A Review on PDIS (Plant Disease Identification Systems)

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***Abstract*— Plant diseases are one of the most important factor which can harm agricultural crops. Advances in image processing and other information technologies are serving as promising solutions for real time crop disease detection and recognition. Researchers from all around the world have put forward their ideas for developing such systems but success still seems too far away because proposed and developed systems have few limitations.**

This review will provide aid to researchers for understanding image processing applications in plant disease detection and recognition as it summarizes various plant diseases, disease detection systems, their challenges and their working.

Keywords*— *Plant Diseases, Image classification, Image Segmentation

I. INTRODUCTION

Agriculture mainly depends upon the quality of its products. Quality of these agricultural products can be degraded due to several diseases which may occur on plants. Detection of these diseases was earlier done manually by human experts with their experience but this manual detection was in efficient as it lacks accuracy. Thus this compelled researchers to develop techniques for easing this task so there has been lot of research on developing an automated system for identifying and recognizing plant diseases. Identifying diseases is the key to prevent losses of agricultural crops and by recognizing them appropriate corrective measures can be taken. Due to this image processing techniques are in need these days as for detection of diseases in early stages and overcoming limitations of eye sight of human. Large numbers of disease identification systems are developed which can effectively recognize diseases so that proper measures can be taken at early stages of plant growth. Various researchers used image- processing techniques in agricultural sector for identification of weeds in the field, detecting diseases, sorting of vegetables and fruits, etc. Automatic identification of plant diseases is very necessary research topic and may prove beneficial for monitoring large number of crops and identify the symptoms of diseases when they appear on plants. Different disease identification techniques are surveyed in this literature. Paper is divided as follows section1 surveys work done by existing researchers from all around the world, section 2 describes different plant diseases that can occur in plants, section 3 explains Plant Disease Identification Systems and last section is conclusion.

II. RELATED WORK

Joshi and Jadhav [2] proposed an Image processing system for detection and classification of four rice diseases (bacterial blight, blast brown spot and sheath rot) Image samples of diseased rice plant were collected and stored in jpeg format, then color space conversion were RGB images were converted to YCbCr where color and shape features were extracted, finally Minimum Distance Classifier and K-nearest neighbor were used for classification of diseases.Authors concluded that texture features can also be extracted from the samples and other rice diseases can also be identified using same algorithm. Table 1 lists some techniques for identification and classification of plant diseases.

Dey et.al [4] used Otsu method for segmenting rot disease in leaf of betel vine plant. Twelve diseased images were captured using scanner and in preprocessing step images were cropped then color conversion was applied for accurate detection of disease. Finally diseased area of the leaf was calculated and severity scale prepared. Author concluded that on the basis of severity the amount of pesticides used can be reduced which will be finally helpful in reducing environment pollution.

A model was proposed by Ratnasari et.al [5] for determining severity of leaf spot in sugarcane plant. On the basis a* component of L*a*b color space segmented spot was obtained.SVM based classifier was used which uses color features (L*a*b color space) as well as texture features (GLCM) for classifying type of spot disease. Accuracy of proposed model was 80% with 5.73 error severity calculation average. Authors concluded that proposed model has high accuracy with low error and in future preprocessing can be performed for reducing this error.

Mokhtar et.al [6] introduced image processing based approach for detecting diseased tomato leaves. This approach was subdivided into three phases i.e. preprocessing, feature extraction and classification phase. Texture features were extracted using GLCM for

determining state of tomato leaves, later these features acted as input to SVM based classifier for identifying whether leaf is healthy or infected. Author validated that by using this approach 99.83% accuracy was achieved.

Digital image analysis based system was proposed by Majumdar et.al [7] for recognizing wheat leaves diseases. Fuzzy c means clustering algorithm was used for extracting disease features then ANN was used for recognition of diseases. Author concluded that this system can identify rust diseases of wheat. In future web based interface can be developed for efficient disease detection.

Sannakki et.al [8] proposed a system based on image processing and AI techniques for diagnosing grape plant diseases. Background of input grape leaf image is removed using thresholding and masking techniques after that preprocessing was applied used for segmentation, later GLCM was used for extracting texture features which served as input to BPNN classifier. Authors concluded that in future proposed system can be applied for detection of other grape diseases and other segmentation techniques can also be used in this model.

Barbedo[9] surveyed methods of image processing techniques for detecting and classifying crop diseases from images. Author considered the images of leaves and stems for disease detection because techniques dealing with other parts of plants (fruit, root, seeds etc) have some abnormal characteristics. This survey was subdivided into three categories namely detection, quantification of severity and classification. Based on these three categories several methods were presented by the author.

Xiao et.al [10] used PCA and BPNN techniques for classification and detection of Rice blast disease. The proposed model eradicates short comings of existing problems like inaccuracy and inefficiency. Firstly color, shape and texture features were extracted from the lesion of each image then step wise regression analysis was performed. PCA method was applied to map 21 features to 6 features as a input parameter to BPNN. Overall accuracy of proposed model was 95.83%.Author concluded that this report can be used for rapid detection of Rice Blast disease in real time environment.

PROPOSAL	PLANT	DISORDER/ DEFFICIENCY	NUMBER OF IMAGE SAMPLES COLLECTED	MAJOR TOOLS USED	ACCURACY
Joshi et.al[2]	Rice	Blast, Blight ,Brown Spot, Sheath Rot	113	MDC and KNN Classifier	87.02% And 89.23%
Dey et.al[4]	Betel Vine	Rot Disease	12	Otsu Thresholding Method	-
Ratanari et.al[5]	Sugarcane	Spot Disease	30	SVM	80%
Mokhtar et.al[6]	Tomato	Powdery Mildew, Downy Mildew	200	K-Mean Clustering and SVM	99.5%
Majumdar et.al[7]	Wheat	Rust Disease	300	ANN	85%
Sannakki et.al[8]	Grape	Downy Mildew, Powdery Mildew	33	K-Mean Clustering and Feed Forward BPNN	100% (In training phase)
Xiao et.al[10]	Rice	Blast	374 lesions	PCA and ANN	95.83%
Suresha et.al[11]	Paddy	Blast, Brown Spot	330	KNN Classifier	76.59%

TABLE 1: PLANT DISEASE IDENTIFICATION AND RECORNIZATION TECHNIQUES

Suresha et.al [11] worked on two major fungal diseases of rice crops namely Rice blast and Rice brown spot using KNN classifier.RGB images were converted into HSV color images in segmentation step and then features like perimeter, area, major and minor axis were extracted and were provided to KNN classifier for recognition. Authors concluded that accuracy of proposed system was 79.59% which was better than SVM classifier.

III. PLANT DISEASES

There are two types of plant diseases namely biotic and abiotic. Those diseases which originate from other living organism are known as biotic diseases. Biotic diseases are caused due to fungi, virus and bacteria. Abiotic diseases are those which are originated from non living things such as weather conditions, hails, burning of chemicals, frosts etc.

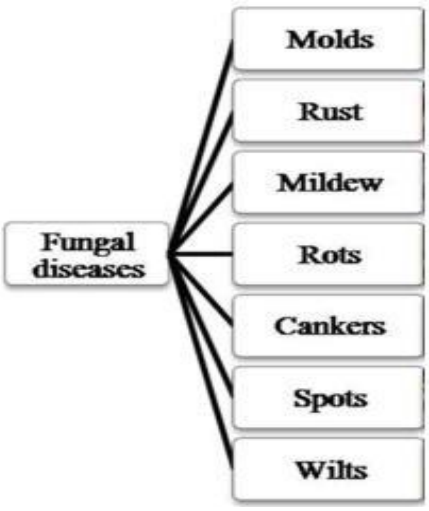

Figure 1: Fungal Diseases [3]

Abiotic diseases are non transmissible, non infectious, avoidable and least dangerous. In this paper only biotic diseases are discussed. As discussed earlier biotic diseases are mainly caused due to Fungus, bacteria and virus. FIgure1 lists major fungal diseases which may occur in plants. These diseases are Molds, Rusts, Mildews, Rots, Cankers, different types of spot diseases and wilds. Figure 2 displays bacterial as well as some diseases caused by virus. Bacterial diseases are soft spots, wilt and spots, while viral diseases are mottling, distortion and dwarfing.

IV. PDIS

Plant disease Identification system may consist of five modules. Each of these modules has several techniques and it totally depends upon researchers to choose any technique or find some new technique to propose model. In preprocessing stage we have several tasks like color space conversion, filtering, noise removal, blur improvement etc.

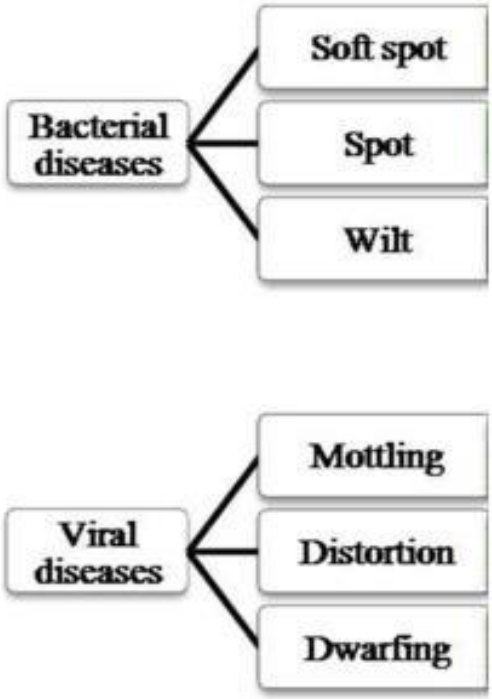

Figure 2: Bacterial Diseases and Viral Diseases [3] Then in Segmentation stage several techniques can be

used for segmenting of infected or diseased portion of the plant these techniques can be edge based, clustering based, thresholding based etc. Then features are extracted namely three categories of features can be extracted is color, shape and texture. Finally in recognition step disease is identified .Several kinds of classifiers are used by researchers; these are ANN, SVM, K-NN, Rule Based, Fuzzy classifiers etc [9].

Figure 3 shows general architecture of a plant disease Detection system which has following modules namely: acquisition, preprocessing, Segmentation, feature extraction, and recognition.

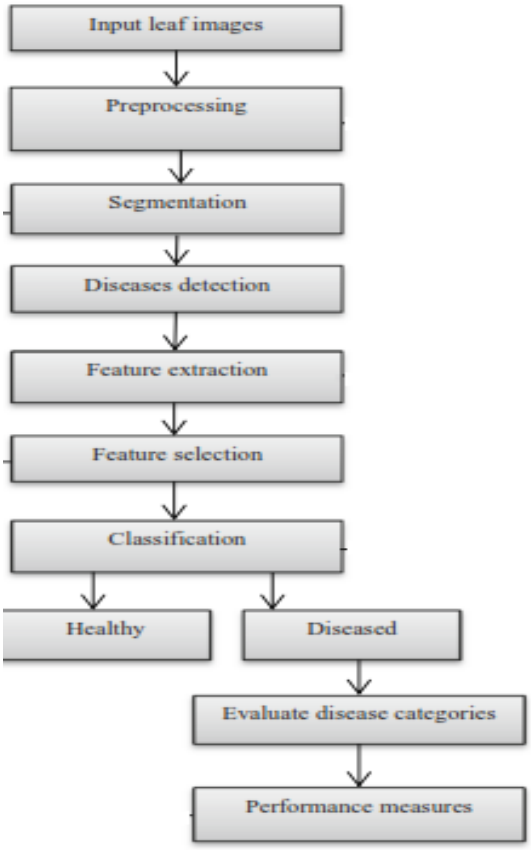

Figure 3: Architecture of PDIS [1]

Each PDIS may have two phases, the training phase and the testing phase. In Training phase image capturing is done which is known as image acquisition an image. Images of a part like leaves, roots, stems, and branches can be gathered. Images may be pre-processed for correction of various misrepresentations, conversion to grey level, noise Reduction, and for removing blur. Segmentation is process of separating the regions of interest from the background and is used for identifying regions from the infected image. In testing phase, a image undergoes through pre-processing, segmentation and feature extraction modules.The trained classifier identifies the test image as an infected or a healthy image. The effectiveness and applicability of these systems are popularly assessed using accuracy as a performance measure.

V. CONCLUSION AND DISCUSSION

This paper highlighted the techniques used by several researchers for identifying and classifying plant diseases. The ultimate aim is to minimize the impact of diseases on agricultural crops by using image processing techniques. Several agricultural applications based on the identification and classifications of plant diseases are briefly described in this literature. Moreover several causes and types of plant diseases are also discussed. The key findings of this paper can also be investigated for the other problems and reader can use given references for complete understanding of each proposed model.

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