DETECTING JUTE PLANT DISEASE USING IMAGE PROCESSING AND MACHINE LEARNING

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Abstract

Image processing is the analysis and manipulation of a digitized image, for improving its quality. This system is an attempt towards the detection of stem disease of jute plant. Farmers will capture the image of the stem using camera of mobile phones and send it to server via mobile application. At server side, the image of the stem will be analyzed based on visual and textural attributes using image processing algorithms, color co-occurrence matrix algorithm, texture analysis algorithm, multi-support vector machine (SVM). On the server side, the affected portion from the image of stem will be segmented using customized thresholding based on hue-based segmentation. Masked image will be extracted from the segmented portion of the stem for texture analysis using color co-occurrence methodology. The extracted features, contrast, correlation, homogeneity and energy of diseases will be compared with the sample features of diseases stored at the server side which will lead the disease to be identified and classified using Multi-SVM classifier. This system will classify disease which is the result which will be sent back to the farmer through the mobile application installed on their phones.

Index Terms: hue based segmentation, color co-occurrence methodology, texture analysis, Multi-SVM classifier, Android application

I. INTRODUCTION

"Jute", the 'Golden Fiber' is considered as an important cash crop of many Asian countries. Like many other crops, jute plants get affected by various diseases every year. They cause a huge damage to the crop for which the farmers face a huge loss. Most of the jute plant (60% - 70%) may die in the field due to stem rot if no control measure is taken. For that reason we came up with the idea of helping the farmers to detect the diseases at the initial stage and we will also attempt to provide them with necessary control measures. In this system, an attempt is made to develop a system that will detect the diseases of jute plants through image processing where farmers will capture the image of the stems of their disease affected jute plant and send them to the system server where the image will go through several levels of processing to detect and identify the disease. The result along with suggestions to improve the crop condition will be sent back to the farmer.

II. LITERATURE REVIEW

The application of image analysis on various fields has become significantly important since past few years. At the very beginning the implementation of image analysis was limited to mainly medical and terrestrial images. Gradually, people started to apply this on agricultural purpose such as plant recognition, disease identification and management and so on. S. Arivazhagan and his co-authors have discussed about leaf disease detection using image processing and neural network where they used the Color Co-occurrence Methodology for extracting the features for texture analysis [1]. In [2] Sariputra and Shirolkar has discussed about the basic steps to be taken to classify a disease by processing the image of the affected leaf. They have described the method that includes image acquisition, image pre-processing, segmentation of useful components, feature extraction and statistical analysis by using a spatial gray-level dependence method. Besides, referring to the integration with mobile applications Amos Gichamba andIsmail Ateya Lukandu have described different employments of mobile applications for agricultural purpose and presented a general model for designing such systems [3]. However, their focus of interest was detecting the leaf diseases of plants rather than the stem diseases. Another mobile-application based system named 'Beetles' has been presented by Rahat Yasir and Nova Ahmed which has been designed to support farmers in rural area to detect crop diseases from the image captured by a cell phone in real-time using histogram and color information of the image [4]. Referring to the integration with mobile applications, Amos Gichamba and Ismail Ateya Lukandu in [3] described different implementations of mobile systems in agricultural purpose and presented a model for designing such applications. They also observed that the development of mobile solutions in the agriculture sector has not been yet done widely and showed how solutions can be created using mobile technology that will help in addressing some of the crop related problems faced by the farmers [5]. On the other hand, H. Al-Hiary and his co-authors have come up with the detection process of stem disease in such way that their system requires the background of the picture to be plain or unicolor [6].Regrettably, as their segmentation method is based on masking the green pixels the efficiency has been compromised for most of the cases where stems turn brownish in color at matured stage [6]. To overcome this defect Y. Sanjana and her co-authors have proposed a system to detect different leaf diseases of crops using image analysis consisting of mathematical morphology for segmentation, texture, shape and color feature extraction for classification of diseases [7]. Monika et. al [8] Give a system for disease detection and fruit grading. For feature extraction three feature vectors have been used, namely, color, texture and morphology in which morphology give better result. For the classification artificial neural network has been used. Lai and Leow in [9] have emphasized on different ways of texture analysis namely statistical measures, Wold features and Gabor features. According to [9], Statistical measures are obtained by local statistical distribution of image intensity that measures coarseness, contrast and directionality as texture features. Similarly, the Wold model extracts the periodicity, randomness and directionality of a texture [9]. Periodicity and directionality are related respectively to the spatial frequency and orientation of the texture, and randomness measures how uniform is the texture [9]. Beside these two, they conducted their research with Gabor features where the features are obtained by convolving an image with a set of Gabor filters.

III. SYSTEM OVERVIEW

In this system an attempt is made to develop a system which can be operated by using a mobile application on Android phones. The farmers are the target user for this system.

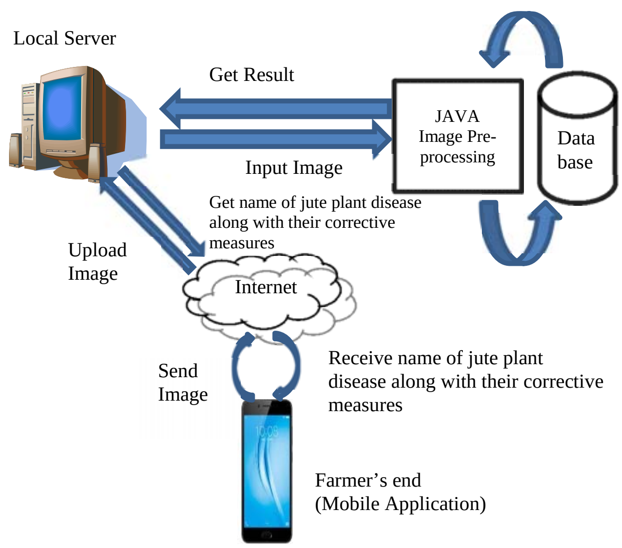


Fig I:- System Overview

The jute crops get affected by several diseases within June to November. During this period, farmers need to be more cautious about their crops and sometimes they need to take immediate initiatives to save their crops from a certain disease. If a farmer wants to assess a disease-affected stem and need to be assured if the plant is affected by a certain disease or not, then he just has to use the mobile application and take a picture of the disease-affected stem of the jute plant. Then he will be given the option to send this image to the dedicated system server.

IV. SYSTEM IMPLEMENTATION

1) Image preprocessing:

Before moving onto image analysis the image should be first processed in order to obtain a better result. Images sent by the user contain different noises which alters the analysis result. The image preprocessing is performed by using the following steps:

a) Resize image: To perform classification, the size of the images stored in the database must match the size of the input image. Thus, it is required to set the size of the input image to a fixed dimension.

b) Enhance image: The intensity values of the image are to be adjusted such that the data is saturated at low and high intensities. It uses different functions to adjust the contrast of the image that would return a two-element vector of pixel values which specifies lower and upper limits to be used.

c) Noise Removal: Different types of noises may be present in the uploaded image which can turn a simple thresholding problem into a complex one. Thus it is important to remove the noises from the image.

2) Hue based image segmentation:

To segment only the affected portion from the image, hue-based segmentation method is used in our system. It is not possible to simply mask the green pixels from the image as the whole process will be conducted on stem diseases. As a result, hue-based segmentation method has been used.

a) Thresholding: Image thresholding is done in order to dividing an image into a foreground and background. Binary mask is generated by thresholding the saturation image with a threshold value which is equal to ten percent of the maximum value of the image. As contrast of the input image has already been adjusted through preprocessing, image thresholding can be used to get better results. Any pixel value greater than the threshold is set to 1 (white) and all others are set to 0 (black). After that masked saturation image has been multiplied with the hue image.

(a) (b)

Fig. II. a) Original Image b) Threshold Image

b) HSV conversion: Firstly, the RGB image has been converted to HSV image. Image is to be segmented based on color and the process on individual planes is carried out for thresholding. In HSV image, the hue image represents the original color and saturation is used to mask the image and extract the region of interest.

Fig. III. HSV Image

c) RGB conversion: For further analysis, it is needed to convert the segmented portion back to its original color. That’s why segmented image has been converted to RGB color space.

3) Feature extraction: In our system, feature values are calculated for each of the input images for performing texture analysis. Features are as below:

1. Contrast
2. Homogeneity
3. Mean
4. Variance

Contrast: Contrast parameter measures the spatial frequency of an image and is difference moment of GLCM. Contrast is nothing but the difference between the maximum and the minimum values of a set of pixels. It measures the amount of local variations present in the image.

Homogeneity: Homogeneity parameter also known as inverse difference moment measures image homogeneity as it assumes larger values for smaller gray tone differences in pair elements. Homogeneity is a measure that takes high values for low-contrast images.

Variance: The variance is a measure of how far a set of numbers is spread out. It is one of several descriptors of a probability distribution, describing how far the numbers lie from the mean (expected value). The variance is one of the significant value of a distribution. In that context, it forms part of a systematic approach for distinguishing between probability distributions. While other such approaches have been developed, those based on moments are advantageous in terms of mathematical and computational simplicity.

Mean: Mean as a basic statistical measure is defined as an average value attained. The statistical mean refers to the mean or average that is used to derive the central tendency of the data. It is calculated by adding all the data points and then dividing the total by the number of points. The resulting number is known as the mean or the average. With less time and resources available for calculation of complex or complicated measures, mean is considered desirable to get a quick, first hand estimate of future returns based on the data available of the returns from the asset.

4) Classification:

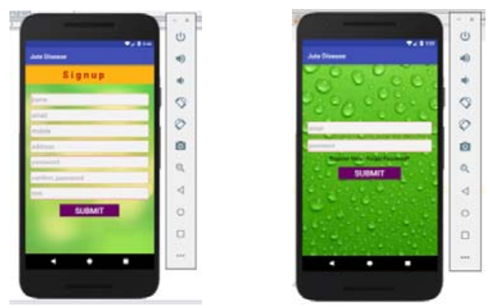
After the extraction of all the necessary features, these features have to be compared with the pre-calculated dataset. In this SVM (Support Vector Machine) classifier is used for classifying the disease. Support vector machines (SVMs) are a set of related supervised learning methods used for classification and regression. Supervised learning involves analysing a given set of the training dataset (labelled set) so as to predict the labels of the test dataset (unlabelled set) future. More formally, a support vector machine constructs a hyper plane or set of hyper planes in a high- or infinite-dimensional space, which can be used for classification, regression, or other tasks. Intuitively, a good separation is achieved by the hyper plane that has the largest distance to the nearest training data point of any class (so-called functional margin), in general the larger the functional margin the lower the generalization error of the classifier Multiclass SVM aims to assign labels to instances by using support vector machines, where the labels are drawn from a finite set of several elements. The dominant approach for doing so is to reduce the single multiclass problem into multiple binary classification problems. Common methods for such reduction include: building binary classifiers which distinguish between (i) one of the labels and the rest (one-versus-all) or (ii) between every pair of classes (one-versus-one) In this case, the classification of new instances or input images for the one-versus-all case is done by a winner-takes-all strategy, in which the classifier with the highest output function assigns the class and detects the particular disease.

SVM maximizes the marginal distance between different classes. The division of classes is carried out with different kernels. SVM is designed to work with only two classes by determining the hyper plane to divide two classes. This is done by maximizing the margin from the hyper plane to the two classes. The samples closest to the margin that were selected to determine the hyper plane is known as support vectors.

Multiclass classification is used here and is basically built up by various two class SVMs to solve the problem, either by using one-versus-all or one versus-one. The inning class is then determined by the highest output function or the maximum votes respectively.

VI. RESULT

In our system, the diseased portion is segmented from the training image after being preprocessed and then the features are extracted.



(a) (b)

Fig IV. a) Registration Page b) Login Page

(a) (b)

Fig. V. a) Upload Image b) Threshold Image

(a) (b)

Fig. VI. a) HSV Image b) Login Page

VII. CONCLUSION

Jute is a very important crop for the economy. It has played a vital role in the economy in past years but not so much in the recent times as it lacks proper direction and patronization. The recent awareness regarding jute cultivation is increasing and what other better way there is than introducing a service that can be used by anyone through their mobile phone.Our system classifies the result and yield the type of disease of the jute plant along with their corrective measures which is sent back to the farmer through the mobile application installed on their smart phones. The barrier between the farmers and the technology will not exist if we try to utilize the benefits of technology. This system does not contain disease detection technique for the leaves. sIn future, it will be a great challenge for us to build a universal app that can be used to detect any sort of disease of the jute plants considering both stems and leaves.

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