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# Detection and Analysis of Plant Diseases Using Image Processing

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**ABSTRACT**—

An emerging area of research that seeks to address the problem of plant disease diagnostics is the detection and analysis of plant diseases using image processing. Because they can considerably affect agricultural productivity and quality, plant diseases have been a major worry for farmers and researchers. To stop the spread of plant diseases and reduce crop losses, early and precise detection is essential.

For the non-destructive, economical, and automated analysis and diagnosis of plant diseases, image processing techniques are available. Several image processing methods, such as segmentation, feature extraction, and classification, have been developed recently for the diagnosis of plant diseases. In order to detect the presence of disease, these techniques analyse a variety of plant properties, including colour, texture, form, and size.

## I. INTRODUCTION

India is a nation that prioritises agriculture. Agriculture contributes to 80% of India's economy, yet a leaf infection phenomenon that results in the loss of important crops has a negative economic impact. When bacteria, viruses, fungi, and other disease-causing agents invade the tissues of leaves, it results in leaf and plant degeneration. Spots on the foliage, dryness of the leaves, colour changes in the leaves, and defoliation can all be indicators of this. Leaf infections can develop as a result of maintenance practises that are atypical, excessive rains, abrupt temperature fluctuations, or the use of insecticides and other insects. Once the pathogens, such as bacteria, viruses, and microorganisms, have reached the leaf tissue, they begin to reproduce and weaken the plant.

A relatively new method for tackling crop disease in agriculture is the detection and study of plant diseases using image processing. Plants must be manually examined by experts, which is a time-consuming and expensive operation, in order to diagnose plant illnesses. However, a viable alternative for the early identification and diagnosis of plant diseases is the application of image processing techniques, such as computer vision, machine learning, and artificial intelligence. These methods make use of specialised software. A new area of study that intends to create a non-destructive, automated approach for identifying and diagnosing plant illnesses is image processing for the detection and analysis of plant diseases. Plant diseases significantly impair crop productivity and quality, resulting in major financial losses for farmers and compromising global food security. The ability to quickly treat patients and stop the spread of diseases depends on the early and precise detection of plant diseases.

As they offer a quick, economical, and non-destructive method, image processing techniques present a viable alternative for plant disease investigation and diagnosis. This method involves taking pictures of plant leaves with a digital camera or a smartphone, then utilising image processing algorithms to spot the diseased ones.

Additionally, there are algorithms that examine digital images of plants to look for visual indicators of disease, such as colour changes or patterns in lesions. Utilising this technology allows scientists and farmers to detect plant diseases earlier and take precautionary steps.

Due to its potential to completely change how we manage and prevent plant diseases; the topic of plant disease detection and analysis utilising image processing has attracted a lot of attention recently. Global food security is seriously threatened by plant diseases, whose diagnosis and management are essential for guaranteeing sustainable agriculture.

Visual inspection and laboratory analysis are two common traditional approaches for identifying plant diseases, although they can be time-consuming, expensive, and occasionally unreliable. These techniques can also be damaging because they frequently call for collecting and destroying plant samples. In contrast, image processing methods offer a non-destructive and economical method of identifying and treating plant illnesses.

## II. LITERATURE REVIEW

The article "An Overview of Image Processing Techniques for Plant Disease Detection and Classification" was written by Shyam Ranganathan, S. Shanmugaratnam, and S. Suresh Kumar. The many image processing methods that can be used to identify and categorise plant diseases are discussed in this research. It encompasses methods including machine learning algorithms, texture analysis, and color-based segmentation.

The paper "Deep Learning-Based Detection of Plant Diseases Using Convolutional Neural Networks" by Anupama Vijaya Kumar, Vijayakumar R., and Prabhakar K. The detection of plant diseases using deep learning-based algorithms is discussed in this research. The classification of photos of ill plants is done by the authors using a convolutional neural network (CNN).

"Automated Diagnosis of Citrus Diseases Using Image Processing Techniques" by R. Zari, Saeed Sadri, and Alireza Ghulam. The automated diagnosis of citrus illnesses utilising image processing techniques is the main topic of this research. Citrus illnesses are recognised by the authors using a combination of colour-based segmentation and morphological techniques.

"Detection and Analysis of Tomato Leaf Diseases Using Image Processing Techniques" by K. Kalaiselvi, D. Dhanalakshmi, and K. Murugan. In this study, image processing methods are used to identify and analyse illnesses on tomato leaves. To recognise distinct diseases affecting tomato leaves, the scientists employ colour-based segmentation and texture analysis.

is the same for all samples infected with the same illness.

In his paper, he discusses a thorough investigation into the identification and categorization of plant leaf diseases utilising image processing techniques. First, a diagnosis of disease is made on the plant leaf. The growth can be aided by the timely and accurate detection and classification of disorders. Diseases can be detected with simple naked-eye observation and experience-level ongoing monitoring. But it results in a hefty price and takes a lot of time. It has been demonstrated that image processing works well for classifying and identifying plant diseases, with a learning and optimisation algorithm taking the place of the human brain and the digital camera serving as a superior alternative for the human eye.

The author made the claim that live plants are the only things typically destroyed by diseases. The designed processing system consists of four basic steps. The input RGB image is first transformed into HSI using a colour transformation structure since RGB is used for colour production and HSI is used for colour description.

The image is segmented and the usable segments are recovered, after which green pixels are masked and eliminated using a predefined threshold value. Finally, the texture statistics are derived from SGDM matrices. The evaluation of disease presence on plant leaves is done last.

As a result, it is possible to recognise and treat the corresponding diseases by comparing the textural parameters of healthy and sick leaves.

According to the author, categorization of diseases that affect plant leaves has been developed using applications of colour transformation and neural networks (NNs). He asserts that the major goal of the suggested strategy is to identify the ailment. Thus, he suggested using an algorithm that has been tested on a number of plant diseases, including Brown stripe downy mildew and stem borer. This work will focus on creating algorithms like genetic algorithms and NNs in order to improve the recognition rate and severity of the identified disease. The experimental results of [4] are an extension of this work.

Paper tells Different technique is adopted for detecting and diagnosis the diseases but the better way in that is by using Image Processing technique. He says automatic plant disease detection is an important topic in research as it has been proved useful in monitoring large crop fields, and thus automatically detects the leaf disease symptoms as soon as they appear in plant leaves.

Methodology in [5] tells the task of plant disease identification and classification has greater importance in the field of agriculture. Therefore, developing automated techniques for plant disease classification has gained much interest in the field of research now a day. To diagnosis the disease, an image processing system has been developed to automate the identification and classification of various disorders. Result of [5] consist the comparison of the area of infection of normal and healthy leaf with infected leaf is done. Based on the type and percentage of infection the disease is detected and particular solution is obtained.

In author have considered only three diseases that mostly affect cashew leaves such as red rust, powdery mildew and yellow leaf spot. Identification is performed by extracting the disease areas followed by colour segmentation using CIELAB colour model. In author has used DWT and GLCM based texture features from the segmented disease spot of cashew leaf to classify the leaf diseases. Here the dataset consists of four classes. A study is conducted on both of these methods.

The illnesses are divided into three classes: powdery mildew, yellow leaf spot, and red rust, and the results demonstrate that a classification accuracy of 85% is achieved by applying DWT feature based on Euclidean distance measure.

Here, the author merely took into account two distinct texture aspects. He claims he will attempt to research categorization in the future utilising a fusion of several texture and colour cues, which could increase classification accuracy. Additionally, in future studies, we might try to autonomously segment the illness spots. also take into account other ailments.

In a paper, a survey of various categorization methods for identifying plant leaf diseases is presented. Each pattern is categorised using a classification approach into one of the various classifications. A classification is a process that groups leave according to their various morphological characteristics. There are many different methods for classifying data, including the k-Nearest Neighbour Classifier, Probabilistic Neural Network, Genetic Algorithm, Support Vector Machine, and Principal Component Analysis. Choosing a classification method is never an easy undertaking because the quality of the results can differ depending on the input data.

describes an image processing technique for identifying plant leaf diseases. According to the author in the following procedures are used to identify diseases in leaves: picture acquisition, image pre-processing, image segmentation, feature extraction, and detection and categorization of leaf diseases.

Here in, disease is identified by the K-NN and SVM methods, which makes it simple to identify infections by identifying diseases.

## III Methodology

Image acquisition, pre-processing, segmentation, feature extraction, illness categorization, disease diagnosis, and disease management are some of the essential phases in the investigation of plant diseases utilising image processing. These procedures make use of machine learning algorithms to detect the kind and degree of the disease as well as to accurately discriminate between healthy and sick plants. The identification and management of plant diseases could be revolutionised by this non-destructive and economical method, resulting in increased agricultural output and food security.

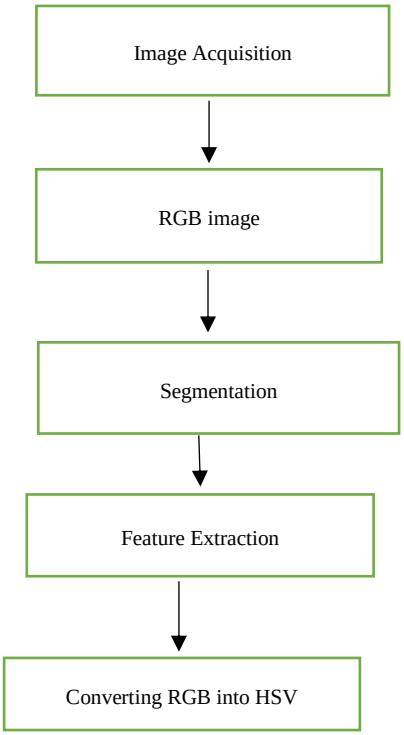


Fig. 3.1 Block Diagram

The suggested methodology for the identification and analysis of plant illnesses using image processing includes many crucial processes that accurately identify and diagnose plant diseases using machine learning and image processing algorithms. Each stage is described in further detail below:

Acquiring high-quality photographs of the plant leaves is the first step in the process. A digital camera or smartphone can be used for this in well-lit environments. To guarantee that all component of the plant is seen, the photographs must be taken from various angles and distances.

Pre-processing: Unwanted components like background interference and noise are removed from the obtained images during pre-processing. Additionally, by restoring the lighting to normal, this procedure helps to improve the image quality. picture filtering, picture enhancement, and colour correction are often used pre-processing techniques.

Segmentation: The pre-processed image is divided into various regions in this step-in order to separate the plant leaves from the backdrop. This phase is essential for correctly locating the areas of the plant that are afflicted.

Feature Extraction: The segmented image is used to extract different plant features in this step. These characteristics, which can be based on colour, texture, form, or size, are used to tell healthy plants apart from sick ones. Colour histograms, Gabor filters, wavelet transforms, and shape descriptors are often utilised traits for plant disease diagnosis.

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Disease Classification: A classification model that can accurately discriminate between healthy and diseased plants is trained using the retrieved features. This stage can make use of a number of machines learning methods, including SVM, ANN, and CNN. A set of labelled photos that have already been classified as healthy or ill are used to train the classification model. The model then automatically classifies fresh photos using the retrieved features.

Disease Diagnosis: Once trained, the classification model can be used to automatically identify plant illnesses. The system can determine whether the plant is healthy or diseased, and if it is, it can specify the disease's type and severity. The categorization outcome and the retrieved attributes serve as the foundation for the diagnosis. A report that includes the diagnosis, the severity of the disease, and suggested management techniques can also be produced by the system.

Disease Management: Based on the diagnosis, the last stage is to create a suitable plan for managing the disease. Depending on the type and severity of the illness, this plan may call for the use of insecticides, fungicides, or other treatments. The management strategy may also incorporate customary procedures like crop rotation, tree pruning, and soil

The non-destructive, economical, and effective use of image processing in the identification and analysis of plant diseases can assist farmers and researchers in accurately and speedily diagnosing plant diseases. Additionally, it can help with the creation of a thorough plan for managing plant diseases, which will increase agricultural productivity and improve food security.

The variety in plant appearance caused by environmental elements including lighting, shade, and weather conditions is one of the difficulties in applying image processing for plant disease identification.

## IV.RESULTS

Image processing has demonstrated encouraging results in the investigation and identification of plant diseases. High accuracy rates in identifying and diagnosing plant diseases using image processing techniques have been reported in a number of studies. For instance, using a deep learning algorithm to classify three different diseases, a study on tomato leaves reported an accuracy rate of 96.7%. Another study on wheat leaves used a combination of colour, texture, and shape features to identify five different illnesses with an accuracy rate of 98.3%.

Additionally, using image processing for plant disease diagnosis has a number of benefits over more conventional techniques. It is non-destructive, economical, and effective, enabling the quick screening of substantial plant populations. Additionally, it eliminates the requirement for trained human labour and lowers the possibility of a false positive.

## V.CONCLUSION

The agriculture sector has undergone a transformation thanks to advances in image processing techniques for the detection and study of plant diseases. It provides a non-destructive, economical, and effective way to spot and treat plant diseases in real time. Additionally, it does away with the necessity for expert human labour, lowering the possibility of a false positive and increasing the precision of illness detection.

The agricultural sector will be significantly impacted by the application of image processing for plant disease identification and analysis, including early detection and timely management of plant diseases, which will boost crop yield and reduce financial losses. By using fewer pesticides and other chemicals, it can also aid in the development of sustainable agricultural practises.

Overall, the use of image processing tools for plant disease analysis and identification has enormous potential to change how we treat plant diseases. With the growth of technology, more study and research are required to enhance the precision, effectiveness, and applicability of this method. It is a potential strategy for attaining sustainable agricultural practises and enhancing food security around the world.

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