OPEN ACCESS INTERNATIONAL JOURNAL OF SCIENCE & ENGINEERING

A SURVEY ON DETECTION OF PLANT DISEASE BASED ON IMAGE CLASSIFICATION TECHNIQUES

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Abstract: ***Agriculture is the foundation of every economy on the planet. Crop output is one of the most important elements impacting a country's domestic market situation. Agricultural output, in any area of the world, is a fundamental precondition for economic development. It is vital because it offers raw materials, work, and food to a variety of individuals. Estimated crop output varies greatly around the globe due to a variety of factors. Overuse of chemical fertilizers, the presence of chemicals in water supplies, irregular rainfall distribution, varying soil fertility, and other factors are among them. Aside from these difficulties, one of the most commonly encountered challenges throughout the world is the destruction of a large portion of output due to disease. After giving appropriate resources to the fields, the presence of diseases in the plants cultivated reduces a large portion of the production. Plant diseases must be controlled since agricultural yields account for 70% of the Indian economy. To avoid infections, plants must be watched from the very beginning of their life cycle. The conventional form of supervision is naked eye inspection that is time-consuming, costly, & requires a great deal of experience. So, to speed up this procedure, the illness detection system must be automated. Image processing techniques will be used to create the illness detection system. Numerous investigators have created systems based on several image processing approaches. This study examines the possibility of technologies for detecting illness in plant leaves, which aids agricultural progress. Image capture, segmentation, feature extraction, & classification are some of the steps.***

Keywords: *Computer Vision; Digital Image Processing; Plant Disease; Leaf*

I INTRODUCTION

Agriculture has a significant role in India's economic growth. Agriculture accounts for around 70% of the Indian economy. As a result, crop damage would result in a significant loss of production, affecting the economy. Because leaves are a vulnerable component of plants, they display disease signs first [1]. From the beginning of their life cycle until they are prepared to be collected, crops must be checked for illnesses. Initially, the conventional naked eye observation approach was employed to monitor the plants for illnesses, which is a time-consuming strategy that needs specialists to physically monitor the crop fields [2]. A variety of approaches have been used to build autonomous and semi-automatic plant disease detection systems in recent years. To this point, these methods are faster, cheaper, & more precise than farmers' conventional approach of manual opinion [3]. As a result, researchers are being urged to develop more sophisticated technology methods for detecting plant diseases that do not require human interaction.

Plant disease affects the quality of vegetables, fruits, legumes, and grains, resulting in significant production losses and consequent economic losses, necessitating the development of rapid & operative plant disease detection & evaluation technologies. [4] [5]. Authorities do the manual processes for detecting plant disease. Multiple specialists are necessary for bigger farmlands, which would be quite expensive. Farmers in certain nations, on the other hand, lack adequate fitted workplaces from which to contact specialists. Farmers must enlist the help of specialists from elsewhere, which is costly. The automated illness detection approach becomes critical in resolving this issue. The automated illness detection procedure is far more straightforward and limited than manual disease detection. Image processing is also supported, allowing for customized process control, inspection, and robot guidance based on pictures. [6]. When image classification algorithms are used to identify diseases, the findings are more accurate. This method proved to be the most effective way to avoid agricultural failure.

Visual detection of plant diseases is becoming more complex while also becoming less accurate. However, if a disease detection approach is employed, it will require less time & processing resources, & it will prove to be more accurate over time. Some plant illnesses show as dark-colored, yellow patches, while others are infectious, viral, and bacterial infections. For estimating the affected region, image processing is employed. The process of gathering pictures and segmenting them into various sections is known as image segmentation. There are a variety of techniques for doing image segmentation nowadays, ranging from the most basic thresholding procedure to front-facing hiding picture division systems. Because computers lack a specific approach for recognizing sentient things, a variety of strategies have been devised. The segmentation method is based on the image's different characteristics. This might include shading information, picture limitations, or a portion of an image.

II DISEASE ANALYSIS

The following purposes are served by image analysis:

- Detecting illnesses of the leaves, stems, and fruits.
- Determine the size of the impacted region.
- Determine the cause of the afflicted area.
- Find out what color the afflicted area is.
- Decide on the size and form of the fruits.

Leaf disease is mostly caused by viral, bacterial, and fungal infections. These signs and symptoms are readily apparent. Changes in color and form of the plant are examples of these. Some signs for detecting infections in plants while they are growing are listed below:

A. Symptoms of a viral infection:

Infection-borne plant diseases are the most difficult to diagnose of all plant diseases. There are no preceding signs or symptoms that can be continually monitored, and they are often misdiagnosed as nutrient shortages or injuries. This disease is spread by aphids, leafhoppers, whiteflies, & cucumber creepy crawlies bugs.

Fig. 1. Viral disease

B. Bacterial infection Symptoms:

Pathogenic bacteria infect plants and cause serious diseases. They cannot simply permeate plant tissue; instead, they must enter through wounds or plant holes. Bugs, different diseases, and agricultural equipment can cause wounds on plants during various operations, such as trimming and plucking.

Fig. 2. Bacterial disease

C. Fungal disease symptoms:

Plant leaf diseases, such as Late blight, are caused by fungus. It 1st looks on older, lower leaves that are water-soaked or have grey-green patches. These patches turn black as the parasite illness progresses, allowing the fungus to grow on them.

Fig. 3. Fungal disease

III LITERATURE SURVEY

D. Moshou et al. [7] Established an Early Plant Disease Detection System (PDDS) in Arable (Area Suitable for Agricultural Growth) crops. To do this, sensor fusion and fluorescence imaging were utilized. The yellow rust was used to test a winter wheat disease detection model (Puccinia striiformis). Images have been taken in this model using ambient light and an imagery spectrograph. They could identify diseased plants on the model.

S. Sankaran presents an overview of several illness detection strategies in [8]. Following the investigation, they concluded that establishing a quick, cost-effective model for plant disease detection will aid agricultural developments. Samples of these methods include spectroscopic, imagery-based & volatile profiling PDDS.

In [4,] A. Mahlein discusses current advances in illness diagnosis using non-invasive optical sensors. This helps to diagnose and classify the disease. Close-infrared or distant sensing methods may be used to detect disease in plants since they offer tremendous potential to classify, identify and monitor crops. The most efficient sensors for this process are thermography, chlorophyll fluorescence, and hyperspectral sensors. It is recommended to use an imaging system instead of a non-image system to improve disease detection.

M. Jhuria created a fruit grading and illness detection system in [6]. After plantation through harvesting of fruits, they employed IP to track the development of illness on the fruits. Artificial neural networks are used in this image processing approach. Backpropagation is used in the proposed approach to change the weight of the training dataset. 90% of the predictions were accurate from the morphology characteristic of the vectors using the proposed method. Matlab was used to combine the technique.

In [9], S. Bankar proposes a method for detecting plant diseases. For successful plant disease diagnosis, this approach employs color detection, edge detection, and histogram matching. CBIR mainly focuses on the precise detection of plant diseases and is especially helpful in identifying diseases. They propose an effective sampling technique and efficient. The procedure is divided into two parts. The first stage is to train the dataset, and the second step is to forecast and generate outcomes. They were successful in detecting plant illness.

The possibility of the functional SVM regression on a radial basis is explored by E. Omrani et al [10]. They're looking for various diseases that develop on apple leaves. The 3 are Alternaria, the black apple spot as well as the apple leaf miner bug. In this research, users used IP. They propose several soft-computing approaches linked to ANN & SVM in this work, that are useful in identifying the illness. For detecting infection on plant leaves, they employed KMC. They concluded that the support vector method outperforms ANNs.

F. Martinelli et al. presented an improved approach for identifying plant diseases based on nucleic and protein analysis in [11]. Their research focused on identifying pathogen contamination to better manage the polycyclic disease. They concluded that horizontal stream microarrays may be used to detect illnesses in critical locations. Early assurance determination might be aided by photogenic and phage show sensors. Other innovative approaches, such as RS & spectroscopy-based progressions, can speed up diagnosis over traditional nucleic destructive & serological testing, allowing for a more thorough study of illness's geographical and temporal inconstancy, especially when combined with solid reference data.

V. Singh presents a genetic method for detecting plant diseases in [12]. They suggested an image segmentation approach for automated illness diagnosis after surveying several disease detection strategies. The suggested approach includes many steps, including picture collection, pre-processing, segmentation, & getting usable segments for classification. They were capable of achieving the best outcomes with minimal computing effort. They also concluded that fuzzy logic, artificial neural networks (ANN), hybrid algorithms, and Bayes classifiers might help increase recognition rates.

S. P. Mohanty introduced a DL-based image-based PDD system in [13]. They used a collection of 54306 pictures of 14 crops and 26 illnesses to train the system, concentrating on 2 fundamental architectures AlexNet & GoogLeNet. They concluded that using a DL algorithm on an existing dataset might be used to identify agricultural diseases using a smartphone.

V. Singh [14] discussed how picture segmentation and a soft computing method may be used to identify an illness. The image segmentation is done using a genetic algorithm. From picture acquisition to pre-processing and segmentation, a step-by-step approach was followed. Following pre-processing, they employ a threshold value to create a leaf mask to obtain a better leaf picture. Creating a k-cluster using a genetic algorithm with unlabeled points in various dimensions. They were successful in achieving an acceptable outcome.

In [15], P. Moghadam presents a study on image processing for plant disease diagnosis using hyperspectral imaging. For identification of tomato virus in capsicum plants, they presented hyperspectral imaging & ML approaches. The whole spectrum was used to derive discriminating characteristics. For picture acquisition, they employed a hyperspectral imaging system. For a better sample, the next phase of hypercube pre-processing comprises two processes: leaf segmentation & grid removal. Three phases are involved in feature extraction: vegetation indices, complete spectrum, and feature extraction.

IV THE PROCESS OF DETECTING PLANT DISEASE

As illustrated in Fig. 4, the plant disease detection system procedure is divided into four parts. The initial phase is gathering photos from a digital camera or a mobile phone, as well as from the internet. The second step divides the picture into several clusters, each of which can be treated differently. The next step is about FE approaches, & the end-stage is about illness categorization.

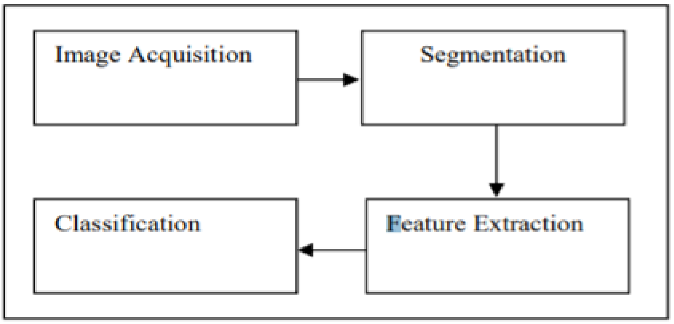

Fig. 4. Phases of PDD system

A.Image Acquisition

Images of plant leaves are gathered via digital media such as cameras, mobile telephones as well as other technologies of the necessary shape and amount. Pictures may also be taken from the web. The rapid application developers are responsible only for creating an image database. The picture DB is responsible for the classifier's improved performance in the detection system's final phase [16].

B.Segmentation of images

This step tries to make an image's representation more understandable and easier to evaluate by simplifying it [17]. This stage is an essential method for IP because it is the foundation of feature extraction. Images may be segmented using a variety of approaches, including k-means clustering, Otsu's algorithm, & thresholding, among others. KMC algorithm divides objects or pixels into K groups based on a set of characteristics. The items and their related clusters are classified by minimizing the sum of squares of distances among them [18].

C.Extraction of features

The area of interest is the result of segmentation to this point. As a result, the characteristics from this region of interest must be retrieved in this phase. These characteristics are required to deduce the meaning of a sample image. Color, form, and texture may all be used to create features [19]. Recently, the majority of researchers have expressed an interest in using texture characteristics to identify plant illnesses. GLCM, color cooccurrence method, spatial grey-level dependency matrix, & histogram-based feature extraction are some of the FE methods that may be used to create a system. The GLCM technique is a texture categorization statistical approach.

D.Classification

The classification phase entails determining whether or not the input picture is healthy. If a sick picture is discovered, some previous research has categorized it into several illnesses. A software program, often known as a classifier, must be created in MATLAB for classification. latest decades, investigators have utilized a variety of classifiers, including KNN, SVM, ANN, BPNN, NB, & DT classifiers. SVM is determined to be the most often utilized classifier. SVM is an easy to use and durable approach [20], even though every classifier has benefits and limitations.

V CONCLUSION

The different variables impacting the total output of agriculture crops are discussed in this article. In this work, we offer a review of numerous research studies in the field of PDD that were conducted over some time and analyze their findings. This document also includes a brief overview of the many types of diseases that impact plant development and their symptoms. From picture acquisition through categorization, there are five main phases in image processing. We determined that the deep learning method produces the best feasible outcomes with the least amount of computing effort and prediction time. We also concluded that visual methods for plant disease identification produce better outcomes than non-visual ones. For the aim of disease diagnosis, digital image processing produces more effective, quicker, and less expensive findings than manual plant examination.

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