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An Analysis of Methodologies for Leaf Disease Detection Techniques

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Abstract – Plant diseases have turned into a dilemma as it can cause significant reduction in both quality and quantity of agricultural products. This is the one of the reasons that disease detection in plants plays an important role in agriculture field, as having disease in plants are quite natural. If proper care is not taken in this area then it causes serious effects on plants and due to which respective product quality, quantity or productivity is affected. Automatic detection of plant diseases is an essential research topic as it may prove benefits in monitoring large fields of crops, and thus automatically detect the symptoms of diseases as soon as they appear on plant leaves.This paper presents survey on different disease detection and classification techniques that can be used for plant leaf disease detection.

Index Terms- Image processing; Plant disease detection; pre-processing; features extraction; classification.

1. INTRODUCTION

Leaf diseases can cause significant reduction in both quality and quantity of agricultural products, thus negatively influence the countries that primarily depend on agriculture in its economy like India.Further, in some developing countries, farmers may have to go long distances to contact experts, this makes consulting experts too expensive and time consuming and moreover farmers are unaware of non-native diseases.

Monitoring crops for detecting diseases plays a key role in successful cultivation.

The naked eye observation of experts requires continuous monitoring which might be prohibitively expensive in large farms and time consuming.

At the same time, in some countries, farmers don't have proper facilities or even idea that they can contact to experts. Due to which consulting experts even cost high as well as time consuming too. In such condition the suggested technique proves to be beneficial in monitoring large fields of crops. And automatic detection of the diseases by just seeing the symptoms on the plant leaves makes it easier as well as cheaper. This also supports machine vision to provide image based automatic process control, inspection, and robot guidance.[3][5][10]

Plant disease identification by visual way is more laborious task and at the same time less accurate and can be done only in limited areas. Whereas if automatic detection technique is used it will take less efforts, less time and more accurately. In plants, some general diseases are brown and yellow spots, or early and late scorch, and other are fungal, viral and bacterial diseases. Image processing is the technique Which is used for measuring affected area of disease, and to determine the difference in the color of the affected area.[3][5][7][8]

Image segmentation is the process of separating or grouping an image into different parts. There are many different ways of performing image segmentation, ranging from the simple thresholding method to advanced color image segmentation methods. These parts normally correspond to something that humans can easily separate and view as individual objects. Computers have no means of intelligently recognizing objects, and so many different methods have been developed in order to segment images. The segmentation process in based on various features founding the image. This might be color information, boundaries or segment of an image.[4][5][7][10]

In the classification phase, the co-occurrence features of the leaves are extracted and compared with the

corresponding features values stored in the feature library. There are various techniques of classification which can be employed here.

Neural Network is one of the first methods that were used for the classification of the texture features of the image. According to [1],[4] the developed neural network classifier that is based on statistical classification perform well and can successfully detect and classify tested diseases with the accuracy of 93%.

Minimum Distance Criterion[5] is one of the classification methods used for the comparison of corresponding features. This classifier make use of "distance" measured which underline already-established goodness of fit tests, the test statistics used in one of these tests is used as the distance measure to be minimized. The classification of new instances is done by a winner-takes-all strategy, in which the classifier with highest output function assigns the class.

Support vector machines (SVMs) [5],[7],[9] are a set of related supervised learning methods used for classification and regression. Supervised learning involves analysing given set of labelled observations (the training set) so as to predict the labels of unlabelled future data (the test set).Specifically, the goal is to learn some function that describes the relationship between observations and their labels. More formally, a support vector machine constructs a hyper plane or set of hyper planes in a high- or infinite-dimensional space, which can be used for classification, regression, or other tasks.

Back Propagation BPNN algorithm is used in are current network. Once trained, the neural network weights are fixed and can be used to compute output values for new query images which are not present in the learning database .After getting the weight of learning database, then testing of query image is done.

2. LITERATURE REVIEW

Dheeb Al Bashish, presents an image-processing-based approach which is used for leaf and stem disease detection. He tested the program on five diseases which effect on the plants; they are: Early scorch, Cottony mold, ashen mold, late scorch, tiny whiteness. The proposed approach is image-processing-based. In this approach, the images at hand are segmented using the K-Means technique, in the second step the segmented images are passed through a pre-trained neural network. Results indicate that the proposed approach can significantly support accurate and automatic detection of leaf diseases. Based on our experiments, the developed Neural Network classifier that is based on statistical classification perform well and can successfully detect and classify the tested diseases with a precision of around 93%.[1]

In this paper[2], there are two phases to identify the affected part of the disease. Initially Edge detection based Image segmentation is done, and finally image analysis and classification of diseases is performed using our Proposed HPCCDD Algorithm. The goal of the system was to develop an Advance Computing system that can identify thedisease affected part of a cotton leaf spot by using the image analysis technique.

In paper [3] there are mainly four steps in developed processing scheme, out of which, first one is, for the input RGB image, a color transformation structure is created, because this RGB is used for color generation and transformed or converted image of RGB, that is, HSI is used for color descriptor. In second step, by using threshold value, green pixels are masked and removed. In third, by using pre-computed threshold level, removing of green pixels and masking is done for the useful segments that are extracted first in this step, while image is segmented. And in last or fourth main step the segmentation is done.

According to Paper [4] disease identification process include some steps out of which four main steps are as follows: first, for the input RGB image, a color transformation structure is taken, and then using a specific threshold value, the green pixels are masked and removed, which is further followed by segmentation process, and for getting useful segments the texture statistics are computed. At last, classifiers used for the features that are extracted to classify the disease. The proposed algorithm shows its efficiency with inaccuracy of 94% in successful detection and classification of the examined diseases. The robustness of the proposed algorithm is proved by using experimental results of about500 plant leaves in a database.

In this paper[5], an application of texture analysis in detecting and classifying the plant leaf diseases has been explained. The system was tested on multiple of plants. The diseases specific to those plants were taken for the approach. The experimental results indicate the proposed approach can recognize and classify the leaf diseases with a little computational effort. In order to improve disease identification rate

at various stages, the training samples can be increased and shape feature and color featurealong with the optimal features can be given as input condition of disease identification.

In this paper[6], PCA/KNN classifier was presented for faithful detection of diseases on cotton leaves. It was found that similar pattern diseases are having more cosines distances during KNN classification due to which there will be chance of mis-classification, i:e: some diseases are having similarities in their color patterns due to which disease patterns are not well recognized. The overall disease recognition accuracy analysis is about 95%, which is 14% more than that of manual observations. It was observed that recognizing the disease on cotton leaf is sometimes tedious task because photosynthesis process mostly hamper recognition rate of real time leaf disease recognition system.

This paper presents[7], a number of image processing techniques to extract diseased part of leaf. SF-CES provides better enhancement of color image, Lab and Ycbcr colorspace supports K-mean clustering for disease part extraction through the means of clusters. Then GLCM texture feature and color textures features are extracted for further classification purpose. Finally classification based on SVM.

Savita N. Ghaiwat et al. present survey on different classification techniques that can be used for plant leaf disease classification. For given test example, k-nearest-neighbor method is seems to be suitable as well as simplest of all algorithms for class prediction. If training data is not linearly separable then it is difficult to determine optimal parameters in SVM, which appears as one of its drawbacks.[8]

In this paper[9], an approach based on image processing is used for automated plant diseases classification based on leaf image processing. The work is concerned with the discrimination between diseased and healthy soybean leaves using SVM classifier. The SIFT algorithm is used to correctly recognize the plant species based on the leaf shape. The SVM classifier used for recognizing normal and diseased soybean leaves with an average accuracy as high as 93.79%.

This paper [10], discussed various techniques to segment the disease part of the plant. This paper also discussed some Feature extraction and classification techniques to extract the features of infected leaf and the classification of plant diseases. The use of ANNmethods for classification of disease in plants such as self-organizingfeature map, back propagation algorithm, SVMsetc. can be efficiently used. From these methods, we canaccurately identify and classify various plant diseases usingimage processing techniques.

3. EXISTING METHODOLOGY

To identify the affected area, the images of various leaves are taken with a digital camera or similar device. Then to process those images, various image-processing techniques are applied on them to get different and useful features required for later analysing purpose.

The step-by-step procedure of system:

(1) RGB image acquisition
(2) Image conversion
(3) Masking the green-pixels
(4) Removal of masked green pixels
(5) Segmentation
(6) Obtain the useful segments
(7) Computing the texture features
(8) Configuring the classifier for Recognition.

Table 1. Review

Sr. no.	Year	Paper	Methodology	Accuracy
1	2010	Dheeb Al Bashish, Malik Braik, and SuliemanBani-Ahmad "A Framework for Detectionand Classification of Plant Leaf and Stem Diseases"	1. Image Pre-processing • K-means clustering for segmentation • RGB to HIS transform • SGDM matrix for hue & saturation	93%
2	2012	P.Revathi, M.Hemalatha "Classification of Cotton Leaf Spot Diseases Using Image Processing Edge Detection Techniques "	1. HPCCDD • RGB to colourspace transform • Colour filtering • Masking &removal of green pixel • Edge detection • Pixel ranging function to calculate RGB features • Texture statistic computation	98%
3	2013	Prof. Sanjay B. Dhaygude, Nitin P.Kumbhar, "Agricultural plant Leaf Disease Detection Using Image Processing "	1. Image pre-processing • RGB to HSV • Masking and removal of green pixels • Segmentation & obtaining useful segments • Colour co-occurrencemethod-SGDM • Future development for SVM &neural network classifier	
4	2013	Arti N. Rathod, BhaveshTanawal, Vatsal Shah," Image Processing Techniques for Detection of Leaf Disease"	• HPCCDD algorithm • Otsu algorithm • K-means • Neural n/w • Image clipping • Filtering • Thresholding • Development of hybrid and neural n/w classifier	
5	2013	S. Arivazhagan, R. NewlinShebiah, S. Ananthi, S. Vishnu Varthini," Detection of unhealthy region of plant leaves and classification of plant leaf diseases using texture features"	1. Image pre-processing • RGB to HIS • Masking and removal of green pixels • Segmentation • texture feature computation	

			2. Classifier • Minimum distance criteria(86.77%) • SVM (94.74%)	
6	2014	Viraj A. , Maheshckumar H. Kolekar "Diagnosis of Diseases on Cotton Leaves Using Principal Component Analysis Classifier"	• PCA / KNN classifier	95%
7	2014	Ms. Kiran R. GavhaleProf.UjwallaGawande Mr. Kamal O. Hajari "Unhealthy Region of Citrus Leaf DetectionUsing Image Processing Techniques"	1. Image pre-processing • Image enhancement • Colour space conversion • RGB to colour space conversion(CIELAB,cyber,HSV) • Image segmentation k-means • Feature extraction-GLCM. 2. SVM • SVM RBI (96%) • SVM POLY (98%)	
8	2014	Savita N. Ghaiwat, Parul Arora "Detection and Classification of Plant Leaf Diseases Using Image processing Techniques: A Review"	• K Nearest Neighbour, SVM, Fuzzy Logic	
9	2015	YogeshDandawate, RadhaKokare "An Automated Approach for Classification of Plant Diseases Towards Development of Futuristic Decision Support System in Indian Perspective"	1. Image pre-processing • RGB to HSV • Background subtraction 2. Classifier-SVM (93.79)	
10	2015	Sachin D. Khirade, A. B. Patil "Plant Disease Detection Using Image Processing"	1. Image pre-processing • Image clipping, smoothing • Image enhancement 2. Classifier- ANN • Back propagation	

4. CONCLUSION

Image processing-based approach is proposed and useful for plant diseases detection. This paper describes different techniques of image processing for several plant species that have been used for detecting plant diseases. In future work, we will explore methods for combining texture, edge and color features.

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