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Cotton Leaf Disease Detection and Recovery Using Genetic Algorithm

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***Abstract*— A plant is the heart of an agricultural field and it improves source of energy as well as financial income. There is a huge source of plants, but due to the effect of environmental condition or as weather, climate change, many non native diseases occur on plants and cause social, ecological and financial losses. Many of the farmers are unable to recognize new disease. So the farmer needs an expert person who recognizes the disease and symptoms appearing on the plants, this will increase the cost of farming. To reduce farming, we introduce Android Application which diagnosis and identify the type of disease and symptoms of disease on plant leaves. The Android application performs basic operations like color transformation, thresholding and edge detection. Our system work on such plant leaves which are affected by many diseases that is a virus, fungi, excess of nutrients and insects, etc. We use image processing to detect and classify these diseases. Implement image processing operation on an android mobile device. It identifies the actual type of disease and its symptoms. Finally, using SVM-GA classifier to diagnosis the cotton leaf disease. Using Android Application type of disease, symptoms, remedy measures and recovery suggestions are given at a very less time and low cost.**

Keywords*— Android application, Image processing-Scaling process, Binarization, Edge detection-canny edge detector.

I. INTRODUCTION

In agriculture field, the cultivation of plants, animals, fungi, and other life structure for fiber, food, medicinal and other products used to sustain and enhance human life. The proposed work gives the brief description of various types of leaf diseases and its identification techniques. It mainly focused on cotton leave diseases and their symptoms. India is a 2nd largest cotton producing country in the world. Cotton growing in this country is around 9 states. The total production of the cotton in 2014-2015 crossed the mark of 400 lakhs Bales. Study of diseases of the cotton leaf can robustly studied by the image processing and also diagnosis using android application. The proposed work develop an Android application through the user can identify the diseases based on image of the plant leaf captured by mobile phone. The captured image species define which type of disease it is, how to recover or how to prevent by infection or viruses or high level nutrients of such diseases for normal growth and maintain quality and higher level production in market. Disease management/Detecting leaf disease is a challenging task in image processing.

II. RELATED WORK

Salve Yosef, Khilari Pranay, Prof. Hase A.K have proposed[1] the leaf disease detection by using android application. This paper introduced to identification of the disease using android application. The k-means algorithm is used for segmentation. To identify the diseases into one of the four diseases discussed in Authors Naikdurgesh Manikrao and A.J Vyavahare discussed [6] .

This work effectively identifies the diseases before it can affect the leaves. In agro field, due to disease on a leaf of plant causes decrease in quantity and quality of agro products. A flock of insects that attacks plant as well as bacteria, fungi also affected on leaf of plant and they damage the plant. So with the more efficiency these diseases have to recognize again and again. Normal Human vision cannot detect the disease more accurately [8]. Paper [7] describes the cotton curl virus disease and its symptom control measure is non-biotic tool is used for detecting cLcuD disease.

Amit et al proposed probabilistic neural network model for leaf identification process. The proposed approach is much faster and accurate than Genetic algorithm, Back propagation neural network and Principal component analysis. [13] This work is analyzing the visual symptoms of disease by using segmentation. Sobel filter and K-means clustering techniques are used for identification of disease.

III. PROPOSED MODEL

The mobile phone camera is used for acquiring the digital image of leaf. The preprocessing techniques are used for resizing the images from the original image. The process is extended to count the RGB pixel values and to convert the color values in RGB. The threshold value is calculated by using threshold techniques. Canny edge detector is used for detecting diseased spot of leaf images.

The proposed algorithm is described below:

Step 1: Capture image from Mobile Camera.

Step 2: Resize the images //Scaling Process.
Step 3: Convert image RGB into HSV image //Color transformation.
Step 4: Convert grayscale image into a binary image //Adaptive Thresholding.
Step 5: Apply the morphological operators for dge detection in the leaf images //

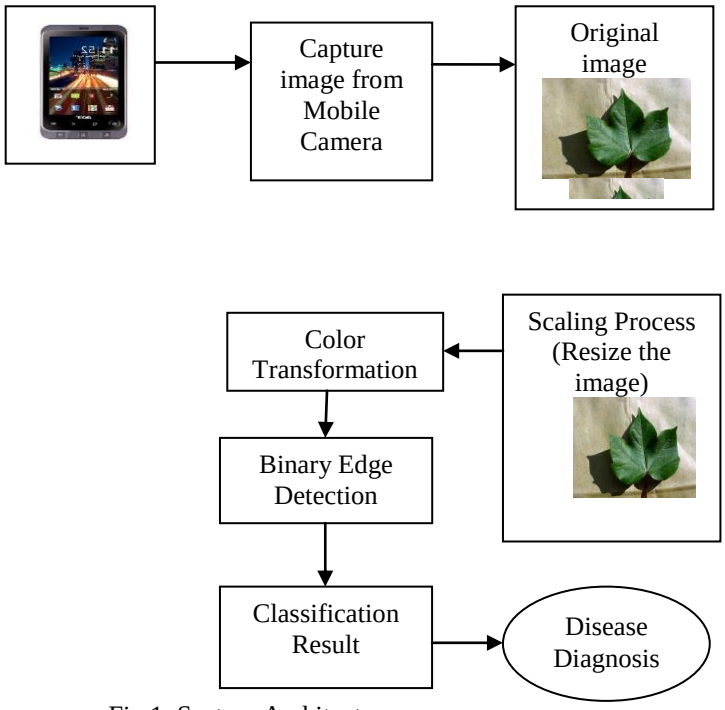

Fig 1. System Architecture

A. Image Preprocessing

In the proposed system, there are three techniques for preprocessing:

(i) Resize of image - After acquisition the image. It can be resized.
(ii) Color Transformation – the image is taken in the form of RGB. The proposed system used to convert RGB into Hue, Saturation, Value color space representation which is ideal for color perception.
(iii) Binary image - Image binarize using a thresholding algorithm

B. Scaling Process

Scaling is the process of changing the size of an image. When we may like to use an image but it is too big to utilize it to cause a memory problem for the devices. The way around the problem is to resize the image and scaling of Image is needed. Scaling an image goes in two ways, making it larger or to make it smaller. By growing an image, some new pixels are constructed by means of interpolation. In android for images, scaling it will appraise three factors height of the image, the width of the image, resolution of the images it measured in a DPI. The HSV model can be used for decoupling the intensity component of color carrying information in a color image.

C. HSV model:

HSV is a device dependent color model and build upon Human Color Perception. After color conversion to HSV, a binary threshold is applied. Binary threshold function reduces a grayscale image intoa binary level image. Threshold method is used in this work is an Adaptive Thresholding algorithm. The essential thing of binarization is to differentiate pixels that belong to the true foregroung region with single strength and back ground with different intensities. If the pixel value is below the threshold, it is assigned to the background value; otherwise it belongs to the foreground value.

Fig 2: Input image

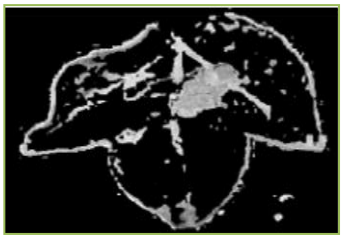

Fig 3: Binary image

D. Image Segmentation

Image segmentation is used to divide the image into various segments. It can also be used to,
• Identify the separate objects within an image
• Find the region of connected pixels with similar properties
• Find the boundaries between the regions
• Remove unwanted region

E. Edge Detection

Mathematical morphological operators are used for detecting edges in the image. Information on the shape of the image is extracted by using the structuring element. A morphological operation is the interaction of a set or function that represent an object with another simpler set. The information of the signal is extracted by using the structural element. Several morphological operators such as dilate, erode, open and close are performed in order to extract the edges of the image. The dilation operation enlarges the input object, whereas the erode operator reduces or shrinks the input object. The proposed work exploits dilate and erode operators. The operators for image f(n) and structuring element g(n) are described below.

$$\text{Dilation: } f(n) \oplus g(n) = \max[f(n-i) + g(i)] \quad (1)$$

$$\text{Erosion: } f(n) \Theta g(n) = \max[f(n-i) - g(i)] \quad (2)$$

The steps used to detect the edges as follows.

Class	Disease Name							
		Bacterial Blight	Fusarium Wilt	Leaf Blight	Root Rot	Nutrient deficiency	Verticilium Wilt	Accuracy
SVM	Precision	0.89	0.86	0.89	0.95	0.90	1.00	0.91 %
	Sensitivity	1.00	0.90	0.85	0.90	0.95	0.90	
	Specificity	0.98	0.97	0.98	0.99	0.98	1.00	
BPN	Precision	1.00	0.87	0.89	0.95	0.90	1.00	0.93 %
	Sensitivity	1.00	1.00	0.85	0.90	0.95	0.90	
	Specificity	1.00	0.97	0.98	0.99	0.98	1.00	
FUZZY	Precision	1.00	0.87	0.94	0.95	0.90	1.00	0.94 %
	Sensitivity	1.00	1.00	0.85	0.95	0.95	1.00	
	Specificity	1.00	0.97	0.99	0.99	0.98	0.90	
PROPOSED	Precision	1.00	1.00	1.00	1.00	1.00	1.00	0.993%
	Sensitivity	1.00	1.00	0.99	0.98	1.00	1.00	
	Specificity	1.00	1.00	1.00	0.99	0.98	1.00	

TABLE 1 Comparison Analysis

a. Dilate and erode the input image S_d and S_r respectively.
b. Calculate the average of S_d and S_r.
c. Calculate the difference between the average and the input image.
d. Apply modulus operation to improve the quality of filtered image.
e. Choose an adaptive threshold as the deciding function.

F. Classification

The process of SVM with genetic algorithm is finding optimal solution of cotton diseases. Our proposed work is based on feature selection using edges, color and shape. These features can be used to identify and classify the leaf diseases. The separation of feature vectors are separated by using SVM and classified by using genetic algorithm. A genetic algorithm determines the number of clusters. The color image of size m*n and every pixel has R,G,B components. The cluster centers are obtained by calculating the mean of each pixel of the clusters.

$$Z(r,g,b) = \frac{1}{n}\sum_x x(r,g,b) \quad (3)$$

The fitness function is calculated by using Euclidean distance between the pixels and their clusters. The conversion of RGB images is performed in HIS color space representation. The color co-occurrence matrices are generated by using pixel map. The genetic algorithm used three operators like selection, cross over and mutation. The feature selection is carried out using Genetic algorithm (GA). The extracted features are inserted into selection process.

IV. PERFORMANCE ANALYSIS

An experimental analysis for various classifiers and the effect of the disease detection metrics on plant leaves is conducted. Performance metrics analyzed using precision, sensitivity, specificity and overall accuracy. Various types of classifiers are used in many image processing techniques. All types of classifiers having some limitations and accuracy level are low.

Table 1: Performance Evaluation of SVM-GA,SVM, BPN and Fuzzy Classifiers in diseases vise Quantitatively, the performance was evaluated in terms of sensitivity, specificity, and precision. In which calculate using false positives (FP), true positives (TP),true negatives (TN), and false negatives (FN).The disease is detected in the early stage before the diseases affect the whole plant. Six diseases can be detecting the cotton leaves by the method of SVM with GA and compare with other methods. The proposed method gives a more success rate. In this method, we achieves 99.3%of accuracy for detecting leaves diseases.

(i)Precision: Precision computed based on the number of correct detections (true positive), the number of incorrect detections (false positive) and the number of missed detections (false negative), to show the robustness of the detection.

(ii) Sensitivity: It relates to the test's ability to determine positive results. Sensitivity is not same as the positive predictive value or precision

(iii) Specificity: If a test has high specificity, a positive result is shown from the test means a high probability of the presence of disease.

Sensitivity = $\frac{TP}{TP+FN}$ (4)

Specificity = $\frac{TN}{TN+FP}$ (5)

Precision = $\frac{TP}{FP+FN}$ (6)

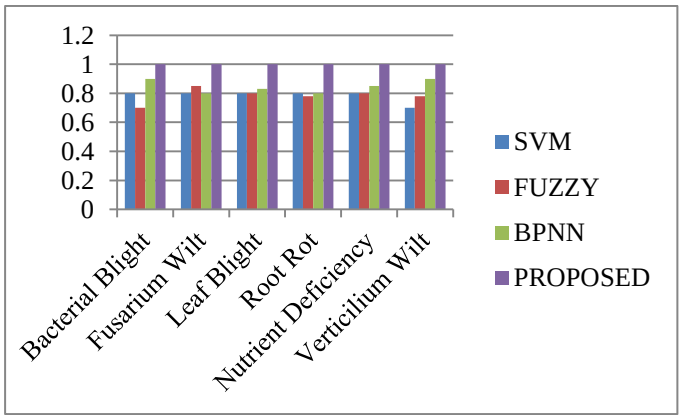

Fig 4: Comparative analysis of various classification techniques.

CONCLUSION

In this paper, the various types of leaf disease, its symptoms and recovery suggestions are discussed. To make an android application for leaf disease detection and recovery suggestions using image processing in which all details are given regarding leaf disease and its preventive measures displays. Through this paper, there are five major steps have been implemented, namely image segmentation, image pre-processing, image acquisition, feature extraction and classification. This is useful to extract accurate features of disease. In this work the new classification method has been proposed using SVM with Genetic algorithm. We found that SVM-GA gives good results, in terms of accuracy, for classification of diseases. The algorithms work successfully with an accuracy of more than 99.3 % for leaf disease detection.

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