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Study and Analysis of Cotton Leaf Disease Detection Using Image Processing

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ABSTRACT: The detection of plant leaf disease is a very important factor to prevent serious outbreak. Most plant diseases are caused by fungi, bacteria, and viruses. Traditionally farmer visually checks the disease. This paper presents an approach for careful detection of diseases and timely handling to prevent the crops from heavy losses. The diseases on the cotton are critical issue which makes the sharp decrease in the production of cotton. So for the study, of interest is the leaf rather than whole cotton plant. About 80-95% of diseases occurred on the cotton leaves are like Alternaria, Cercospora, Red spot, white spot and Yellow spot on the Leaf. In this Paper initially the image of the infected leaf is taken& the image pre-processing is done taking the histogram equalization is applied to increase the contrast in low contrast image. K-means clustering algorithm is used for segmentation which classifies objects based on a set of features into K number of classes and finally classification is performed using Neural-network. Thus image processing technique is used for detecting diseases on cotton leaves is simple and accurately.

KEYWORDS : Crop Image, Agriculture image Processing, Image segmentation, Histogram Equalization.

I. INTRODUCTION

India is an agricultural country; where in about seventy percentage of the population depends on agriculture. Farmers have wide range of diversity to select suitable Fruit and Vegetable crops. However, the cultivation of these crops for optimum yield and quality product is highly technical. It can be improved with the aid of technological support. The management of perennial fruit crops requires close monitoring especially for the management of diseases that can affect production significantly and subsequently the post-harvest life. Cotton," The White Gold" or the "King of Fibers" enjoys a pre -eminent status among all cash crops in the country and is the principal raw material for flourishing textile industry. It provides livelihood to about sixty million people and is an important agricultural commodity providing remunerative income to millions of farmers both in developed and developing countries. This work exposes to automatic detection of disease on cotton leaves. There are certain issues with field crop like to identify deficiency of nutrition in plants, to identify various diseases, various pests which affect crops. Each issue has an importance. Among there one is detection of pests so that proper action should be taken to control it leading to minimize loss. When any of such a condition occurs then farmers become aware about the pest, then they can take correct action and control the situation but if farmers does not have correct knowledge, then misidentification of any pests can be possible and incorrect controls measure like non-affecting pesticides can be used leading to wasting of work and money. Most important it may lead to serious problem to crops. The diagnostician must have very good observation skills, and he/she also needs to be a good detective. It is important to keep an open mind until all of the facts related to the problem can be collected. The possibility of multiple causal factors must also be considered. Control measures depend on proper identification of diseases and of the causal agents. Therefore, diagnosis is one of the most important aspects of a plant pathologist's training. Without proper identification of the disease and the disease-causing agent, disease control measures can be a waste of time and money and can lead to further plant losses. Proper disease diagnosis is therefore vital.

Otherwise they may approach to any agricultural experts who give them suggestion regarding detection of diseases and increase the crop productivity. But, commonly they may face following situations like: Sometimes they have to go long distances for approaching the expert and expert may not be available at that time. Sometimes, the expert whom a farmer contacts, may not be in a position to advise the farmer with the available information and knowledge.

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A. Different types of Diseases on Leaves of Cotton

The diseases on the cotton leaves are classified as,
A.1) Bacterial disease: e.g. Bacterial Blight, Crown Gall, Lint Degradation.
A.2) Fungal diseases: e.g. Anthracnose, Leaf Spot.
A.3) Viral disease: e.g. Leaf Curl, Leaf Crumple, Leaf Roll.

Some of the cotton leaf diseases and treatments presently given explained below.

A.1) Alternaria Spot Disease on Leaf Cotton

Following fig.1 shows the Alternaria Spot Disease on Leaf Cotton.

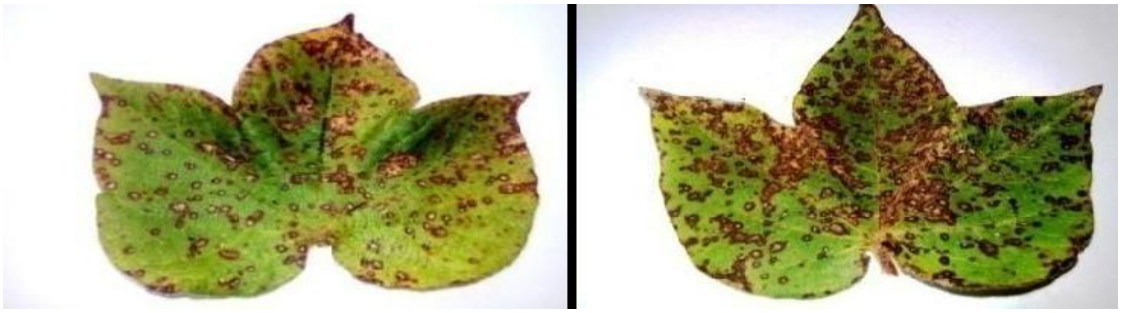

Fig -1: Alternaria Leaf Spot

This disease arises due to potassium deficiency. Leaf shows brown necrotic Neorotic tissues turn a sooty black colour due to prolific sporulation by the fungus.spots. Lesions and concentric rings are seen on the leaves.
Treatment of Pseudomonas fluorescens Pf-1 10g/kg seed and foliar spray @ 0.2% on 30, 60 and 90 DAG

A.2) Cercospra Leaf Spot Disease on Cotton

Following fig.2 shows the Cercospra lesf spot disease on cotton.

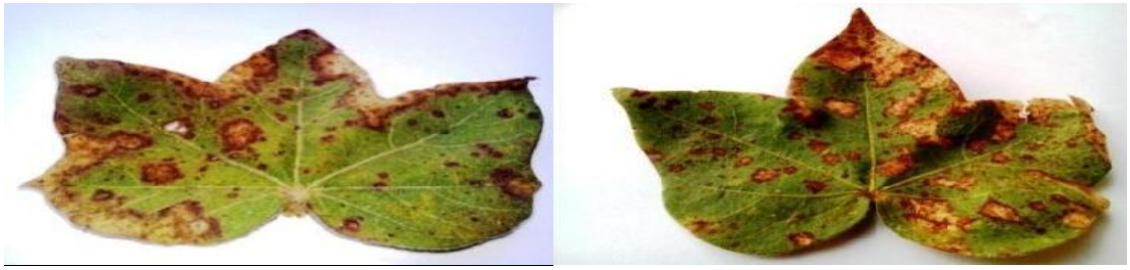

Fig -2: Cercospra Leaf Spot

Red dot marks on the leaves which expand in diameter to about 2 cm. Irregular brown lesions, often surrounded by chlorotic tissues. The angular leaf spot appearance is due to restriction of the lesion by fine veins of the cotton leaf.
Treatment of Pseudomonas fluorescens Pf-1 10g/kg seed and foliar spray @ 0.2% on 30,60 and 90 DAG.

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Red Leaf Spot Disease on Cotton

Following fig.3 shows the red leaf spot disease on cotton.

Fig -3: Red Leaf Spot

Nutritional deficiency symptoms – Nitrogen content below 2% in leaf. Water logged soil conditions. Decrease in minimum temperature below 15^0C lead to the formation of anthocyn in pigment in the leaf.

Cotton Disease Recognition System

Diseases on the cotton plant decreases productivity of the cotton production. The image processing technique is used for detecting diseases on cotton leaves early and accurately. Following fig.4 shows the block diagram of cotton disease recognition system.

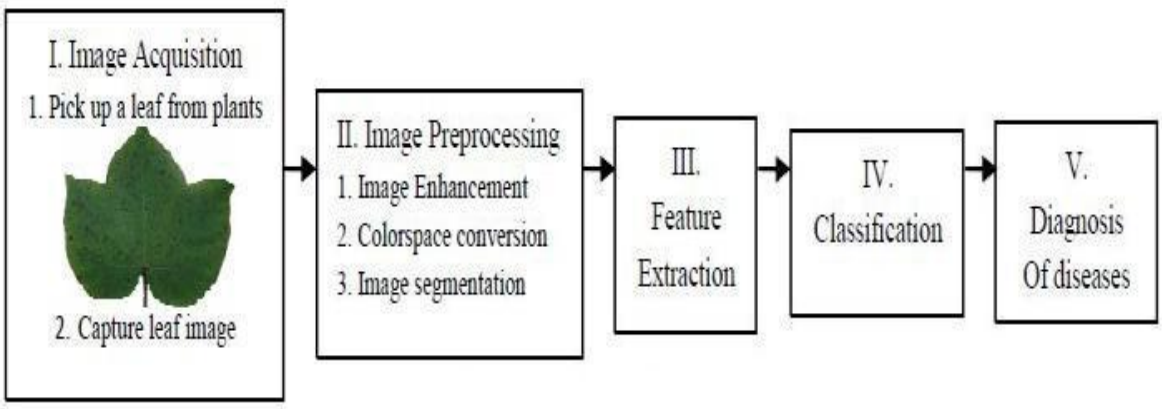

Fig -4: Cotton Disease Recognition System Block Diagram.

Image Acquisition: For capturing the rich details of cotton leaf patterns, an acquisition system should have a minimum resolution of 512 X 512 pixels in frame.

Image Pre-processing: Here initially pre-processing the input image using histogram equalization is applied to increase the contrast in low contrast image.

Feature Extraction: In this, Color feature variance is used for matching the train image features to database images.

Leaf Segmentation: For detection of internal and external boundaries of the cotton leaf, use K-mean clustering algorithm technique.

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Leaf Recognition: Before actual recognition process of cotton leaf image, the disease spot is located using color feature technique. Finally recognition is performed using neural-network to recognize the diseases.

II. EXPERIMENT WORK

Initially, the digital images are acquired by using a digital camera. Then image-processing techniques are applied to the acquired images to extract RGB Pixel counting features that are necessary for further analysis. After that, some analytical perceptive techniques are used to classify the images according to the specific problem at hand. In this work farmers can take decision immediately at the time. They want to get the best solution to diseases and pest recommendation in 3 languages Marathi, English, Hindi, Production can be improved, the yield loss can be reduced, they minimum cost of ultimate system very useful to farmers and we can increase the economics of the country. The proposed method is flexible for all image sizes. It is common practice to have the pre-processing of Cotton leaf images before it has been extracted and classified. The processing scheme consists of image acquisition through digital camera or web, image pre-processing includes image enhancement and image segmentation where the affected and useful area are segmented, feature extraction and classification. Finally the presence of diseases on the plant leaf will be identified. For feature extraction, I am using K-mean clustering algorithm method for classification and Neural-network as recognizer.

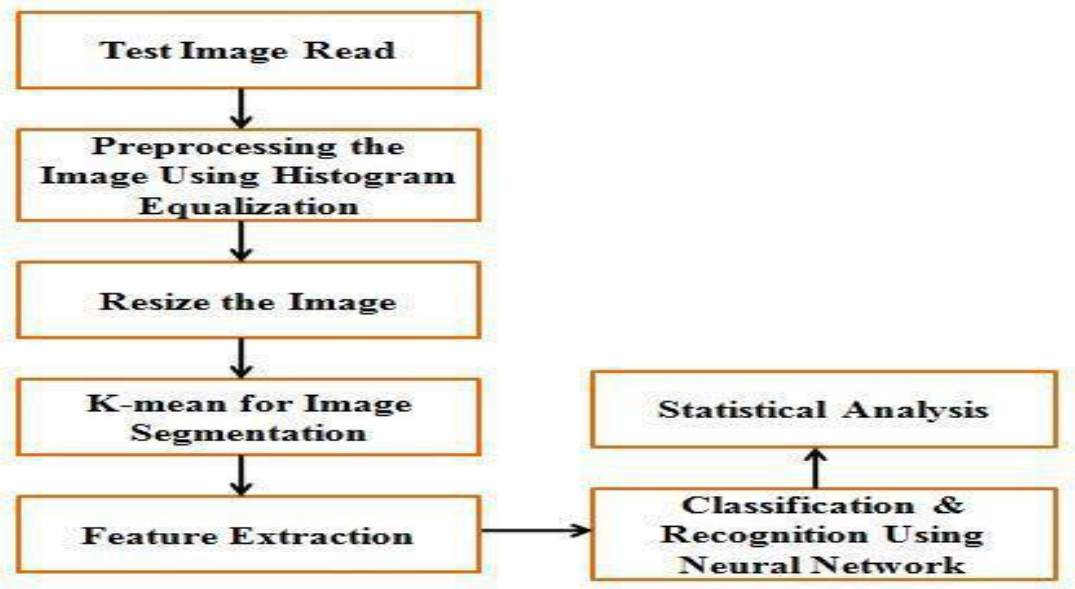

Fig -5: Flow Chart for Cotton Leaf Disease Detection Using Image Processing Technique (Ref.8)

III. PREPROCESSING STAGES

It is common practice to have the pre-processing of Cotton leaf images before it has been extracted and classified. There are several steps used for the detection of plant leaf diseases as shown in fig.5. The processing scheme consists of image acquisition through digital camera or web. Image pre-processing includes image enhancement and image segmentation where the affected and useful areas are segmented; feature extraction and classification are carrying out. Finally the presence of diseases on the plant leaf will be identified. In the initial step, RGB images of leaf samples were picked up. The step-by-step procedure is shown as below.

1) RGB image acquisition
2) Preprocessing of image using histogram equalization
3) Resize the image

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4) K-mean Algorithm for image segmentation
5) Computing features extraction
6) Classification & Recognition using neural networks
7) Statistical analysis.

A. Preprocessing of Cotton Leaf Image

The input image has to be preprocessed because images are corrupted by a type of multiplicative noise like light intensity and shadow on a cotton leaf images that may contain useful information about the leaf spot that can be used in the diagnosis. The preprocessing is done with the contrast enhancement using Histogram equalization.

B. Contrast Enhancement

It improves the perceptibility of objects in the prospect by enhancing the intensity difference between objects and their background. It is typically performed contrast stretch followed by tonal enhancement. This procedure could both be performed in single step. A contrast stretch improves the intensity differences consistently across the dynamic range of the image, whereas tonal enhancements improve the intensity differences in the highlight (bright), midtone (grays), or shadow (dark) regions at the expense of *the* brightness differences in the further regions. The fig.6 (a&b) shows the capture Image & Image after reflection removed respectively.

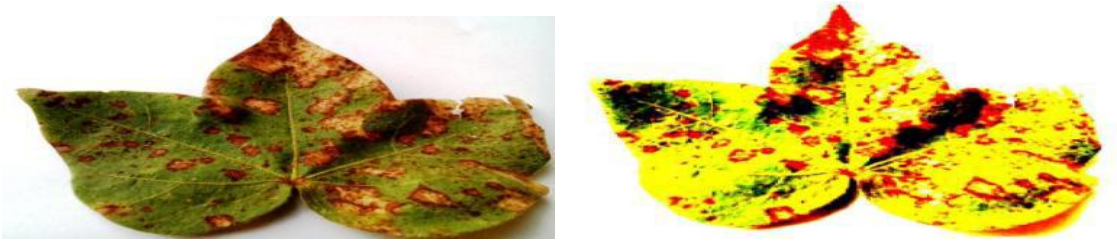

Fig -6: (a) Capture image. (b) Image after reflection removed

C. Image Segmentation

The leaf spot in the capture image generally contains reflection from source, which forms some intense spot in the cotton leaf, but pixel value within the cotton leaf is over a particular threshold then it is replaced by pixel value of some neighbourhood pixel. This operation fills all intense leaf spot present in cotton leaf area as shown in Fig -7.

Fig -7: Segmented Result

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D. Classification

Instance-based classifiers, such as the k-mean classifier operate on the premises that arrangement of unknown instances can be done by concerning the unknown to the known considering to some distance/match function. The instinct is that 2 instances distant separately in the instance space defined by the appropriate distance function are less probable than 2 closely located instances to belong to the similar class.
The objective of the k-mean clustering algorithm is to use a database in which the data points are separated into several separate classes to predict the classification of a new sample point.
The non-parametric k-mean classifier is tested in this study. It classifies a test sample to a class according to the majority of the training neighbours in the feature space by using the minimum Euclidean distance criterion. The algorithm for the nearest neighbour rule is summarized as follows; given an unknown feature vector x and a distance measure, then Out of the N training vectors, identify the k nearest neighbours, regardless of class label.
Out of these k samples, identify the number os vectors, ki, that belong to class wi, i=1, 2, …….M.
Assign x to the class wi with the maximum number ki of samples.

E. Image Enhancement

The image enhancement of normalized image has been carried out due to reasons of low constract, background illumination and non uniform brightness. This type of problem can be overcome by removal of background illumination in order to get a good distributed texture image shown in fig.8.

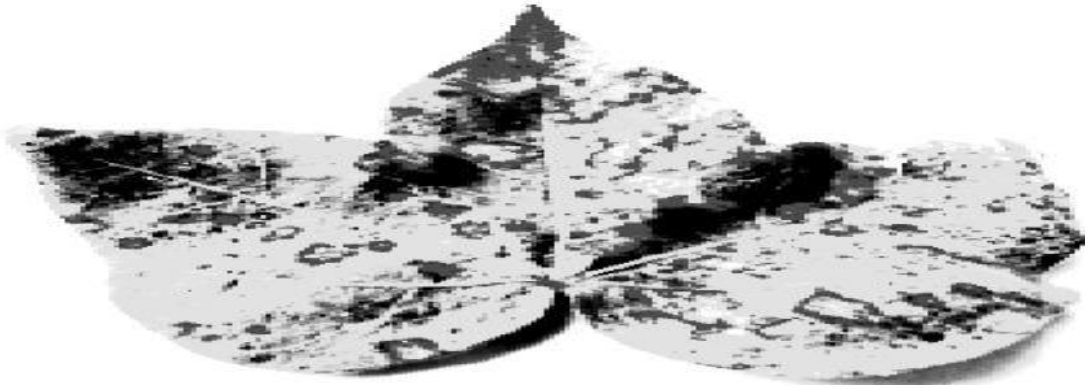

Fig -8: Enhanced Version

IV. EXPERIMENTAL RESULTS

A. Pre-processing Result of Cotton Leaves Disease

The actual leaf image can be obtained by taking a photograph by using high resolution camera or database. The fig.9 shows the input Image.

Fig -9: Input Image

The same input is converted into gray image by using function rgb2gray in Matlab tools. The following fig -10.shows

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the gray image.

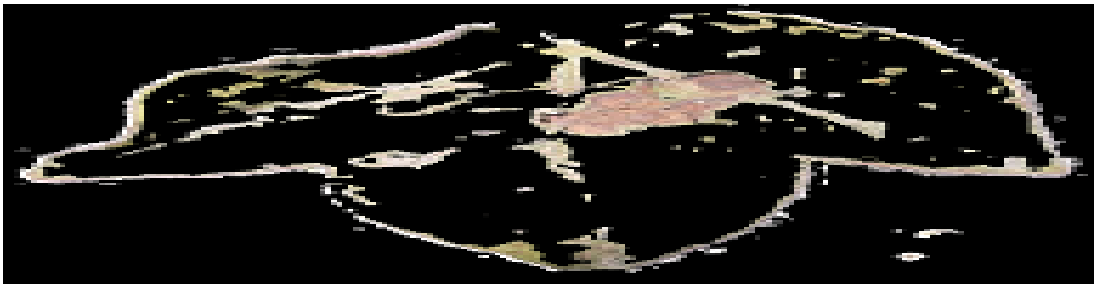

Fig-10: Gray Image

First convert gray images into RGB and then convert it into Binary image. An below Segmented result with 0 and 1 has shown as black and white. Based on those segmented pattern we have obtained an image shown in Fig -11.

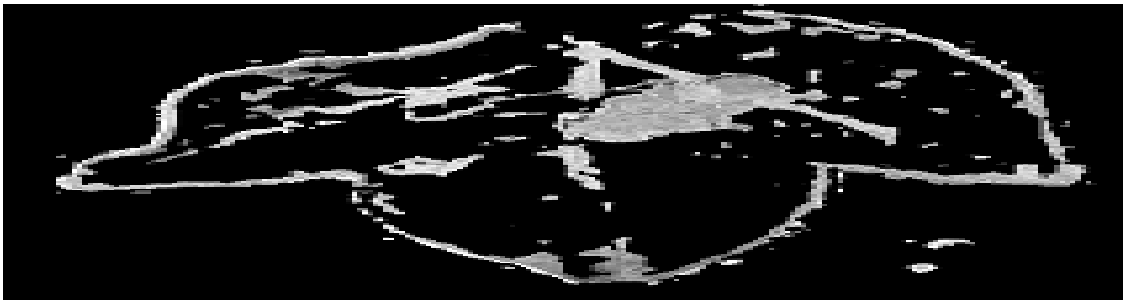

Fig-11: Binary Image

Morphology is a broad set of image processing operations that process images based on shapes. Morphological operations apply a structuring element to an input image, creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbours. By choosing the size and shape of the neighbourhood, you can construct a morphological operation that is sensitive to specific shapes in the input image.

The most basic morphological operations are dilation and erosion. Dilation adds pixels to the boundaries of objects in an image, while erosion removes pixels on object boundaries. The number of pixels added or removed from the objects in an image depends on the size and shape of the *structuring element* used to process the image. In the morphological dilation and erosion operations, the state of any given pixel in the output image is determined by applying a rule to the corresponding pixel and its neighbors in the input image. The rule used to process the pixels defines the operation as dilation or erosion.

Fig-12: Eroded and dilated image

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Using morphological operation erosion and dilation on images to get the proper detection of disease. The fig.12 shows the eroded and dilated image.

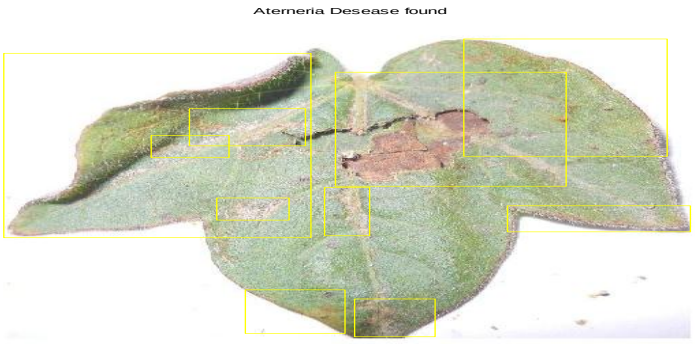

Fig-13: Alternaria Disease

The figure 13 shows the Alternaria disease found.

V . CONCLUSION

In this paper, Study of diseases on the cotton leaf studied by using the image processing toolbox and also the diagnosis by using MATLAB helps us to suggest necessary remedy for that disease arises on the leaf of cotton plant. We know that recognition of the human eye is not so much stronger that he can differ minute variation in the infected part of image because that minute variation pattern of color can be a different disease present on the leaf of cotton. MATLAB software can provide the exactly differentiating the variation of color present on these leaves and depending upon that variation the further compare with database stored image features related to the color. This paper provides a method to detect cotton leaves diseases using image processing technique. Firstly, K-means clustering algorithm is used for segmentation which classifies objects based on set of features into K no. of classes where feature extraction is color feature variance used for matching the train image features from database images and finally recognition is performed using Neural-network. The recognition accuracy for K-Mean Clustering method using Euclidean distance is 89.56% and the execution time for K-Mean Clustering method using Euclidean distance is 436.95 second and also thresholding is done by a dynamically range [0,1] depending on color intensity from leaves image.

Hence that disease detection using K-Mean Clustering method using Euclidean distance is the excellent methods to disease detection on cotton leaves.

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