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Implementation of Digital Signal Processing for Monitoring Plant Health

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Abstract- the diseases of plants is one of the major reason behind the reduction in the amount and quality of agricultural productivity. Great difficulties are encountered by farmers for the control and diagnosis of diseases of plants. Thus it becomes crucial to detect the diseases of plants during the initial stages for the suitable and timely action in order to avoid further losses. The approach of image processing is followed for detecting the diseases of cashew plants in this project. The image of leaf is uploaded on the system for the identification of cashew disease. A set of algorithms are used in a system for the identification of type of disease. The several processing steps are followed at the image given as input for the detection of disease and results are displayed to the user via android application.

Keywords: Segmentation, disease, K-mean, SVM, android.

I. INTRODUCTION

The diseases of plants are detected and identified by naked eye observation of experts. For the large area of farms, a continuous monitoring along with large team of experts is required for diagnosing the diseases of plants. But when it comes to rural areas where most of the farmers are uneducated, they don't have an idea about contacting the experts or they don't have proper facilities to do so. This leads to large consumption of time and the high monetary expenditure as consulting the experts have high cost. In this scenario, it is beneficial to choose the technique suggested in this paper in order to monitor large fields of crops. By looking at the symptoms on plant and detecting the diseases automatically is an easier as well as a cheaper way. Identifying the diseases of plants visually is a laborious work to do because it can be done in limited areas only and at the same time accuracy is also less. Whereas, less efforts and less time are required for the automatic detection of diseases. The microbial diseases of a plant can be viral, bacterial or fungal, or generally plants may have yellow and brown spots, or late and early scorch. The areas affected due to disease are measured by the technique of image processing and also the variation in colour of affected area is determined by this technique[1].

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The process of grouping and separating an image into different parts is known as the image segmentation. The method of simple thresholding and advanced colour image segmentation are the different methods of performing image segmentation.
There are various features found in an image on which the process of segmentation is based, such as segment of an image, boundaries of an image and the colour information of an image.

II. LITERATURE SURVEY

For identifying the diseases of plants automatically, extensive researches have been conducted. The disease can be manifested in any part of the plant such as stem, leaves, roots or fruits. The main focus of this work is leaves.
Paper [2] explains the methodology for identifying the diseases present on the stem and leaves of plants. The classification of segmented images is done by neural network after segmenting by K-Means segmentation technique. The image processing algorithm is used for the detection of visual signs of diseases of plants. For testing the accuracy of this algorithm, the comparison of automatically segmented images was done with manually segmented ones.
In Paper[3] , that part of the plant which has disease is segmented using several techniques is discussed. This paper discusses the techniques of classification that extracts the characteristics of an infected leaf and classifies the diseases of plants. The diseases in plants can be classified by using methods such as back propagation algorithm, self-organizing feature map, SVMs etc. Various techniques of image processing are used for correctly identifying and classifying the diseases of plants.
Paper [4] proposes the classification of plant diseases by using the technique of image processing that uses SVM classifier for discriminating healthy and diseased soybean leaves. Different mobile cameras were used in different farms and a database of 120 images is prepared for testing the algorithm. The classification of species of plants was done based on the shape of leaves by using SIFT algorithm. The accuracy pf 93.79% is achieved for the recognition of diseased and normal soybean leaves using SVM classifier [5].
An autonomous DSS is provided by inputs for providing necessary aid to farmers when needed over mobile is the main aim of this proposed work. Minimal efforts will be needed for providing help to the farmer by this system. No additional inputs are required because only the image of a plant leaf is captured by using a camera of mobile and send it to DSS.
Paper [6] has the work that detects the diseases of a plant and the parts that are infected.

The image processing is started after taking the input images. The first step contains the segmentation of background and black pixels. The separation of saturation and hue part of image is also done. And at last, the part that is infected and the percentage of area infected and the name of disease is declared. The better results are provided by studying the enhancement and advancement in computing classifiers of the approach of neural network. The percentage of area infected in plants is calculated in this study work.

III. PROPOSED TECHNIQUE

This section explains the flow diagram of steps that are followed for achieving the desired result. There are four major steps that are followed in this approach: cashew leaves' image acquisition and feature extraction, and disease classification and statistical analysis. The figure 1 illustrates the general flow of disease detection system.

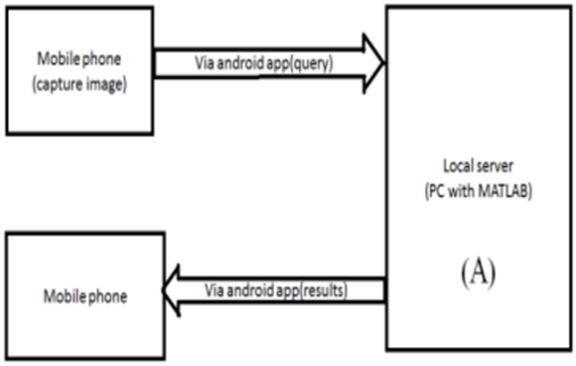

Fig. 1 General Block Diagram

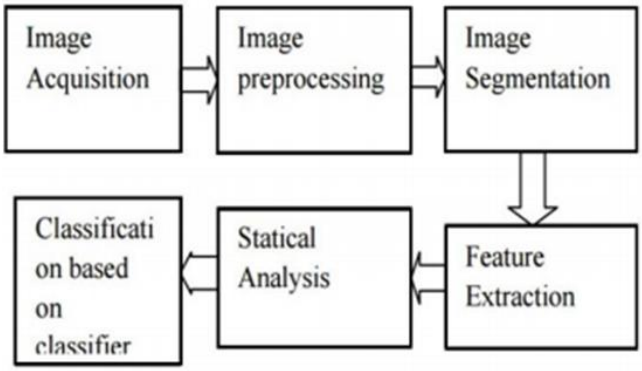

Fig. 2 Block diagram of image processing at server

In the initial step of this approach, a mobile camera is used to capture the acquiring images of leaves of cashew.

A. Image Acquisition

A camera is used to capture the images of a plant leaf in RGB. RGB stands for red, green and blue and it is created for colour transformation structure and then the application of a device independent colour space transformation for the transformation of colour is done [5].

B. Image Pre-processing

Different types of pre-processing techniques are considered for removing any object or noise from the image.

C. Image Segmentation

The segmentation means to partition an image into number of partitions that have similar characteristics or features. According to the features, the objects are classified into K number of classes in the K-means clustering. The classification of object is done by minimizing the sum of the squares of the distance between the object and the corresponding cluster.

K – Means Clustering Algorithm:

1. Choose a center of K cluster either heuristically or randomly.
2. The distance between the center of cluster and the pixel is minimized by assigning each pixel in image to the cluster.
3. All the pixels in the cluster are averaged and the center of the cluster are again computed. Steps number 2 and 3 are repeated again and again until the convergence is attained.

$$J = \sum_{j=1}^{K} \sum_{n \in S_j} |x_n - \mu_j|^2,$$

X_n represents the nth data point and μ_j represents the geometric centroid of data points in S_j .

D. Feature Extraction

Feature extraction plays an important role for identification of an object. In many application of image processing feature extraction is used. Colour, texture, morphology, edges etc. are the features which can be used in plant disease detections [3]. The features normally used for analysis are contrast, energy, correlation, homogeneity etc. [4].

E. Statistical analysis and classification:

The unique features are extracted from leaf and the classification is done as disease or healthy. The SVM classifier is used to do this. SVM stands for Support Vector Machine. The methods used for pattern and recognition employ SVM classifiers for supervised learning methods [7]. The assumptions for a new dataset which is known as the testing dataset is made by supervised learning that employs a known dataset. With an increase in the number of sample in training dataset, the accuracy of SVM classifier improves.

IV. RESULTS

1. The capturing of image was done through a mobile camera.
2. An android application is used to upload the captured image to local server.
3. The disease is determined by various image processing algorithms at the end of a server.
4. The result states the name of determined disease which is sent back to the mobile application.

The process is shown step by step in the following figure.

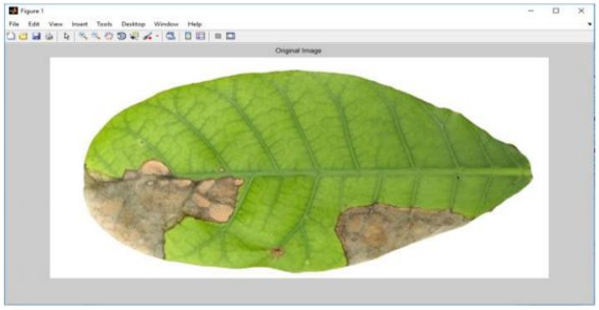

Fig. 3 Actual image

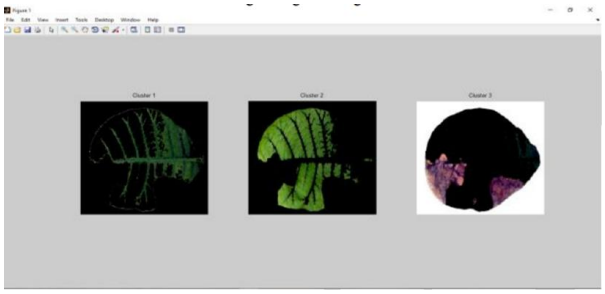

Fig. 4 Clusters formed after K-mean clustering algorithm

(a)

(b)

(c)

(d)

(e)

Fig. 5 The processes in mobile application where (a) Home page of application (b) After clicking upload button (c) Choosing an image for uploading (d) Uploading of an image on local server (e) Diseases obtained on server.

V. CONCLUSION

It is very crucial to classify and detect the diseases of a plant for successfully cultivating the crop and the technique of image processing is employed to do so. An automated technique for segmenting the diseased part of plant is discussed in this paper. Also the classification and feature extraction techniques for extracting the characteristics of infected leaf and classifying the diseases of plant are discussed here.

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