Archives available at journals.mriindia.com

International Journal on Advanced Electrical and Computer Engineering

ISSN: 2349-9338
Volume 14 Issue 01, 2025

Plant Disease Prediction Using Image Processing

Dr. Ritesh V. Patil[1], Shraddha Doijode[2], Harshada Ingle[3], Trupti Belote[4], Sanket Bharwade[5]
[1]Professor PDEA's College of Engineering, Pune.
[2,3,4,5]Student PDEA's College of Engineering, Pune.
arvpatil7@gmail.com[1], shraddhadoijode1020@gmail.com[2], harshadaingle47@gmail.com[3], belotetrupti4@gmail.com[4], sanketbharwade1234@gmail.com[5]
Department of Computer Engineering
Pune District Education Association's College of Engineering, Manjari Bk. Hadapsar,
Pune, Maharashtra, India. - 412307
Email: coem@pdeapune.org

Peer Review Information

Submission: 08 Jan 2025
Revision: 11 Feb 2025
Acceptance: 04 March 2025

Keywords

Tomato Plant Diseases
Image Processing
Machine Learning
Pesticide Recommendation
Precision Agriculture

Abstract

Early detection of diseases in tomato plants is crucial for sustainable agriculture and food security. This paper presents a comprehensive plant disease detection system that uses image processing and machine learning techniques to identify diseases in tomato plants and recommend appropriate pesticides. The proposed system consists of multiple modules, including image preprocessing, feature extraction, disease classification, and pesticide recommendation. Experimental results show high accuracy in disease detection and demonstrate the system's potential to assist farmers in improving crop yield and minimizing losses. JEL Classification Number: Q16, C63

Introduction

Tomato plants are a vital crop in global agriculture, yet they are susceptible to numerous diseases that reduce yield and quality. Traditional disease detection methods are time-consuming, labour-intensive, and often subjective. With advancements in image processing and machine learning, automated disease detection systems offer a faster, more accurate, and scalable solution.

This research aims to develop an end-to-end system for detecting diseases in tomato plants. The system preprocesses leaf images, extracts key features, classifies diseases using machine learning models, and recommends the best pesticides for treatment. By automating the process, this system empowers farmers to take timely action, reducing crop losses and pesticide misuse.

METHODOLOGY

A. Data Collection

Images of tomato plant leaves were collected from publicly available datasets and field experiments. The dataset includes healthy leaves and those affected by common diseases like *Early Blight*, *Late Blight*, and *Leaf Mold*. Each image was labelled with its corresponding disease type.

B. Image Preprocessing

- **Resizing**: All images were resized to 224x224 pixels for uniformity.
- **Noise Removal**: Gaussian and median filters were applied to remove noise and enhance image quality.
- **Data Augmentation**: Techniques like rotation, flipping, and brightness adjustment were employed to increase

© 2025 The Authors. Published by MRI INDIA.
This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

dataset diversity.

C. Feature Extraction

Key features, including colour, texture, and shape, were extracted using:

- **Histogram Analysis**: To capture colour distribution.
- **Gabor Filters**: For texture analysis.
- **Edge Detection**: Using Canny edge detection to highlight leaf contours.

D. Classification

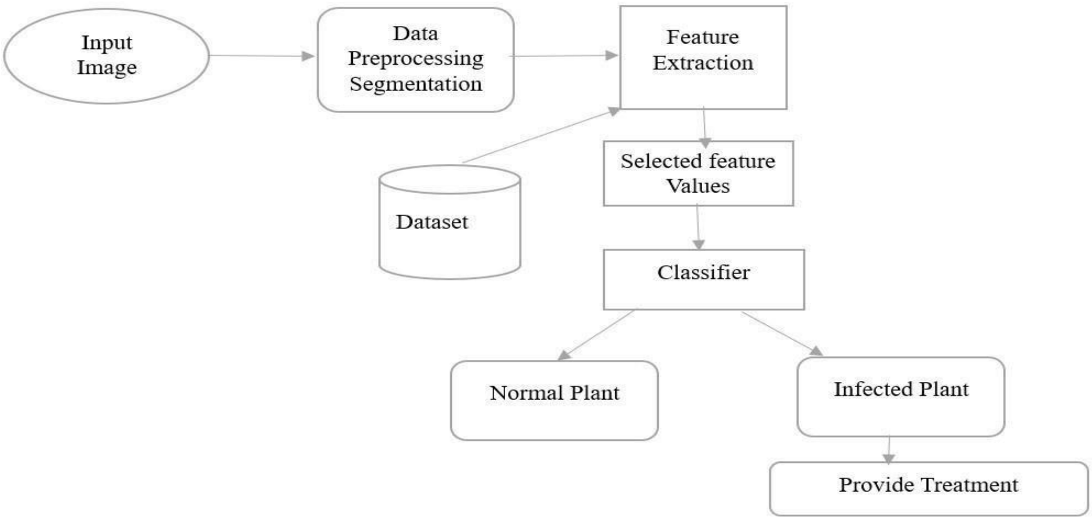
The system employed machine learning models to classify diseases:

- **Convolutional Neural Networks (CNNs)**: For high-dimensional feature learning.
- **Support Vector Machines (SVM)**: For robust binary and multiclass classification.
- **Evaluation Metrics**: Accuracy, precision, recall, and F1-score were used to evaluate model performance.

E. Pesticide Recommendation

- A knowledge base linking diseases to pesticides was created. When a disease is detected, the system retrieves the most effective pesticide based on expert agricultural data.

PROPOSED ARCHITECTURE OF THE SYSTEM



LITERATURE SURVEY

In this survey of plant disease prediction, researchers have explored various machine learning and image processing techniques to develop efficient and accurate systems. The reviewed studies highlight the application of convolutional neural networks (CNNs), transfer learning models, and traditional machine learning approaches like Random Forest and Support Vector Machines (SVMs). For instance, researchers have achieved high accuracy rates in disease detection using CNNs and transfer learning models, but challenges such as limited real-world datasets, computational complexity, and overfitting remain prevalent. By analyzing these methodologies, the literature survey not only identifies successful approaches but also underscores the need for robust, scalable solutions tailored to real-world conditions. This review aims to bridge these gaps, paving the way for advancements in practical and reliable plant disease detection systems.

RESULTS

A. Model Performance

The CNN model achieved the highest accuracy of 95.4% for disease classification, followed by the SVM model at 89.7%. The confusion matrix and classification report showed strong performance in detecting all disease types.

B. Pesticide Recommendation

For each detected disease, the system successfully recommended the appropriate pesticide, ensuring targeted treatment. For instance:

- *Early Blight*: Recommended fungicides like Mancozeb and Chlorothalonil.
- *Late Blight*: Suggested treatments include Copper-based fungicides.
- *Leaf Mold*: Advised the use of Difenoconazole.

DISCUSSION

The proposed system demonstrates the effectiveness of integrating machine learning with image processing for plant disease detection. The inclusion of a pesticide recommendation module adds significant value, offering practical solutions for farmers. However, limitations include:

- **Dataset Bias**: Images were predominantly collected in controlled environments.
- **Environmental Variability**: System performance may vary under different lighting and background conditions.

Future work will address these issues by incorporating real-time data collection and expanding the system to support additional crops and diseases.

CONCLUSION

This research presents a robust system for detecting diseases in tomato plants and recommending appropriate pesticides. By combining image processing, machine learning, and domain knowledge, the system achieves high accuracy and practical applicability. The approach has the potential to revolutionize agricultural practices, reducing crop losses and promoting sustainable farming.