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A Surveillance on Identification of Plant Leaf Diseases using Image Processing Techniques

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Abstract- Digital image processing is fast, reliable and accurate technique for the detection of diseases. Disease detection helps the farmers for early protection of plants from diseases and improves its productivity. There are various algorithms available for the identification and classification of leaf diseases in plants. The main objective of this paper is to review and analyses the plant leaf diseases using image processing techniques such as feature extraction, clustering method, color-based image analysis method, SVM classification and artificial neural network.

Index Terms - *Leaf disease; SVM; morphological processing; features extraction;*

1. INTRODUCTION

Computers play vital role in all the fields due to their remarkable technological developments, it's powerful nature, and flexible computing devices. The potential of computer and communication technologies are explored in engineering, medicine, science, commerce, law, agriculture, horticulture and also were deployed in inspection of food products, packing of products, interpretation of grain and crop images in the agro-food industry. The major advantage of using computers is that, they are more accurate, precise and efficient as compared to human beings in the real world. The major progress in the area of computer vision and image processing (CVIP) has led to a good number of real world applications in industry, business, biological science, material science, medical science.

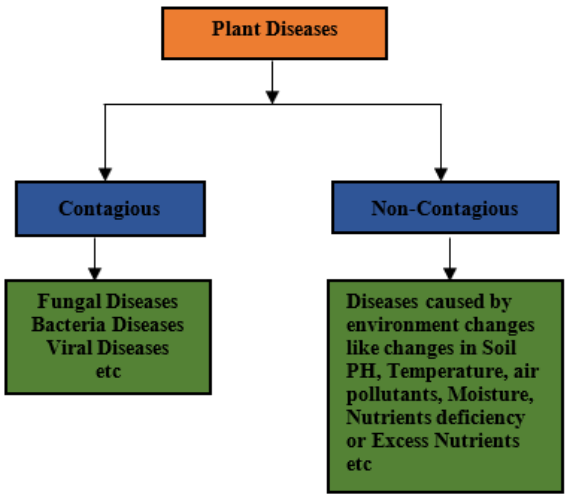

Fig. 1. Types of Plant Diseases

India is an agricultural country. Most of the Indian population depends on agriculture. Indian economy depends on agriculture. Farmers have wide range of selection in crops. Though the choices are more, the cultivation is affected by various types of diseases. Hence the productivity is reduced. Most of the plant diseases is caused by many pathogens such as bacteria, fungi, viruses etc. It is very difficult to detect the diseases by naked eyes by the farmers. Hence there is a great loss to the farmers economically. To overcome this problem, and to improve the quality and quantity of the crops technological support is necessary. Therefore, proper care need to be considered. The following Figure Fig. 1 depicts different types of plant diseases.

The development of computer science in the areas including artificial intelligence, pattern recognition, image processing, neural networks, promise the required technological support to tackle the various issues in computer vision. One of the view in the present study is concerned with processing of images of agriculture crops affected by diseases.

There are lots of techniques exists to detect the different types of plant diseases in the early stages. Conventional Naked eye observation method is not sufficient to detect the disease for large crop. Digital Image Processing Techniques is proficient and accurate to detect diseases with less time duration.

Image processing techniques help the researcher for accurate plant disease detection**.** Lot of algorithms have developed by different researchers for image processing. This paper provides a state of art on diverse types of image processing techniques for

detection and classification of different plant leaf diseases. This paper is organized with 3 sections. First section gives an introduction on importance of plant leaf diseases detection and how computers are used to do so. In Section 2, a general literature survey in this connection is carried out. This survey includes the views and techniques used by different authors. Section 3 presents a classification of plant diseases and review table for quick information about techniques used by other authors in different papers. Section 4 concludes with the future work.

2. SUMMARIZATION OF DIFFERENT PROPOSALS

Many researchers had done their research in the field of detecting plant diseases. The following contents are associated with the summarized review of the proposed works.

To diagnose the disease of brinjal leaf a technique was proposed [1] using image processing and artificial neural techniques . The diseases on the brinjal are critical issue which makes the sharp decrease in the production of brinjal. The study of interest is the leaf rather than whole brinjal plant because about 85-95 % of diseases occurred on the brinjal leaf like, Bacterial Wilt, Cercospora Leaf Spot, Tobacco mosaic virus (TMV). The methodology to detect brinjal leaf disease in this work includes K-means clustering algorithm for segmentation and Neural-network for classification. The proposed detection model based artificial neural networks are very effective in recognizing leaf diseases.

A software prototype system for rice disease detection was proposed [2] based on the infected images of various rice plants. Images of the infected rice plants are captured by digital camera and processed using image growing, image segmentation techniques to detect infected parts of the plants. Then the infected part of the leaf has been used for the classification purpose using neural network. The methods evolved in this system are both image processing and soft computing technique applied on number of diseased rice plants.

In paper [3] application of texture statistics for detecting the plant leaf disease had been explained Firstly by color transformation structure RGB is converted into HSV space because HSV is a good color descriptor. Masking and removing of green pixels with pre-computed threshold level. Then in the next step segmentation is performed using 32X32 patch size and obtained useful segments. These segments are used for texture analysis by Color Co-occurrence Matrix (CCM). Finally, if texture parameters were compared to texture parameters of normal leaf.

abnormalities for a given crop are manifested as symptoms on various plant parts. To enable an expert system to produce correct results, end user must be capable of mapping what they see in a form of abnormal symptoms to answer to questions asked by that expert system. This mapping may be inconsistent if a full understanding of the abnormalities does not exist. The proposed system consists of four stages; the first is the enhancement, which includes HIS transformation, histogram analysis, and intensity adjustment. The second stage is segmentation, which includes adaptation of fuzzy c-means algorithm. Feature extraction is the third stage, which deals with three features, namely color size and shape of spot. The fourth stage is classification, which comprises back propagation based neural networks [4].

The main focus had given by the author on the critical analysis of different plants disease segmentation techniques. It has provided the description of leaf disease detection using image processing that can recognize problems in crops from images, based on colour, texture and shape to automatically detect diseases and give the fast and accurate solutions to the farmer using SVM, K-Means Clustering [5].

A methodology has proposed for detecting plant diseases early and accurately, using diverse image processing techniques such as Gabor Filtering and artificial neural network (ANN). The work begins with capturing the images. Filtered and segmented using Gabor filter. Then, texture and colour features are extracted from the result of segmentation and Artificial neural network (ANN) is then trained by choosing the feature values that could distinguish the healthy and diseased samples appropriately. Experimental results showed that classification performance by ANN taking feature set is better with an accuracy of 91% [6].

Support Vector Machine (SVM) classification, K-Means Clustering approach was proposed to detect plant disease for early identification of diseases [7].

An Artificial Intelligence based Digital Image Processing technique was proposed for automatic detection and classification of sugarcane leaf diseases. The images of the infected sugarcane leaves were captured. Those images were pre-processed and the diseased regions were identified and segmented with the help of K-Means Clustering. GLCM features were extracted from each segmented region and given as input to the SVM classifier [8].

In this paper [9], the lesion areas which are damaged by disease anthracnose are separated by using segmentation techniques, scaling on the basis of percentage of damaged area and to classify unaffected and anthracnose affected part of fruits, artificial neural network is used. In this paper, mainly three varieties of fruit i.e. mango, grape and pomegranate are used for study. The proposed methodology contains two phases: firstly, segmentation techniques like thresholding, region growing, K-means clustering and watershed are applied for separating damaged lesion areas and unaffected area. Then scaling of the damaged areas is done by estimating the percentage of affected area. In the second phase, Run length Matrix (RLM) is used to extract texture based features. Classification is done by using ANN classifier on the basis of these extracted features.

To identify the plant diseases the basic digital image processing techniques were followed as steps, like loading the image, contrast enhancement, converting RGB to HSI, extracting the features and SVM [10].

A common practice for plant scientists is to estimate the damage of plant (leaf, stem) because of disease by an eye on a scale based on percentage of affected area. It results in subjectivity and low throughput. This paper provides advances in various methods used to study plant diseases/traits using image processing. The methods studied are for increasing throughput & reducing subjectiveness arising from human experts in detecting the plant diseases [11].

A framework was proposed [12] based on image-processing and was composed 2 steps. In the first step, the K-Means technique was used to segment the images. The segmented images were passed through a pre-trained neural network in the second step. This proposed approach can significantly support accurate and automatic detection of leaf diseases. The developed Neural Network classifier that was based on statistical classification and was used successfully to detect and classify the tested diseases with a precision of around 93%.

Gabor wavelet transform technique was applied to extract relevant features related to image of tomato leaf in conjunction with using Support Vector Machines (SVMs) with alternate kernel functions in order to detect and identify type of disease that infects tomato plant. Initially, diseased tomato leaves isolated as single image. wavelet based feature technique was employed to identify an optimal feature subset. Finally, a support vector machine classier with different kernel functions including Cauchy kernel, Invmult Kernel and Laplacian Kernel was employed to detect and identify where tomato leaf infected with Powdery mildew or early blight. Efficient result obtained from the proposed approach with accuracy 99.5% [13].

Leaf biometric feature was analyzed using computer based method like morphological feature analysis and artificial neural network and Naive bayes based classifier. KNN classification model took input as the leaf venation morphological feature and classify them into four different species. The result of this classification based on leaf venation is achieved 96.53% accuracy in the training of the model for classification of leaves provide the 91% accuracy in testing to classify the leaf images [14].

Bacterial leaf scorch (BLS) is a common infection seen in different shade tree species. The disease is caused by the bacterial pathogen *Xylella fastidiosa*. A scheme was proposed and uses a novel approach to detect the infected areas of the plant by segmenting the plant leaves by clustering. K-means clustering is performed for different cluster centres to obtain different cluster groups of the region of interest (ROI) [15].

This literature surveillance has exposed that there is fair amount of scope for plant leaf disease identification in the area of agriculture and horticulture.

3. DISEASE CLASSIFICATION AND IMAGE PROCESSING TECHNIQUES

Most of the plant diseases including leaf spots, mildews, rots, rusts, wilts, anthracnose and white mould are caused by different species of fungi. The fungal body contains a small thread like structure ‘mycelium’ grows extremely fast and produce numerous microscopic seed like ‘spores’ under optimal environmental conditions. Insects or Pests, rain, wind and irrigation water can easily transport these spores from infected plants to healthy plants and are responsible for rapid transmission of the disease. The common symptoms of bacterial diseases are leaf spots with yellow halo, wilts, canker and blight commonly occurs by water, insects, seeds . Here Fungal diseases classified based on the image processing techniques used for detecting diseases.

The following figure Fig.2 depicts the different types of fungal diseases and the different image processing techniques proposed by various authors to identify the plant fungal diseases [16].

The following figure fig.3 shows the different image processing methods such as image acquisition which captures the image. It is then followed by Image binarization which converts the

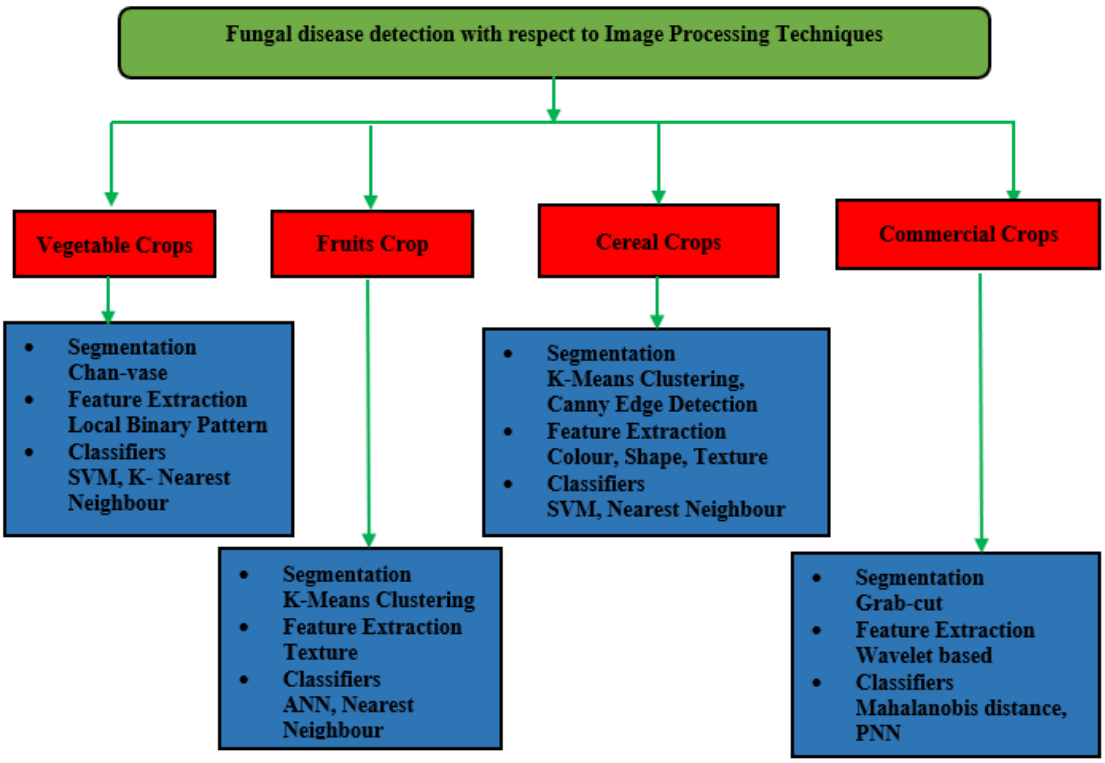

Fig. 2. Fungal diseases and the Image Processing Techniques to detect fungal diseases [16]

color image to binary image. It can also be smoothening and enhanced using histogram equalization. The next step is ROI selection in which particular region of the plant leaf is selected to identify the disease. It is then followed by extraction. Final step is to classify the leaves using different classifiers.

The following table Table I list out the summarization of the proposals of various authors.

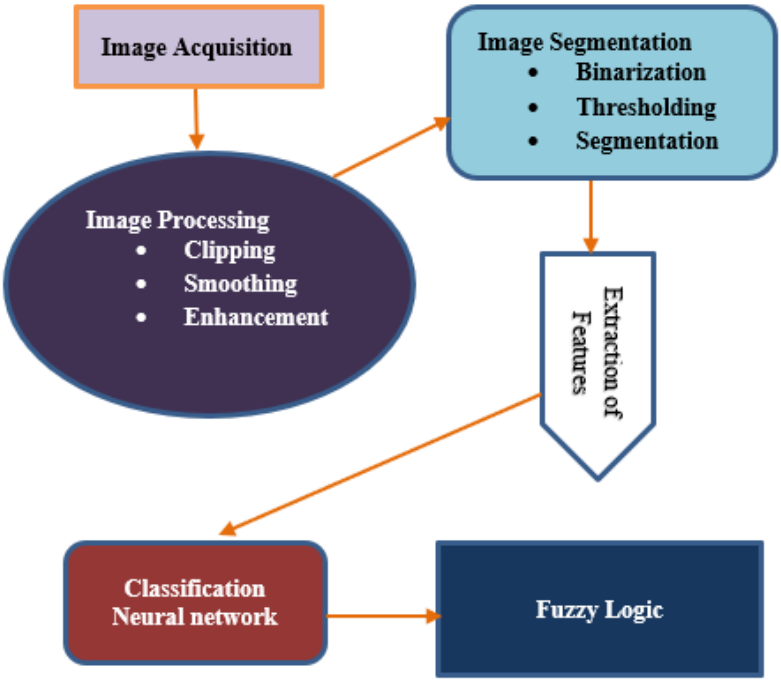

Fig. 3. Image Processing Techniques to be used

S. No.	Review Paper	Techniques
1	An application of image processing techniques for detection of diseases on brinjal leaves using k-means clustering method	K-Means, Artificial Neural Network
2	Rice Disease identification using Pattern Recognition Techniques	Pattern Recognition, ANN
3	Agricultural plant Leaf Disease Detection Using Image Processing	HSI, Color Co-occurrence Matrix, Texture Features
4	Agricultural Plant Leaf Disease Detection and Diagnosis Using Image Processing Based on Morphological Feature Extraction	ANOVA, Classifier, FCM, Feature extraction, HIS Transformation
5	Detection and Recognition of Leaf Disease Using Image Processing	K-means clustering algorithm, SVM
6	Applying image processing technique to detect plant diseases	Gabor filter, ANN
7	Plant Disease Classification Using Image Segmentation and SVM Techniques	K-means clustering algorithm, SVM
8	Application of Image processing techniques in Plant Disease Recognition	GLCM K-Means, Pattern Recognition, SVM
9	Skin Diseases Detection Models using Image Processing	K-Means, Run Length Matrix, ANN
10	Leaf disease detection using image processing	Contrast enhancement, HSI, SVM, RGB
11	Advances in image processing for detection of plant Diseases	RGB to HSI, K-means clustering, SGDM Matrix, GLCM
12	A Framework for Detection and Classification of Plant Leaf and Stem Diseases	K-Means, Neural Network
13	Tomato leaves diseases detection approach based on Support Vector Machines	Support vector machine (SVM), image processing, K-Mean clustering algorithm, Gabor wavelet transform
14	Detection of Unhealthy Region of plant leaves using Neural Network	Artificial neural network, K-NN Classification, Leaf venation pattern, Morphological Features
15	A novel algorithm for detecting bacterial leaf scorch (BLS) of shade trees using image processing	Region of interest (ROI), BLS, segmentation, clustering, k-means clustering, cluster centers

TABLE I . LIST OF DIGITAL IMAGE PROCESSIN G METHODS PROPOSED BY VARIOUS AUTHORS[12]

CONCLUSIONS

This paper presents the surveillance on different methods for plant leaf disease detection and classification techniques using image processing.

Different authors used different algorithms for accurate detection of diseases. Advantage of using image processing method is that the plant leaf diseases can be identified at its early stage. For improving recognition rate, most of the researchers used Artificial Neural Networks and classifiers like ANN, SVM, etc. All the methods referred in this paper save time and provide efficient results.

The future scope of this work could be focused on combining image processing with data mining and evolutionary computation / bio inspired computation to detect the diseases of the plants to speed up the recovery process. This will help many farmers for early identification of leaf diseases and also will help the researchers.

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