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Cocoa Care - An Android Application for Cocoa Disease Identification

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Abstract—India is an agricultural country. The correct and timely identification of diseases in crops is very much essential in agriculture. To obtain more valuable products, a product quality control is basically mandatory. Cocoa is an economically important crop that nowadays enlarges its production in southern India. To assist the farmers growing cocoa, we developed an android application Cocoa-Care. This application automatically identifies the diseases of cocoa crops, thereby helps the farmers who have little or no information about the disease. This application is developed by applying digital image processing techniques on the diseased cocoa images. Our approach replaces the manual disease inspection by the android application that identifies the cocoa disease from the captured image and suggests the possible remedies for the farmer. We used moment based texture features for the image representation and description. The matching is performed by nearest neighbor classifier. The results obtained are promising and this application can be used in the real time.

Keywords- *Cocoa Disease, Training, Classification, Feature Extraction*

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I. INTRODUCTION

Cocoa is an important commercial plantation crop of the world. At present, cocoa is cultivated in an area of 17,800 hectares in India with a production of 10,000 metric ton. Kerala accounts for 71 percent of the area and 80 percent of the production.

Diseases are the biotic factor with the greatest impact on cocoa production. Farmers and agricultural technicians regularly monitor the well-being of their crops. As diseases of the crops are inevitable, disease management is a challenging task. Precise quantification of these visually observed diseases, pests, traits has not studied yet because of the complexity of visual patterns.

There are some variety of factors that affect the cocoa growth and production. They are mainly: diseases affected to the cocoa, damage caused by the insect bites and nutrient deficiency. Black pod disease, canker, charcoal pod rot are some important diseases affecting the cocoa plant.

As of today, farmers and agricultural technicians mainly perform manual visual perception to assess the severity of the disease. It is not only tremendous amount of work but also suffers from two major issues: excessive processing time and subjectiveness rising from different individuals. Though automation is adopted in different areas of agriculture, the identification of cocoa disease not yet automated. Hence there has been increasing demand for more specific and sophisticated image pattern understanding. To conduct high throughput experiments, plant biologist need efficient computer software to automatically extract and analyze significant content. Here image processing plays important role. Thus there is a need to develop an application that identifies the disease affected by the cocoa plant. Our work focuses on providing the information regarding the diseases in cocoa plant and the possible solution for the corresponding diseases.

II. LITERTURE SURVEY

Technology is rapidly growing in the world nowadays. Almost all the mobile phones use the computer vision technology in them for providing the best features to the users. The evolution of these systems in the mobile phones exponentially diminished the use of ancient mobile phones. The technology has developed starting after the mid of 20th century. Computer vision and the scope of Digital Image Processing opened the path for this. The software solution for automatic detection and classification of plant leaf diseases gradually replaces the ancient manual processing of plant diseases. The proposed solution is an improvement to the manual processing as it provides faster and more accurate solution.

Color is an integral feature in object classification. In [1], Tan et al. presented the classification based on the color. Images taken from cameras are usually in the red-green-blue (RGB) color space. Classification based on RGB have been implemented in detecting raisins [5], skin defects in citrus fruits such as oranges [6][7][8], strawberries[9]. The RGB color space however is dependent on lighting conditions. Hence, other color spaces are also used in image processing to extract features and segment objects. Unlike RGB, HIS decouples the brightness of the image from its color components. HSI stands for Hue, Saturation and Intensity [10][11][12]. Hue stands for the pure color, saturation for the color contrast, and Intensity for the brightness of the image.

The system should produce the same results regardless of the time of day and weather conditions, the HSI is used to achieve this.

For the fruit disease identification problem, in [2], Dubey et al. proposed that precise image segmentation is required; otherwise the features of the non-infected region will dominate over the features of the infected region. Image segmentation is a convenient and effective method for detecting foreground objects in images with stationary background. K-means clustering technique is used for the defect segmentation. Images are partitioned into four clusters in which one or more cluster contains only infected region of the fruit. K-means clustering algorithm was developed by J. MacQueen[13] and later by J. A. Hartigan & M. A. Wong[14]. The K-means clustering algorithms classify the objects (pixels in our problem) into K number of classes based on a set of features. The classification is carried out by minimizing the sum of squares of distances between the data objects and the corresponding cluster. The steps necessary for clustering include reading the image, transforming them from RGB to L*a*b color space, classifying the colors using 'K' means clustering in a*b space, labeling the pixels one by one in the image using the results obtained from K-means, generating images followed by segmentation by color and finally selecting the segment containing diseases.

To validate the accuracy and efficiency of the proposed approach we use extraction of some features. In [3], Gaikwad proposed that feature extraction is one of the major supplements in image processing. Feature extraction is a process to select important characteristics of an image. Feature extraction is a special form of dimensionality reduction. Analysis with a large number of variables generally requires a large amount of memory and computation power or a classification algorithm which over fits the training sample. Different features like color features, size, and shape etc are calculated. Transforming the input data into the set of features is called feature extraction. The input data will be transformed into a reduced representation set of features also named features vector.

After the feature extraction, images are classified by using different classification techniques. In [4], Barot proposed the various techniques for classification: Artificial Neural Network, Backbone Propagation Neural Network, Feed forward Back propagation Neural Network, Probabilistic Neural Network, Support Vector Machine, Multiclass Support Vector Machine and etc. Finally any input image can be categorized into one of the module using feature derived from segmented part of the input image[3].

III. METHODOLOGY

To enhance the production of cocoa, the disease management in cocoa should be done in a more efficient and precise manner than the previously exercised manual disease identification.

The proposed android application helps to perform the following three operations. (1) The farmer captures a diseased cocoa image and uploads to the android application. (2) The uploaded image is processed using image processing techniques and disease is identified. (3) The farmer is updated with information such as the disease name, affected area, and possible remedies automatically by the application. Also, provision will be given to get the expert opinion from the scientist if required.

The diseased cocoa images can be acquired using a mobile camera. There is no restriction imposed on resolution and image format. Generally the digital image is two dimensional in nature and RGB image. In some cases we can use gray images also. The area of interest in the image can be cropped in order to process it. Segmentation can be used so that we process only the cocoa shape. The block diagram of the overall system is given in Fig. 1.

The major modules of the proposed system are: (a) Diseased cocoa image acquisition (b) Cocoa segmentation (c) Feature extraction of diseased cocoa (c) Implementing feature matching and Identification of kind of disease affected to cocoa.

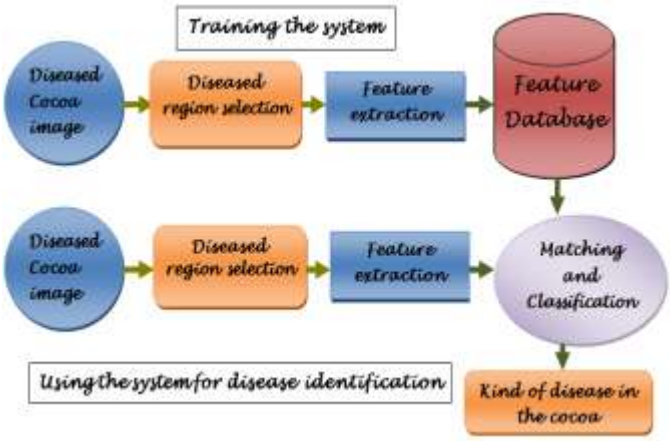

Figure 1. Block diagram of image based cocoa disease identification

A. *Diseased Cocoa Image acquisition:*

The application will take the image of the disease affected cocoa which is captured through a mobile camera. The digital information given by the image is represented as matrix where each value represents the brightness value of the corresponding pixel. To reduce the memory requirement which is a non-functional requirement, the color image is converted to a gray scale image.

B. *Cocoa Segmentation*

Segmentation involves selecting the region of interest. The input cocoa image is cropped as of requirement to extract the disease affected area. The goal of segmentation is

to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Segmentation is required because it will make the further processing easier.

C. *Feature Extraction of Diseased Cocoa*

Feature extraction is done by considering the texture analysis. We have used 7 features of Hu moments for the extraction of features to identify the cocoa disease.

Hu moments: Moment invariants have been widely applied to image pattern recognition in a variety of applications due to its invariant features. Based on normalized central moments, Hu introduced seven moment invariants.

D. *Implementing feature matching and Identifying the disease affected by cocoa*

When a test image is received, its features are extracted and compared with those features stored in the knowledge-base. When a match is found we confirm the disease. Accordingly the output is displayed showing the details of the disease and the possible remedies.

The project involves two phases: Offline Process and Real time Process

Phase 1: Offline process involving the enrollment of cocoa images

1.1. Collecting the information of cocoa diseases.
1.2. Capturing diseased cocoa images to prepare a training data set.
1.3. Segmenting the cocoa image. This involves image enhancement and segmentation.
1.4. Extraction of texture features from the cocoa image. The features represent the cocoa images uniquely.
1.5. Creation of repository of the features to form a knowledge-base.

Phase 2: Real time process involving identification of cocoa disease

2.1. Capturing the image of the diseased cocoa to be identified.
2.2. Performing the segmentation and feature extraction as per step 1.2 and Step-1.3
2.3. Match the features with the created knowledge-base (as per step 1.5 and compute match-score.
2.4. Based on the match-score, classify/identify the disease.

IV. EXPERIMENTAL RESULTS

The results obtained on running Cocoa-care application are shown in fig 2. The figures show the working of proposed system for one example test image of ‘canker’ disease.

Fig.2.a shows the application providing multiple options for the user to select one option from them. Only administrator of the application has the permission to add the new diseases for training the database using ADD DISEASE button. User can select the IDENTIFY DISEASE button for identifying the disease and getting the possible remedies for the identified disease. User can select the USER GUIDE button for knowing about the steps to use the application. EXIT button is used for termination of the application.

Fig. 2.b. shows the user selects the region of interest by cropping the input image for the identification of the disease.

In this project we are using 30 image samples among which 10 images are used for training the system and 20 images are used for testing the application. Comparing the results we obtained using “Cocoa-Care” with that of the results obtained using manual detection of disease by experts we obtained a recognition accuracy of 100%. The application is tested on the assumption that the user inputs only diseased cocoa images to the application.

V. CONCLUSION

In spite of rapid evolution of technology, large number of farmers still relies on the older methods of farming. This is especially true for identification of the diseases. Detection and identification of agricultural crop diseases is an interesting field in both scientific and commercial point of view. Compared to other recognition systems the crop disease identification requires some additional skilled understanding. Cocoa is developing as an important crop in southern India nowadays. Cocoa-care is a useful application that helps the cocoa farmers in the identification of cocoa diseases. Without any professional knowledge it is difficult for anyone to identify the disease. We have developed an android application that takes the disease affected cocoa image as input. The region of interest is selected from the input cocoa image. From the input image the application extracts features. Create a repository of features to form the knowledge-base. Captured cocoa image is identified based on the match score from the knowledge-base. The matched label of the disease is displayed. The accurate recognition of cocoa diseases is of essential requirement for the cocoa farming.

In future we can improve the performance of the system by adding the capability to differentiate between the cocoa images and non-cocoa images. The application can be further modified to recognize diseases affected by other crops too. So that it will be helpful to the farmers to take the required measures to protect the crops as soon as possible.

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(a)

(b)

Figure.2. Sample snapshots of the application. (a) Home Screen of Cocoa-care Application (b) Selecting the region of disease from query image (c) Final results to the User

(c)

Figure.3. Final results to the User

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