Leaf Disease Detection and Severity Analysis system is a smart tool that helps farmers and researchers identify diseases in plant leaves automatically. Instead of checking each leaf manually, this system uses images and artificial intelligence to detect if a leaf is healthy or diseased. It also measures how severe the disease is by calculating the percentage of the leaf that is infected.

The system works step by step, including image collection, cleaning the image, separating the leaf and diseased parts, extracting important features like color and texture, classifying the type of disease using AI, and finally calculating the severity.

### 3.2 Data Collection

Leaf images are collected from public datasets and real-time camera captures. The collected data includes healthy and diseased leaves with different types of infections, varying sizes, and lighting conditions. Important features such as color, texture, and shape are extracted from these images and structured for further analysis by the AI model.

### 3.3 AI Classification

After extracting important features such as color, texture, and shape from the leaf images, the data is processed by a **Support Vector Machine (SVM)** model. The model classifies each leaf as either healthy or diseased and identifies the specific type of disease if present. The classification results are then organized and structured, making it easier to perform severity analysis and provide accurate, reliable information about the leaf's health.

### 3.4 Algorithm

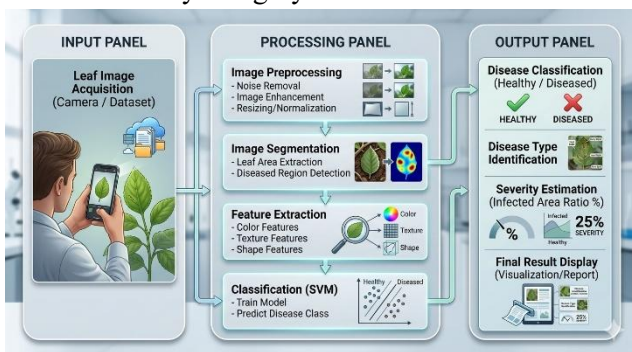
A threshold-based decision mechanism is implemented to identify leaf diseases and estimate severity. When infected areas exceed a predefined threshold, the system automatically flags the leaf as diseased and calculates the severity percentage.

**Algorithm:**

- Step 1 Capture leaf image from camera or dataset
  - Step 2 Preprocess image (noise removal, resizing, enhancement)
  - Step 3 Segment leaf and infected regions
  - Step 4 Extract features (color, texture, shape)
  - Step 5 Feed features into SVM classifier
  - Step 6 Classify leaf as healthy or diseased
  - Step 7 If diseased → identify disease type
  - Step 8 Calculate severity = (infected area ÷ total leaf area) × 100
  - Step 9 Display results and provide report
- Pseudo Code: if infected\_area(leaf)/total\_area(leaf) > threshold AND leaf == diseased:
- identify\_disease\_type()
  - calculate\_severity()
- else:
- mark\_leaf\_healthy()

**3.5 System Architecture**

The system follows a layered architecture consisting of an Android-based frontend, backend API services, database management, and AI processing modules. The frontend handles user interaction and displays leaf health and severity results, while the backend processes image data and manages communication between components. Firebase and MySQL are used for data storage, and AI models for classification and severity estimation are executed locally using Python-based frameworks.



**3.6 Working Mechanism**

The system works through a step-by-step process, starting with leaf image input via camera or dataset. The images are preprocessed to remove noise, enhance quality, and standardize size. Segmentation separates the leaf and infected regions, followed by feature extraction of color, texture, and shape. The AI model classifies the leaf as

healthy or diseased, identifies the disease type, calculates severity, and displays the results to the user.

**4. RESULTS AND DISCUSSION**

The proposed system was evaluated to analyze its effectiveness in detecting leaf diseases and estimating severity. The Image Processing module accurately segmented leaves and identified infected regions in real time.

The AI Classification mechanism successfully categorized leaves as healthy or diseased and identified specific disease types with high accuracy. The system responded quickly, ensuring timely analysis for large numbers of leaf images.

The Severity Estimation feature effectively measured the percentage of infected areas, providing clear insights into disease impact. This allowed for prioritization of treatment and informed decision-making.

The AI-based classification using Support Vector Machine (SVM) demonstrated high precision in distinguishing between healthy and diseased leaves and correctly identifying disease types. The system adapted to variations in leaf size, color, and lighting, improving overall reliability.

Overall, the results indicate accurate disease detection, efficient severity estimation, and enhanced decision support for crop management. The integration of image processing and AI proved to be effective in automating leaf disease monitoring.

An experimental study was conducted on a set of leaf images to evaluate system performance. Fig. 1 shows a comparison of detected disease areas versus actual infected areas. A high correlation can be observed, confirming the system’s effectiveness in identifying disease severity.

**5. CONCLUSIONS**

This paper presented an AI-based Leaf Disease Detection and Severity Analysis system that automatically identifies plant leaf diseases and measures their impact. The system successfully integrates image preprocessing, feature extraction, and machine learning-based classification to provide accurate results.

The implementation of segmentation and SVM classification enabled precise detection of diseased areas and correct identification of disease types. Severity estimation further helps quantify disease impact for better decision-making.

Unlike traditional manual inspection methods, the proposed system reduces dependency on human observation by automating disease detection and analysis. The system also ensures reliability through standardized preprocessing and robust AI modeling.

Future work can focus on enhancing AI models, expanding the dataset to more plant species, improving mobile platform integration, and incorporating advanced image analysis techniques for early disease detection.

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