OPEN ACCESS INTERNATIONAL JOURNAL OF SCIENCE & ENGINEERING

# IDENTIFICATION OF VARIOUS DISEASES IN PLANT LEAVES USING IMAGE PROCESSING AND CNN APPROACH

**Yash Snehakant Magar [1], Aryan Dinesh Mahajan [2], Abhinaykumar Ravindra Jha [3], Sohan Devidas Patil[4], Balkrishna Patil[5]**

*Student, Departnment of Computer Engineering, SITRC, Nashik-422213, India[1,2,3,4]*

*Professor, Department of Computer Engineering, SITRC, Nashik-422213, India[5]*

*yashmagar53@gmail.com[1]* , rugvedmahajan1125@gmail.com [2] , *jhaabhinay20@gmail.com [3] ,sohanpatil1502@gmail.com[4] ,balkrishna.patil@sitrc.org [5]*

***Abstract: This research presents an automated approach for plant disease detection using deep learning, specifically leveraging Convolutional Neural Networks (CNNs). The system analyzes images of plant leaves to accurately classify diseases, assisting farmers and agronomists in early diagnosis of crop health issues. By eliminating reliance on traditional manual inspection, which is often time-consuming and error-prone, the proposed solution enhances efficiency and precision. The model is trained on an extensive dataset of labeled leaf images, covering various plant species and diseases. To improve performance and generalization, image augmentation techniques such as rotation, zooming, and flipping are employed, allowing the model to handle diverse variations in the dataset. The objective of this study is to develop a scalable, reliable, and user-friendly system for plant disease detection, facilitating proactive crop management and minimizing agricultural losses. Furthermore, the system has the potential to be integrated into real-time applications for enhanced decision-making in farming and agriculture.***

***Keywords: Deep Learning, Convolutional Neural Networks, Image Processing, Plant Disease Detection, Image Classification, Data Augmentation.***

## I.INTRODUCTION

Agriculture is a crucial and economically significant sector in India, with many families depending on farming due to the country's fertile and diverse soil, which supports the cultivation of high-quality crops. However, plant diseases threaten productivity, leading to substantial financial losses for farmers. Traditional disease identification methods rely on manual inspection, which is time-consuming, error- prone, and impractical for large-scale farming. To address these challenges, deep learning-based automated solutions have been developed, providing faster and more accurate disease detection. This study employs Convolutional Neural Networks (CNNs) to classify plant diseases using leaf images, offering an efficient and scalable solution. CNNs are highly effectivein recognizing complex disease patterns, making them suitable for plant health assessment.

The model is trained on an extensive dataset of labeled images representing different plant species and diseases. To improve accuracy and enhance generalization, image augmentation techniques such as rotation, zooming, and flipping are applied, allowing the model to handle diverse visual variations. By automating disease identification, this approach assists farmers in making timely decisions, reducing crop losses, and improving agricultural productivity. The integration of CNN-based technology into farming supports precision agriculture by enabling real-time plant health monitoring.

## II.BACKGROUND

Agriculture plays a crucial role in global food security, with plant health directly impacting crop productivity and economic stability. Farmers have traditionally relied on manual disease identification, which requires expert knowledge and visual inspection. However, this method is time-consuming, inconsistent, and prone to human error, especially when dealing with large-scale farms or early- stage symptoms. The need for automated, accurate, and scalable disease detection methods has led to the integration of artificial intelligence (AI) in agriculture.

Recent advancements in computer vision and deep learning have enabled the development of image-based plant disease detection systems. Among these, Convolutional Neural Networks (CNNs) have emerged as a powerful tool due to their ability to extract complex features from images. CNNs have demonstrated superior performance in image classification and object recognition, making them well-suited for identifying plant diseases from leaf images. Several studies have successfully applied CNN-based models to classify diseases in crops like apples, tomatoes, potatoes, and corn, highlighting the effectiveness of deep learning in agriculture.

In addition to accurate disease detection, real-time accessibility is another key factor in modern agricultural solutions. Cloud-based and web-based applications provide farmers with instant diagnosis and recommendations. Streamlit, a lightweight Python framework, allows seamless deployment of AI models into interactive web applications. By integrating a CNN model with Streamlit, farmers can upload images and receive instant disease predictions, eliminating the need for specialized hardware or software installations.

This study builds upon existing research by developing a CNN-based plant disease detection model, trained on a diverse dataset of leaf images. By incorporating data augmentation techniques, the model is enhanced to recognize variations in disease symptoms, ensuring robust and generalized predictions. Additionally, a user-friendly Streamlit interface is implemented to enable easy image uploads and real-time disease classification. This combination of deep learning and interactive web applications aims to provide a practical and scalable solution for plant disease management.

Furthermore, integrating AI into agriculture not only enhances disease detection but also contributes to precision farming, where data-driven insights optimize crop management practices. Automated detection reduces the dependency on traditional expert consultation, making disease diagnosis more accessible to small and large-scale farmers alike.

## III. METHODOLOGY

The proposed model consists of dataset collection, preprocessing, detecting the plant disease and building the Front End.The proposed work performs the task of detecting plant diseases along with the remedies provided for that diseases. This work uses Image Processing and CNN model to detect diseases in plants

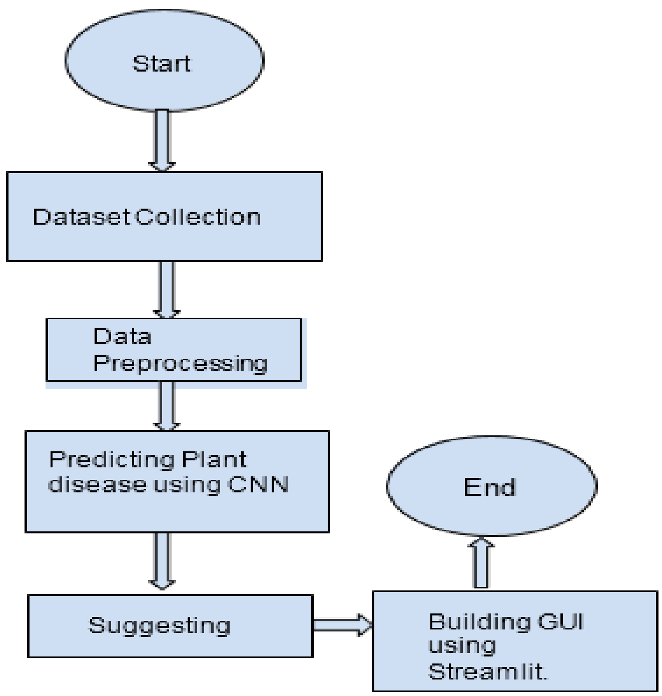


*Fig 1.1 Proposed Model Flow*

**Module 1**: The project begins by collecting a dataset of plant leaf images, both healthy and diseased, from available sources. Preprocessing is then applied to standardize the images before model training. This includes resizing images to a fixed dimension (224x224 pixels) using the PIL library and converting them into numerical arrays. The pixel values are normalized by scaling them to a range of 0 to 1, ensuring consistency in data representation. These preprocessing steps help maintain uniformity across inputs, enabling the CNN model to effectively learn disease patterns and make accurate predictions. Additionally, images are expanded with an extra dimension to match the model's expected input shape. Proper preprocessing ensures that the deep learning model generalizes well across various plant species and disease conditions.

*Fig. 1.2 Preprocessing Stage*

**Module 2: Detecting plant disease**

**CNN-APPROACH:**

To classify an image dataset, a convolutional neural network (CNN) is employed. The CNN is designed to interpret various elements of an input image and differentiate between them. It consists of an input layer, hidden layers, and an output layer. By utilizing Sigmoid or Softmax algorithms, each class is represented as probability values. The CNN model is constructed using convolutional layers, activation function layers, and pooling layers.

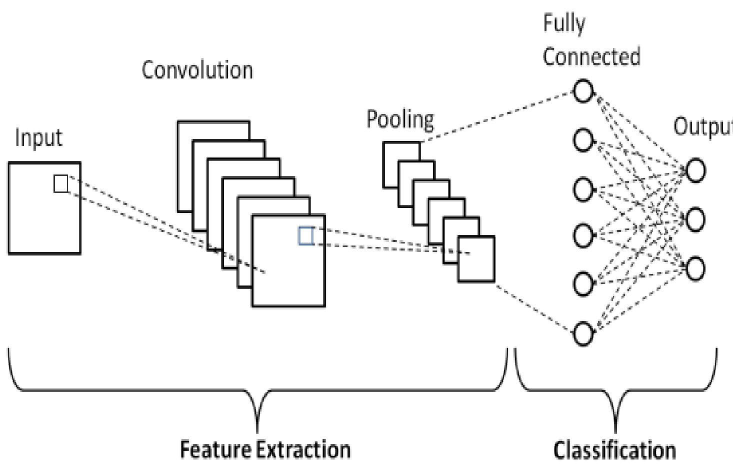


*Figure 1.3 Representation of a CNN*

The proposed model takes the image as input from the user and predicts the type of disease in the plant. Based on the results obtained suggests possible remedies that can help the plant cure.

**Module 3:Building User Interface :**

A key objective of this study is to develop an intuitive and accessible interface that allows farmers and agricultural professionals to upload leaf images for disease diagnosis. By ensuring a simple and user-friendly design, the system facilitates real-time decision-making, enabling users to detect plant diseases swiftly and take necessary preventive measures. Once the CNN model is trained, it is saved and optimized for deployment in a real-world application. The interactive Streamlit-based frontend enables seamless image uploads, processing, and instant disease predictions, providing users with a fast and accurate diagnosis. This approach enhances crop management strategies, empowering farmers with data-driven insights to minimize losses and improve agricultural productivity. Additionally, the system eliminates the dependency on expert knowledge, making advanced plant disease detection more accessible to small-scale farmers. By integrating AI-based analysis with a web-friendly interface, this technology bridges the gap between innovation and practical application, ensuring that disease identification is both efficient and widely available to the agricultural community.


*Fig.1.4 User Interface*

## IV.RESULTS

The CNN-based plant disease detection system was evaluated using a dataset containing multiple plant species and disease categories. The model demonstrated high accuracy in distinguishing between healthy and diseased leaves, effectively recognizing different plant diseases based on visual symptoms. The application of data augmentation techniques, including image rotation, zooming, and flipping, played a crucial role in improving the model's generalization, allowing it to perform well on previously unseen images. These techniques helped the model adapt to variations in lighting conditions, leaf orientations, and environmental factors, ensuring robust predictions in real-world scenarios.

To assess the effectiveness of the model, various performance metrics such as accuracy, precision, recall, and F1-score were analyzed. The model achieved a high classification accuracy, confirming its reliability in disease detection. Precision and recall values indicated that the system effectively minimized false positives and false negatives, making it a dependable tool for farmers and agricultural experts. The system's real-time inference capability was tested through the Streamlit-based frontend, where users could upload images and receive instant disease classification along with recommended treatments. The interface functioned seamlessly, providing an interactive and accessible platform for plant disease identification.

Further evaluations were conducted to test the model's robustness under different environmental conditions, including variations in lighting, image resolution, and background noise. The system consistently delivered accurate predictions, demonstrating its ability to adapt to diverse agricultural settings. Additionally, the integration of a fertilizer recommendation system added further value by suggesting appropriate treatments based on the identified disease. This feature enhances the practical applicability of the system, allowing users to take immediate corrective actions to prevent further crop damage.

The results confirm that the combination of deep learning and an intuitive user interface provides an effective and scalable solution for plant disease detection. The system's ability to deliver real-time, accurate diagnoses ensures that farmers can make informed decisions about crop health management. By reducing the dependency on traditional manual inspection methods, this technology enhances efficiency in agriculture, helping to minimize crop losses and promote sustainable farming practices.

## V.CONCLUSION

This project successfully implements a CNN-based approach for detecting plant diseases, marking a significant advancement in agricultural technology. By leveraging data augmentation techniques, the model's performance is notably improved, allowing it to learn from a diverse set of images and generalize effectively to new data. Advanced optimization techniques further enhance the model's accuracy and reliability. The developed system offers an efficient and scalable solution for automated plant disease detection, enabling farmers and agricultural experts to make informed decisions regarding crop management. By facilitating early diagnosis, this tool not only helps in minimizing crop losses but also promotes sustainable agricultural practices, ultimately contributing to enhanced food security and improved agricultural productivity in the face of growing global challenges.

## VI.REFERENCES

[1].Shubham Sharma, Man Vardhan, "Hyperparameter Tuned Hybrid Convolutional Neural Network (H-CNN) for Accurate Plant Disease Classification".

IEEE_Xplore:https://ieeexplore.ieee.org/document/ 10169257

[2].P.Vishnu Raja,Ninisa B A, Samiksha M, "Convolutional Neural Networks based Classification and Detection of Plant Disease" .

IEEE_Xplore:https://ieeexplore.ieee.org/document/ 9753846

[3]. Hafsa Arid, Insaf Bellamine, " Plant leaf diseases classification using Deep Learning".

IEEE_Xplore:https://ieeexplore.ieee.org/document/ 10410019

[4]. E.Anna Devi, S.Gopi, U.Padmavathi,Sajeev Ram Arumugam, S.P.Premnath "Plant Disease Classification using CNN-LSTM Techniques".

IEEE_Xplore:https://ieeexplore.ieee.org/document/ 10061003

[5]. Pedapudi. Nagababu, Shaik. Nageena, Veeranki. Dharani, Darsi. Naveen"Plant Disease Detection and Diagnosis".IEEE_Xplore:https://ieeexplore.ieee.org/ document/1058303

[6]. Jirasak Wongbongkotpaisan , Sopon

Phumeechanya "Plant Leaf Disease Classification using Local-Based Image Augmentation and Convolutional Neural Network".

IEEE_Xplore:

https://ieeexplore.ieee.org/document/9454672

[7]. Raida Moyazzoma, Md. Al Amin Hossain

"Transfer Learning Approach for Plant Leaf Disease Detection Using CNN with Pre-Trained Feature Extraction Method Mobilnetv2".

IEEE_Xplore:https://ieeexplore.ieee.org/document/ 9331214

[8]. Diksha Tandekar, Snehlata Dongre "Identification of Various Diseases in Plant Leaves Using Image Processing and CNN Approach".

IEEE_Xplore:https://ieeexplore.ieee.org/document/ 10306979