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Automatic Early Leaf Spot Disease Segmentation on Cotton Plant Leaf

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Abstract: ***Diseases are decreasing production of plants. At present, farmers are identifying, diagnosing diseases and monitoring health in plants by their own knowledge and experience. Naked eye observation by farmers and experts on big plantation areas cannot be possible each time and it can be expensive. Accurate identification of visually observed diseases, symptoms and controls has not studied yet. Therefore a fast automatic, economical and accurate system is an essential research topic that may improve in leaf disease detection of plant disease. The proposed automatic early leaf spot disease segmentation on leaf of cotton plant system is based on image processing and machine learning where segmenting the three major diseases such as Bacterial Blight, Alternaria leaf spot and Cercospora leaf spot. Initially, the infected leaf images are captured from cotton plant fields by using a digital camera. Scaling, background removing and color conversion are done in the preprocessing phase. After preprocessing, the infected region is obtained by using K-means clustering algorithm. The infected region can be applied for detecting the diseases on cotton plant.***

Keywords: clustering, feature extraction, image processing, segmentation.

I.INTRODUCTION

Cotton is the most important crop for Indian economy. Cotton has most globally significance in oil and protein yielding as well as making fiber. India is the second largest producer of cotton in the world and produced 6.71 million metric tons of cotton. Automatic early disease detection of cotton plant may be useful for monitoring large fields of cotton crops and also prevent production losses. There are more than 80% diseases of cotton plant on its leaves. So it is easy to capture images of cotton leaves [15]. The Cotton plant leaf has diseases like bacterial, fungal, viral and due to insects. The major diseases on cotton plant leaf are leaf spot, Alternaria, Bacterial blight and leaf curl. Computer is an important device in the agriculture application for image processing. First healthy and infected images are captured through the camera. Image preprocessing is required for removing noise and smoothing of the images.

Image segmentation is an important technique for segmenting the images into smaller segments that are more meaningful. Images are segmented based on the similar properties of objects like texture, shape and color.

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In this application, we segment and detect infected region on Bacterial Blight, Alternaria leaf spot & Cercospora leaf spot disease which are often found on the leaves of cotton plant.

II.LITERATURE SURVEY

In this survey, we describe the methods, classification techniques, plant name & size of dataset used in previous work.

Table 1: Literature Survey

Sr. No	Reference Paper & Year	Classifier	Plant	Dataset
1	Elham Omrani et.al [2],2014	K-mean clustering SVM	Apple	320
2	Amar Dey, et al, [4],2016	Otsu thresholding	Piper Betel	120
3	H. Sarbol, et. al[5], 2016	Classification Tree	Tomato	383
4	Vijay singh, A.K. Mishra, [6], 2017	Genetic Algo rithm	-	60
5	Ajay Kaul, et. al[7], 2018	Radial Basis Function & Neural Network	Fungal Dis-eases	277
6	Bin Liu,et al,[8], 2018	Deep Convolutionall NeuralNetwork	Apple	13,689
7	Serawork Wallelign, et. al[9],2018	Convolutional Neural Network	Soybean	12,673
8	Guiling Sun, et. al[10], 2018	Multiple Linear Regression	-	-
9	Shima Ramesh, et al[11], 2018	Support Vector Machine	-	-
10	Sardogan, et. al[13], 2018	Convolutional Neural Network	Banana	-
11	Hong Zhang, et al[12], 2019	Convolutional Neural Network	-	-

Leaf spot segmentation and detection is critical and complicated task to implement.

Many researchers have used various techniques for finding the infected region and different types of machine learning algorithms for detecting and classifying the diseases on plant leaves.

III.PROPOSED SYSTEM

The proposed system for leaf spot segmentation using image processing consist of following steps:

1. Cotton plant leaf image acquisition
2. Image preprocessing of acquired images
3. Color based Segmentation
4. Edge Detection

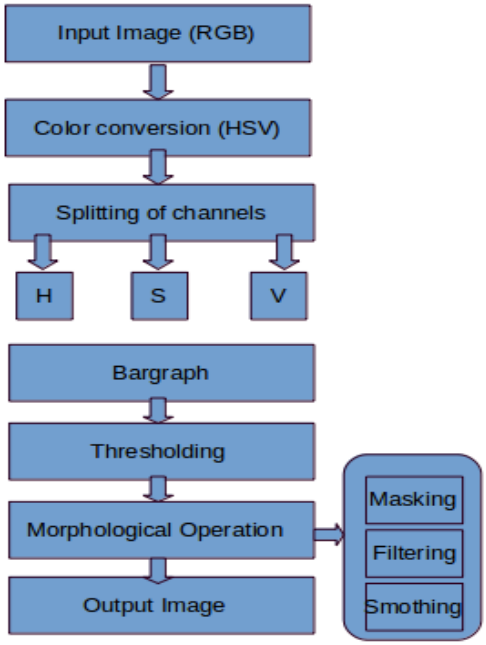

Fig 1: The flow diagram of proposed system

A. Cotton plant leaf image acquisition:

Initially, the infected leaf images are captured through digi-cam with 300*500 resolutions from the region of Maharashtra, India. By default all images are saved in the RGB color space model while capturing the images from a digital camera. Some of the images were downloaded from the PlantVIllage database. The size of the dataset is 1070 leaf images of four classes including healthy images. The dataset is summarized per classes as followed:

Table 2: Types of Diseases

Sr. No.	Types of Diseases	Number of Images
1	Healthy Images	400
2	Bacterial Blight	250
3	Alernaria leaf spot	200
4	Cerespora leaf spot	200
Total		**1070**

B. Diseases on cotton plant leaf

- *Bacterial Blight (Angular leaf spot):* It is bacterial disease, where more than 10% losses on cotton plant yielding are due to bacterial blight. It is affected by Xanthomonas citri bacteria. The red or brown border is shown on lesion of leaf. It is also infected on stem and petiole of cotton plant. Angular shape is progressed on lesions of upper leaf surface.

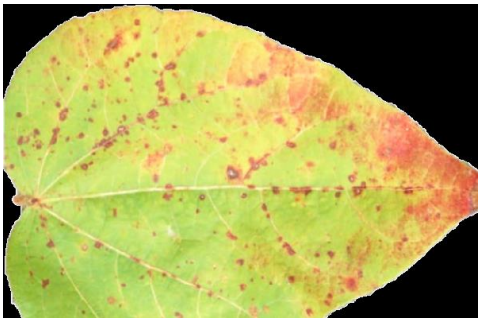

Fig. 2. Bacterial Blight on upper part of leaf

Fig. 3. Bacterial Blight on lesion of leaf

- *Alternaria Leaf Spot:* It is one the major disease which is observed on all cotton plantation countries in the world. This foliar disease is highly infected on cotton production and reduced quality and quantity. Brownish spot is shown on lower leaf surface and on boll of plant.

Fig. 4. Alternaria leaf spot

- *Cerespora leaf spot:* This is also foliar disease caused by Cercospora gossypina. Raddish spot is shown on middle of leaf. It is usually affected with stress such as drought and nutrient deficiency.

Fig. 5. Cerespora leaf spot

C. Image preprocessing of acquired images:

Image preprocessing operations such as resizing, color transformation, filtering, removing noise and background are required for finding meaningful contents from infected images. To find the infected region, It is necessary to convert RGB color space into the device-independent color space. In the RGB color space, the actual color is produced on the basis of tools used in the system. Whereas in a device dependent color space, the co-ordinates specify the color and produce the same color regardless of the device used to draw it. Therefore, convert RGB to HSV device dependent color space. In HSV color space, H is hue the color portion of the model. S is the saturation, describes the amount of grey in a particular color, V indicates value, works in a conjunction with saturation and describes the brightness or intensity of the color[2]. Python is used to implement all proposed algorithms in
this work. The PyCharm Community 2019 3.5 is used for implementation.

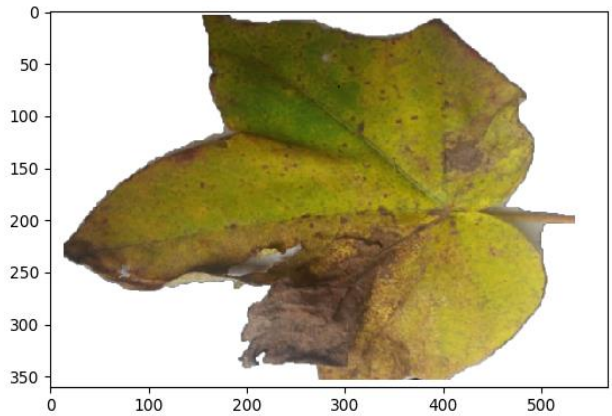

Fig. 6. Original RGB Image

After RGB to HSV color conversion shown in fig 7, each HSV image is observed that hue describes the clear perception of cotton infected leaf area also Hue is useful for masking the background and rest of the infected leaf image

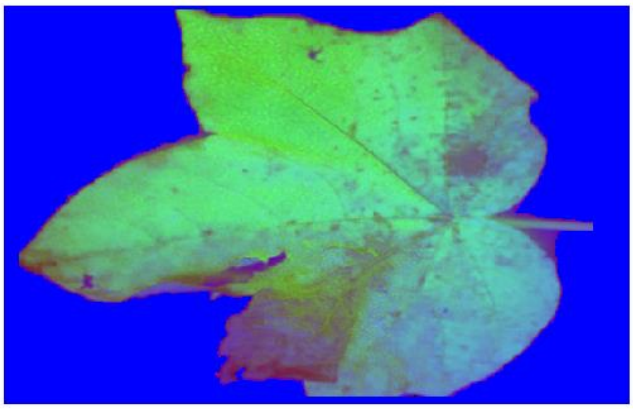

Fig. 7. HSV Image

D. Color based Segmentation and Smoothing of the image:

In the Image segmentation phase, it is the process of segmenting an image into multiple segments, often based on characteristics of the pixels in the image. Here, K-mean algorithm is used for segmentation. Color based segmentation is used to find infected regions that describe homogeneous colors in the infected leaf image correspond to separate clusters.

Cluster is a class of pixels based on similarities in color is shown in fig 9. Smoothing is used to reduce noise within HSV image.

Smoothing is performed by using MeanShift Filtering method to enhance and improve quality of image as shown in fig 8. K-Means clustering apply on smooth image to find infected region, it generates four color based cluster(k=4) as shown in bargraph. K –Mean clustering is used and based on the Euclidean distance formula (minimizing the sum of squares of distances between the objects and the corresponding centered classass)

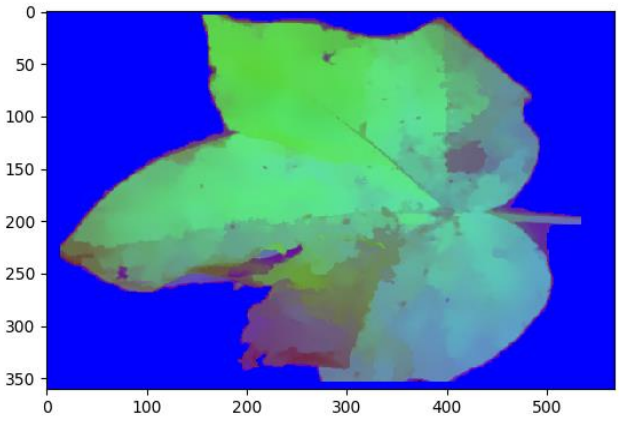

Fig. 8. Segmented Image

Fig. 9. Bargraph

E. Edge Detection

Edge Detection is an important technique for finding the boundaries of objects within the infected images. Edge feature is very important for every leaf image. Canny Edge detection algorithm is used for finding the boundaries in the form of tooth, smooth and wavy. It also finds the midrib alignment and vein pattern of infected leaf images.

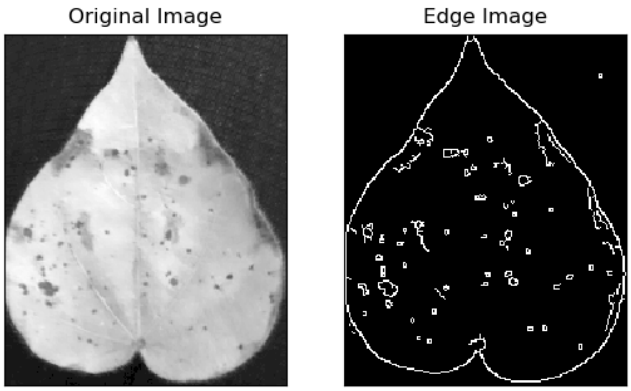

Fig. 10. Edge Detection

IV.CONCLUSION

Farmers judge the diseases by their own experience and knowledge; it results in misidentification of disease. So automatic leaf spot disease segmentation and detection is an expert system which is helpful for finding the infected region through segmentation and edge detecting the diseases. It is reducing the losses due to misidentification of the diseases. Three major diseases like Bacterial Blight, Cercospora Leaf Spot, Alternaria Leaf Spot are automatically classified based on image preprocessing and K-mean clustering technique.

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