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AN ANALYSIS OF IMAGE DETECTION TECHNIQUES IN THE EARLY IDENTIFICATION OF PLANT DISEASES THROUGH LEAF IMAGES

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ABSTRACT

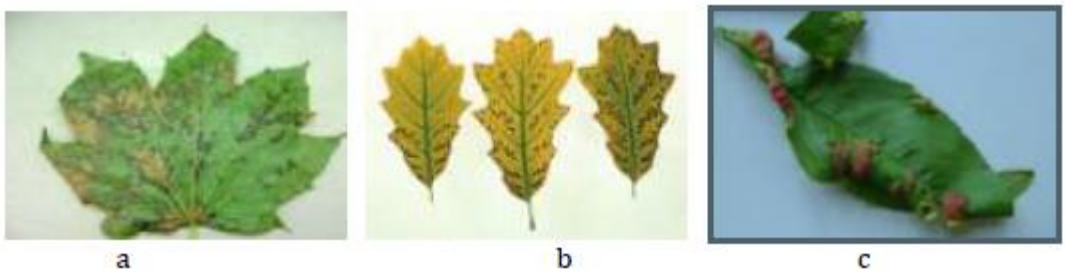
Plants productivity will be reduced due to the presence of diseases. Automatic detection of diseases on plant leaves is an important research topic which proves the benefits by identification of diseases through machine vision. This paper presents the study of various image processing techniques in identification of diseases on plants through leaf images. Image processing involves capturing the leaf images and pre-processing is done to improve the quality of the acquired images. Segmentation is applied to differentiate the disease affected region from the normal one. Various features are extracted from the segmented region and are fed in to the classifiers to identify the type of disease affected on the leaves.

1. INTRODUCTION

Diseases oc cur on plants is a crucial issue leading to the sharp decrease in the economic growth of a country. Proper diagnosis and timely handling is needed to protect the crops from heavy loss. In practice the main approach utilized in identification of diseases is through naked eye observation of experts which is time consuming and leads to inconvenience. Automatic detection of diseases on plants plays an important role nowadays and it may prove benefits to detect diseases from the symptoms that appear on the plant leaves. The common diseases that occur on plant leaves are bacterial, fungal and viral infections. Various papers have been published on image processing including the techniques for detection of objects, extraction of features, classification of diseases based on the properties such as shape, colour, boundary, intensity of the pixels, etc. We have reviewed papers that have been researched on the identification of plant diseases through their leaf images.

2. STEPS IN IMAGE PROCESSING

The basic steps of plant disease detection are shown in Fig. 1.



a b c

d e f

2.1 Image Acquisition

The input image required for processing is captured and stored as a database for further processing. Some of the diseased leaf images are shown in Fig. 2

2.2 Pre-processing

Pre-processing is an improvement of the picture information that stifles reluctant bends and upgrades some picture highlights significant for further handling.

2.3 Segmentation

Image Segmentation is the way toward parcelling an advanced picture in to various fragments. The objective of division is to improve the portrayal of a picture in to progressively significant and simpler to break down. The consequence of picture division is a lot of sections that altogether spread the whole picture or a lot of shapes separated from the picture. Every one of the pixels in a locale is comparative as for some trademark.

2.4 Feature extraction

Feature extraction begins from an underlying arrangement of estimated information and manufactures determined qualities as highlights planned to be educational and non-repetitive, encouraging the ensuing learning and speculation steps.

2.5 Classification

Classification will be executed on the base of spectral or spectrally defined features, such as density, texture etc. in the feature space. Classification divides the feature space in to several classes based on a decision rule.

3 LITERATURE REVIEW

N.S. Bharti, et.al described the detection and classification of plant diseases by implementing K-means clustering algorithm for segmentation and Artificial Neural Network for classification of six classes considered in the work. The texture statistics for each image was generated using Spatial Gray Dependency Matrix (SGDM). The extracted features were given in to the Feed Forward backpropagation neural network to identify the type of disease with an accuracy of 94%. K. Jagan

Mohan et.al proposed that brown spot, leaf blast and bacterial blight diseases of paddy plants are detected and recognized using image processing techniques. In disease detection, the disease affected portion of the paddy plant was identified using Haar-like features and Adaboost classifier. The detection accuracy rate was found to be 83.33%. In disease recognition the paddy plant disease type was recognized using Scale Invariant Feature Transform (SIFT) and the classifiers namely k-Nearest Neighbor (k-NN) and Support Vector Machine (SVM) were used. The disease recognition accuracy rate was 91.10% using SVM and 93.33% using k-NN. Megha.S et.al represented Fuzzy C-means (FCM) clustering technique for segmentation. Colour correlogram was used to extract colour features, Spatial Gray Dependency Matrix (SGDM) for texture features and Ostu for shape features. Support Vector Machine (SVM) was used for the classification of leaf diseases by training and testing the features extracted. Prakash M. Mainkar et.al presented in their work the detection and classification of leaf disease by creating color transformation structure. K-means clustering was applied for segmentation. The green pixels were masked and masked cells inside the boundaries of the infected cluster were removed. The infected cluster from RGB was converted in to HSI. SGDM matrix was generated for H and S. Gray Level Co-occurrence Matrix (GLCM) function was used to calculate the features. Feed Forward Back Propagation Neural Network was implemented for classification. Pramod S. landge et.al proposed the HSI color transformation structure for the acquired images. From the hue content binary image was generated. The feature sets were used for the analysis of type of disease using neural network. Sachin D. Khirade et.al discussed on the detection and classification of plant disease using image processing. Various segmentation methods like otsu's method, K-means clustering, converting RGB images into HSI model were used to detect the diseased leaves. The color and texture features were identified using the Color Co-occurrence Method. Self-organizing feature map, back propagation algorithm and SVM were used for classification.

Sanjay B. Dhaygude et.al proposed image processing techniques in detection of plant leaf disease. Color transformation structure for the input RGB image was created by converting it in to HSI. Then green pixels were masked and removed using threshold value to segment the useful regions. Finally, the texture statistics were computed using SGDM matrices to evaluate the presence of diseases on plant leaf. Smita Naikwadi et.al implemented color transformation structure for the RGB images. K-means clustering algorithm was applied and the green pixels were masked. The infected clusters were converted from RGB to HSI. SGDM matrix was generated for H and S. GLCM function was called for feature extraction. Neural network was configured for the recognition of diseases. Surender Kumar et.al reviewed various image processing techniques for plant disease detection. In the proposed work the authors surveyed the feature extraction techniques such as GLCM, SGDM, Gabor filters, Wavelet Transform, Principal Component Analysis. The classification methods like k-Nearest Neighbor (k- NN), Radial Basis Function (RBF), Probabilistic Neural Network (PNN), Back Propagation Network (BPN), and Support Vector Machine (SVM) were compared with their merits and demerits. Sushil R. Kamlapurkar et.al described that Powdery Mildew and Downey Mildew diseases of plant leaves were identified by extracting the color and morphological features. The extracted features were used for classification by training the samples

in the Artificial Neural Network. Region based segmentation algorithm was implemented to identify the diseased area. Trimi Neha Tete et.al used two different segmentation techniques such as Thresholding and K-means clustering algorithm to detect the diseased parts of the leaf images. Early Blight, Anthracnose and Shoot Blight were the three classes considered. Thresholding segmentation segregates objects by transforming grayscale images into binary images. Choice of threshold value is the key parameter in the Thresholding process. In K-means clustering standard Euclidean distance was used. The color, texture, edges and morphological features were extracted and fed in to the feed forward backpropagation neural network to classify the type of disease. Vaibhavi S. Bharwad et.al surveyed that major techniques used for detection of plant diseases are SVM and Neural Network for classification and K-means clustering for segmentation.

4 IMAGE PROCESSING TECHNIQUES

Digital image processing is the methodology used to achieve fast and accurate result in identification of the plant leaf diseases. It will reduce many problems in agricultural aspect and improve productivity by detecting the appropriate diseases. For disease detection, image of an infected leaf should be examined through the set of procedures shown in Fig. 1. As per the review undergone the various image processing techniques applied so far is given in the Table 1.

Table 1 Comparison of Segmentation algorithms and Classification Techniques

Segmentation Algorithms	Advantages	Classification Techniques	Advantages
K-means Clustering	Computationally faster than hierarchical clustering, if we keep K smalls	**Feed Forward Backpropagation Neural Network**	Can be used for complex problems
Fuzzy C-means Clustering (FCM)	Overcomes the coincident clusters problem, ignores the noise sensitivity deficiency	**Support Vector Machine (SVM)**	Does not require parameter tuning, robustness
Otsu algorithm	Automatically perform clustering-based image segmentation	**k-Nearest Neighbor (k-NN)**	Can be applied to data from any distribution, simple, good classification if the number of samples is large enough
Region based Segmentation	Simple, correctly separate the regions that have the same properties we define	**Adaboost**	Powerful algorithm, select the weak classifier that works best at that round of boosting
Thresholding Segmentation	Simple, fast if implemented on similar images	**Self-organizing feature map**	Data is easily interpreted and understood, capable of clustering large, complex datasets, trained in a short amount of time

CONCLUSION

This paper reviews and summarizes the various image processing techniques used in identification of plant leaf diseases. In common the colour, shape and texture features are extracted for classification. Among several classifiers used Support Vector Machine (SVM) and Feed Forward Back Propagation Neural Network classification techniques leads to better performance.