A Survey on Classification Techniques for Plant Disease Detection using Image Processing

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Abstract— Plant diseases detection is crucial and significant operation and might have an effect on crop production. Main problems of farmers can be resolved when they will be able to easily detect the plant disease and take related remedial actions. This paper provides survey of different Image processing techniques for plant disease detection. Classification techniques such as k-Nearest Neighbor, Artificial neural network, k-means Classifier, Genetic Algorithm, Support Vector Machine, Neural Network, Fuzzy logic and Principal Component Analysis have been discussed. This paper is predicted to be helpful to research scholars operating each on Plant disease and recognition task, giving a comprehensive and accessible summary of this necessary field of analysis.
Key words: Image Processing; Plant Diseases

I. INTRODUCTION

India ranked under the five largest producers of agricultural product in world. One report from 2008 claimed India's population is growing quicker than its ability to provide rice and wheat [14]. It is an alarming situation for Indian government and population of India. This situation have scope of improvement because fact shows that many of the crops have large field area and relatively low crop production, for example India accounts for approximately 25 percent of world's cotton area and 16 percent of total cotton production.

However, the cultivation of those crops for optimum yield and quality manufacture is very technical. It may be improved by the help of technological support. The management of perennial fruit crops needs shut watching particularly for the management of diseases which will have an effect on production considerably and later on the post-harvest life.It is a brand new and developing technology that devotes itself to include the high-techs to use the correct quantity of inputs within the right place and at the correct time and save phytosanitary and fertilizer prices[13]. Within the exactitude agriculture, some major factors ought to be taken into consideration like the herbicides, pesticides, irrigation, fertilizers and therefore the quality of yield. So as to investigate these issues, completely different techniques area unit applied.

The visual analysis technique is that the standard technique of illness detection in plants. The optic observation of specialists is that the main approach adopted which needs continuous observation of specialists. It's to a small degree inefficient and cumbersome particularly in massive farms. Additionally, some farmers are unaware of some diseases and creating continuous contact with specialists is additionally pricey and time wasting. Image processing techniques can help to measure the parameters related to agronomy and then decision making will be easy related to vegetable sorting, disease detection, pesticides and fertilizers.This survey mainly focuses on discussing the applications of image process in disease detection that is given in next section.

II. CLASSIFICATION OF NOISE

In Plant diseases detection, there are many information which require to be collected and processed. The information isgenerally in the form of an image.The structure of all image processing techniques is almost the same. First task is image acquisition, digital images can be acquired from any of the image acquisition device. Digital image could be a numerical illustration of a picture that may be computationally processed. Then image preprocessing is applied to enhance the images to focus on the options and regions of interest. After that, image processing techniques are applied like image segmentation and feature extraction. Image segmentation aims to separate the item of interest from alternative objects within the image. Feature extraction simply extracts the relevant options like the morphological, chromatic, structural and textural characteristics that are helpful for any analysis. Then, these features are compared with the database then decision is made depending upon the comparison.

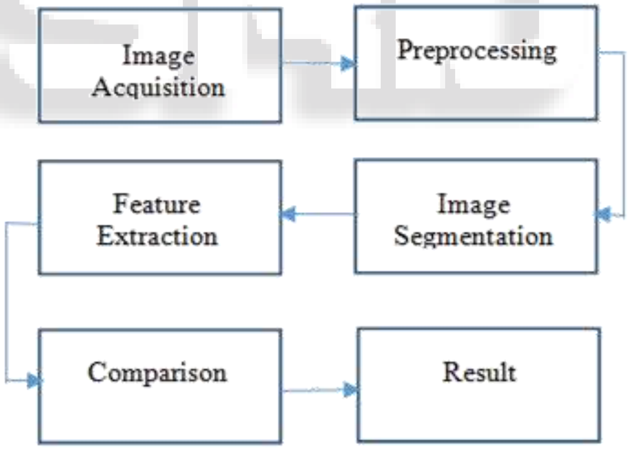


Fig. 1: Basic Image Processing Technique for Plant Disease Detection

A. *Edge Detection Techniques*

P.Revathi and M.Hemalatha[10] presented a paper Classification of Cotton Leaf Spot Diseases Using Image Processing Edge Detection Technique. In this work we express new technological strategies using mobile captured symptoms of cotton leaf spot images and categorize the diseases using HPCCDD Proposed Algorithm. The classifier is being trained to achieve intelligent farming, including early Identification of diseases in the groves, selective fungicide application, etc. This proposed work is based on Image RGB feature ranging techniques used to identify the diseases (using Ranging values) in which, the captured images are processed for enhancement first. Then color image segmentation is carried out to get target regions (disease spots). Next Homogenize techniques like Sobel and Canny filter are used to identify the edges, these extracted edge features are used in classification to identify the disease spots[10].

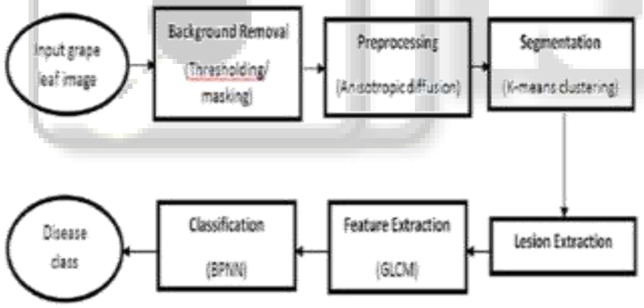
The proposed detection technique have the following steps:

1) RGB image acquisition
2) Create the color transformation structure
3) Convert the color values in RGB to the space specified in the color transformation structure.
4) Apply Color Filtering
5) Masking green-pixels
6) Remove the masked cells inside the boundaries of the infected clusters
7) Find Edge detection (using Sobel and Canny with Homogenous operator techniques)
8) Calling the pixel Ranging function to calculate the RGB features (each and every disease)
9) Texture Statistics Computation
10) Configuring Disease Reorganization and Pest Recommendation

B. *Neural Networks*

In the proposed system, grape leaf image with complex background is taken as input. Thresholding is deployed to mask green pixels and image is processed to remove noise using anisotropic diffusion. Then grape leaf disease segmentation is done using K-means clustering. The diseased portion from segmented images is identified. Best results were observed when Feed forward Back Propagation Neural Network was trained for classification.

Following block diagram shows the proposed system



In image acquisition image is taken as input from different sources.Thenthe input image resized to standard size 300x300. Then, mostly green colored pixels are identified. If the green color component is less than threshold i.e. 70 in present work, then all red, green and blue value of that pixel is assigned zero and green channel of that image is assigned to 255. This is called masking green pixels. This fastens the processing in the next step and also improves accuracy [15].

In the preprocessing step the image is then enhanced using Anisotropic Diffusion to preserve the information of effected portion.One diffusion equationgiven by Perona and malik is used. H component from HSV color space is extracted to reduce the illumination effect.

k-means clustering [10] is used for segmenting an image into six groups which is found to be optimum.Once the image is divided into six clusters, the mean of each cluster is calculated and means are sorted in ascending order. It is observed that the downy affected lesion is extracted at second and powdery affected lesion is extracted at sixth in the sorted clusters. It is observed that this is true for the leaves having lesions of both the diseases at same time.

The next step is to extract texture features of the extracted diseased portions. This is done by calculating Gray Level Co-occurrence Matrix (GLCM) [12]. The colour co-occurrence texture analysis method was developed through the use of spatial gray-level dependence matrices (SGDM's). Co-occurrence matrices measure the probability that a pixel at one particular gray-level will occur at a distinct distance and orientation from any pixel given that pixel has a second particular gray-level.

The feed forward Back Propagation Neural Network classifier consisting of three layers namely input layer, a hidden layer, and an output layer is used for classification.Sigmoid transfer function is used for generating output at each stage. The input layer has 9 nodes, which are related to two 9 texture features—contrast, uniformity, maximum probability, homogeneity, inverse difference, difference variance, diagonal variance, entropy of H bands of lesion area. Output layer contains two neurons. This module assigns an appropriate disease class i.e. Downy or powdery. Result shows that this training achieved training accuracies of 100% when using hue features alone.

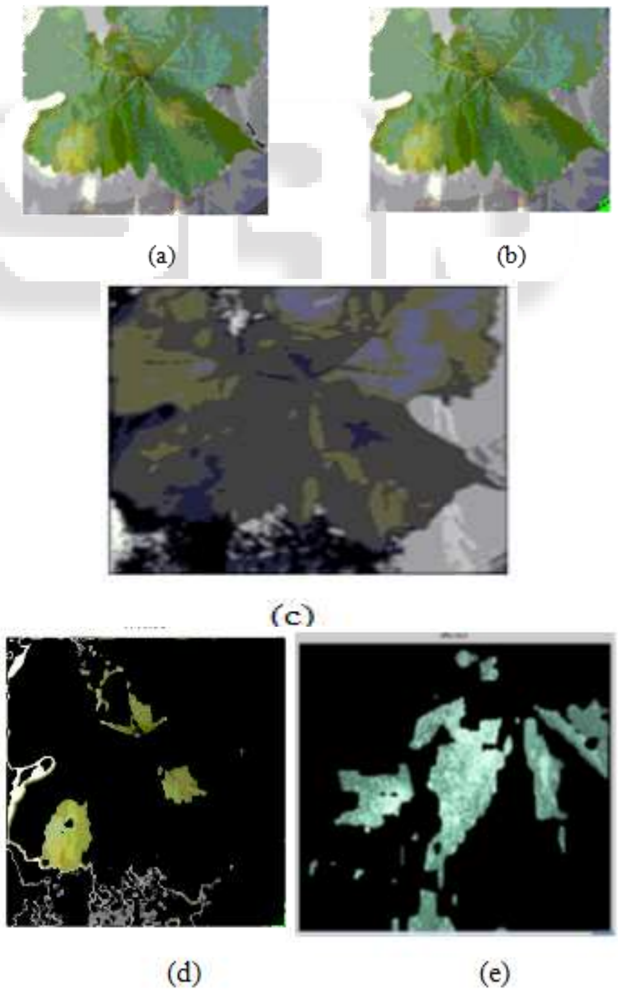


Fig. 2: Images resulted from different levels of detection process
(a) Input Image (b) Masked RGB Image (c) Diffused Image (d) Downy affected region (e) Powdery affected region

C. Fuzzy Logic and Neural Network

In this paper Paddy diseases are extracted from digital paddy leaf images using fuzzy entropy and then the diseases are classified using Probabilistic Neural Network(PNN).To test the model in challenging situation comparatively lower end devices were considered for image acquisition.

Preprocessing task includes three basic steps Image cropping, image conversion and image enhancement respectively. They used Fuzzy entropy to extract the paddy leaf diseases and membership functions to approximate the membership of the dark µd and the bright µb of an image with 256 gray levels.

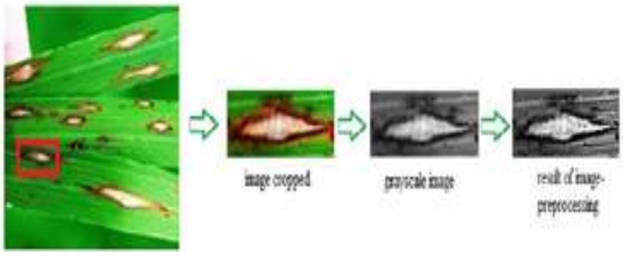


Fig. 3: Preprocessing task in Fuzzy Logic and PNN method

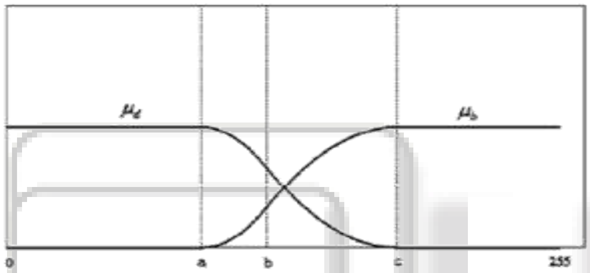


Fig. 3: Fuzzy Membership function graph

After image feature extraction using fuzzy entropy, the next step is image classification. In this research they used Probabilistic Neural Network (PNN) as paddy diseases classifier. PNN has several advantages i.e., its training speed is many times faster than a back-propagation network. PNN consists of four layers, input layer, pattern layer, summation layer and output layer. The accuracy of paddy disease identification is 91.46%.

D. Support Vector Machine

Support Vector Machine performs classification by constructing an N-dimensional hyper plane that optimally separates the data into different parts. SVM models are closely related to neural networks. SVM evaluates more relevant information in a convenient way [16].

Rakesh Kundal & Amar Kapoor in paper of title "Machine learning technique in disease forecasting: a case study on rice blast prediction" proposed a prediction approach based on support vector machines for developing weather based prediction models of plant diseases. In this paper they compared the performance of conventional multiple regression, artificial neural network (back propagation neural network, generalized regression neural network) and support vector machine (SVM). It was concluded that SVM based regression approach has led to a better description of the relationship between the environmental conditions and disease level which could be useful for disease management [17].

III. Discussion

The detection of disease is one in all the vital tasks. A disease reduces the assembly of agriculture. Each year the loss attributable to varied diseases is difficult half in agriculture production. Though work is disbursed until time on detection of diseases however correct segmentation of affected half supported style of family remains AN open drawback as an exploration space. Table1 shows the comparison between reviewed papers.

Author	Detection Technique	Result
P.Revathi and M.Hemalatha	Texture Statistics Computation	Less than 92%
Sanjeev S Sannakki, Vijay S Rajpurohit, V B Nargund and PallaviKulkarni	Neural Network	100% forDowny affected region and Powdery affected region
KholisMajid, YeniHerdiyeni, AunuRauf	Fuzzy Logic and PNN	91.46
RakeshKundal& Amar Kapoor	SVM method	97.2

Table 1: Comparison of detection technique

IV. Conclusion

After reviewing on top of mentioned techniques and strategies area unit able to conclude that there are variety of how by that we are able to observe sickness and nutrient deficiency of bush. Every technique has some professionals also as limitations. On one hand, visual analysis is least dear and easy technique, it's not as economical and reliable as others ar. Image process may be a technique most spoken of. Terribly high accuracy and least time are major benefits offered, however it backs away once implementing much. It'll keep company with alternate ways that in future as heap of analysis goes on during this space. Use of optical sensors is maybe not an excessive amount of helpful as so much as detection is concerned; it's of heap use in observance the plant. Still heap of analysis goes on these days during this matter thus we might see a lot of and a lot of helpful strategies. Comparison of methods shows that SVM classifiers perform better than others. Accuracy of detection can be increased when using SVM classifier with more number of features included to it.

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