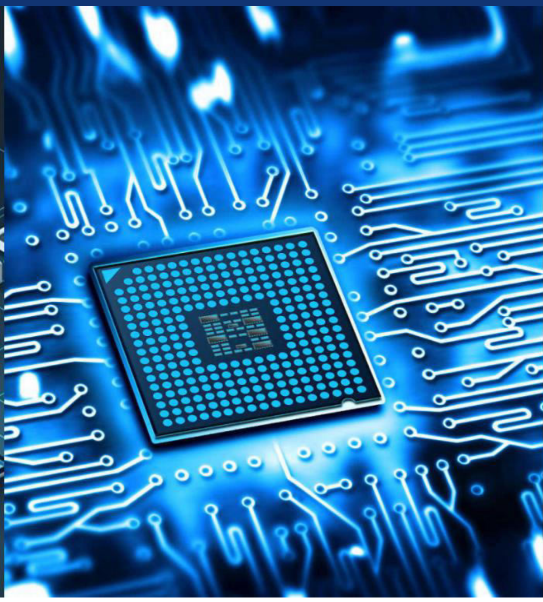
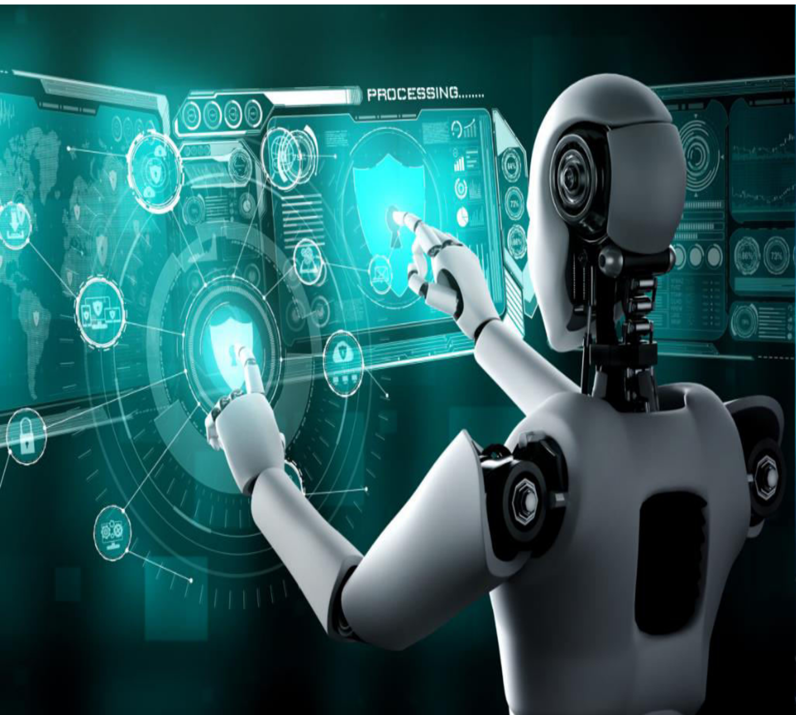
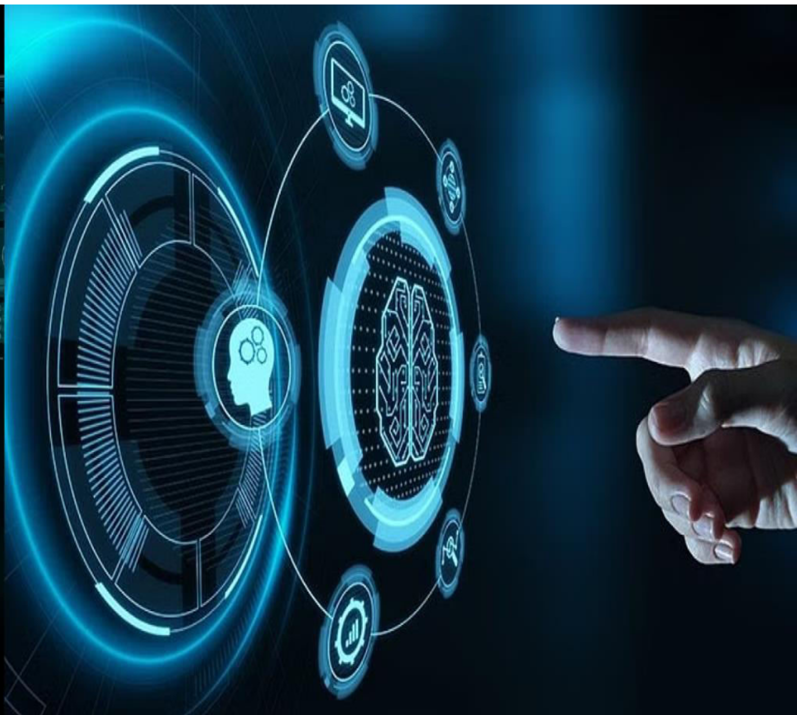
ISSN(O): 2320-9801
ISSN(P): 2320-9798


International Journal of Innovative Research in Computer and Communication Engineering

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)





Impact Factor: 8.771

Volume 14, Issue 4, April 2026

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

LeafNet: A Robust Deep Learning Framework for Early Plant Disease Detection and Smart Remedy Recommendation

Joseph Ambrose[1], Keerthana N M[1], Kiranmayi H K[1], Mangalagouri V G[1], Prof. Archana K N[2]

UG Students, Dept. of CSE, Jain Institute of Technology, Davangere, Karnataka, India[1]

Assistant Professor, Dept. of CSE, Jain Institute of Technology, Davangere, Karnataka, India[2]

ABSTRACT: Agriculture plays a vital role in the economic development of many countries, and plant diseases significantly affect crop productivity and farmers' livelihoods. Traditional disease detection methods are often time-consuming, inaccurate, and require expert supervision. With the advancement of artificial intelligence, deep learning techniques have emerged as efficient solutions for automated disease detection. This paper presents a plant disease detection system using Convolutional Neural Networks (CNNs) to identify diseases from plant leaf images. The proposed system processes leaf images through preprocessing stages such as resizing and normalization before feeding them into a CNN model for classification. The trained model predicts whether a leaf is healthy or infected and provides suitable remedies or pesticide recommendations. Experimental results show that the model achieves high accuracy in disease classification, making it a practical and efficient solution for real-time agricultural disease monitoring. This system contributes to precision agriculture by enabling timely disease detection, reducing crop loss, and improving farming sustainability.

KEYWORDS: Plant Disease Detection, Deep Learning, Convolutional Neural Network, Image Processing, Smart Agriculture, Leaf Disease Classification.

I. INTRODUCTION

Agriculture is one of the most important sectors for economic growth, especially in countries where a significant portion of the population depends on farming as their primary occupation. Healthy crop production is essential for ensuring food security and economic stability. However, plant diseases pose a serious threat to agricultural productivity by affecting crop quality, reducing yields, and increasing production costs. Diseases caused by fungi, bacteria, viruses, and environmental stress can spread rapidly if not identified and treated in time.

Traditional plant disease detection relies on manual observation of visible symptoms such as discoloration, spots, or wilting. This process requires expert knowledge and may not be feasible for small-scale farmers who lack access to agricultural specialists. Moreover, many diseases exhibit similar visual symptoms, making manual diagnosis inaccurate. Delayed disease detection often leads to severe crop damage and economic loss. Therefore, there is a need for automated systems capable of identifying plant diseases quickly and accurately.

With the development of image processing and artificial intelligence, deep learning methods have shown remarkable success in image classification tasks. Convolutional Neural Networks (CNNs) are especially effective because they can automatically learn image features without requiring manual extraction. CNNs have been widely applied in medical imaging, object recognition, and agricultural diagnostics.

In this project, a CNN-based plant disease detection system is developed to classify diseases from plant leaf images. By analyzing leaf patterns such as texture, color, and lesions, the model can determine whether the plant is healthy or diseased. The proposed system not only improves diagnosis accuracy but also provides real-time disease predictions and remedy suggestions.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

The objective of this work is to design a practical, user-friendly solution for farmers, enabling early disease detection and reducing agricultural losses. This system supports sustainable farming by promoting faster decision-making and efficient crop management.

II. RELATED WORK

Plant disease detection has attracted considerable attention in recent years due to the increasing availability of machine learning and image processing techniques. Earlier methods relied on traditional image processing approaches involving segmentation, handcrafted feature extraction, and classical classifiers such as Support Vector Machines (SVM) and K-Nearest Neighbors (KNN).

Bhange and Hingoliwala developed a disease detection system for pomegranate crops using image processing techniques. Their approach extracted features based on color, morphology, and color coherence vectors, followed by SVM classification, achieving an accuracy of 82%. Although promising, this method required manual feature engineering, limiting scalability.

Kosamkar et al. proposed a CNN-based leaf disease detection system combined with pesticide recommendation. Their system used multiple CNN layers for feature extraction and achieved 95.05% training accuracy. This work demonstrated the advantages of deep learning over traditional classifiers.

Singh introduced an AI and cloud-based platform for plant disease diagnosis and outbreak tracking. By integrating deep CNN models with cloud computing, the system enabled real-time disease detection through mobile devices. This research emphasized scalability and accessibility for farmers.

Suma et al. developed a CNN-based disease identification and remedy recommendation system using images captured in natural environments. Their model achieved 99.32% accuracy, highlighting the robustness of CNNs under varying real-world conditions.

Jasim and Al-Tuwaijari used deep learning for classifying diseases in tomato, potato, and pepper leaves, obtaining 98.02% testing accuracy. Their work confirmed the ability of CNNs to classify multiple diseases across plant species.

These studies demonstrate that CNN-based approaches outperform traditional machine learning methods in plant disease recognition. However, challenges remain in improving usability, real-time prediction, and integrated remedy suggestions. The proposed work builds upon these findings to create an accurate and farmer-friendly disease detection system.

III. PROPOSED ALGORITHM

The proposed algorithm is designed to automatically detect plant leaf diseases using a Convolutional Neural Network (CNN) model. The algorithm takes an input image of a plant leaf, preprocesses it, extracts important features, and classifies the image into healthy or diseased categories. Based on the classification result, the system recommends suitable remedies for the detected disease.

The algorithm is composed of several major stages: image acquisition, preprocessing, feature extraction, classification and result generation.

3.1 Image Acquisition

In the first stage, the system acquires leaf images from the dataset as well as from user uploads. These images may contain variations in lighting conditions, orientation, and background noise. To ensure consistency, the input images are resized into a fixed dimension of 224 × 224 pixels before being passed into the CNN model. This standardization improves computational efficiency and ensures uniform processing of all input samples.

3.2 Pre-Processing and Feature Extraction

The input leaf image is first pre-processed using normalization, noise reduction, and tensor conversion to improve image quality and ensure consistency. Normalizing pixel values for improved model performance

The processed image is then converted into tensor format suitable for CNN inference.

© 2026 IJIRCCE | Volume 14, Issue 4, April 2026 DOI: 10.15680/IJIRCCE.2026.1404075

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

$Ip = Normalize(Resize(I, 224\times224))$

Where:

I = input leaf image

Ip = processed image

The processed image is then passed through CNN layers, where features like edges, spots, and textures are extracted using convolution and ReLU activation. Max-pooling reduces the size of feature maps while keeping important information. Finally, the features are flattened and fed into fully connected layers for disease classification.

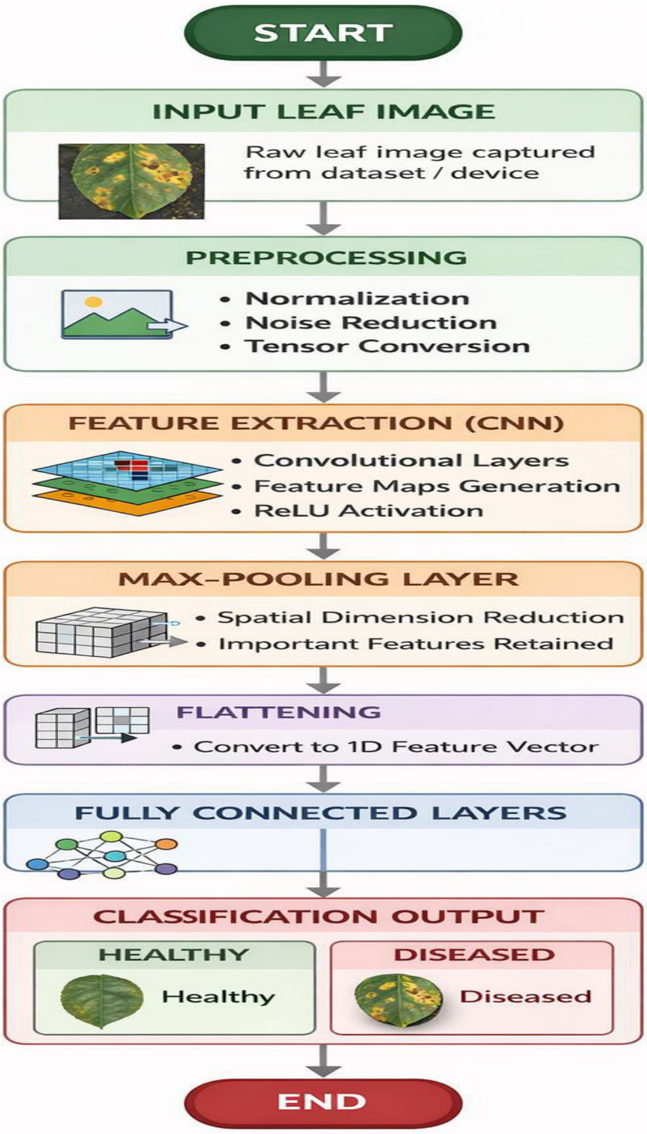


Fig. 3.2: CNN-Based Preprocessing and Feature Extraction Pipeline for Leaf Disease Detection

3.3 Classification and Result Generation

In the classification stage, the flattened feature vector is passed through dense layers where the network learns relationships between extracted features and disease classes. The final output layer uses the Softmax activation function to assign probabilities to all possible disease categories. The disease class with the highest probability is selected as the final prediction result.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Finally, in the result generation stage, the system displays the predicted disease name to the user. If the leaf is infected, the system also provides corresponding remedy suggestions such as pesticide recommendations or preventive measures. In addition, the system offers a "Buy" option, allowing users to directly purchase the recommended products such as pesticides or fertilizers through integrated links or platforms. This makes the system not only a diagnostic tool but also a complete decision-support and action-oriented mechanism for farmers.

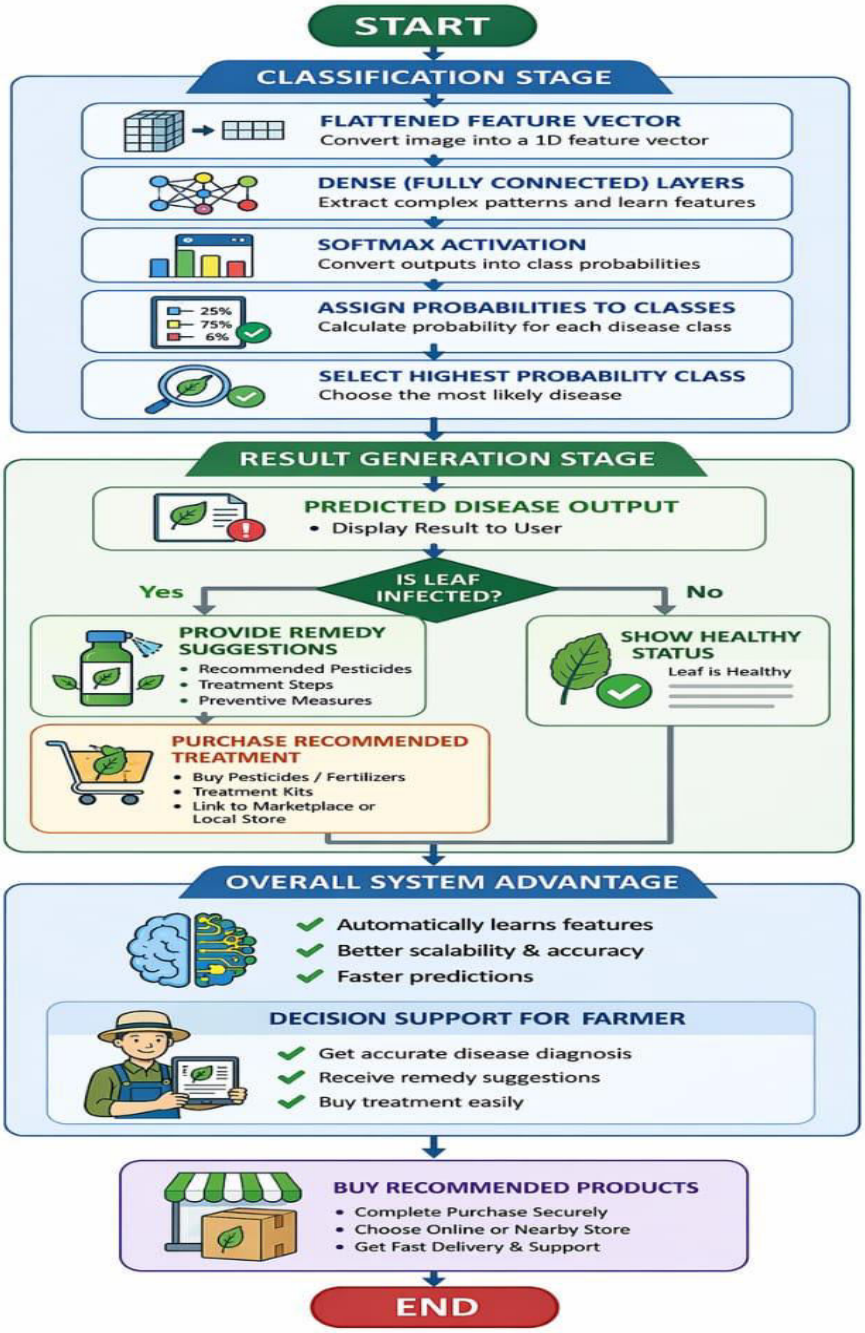


Fig. 3.3: Workflow of Classification and Result Generation in a CNN-Based Plant Disease Detection and Recommendation System with Treatment Procurement

The CNN-based approach improves accuracy by automatically learning features and offers better scalability, faster predictions, and suitability for real-time applications compared to traditional methods.

© 2026 IJIRCCE | Volume 14, Issue 4, April 2026 DOI: 10.15680/IJIRCCE.2026.1404075
www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|
International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)
(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

3.4 AI-Based Decision and Routing Mechanism
Decision Routing: Diseased → Provide remedies (pesticides, prevention, treatment)
Healthy → Display healthy status

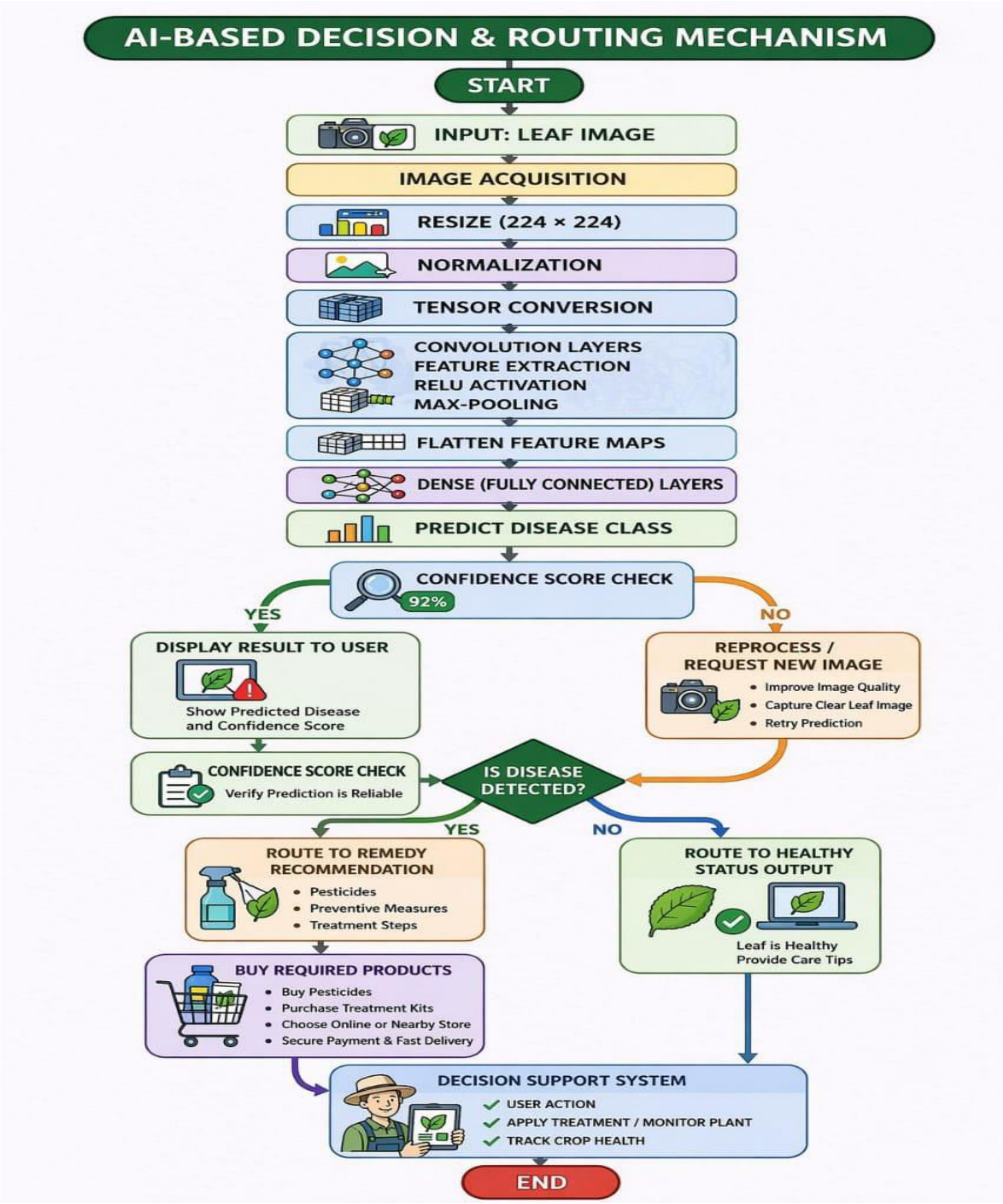


Fig. 3.4: AI-Based Decision and Routing Mechanism for Plant Disease Detection and Remedy Recommendation with Treatment Procurement

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

3.5 Pseudocode of Proposed Algorithm

Step 1: Initialize system components
- Load trained CNN model (leaf_disease_model.h5)
- Initialize database and APIs

Step 2: Capture or upload leaf image

Step 3: Preprocess image
- Convert to RGB
- Resize to 224 × 224
- Normalize pixel values
- Convert to tensor format

Step 4: Classify leaf condition using CNN
- Class ← Predict(image)
- Confidence ← Max probability

Step 5: Confidence check
- IF Confidence < Threshold:
  - Request new/clear image

Step 6: Decision making
- IF Class = Healthy:
  - Action ← Display "Healthy Leaf"
- ELSE:
  - Action ← Disease Detected

Step 7: Generate recommendations
- Suggest pesticides
- Provide preventive measures
- Recommend treatment steps

Step 8: Buy/Recommendation Step
- Display recommended products (pesticides/fertilizers)
- Provide: Product name, Usage details, "Buy Now" option

Step 9: Store results in database
- Save image, prediction, confidence, remedies, and selected products

Step 10: Display output on dashboard
- Show disease name
- Show confidence score
- Show remedies
- Show product purchase options

IV. SIMULATION RESULTS

The front page serves as the entry point of the application, providing an overview of the plant disease detection system. It typically includes the project title, a brief description of the system, and navigation options for users.
- Displays system name
- Contains a short introduction about AI-based disease detection
- Highlights key features such as: Image-based detection, Fast and accurate predictions, Remedy suggestions.
- Includes buttons like: Upload Image, Get Started
- Designed with a simple and user-friendly interface for easy navigation

Purpose: To introduce the system and guide users to start the detection process.

© 2026 IJIRCCE | Volume 14, Issue 4, April 2026 DOI: 10.15680/IJIRCCE.2026.1404075

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Fig. 4.1: Front Page Interface of the Leaf Disease Detection System

This page allows users to upload a leaf image for disease analysis.

- Provides options to:
- Upload image from device
- Capture image using camera (if supported)
- Displays preview of the selected image
- Includes upload/submit button to send image to the model
- Performs basic validation (image format, size, etc.)
- May show loading/progress indicator during processing

Purpose: To collect input data (leaf image) for AI-based analysis.

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|
International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)
(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

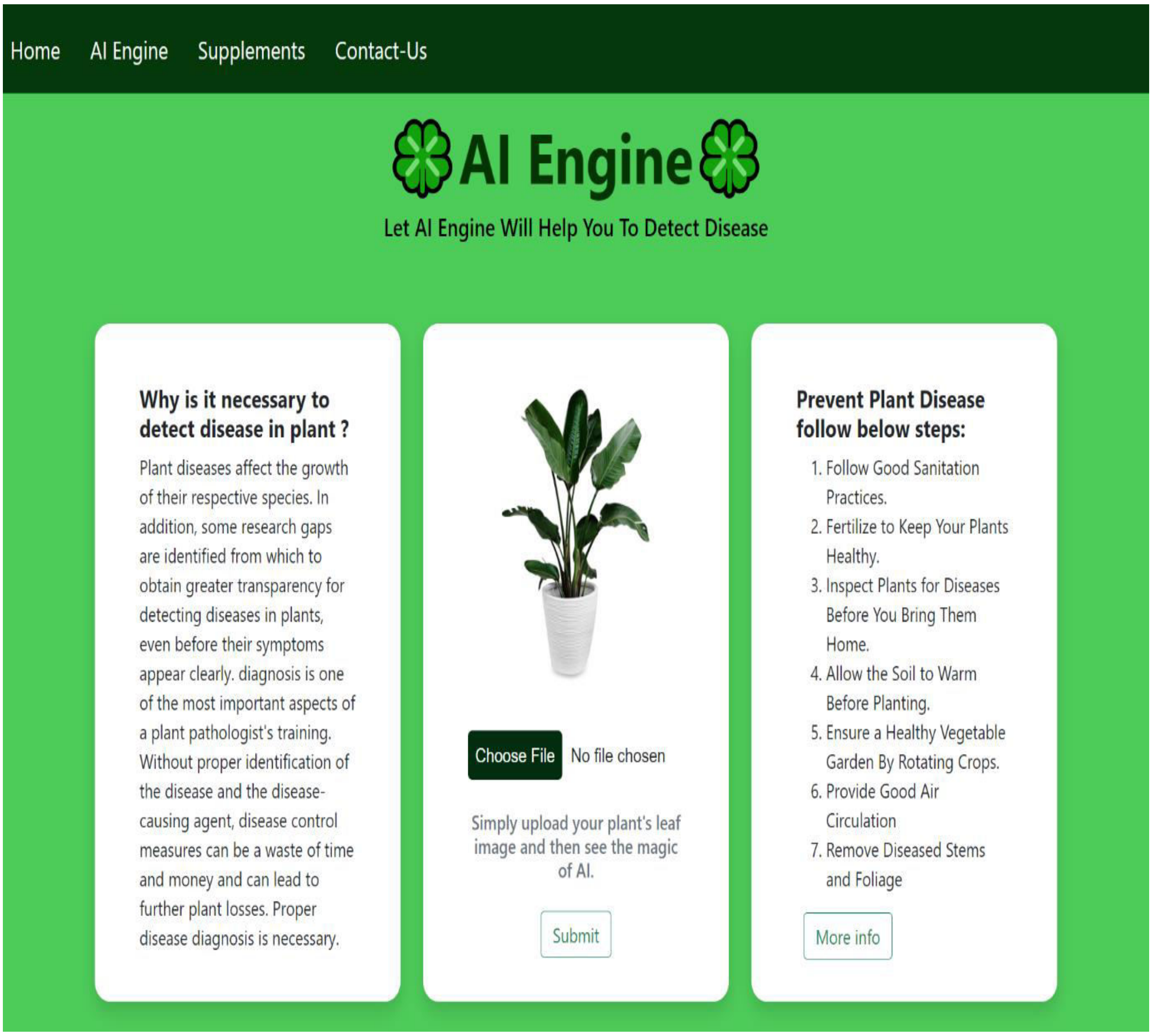


Fig. 4.2: Leaf Image Upload Interface for Disease Analysis

The result page displays the output of the AI model after processing the image.

- Shows the uploaded leaf image
- Displays predicted disease name
- Shows confidence score (accuracy of prediction)
- Indicates whether leaf is: Healthy, Diseased
- Provides remedy suggestions, such as:
- Pesticide recommendations
- Preventive measures
- Treatment steps
- Buy Supplements / Products Section:
- List of recommended products (e.g., pesticides, nutrients)
- Product details: Name, Usage, Price (optional)
- Buttons: Buy Now, View Details

Purpose: Not just detection, but complete decision support + actionable buying options

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Fig. 4.3: Disease Diagnosis Result Interface Displaying Disease Information, Preventive Measures, and Recommended Supplements

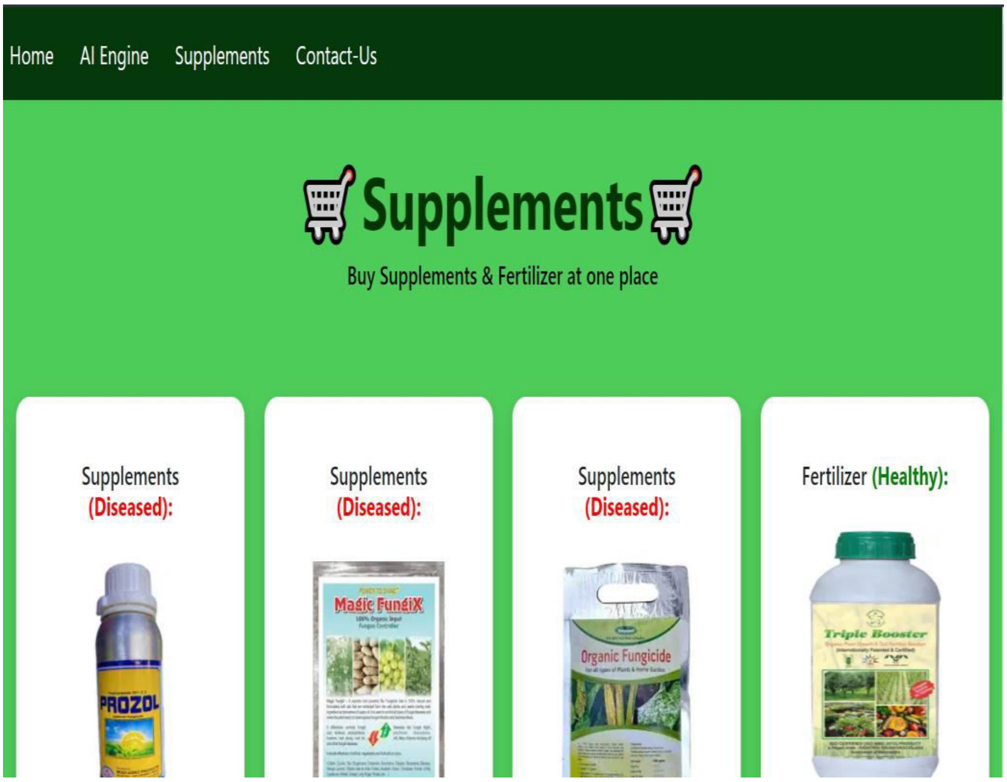


Fig. 4.4: Product Recommendation Interface Showing Disease-Specific Supplements and Healthy Plant Fertilizers

© 2026 IJIRCCE | Volume 14, Issue 4, April 2026 DOI: 10.15680/IJIRCCE.2026.1404075

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

V. CONCLUSION AND FUTURE SCOPE

This research developed a CNN-based plant disease detection system capable of accurately identifying plant diseases from leaf images. The model achieved high accuracy and successfully automated the disease diagnosis process, eliminating the need for manual inspection and reducing human error. The system provides fast and reliable predictions, enabling early-stage disease detection. This helps farmers take timely corrective actions, reducing crop losses and improving agricultural productivity. The solution is cost-effective, scalable, and suitable for real-time field applications. It also supports precision agriculture by enabling data-driven decision-making and can be adapted to multiple crops and disease types.

Furthermore, the system goes beyond detection by providing remedy suggestions, making it a complete decision-support tool for farmers. Its ease of use ensures accessibility even for users with minimal technical knowledge. In Future enhancements can significantly improve the system's performance and usability. Expanding the dataset with more crop varieties and diverse environmental conditions will increase accuracy and robustness. Developing a mobile application with offline capabilities will allow real-time disease detection directly in the field.

Integration with IoT sensors such as temperature, humidity, and soil moisture can enable early prediction of diseases before visible symptoms appear. Cloud integration and dashboard systems can support large-scale data storage, real-time monitoring, and analysis of disease trends. Advanced deep learning techniques such as transfer learning (e.g., ResNet, EfficientNet) can further enhance model performance. Incorporating explainable AI will improve transparency and user trust. The recommendation system can be upgraded to provide region-specific, eco-friendly solutions and integrated with marketplaces for purchasing required products.

Additionally, features like multilingual support, voice assistance, and disease severity detection can improve usability and accessibility for farmers. Overall, the proposed system demonstrates the strong potential of AI in agriculture and can evolve into a comprehensive smart farming solution by integrating deep learning, IoT, and cloud technologies, contributing to sustainable agriculture and increased crop yield.

REFERENCES

1. S. Arivazhagan, R. Newlin Shebiah, S. Ananthi, and S. Vishnu Varthini, "Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features," CIGR Journal, vol. 15, no. 1, pp. 211–217, 2013. https://cigrjournal.org/index.php/Ejounral/article/view/2251
2. H. Wang, G. Li, Z. Ma, and X. Li, "Image recognition of plant diseases based on backpropagation networks," in Proceedings of the 5th International Congress on Image and Signal Processing (CISP), 2012. https://ieeexplore.ieee.org/document/6469798
3. M. Bhange and H. A. Hingoliwala, "Smart farming: Pomegranate disease detection using image processing," in Second International Symposium on Computer Vision and the Internet, vol. 58, pp. 280–288, 2015. https://www.sciencedirect.com/science/article/pii/S1877050915035589
4. P. K. Kosamkar, V. Y. Kulkarni, K. Mantri, S. Rudrawar, S. Salmpuria, and N. Gadekar, "Leaf disease detection and recommendation of pesticides using convolution neural network," in Proceedings of the Fourth International Conference on Computing Communication Control and Automation (ICCUBEA), 2018. https://ieeexplore.ieee.org/document/8697852
5. K. K. Singh, "An artificial intelligence and cloud based collaborative platform for plant disease identification, tracking and forecasting for farmers," in Proceedings of the IEEE International Conference on Cloud Computing in Emerging Markets (CEM), 2018. https://ieeexplore.ieee.org/document/8701311
6. S. V. R., A. Shetty, R. F. Tated, S. Rohan, and T. S. Pujar, "CNN based leaf disease identification and remedy recommendation system," in Proceedings of the Third International Conference on Electronics Communication and Aerospace Technology (ICECA), 2019. https://ieeexplore.ieee.org/document/8822055
7. M. A. Jasim and J. M. Al-Tuwaijari, "Plant leaf diseases detection and classification using image processing and deep learning techniques," in Proceedings of the International Conference on Computer Science and Software Engineering (CSASE), Duhok, Kurdistan Region, Iraq, 2020. https://ieeexplore.ieee.org/document/9142088