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A Review: Cotton Leaf Disease Detection

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Abstract : *India is an agricultural country wherein more than 65% population is depend on agriculture. The crop loss due to diseases is approximately 10 to 30%. Farmers judge the diseases by their experience but it is not accurate and proper way. Sometimes farmers take opinion from experts to detect the diseases but this is also a time consuming way. At the time of inspection of crop damage, the inspection committee faces many problems about the identification of disease and actual percentage loss of crop due to disease. The main motivation of this topic is to identify the type of disease and quantify the damage of crop thereby providing the possible financial help or compensation to suffered farmers. This fast identification and quantification of disease is possible by using image processing techniques on the different parts of cotton crop. This review paper gives the survey of cotton leaf disease detection techniques used by number of researchers.*

Keywords: *image, Segmentation, Classification, feature, color, texture, disease, cotton*

I. Introduction

Cotton is one of the most important fibre crops in entire world to provide basic raw material for cotton textile industry. Cotton crop faces many problems due to diseases which affects it a lot and it is not possible to identify it by naked eyes. The largely affected part for the disease is leaf of the plant. About 80 to 90% of disease on the plant is on its leaves. Fig. 1 shows some examples of diseased and non-diseased cotton leaves. So, our study of interest is leaf of the crop rather than whole cotton crop. The diseases on the crop are classified as:

- Red Spot Disease (Lalya)
- White Spot Disease (Pandhari Mashi)
- Crumple Leaf Disease (Kokada)

(a) Normal Leaf (b) Red Spot (c) White Spot (d) Leaf Crumple

Fig. 1 Cotton Leaves (a) Normal (b)(c)(d) Diseased

II. Literature Review

In agricultural research, automatic disease detection on crop leaf is essential research topic as it monitors large crop fields and thus automatically detect disease as soon as they appear on plant leaves. The term 'disease' is normally used for destruction of live plants. To improve agricultural products, automatic disease detection of crop leaves is beneficial. This literature review is used to study different types of crop leaf disease detection techniques. Below are certain papers for the detection of diseases on the crop. By using these papers, the survey is done for the invention of new technique.

[1] The detection of disease on a leaf is done in number of steps. Firstly the original True-color image transformation is done into HSV which is a color descriptor structure where hue component is used for further analysis. Next, green color masking is performed by assigning zero or some background value to the green pixel which is not our part of interest. Thus segmentation is done and useful segments are obtained which contains significant amount of information. For texture feature analysis, color co-occurrence method is used by computing the parameters of Spatial Gray-level Dependence Matrices (SGDM) like Contrast, Energy, Local

homogeneity and correlation for hue content. [2] In pre-processing, truecolor image is converted to intensity image. During thresholding process, each pixel is considered as an object if its pixel value is greater than threshold value. The histogram of this thresholded image is obtained and is equalized. Now textural features are extracted using color co-occurrence matrix (CCM) and K-means clustering technique is used for disease detection.

[3] The system is divided in three steps: (i) Leaf segmentation (ii) Disease segmentation and (iii) Classification of disease. For leaf segmentation, LAB color space is used. This resulted image is clustered using Self-organizing feature map (SOFM) and color features are extracted using Back Propagation Neural Network (BPNN). Now grape leaf disease segmentation is performed using modified self organizing feature map with genetic algorithms for optimization and Support Vector Machine for classification. Gabor filter is also used to analyze leaf disease color features more efficiently. [4] The captured image is firstly enhanced followed by color image segmentation using edge detection techniques like Sobel and Canny. Image classification & diseased spot identification is performed using HPCCDD algorithm. The input captured images are directly sent by the farmers and after disease identification, the best solution to disease and pest recommendation is sent in 3 languages. [5] The system is proposed to regularize and extract eigenfeature from cotton leaf image. To extract the eigenfeature, scatter matrices are created using 100 sample images. This scatter matrix is developed which is within class type and this matrix is decomposed into various subspaces related to various diseases by considering the various variation of pixel value. Feature extraction and dimensionality reduction occur at the final stage. After comparison of feature, it results in disease identification.

[6] The RGB is transformed into other color space and most green color pixels are identified by applying K-means clustering technique. For masking these green color pixels, Otsu's method of thresholding is used. Next, diseased segmented RGB image is converted to HIS format and texture features are calculated using Color Co-occurrence Matrix (CCM) technique. Finally, the recognition process is performed for the extracted features through a pre-trained neural network. [7] The methodology is proposed for early and accurate disease detection on plant using diverse image processing techniques and Artificial Neural Network (ANN). The work starts with capturing sample images. These RGB images are converted into the CIE L*a*b* or CIELAB color scale for segmentation purpose. The images are filtered by Gabor filter to extract the texture and color features. Finally ANN is used for recognition and classification of image.

[8] Firstly the image is converted from RGB to gray, filtered using LPF and guassian filter. For segmentation, K-means clustering is applied followed by graph cut energy minimization operation. In color feature extraction, the segmented RGB image is partitioned into 64 blocks and a single representative color is calculated by averaging of pixel colors from each block and converted the image from RGB to YCbCr color space. Now 8X8 DCT is applied to obtain DCT of Y, Cb, Cr and zigzag scanning is performed to get color layout descriptor of the input image. By considering the parameters like area, perimeter, sharpness, etc., the shape features are calculated. [9] The image acquisition is done using digital camera and images are enhanced or smoothened with the help of Low Pass Filter and Gaussian filter. Active contour model (snakes) is used for image segmentation and seven Hu's moments are extracted as features to train the classifier . Those hu's moments are variable in rotation, scale and object translation. Finally using this feature vector, the feed-forward back propagation network method is used for the classification of disease.

[10] The effect of RGB to Gray, YCbCr, HSI and CIELAB color space is compared during pre-processing stage to detect the diseased spots on leaf. The converted image is then smoothened using Median filter by removing noise. From this noise free image, the diseased spots are detected by the application of Otsu's thresholding method on perticular color plane. In Method 1: RGB image is converted to Gray and applied Otsu's thresholding on the same. In Method 2: RGB image is first converted into YCbCr color space and after filteing otsu's threshold method is applied on "Cr" plane to detect the diseased spots. In Method 3: Here, instead of YCbCr, RGB image is converted to HSI color space, filtered and otsu's method of thresholding is applied on "H" component. In Method 4: Again same work is done for CIELAB color space and thresholding is applied on "A" component of filtered LAB color space. Finally CIELAB color model is used after comparing all methods. [11] The samples of diseased rice leaves are collected and the images are captured in macro mode through Digital camera. During pre-processing, captured images are replaced into Hue Intensity Saturation (HIS) model for segmentation after increasing brightness and contrast to preserve the image information. For segmentation, Entropy based bi-level threshoding method is used and boundaries are detected to extract the diseased spots with the help of 8-connectivity method. The spot size is defined for the range between 300x300 to 1500x1500. In post-processing, Self Organizing Map (SOM) neural network method is used for classification of disease on rice.

[12] In the proposed system, the work is done on Grape leaf for the diagnosis and classification of diseases using NN. Initially, the grape leaf image with complex background is captured as input and resized to standard size 300X300. The background is removed using green color pixel masking and the noise is removed with the help of anisotropic diffusion upto 5 iterations to preserve the infected part information. Then, disease

segmentation is carried out using K-means clustering and the textural information from diseased part of segmented image is calculated from GLCM matrix for nine features. The extracted features are used by Feed forward BPNN to classify. [13] In this system, a color image is captured by digital camera in the laboratory with dark background to avoid the effect of environmental factors and then images are transferred to the computer. The segmentation is done to get the diseased part by setting appropriate threshold value mathematically & edges of image are detected using Sobel method. Next, The extraction of texture-feature for color image is done using CIE XYZ color space and the extraction of color-feature for color image is done using CIE L*a*b* color space. The shape feature is also extracted by considering the parameters like area, roundness, shape complexity, etc. Using these features, membership function is calculated and defined for each class of disease for disease recognition and lastly it is used in a nearest neighbor classification.

III. Summary Of Literature Review

From above literature survey it is observed that numbers of methods are used by number of researchers for leaf disease detection and classification. While developing the system, researchers considered some key points like accuracy, speed, complexity, cost and flexibility. Following is the summary of used techniques and the gaps identified by the researchers:

Ref. No.	Techniques Used	Features	Gaps Identified
1	RGB to HSV color space, green color masking, CCM using SGDM	HSV color space gives good color description to extract the textural information.	The recognition rate of classification process is slow.
2	Grayscale, Histogram, Histogram equalisation, HSI, CCM, K-means clustering	Enhances accuracy in automatic detection of normal and affected produce	Limited database used.
3	LAB color space, SOFM, BPNN, Genetic Algorithm, SVM classifier, Gabor filter	Gives automatic plant disease diagnosis with very efficient classifier.	Limits to extract ambiguous color pixel from background.
4	Image enhancement, Sobel & Canny edge detection, HPCCDD Algorithm	The proposed HPCCDD algorithm gives highest detection accuracy of 98.1%	System is complex.
5	Eigen feature extraction, Scatter matrix	Eigen feature extraction has more success rate than other methods. It gives 90% accuracy to detect red spot disease.	Less accuracy to detect the diseases other diseases red spot disease.
6	HIS, K-means clustering, Otsu's thresholding, CCM method, Neural network	The system is robust with 83% to 94% detection accuracy.	The recognition rate is less as compared to other classifiers.
7	CIE L*a*b*, Gabor filter, Artificial Neural Network	Gabor filter and ANN gives better results with 91% recognition rate.	Complex algorithm.
8	K-means clustering, Graph cut energy minimization, Image quantization, YCbCr, DCT, Zigzag scanning	The system gives good result using color & shape feature for 3 kinds of diseases followed by any classifier.	The system is complex due to more number of algorithms
9	LPF, Gaussian filter, Active Contour model (snake), Feed-forward back propagation neural network	The classifier gives average accuracy about 95.52% with automatic disease detection.	The processing time increases due to snake segmentation algorithm.
10	YCbCr, HSI, CIELAB color space, Median Filter, Otsu's thresholding	Noise introduced due to camera flash, background & veins can be eliminated using CIELAB color space successfully.	Disturbance of veins with different color than green is hard to ignore.
11	HIS color space, Entropy based bi-level thresholding, boundary detection, SOM neural network classifier	Detection technique is computationally efficient which gives satisfactory classification of test images.	The system is time consuming.
12	Image resizing, Anisotropic diffusion, K-means clustering, GLCM, Feed-forward back propagation neural network	The system is robust which can work for complex background, varying distance & lightening condition at the time of image capturing.	Only 2 diseases detected with limited sample images
13	CIE XYZ color space, CIE L*a*b* color space, Sobel method, membership function, nearest neighbour classifier	The system gives 70% classification accuracy with less than 2sec recognition time	3.2Mpixel low resolution digital camera may give wrong result and limited sample images may affect system accuracy.

IV. Conclusion

Thus, this paper gives the review of techniques for disease detection on crop leaves. To propose the methodology, number of parameters are considered by the researchers like simple and robust system, recognition time & accuracy, automatic detection, proper classification and less computational time. This paper is very much helpful for the study of existing systems and development of new technology for disease detection on crop leaves.

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