Detection of Disease in Tomato Leaf

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Abstract—Diseases in plants cause major production and economic losses as well as reduction in both quality and quantity of agricultural products. Now a days plant diseases detection has received increasing attention in monitoring large field of crops. Farmers experience great difficulties in switching from one disease control policy to another. The naked eye observation of experts is the traditional approach adopted in practice for detection and identification of plant diseases. On the other hand, mobile phone usage has increased exponentially among the population of India. People from all walks of life are using mobile phones and different associated applications for gaining economic and social benefits. However, very few mobile phone applications benefit agricultural production and specifically aim farmers. In the proposed paper we review the need of simple plant leaves disease detection system through an android application that would facilitate advancements in agriculture. The project is aimed at developing an android application to generate an automated mobile-based system to detect diseases of tomato through image processing of leaves. The purpose of such development is to assemble an application with a user friendly interface and implement some effective algorithms considering the problems. This will improve productivity of crops.

Keywords- Image processing, eclipse, android

I. INTRODUCTION

Images form important data and information in biological sciences. Digital image processing and image analysis technology based on the advances in microelectronics and computers has many applications in biology and it circumvents the problems that are associated with traditional photography. This new tool helps to improve the images from microscopic to telescopic range and also offers a scope for their analysis. The naked eye observation of experts is the main approach adopted in practice for detection and identification of plant diseases. But, this requires continuous monitoring of experts which might be prohibitively expensive in large farms. Further, in some developing countries, farmers may have to go long distances to contact experts, this makes consulting experts too expensive and time consuming and moreover farmers are unaware of non-native diseases.

Automatic detection of plant diseases is an important research topic as it may prove benefits in monitoring large fields of crops, and thus automatically detect the diseases from the symptoms that appear on the plant leaves. This enables machine vision that is to provide image based automatic inspection, process control and robot guidance. Comparatively, visual identification is labor intensive, less accurate and can be done only in small areas. The proposed project has been done on android platform. The accelerometer sensor is used to capture the image of the leaf. The detection and classification of leaf diseases has been done based on masking and removing of green pixels, applying a specific threshold to extract the infected region and computing the texture statistics to evaluate the diseases. Tomato plant diseases may be broadly classified into two types. They are spot disease and fungal.

A. Motivation

Farmers are the backbone of India. Realizing the significance of the problems associated with tomato productions with an intention to contribute to agricultural development in India motivated this work to develop a user friendly application for the persons associated with agriculture development.

B. Problem Statement

To develop an android application that takes image of the leaf via accelerometer sensor and detects the disease of the leaf using image processing techniques and produces proper solution for the detected disease.

C. Literature Survey

Kim et al. (2009) have classified the grape fruit peel diseases using color texture features analysis. The texture features are calculated from the Spatial Gray-level Dependence Matrices (SGDM) and the classification is done using squared distance technique.
Grape fruit peel might be infected by several diseases like canker, copper burn, greasy spot, melanose and wind scar (Kim et al., 2009).

Helly et al. (2003) developed a new method in which Hue Saturation Intensity (HIS) - transformation is applied to the input image, then it is segmented using Fuzzy C-mean algorithm. Feature extraction stage deals with the color, size and shape of the spot and finally classification is done using neural networks (Helly et al., 2003).

Real time specific weed discrimination technique using multilevel wavelet decomposition was proposed by Siddiqil et al. (2009). In this histogram equalization is used for preprocessing. Features are extracted from wavelet decomposition and finally classified by Euclidean distance method (Siddiqil et.al, 2009).

Al-Bashish et al. (2011) developed a fast and accurate method in which the leaf diseases are detected and classified using k-means based segmentation and neural networks based classification. Automatic classification of leaf diseases is done based on high resolution multispectral and stereo images (Bauer et al., 2011). Sugar beet leaves are used in this approach.

Segmentation is the process that is carried out to extract the diseased region and the plant diseases are graded by calculating the quotient of disease spot and leaf areas. An optimal threshold value for segmentation can be obtained using weighted Parzen-window (Jun and Wang, 2008). This reduces the computational burden and storage requirements without degrading the final segmentation results.

D. Objectives
The objectives are as follows:
1. To make an efficient use of image processing techniques.
2. Provide solution with least hardware requirement.
3. To develop an app that is cost efficient.
4. Minimize the use of resources.
5. Easy to use and accurate.

II. SYSTEM MODEL FOR DISEASE DETECTION

At first the image is captured using the motion sensor i.e. accelerometer present in camera. Later the image is set as a preview for the user to get the information of the captured image. The captured image is sent to image processing which is written in JAVA. While processing the pixels of the image are converted into BITMAP one by one and the pixel intensities are stored. The image is converted into gray scale and stored. The stored pixel intensities are thresholded according to the HSI format taking I as the thresh- old component. The thresholded image consists of the part of the leaf which is effected with the disease. Taking the parameters from the image the disease of the leaf is detected and its proper solutions are displayed on the mobile screen.

III. METHODOLOGY

![Fig 2. Flow chart for spot disease detection](image)

![Fig 3. Spot diseased leaf](image)

![Fig 4. Fungus diseased leaf](image)

The aim of the project was to help field level workers in the agricultural sector by detecting diseases of tomato through an android application. In order to test the leaf, different algorithms, approaches and languages were examined that can ensure a user friendly interface. For the detection of two specific tomato diseases - Septonia and Fungal(Buckai Rot) the algorithms were employed.

A. Methodology For Spot Disease Detection

1) Image Colour Transform: In plants, leaf vein is different in intensity and disease spot is different in color, in comparison image, vein will also be present in binary image with the disease spot. But the region of interest is only disease spots, not vein. To minimize the effect of presence of vein, RGB image should be color transformed before segmentation. After then Otsu threshold can be applied on color component to detect disease spot accurately. HSI (Hue Saturation Intensity) COLOR MODEL HSI is device dependent color model and based upon Human Color Perception. In this color model H indicates Hue, which describes a pure color
and is generally related to the wavelength of light. S indicates Saturation, which measures the colorfulness in HSI color Model. I indicates Intensity, which shows the amplitude of the light.

2) Disease Spot Segmentation: Using threshold on I component of HSI color model, disease spots are detected effectively. A technique to detect the disease spot is needed. It is important to select a threshold of gray level to extract the disease spot from plant leaf.

B. Methodology For Fungus Detection

The crop of tomato is very often infected by a disease that leaves spots of brown, gray or off-white colors on the plant’s leafs in winter. Scientifically, this disease is known as Buckeye Rot. It is a kind of fungus that often kills young seedlings. The fungus spreads by air and can also infect tomato plants. Therefore, it is important to monitor the leaf at regular intervals so as to keep track on quality of growing tomato crop. The size of the fungus, color depth and location and locus of the fungus on leaves give an accurate determination of crop quality under the soil. In the presented work, the image of the crop leaves are taken by a good quality camera and processed for getting a gray colored and segmented image depending upon the nature and size of the fungus. A criterion is set for acceptable and rejects crop quality based on the fungus level. Following features are extracted from the segmented image of tomato leaves:

1. Tomato Total Leaf Area
2. Leaf Perimeter
3. Fungus Leaf Area
4. Fungus Location

C. Software flow

Eclipse is the tool used for the development of the android application. Initially the design of the app was done using pencil software. The UI was built in the XML page and was connected to the activity in the main page. The app makes use of the camera module. As soon as the app is launched user can click on the button provided for capturing the image of the leaf. The flow goes to the camera. When the image is taken it will ask whether to save or to discard. If it is accepted by the user then the image will be appearing on the screen as a preview. When 'Detect Disease' button is to be pressed, the image is internally examined using the image processing techniques described above. After the analysis the result will be displayed on the screen. The user is then asked whether another picture is to be analyzed or not. If yes then the loop continues, otherwise the app terminates.

IV. RESULTS

A. Environments

Fig 5. Fungus disease detected

Fig 6. Spot disease detected

The environments set for the project are:

1. Android
2. Eclipse
3. OpenCV
4. JAVA
5. Camera
6. Windows 8

B. Discussion Of Result

The fungal disease in the tomato leaf is detected using image processing techniques. Firstly the image is converted into grey scale. According to Otsu’s threshold method the pixels below the threshold value are converted to white pixels i.e. Pixel value=255. The pixels above the threshold are converted to grey pixels.
The spot disease in the tomato leaf is detected using image processing techniques. The image is converted into grey scale. According to Otsu’s threshold method the pixels below the threshold value are converted to white pixels i.e. Pixel value=255. The pixels above the threshold are converted to black pixels i.e. pixel value=0. The number of pixels with the value of zeros are calculated and based on the calculated value it is identified whether the leaf is diseased with spot or not and the respective treatments will be displayed on the screen.

The image is converted to grey scale. If the image is neither effected with spot nor by fungus then the leaf is said to be healthy leaf.

**C. Challenges**

The development of the application faced several challenges. Android application crashed frequently causing difficulties while implementing the algorithms in a time bound period. Availability and collecting database for the application was another challenge. Although the Leaf Color Chart helped in developing the application, but gaining access to such data was both time consuming and difficult since they can be accessed from very few authentic sources.

**V. CONCLUSION**

The farmers and the persons involved with helping in the production need assistance to ensure good harvest. Mobile phone has become available at the grass-root level providing different social and economic benefit. The aim of this proposal was to develop a user friendly automated system for the farmers that will help them in determining detection diseases of tomato leaves without bringing an expert to the field. To develop the application, the proposed algorithm was implemented by creating a JAVA library in android for leaf disease detection of tomato. The development process of the application also illustrates the challenges of using image processing. Yet with enough data and knowledge, development of different applications can meet the demand of diversified user groups.

The application developed in this proposal had tried to make it as user friendly as possible. Yet it recognizes that many farmers may not be able to use it, especially the illiterate ones. In future the aim will be to make it accessible for those who are not able to read properly. This application only addressed tomato crop, while the farmers produce different varieties of crops. Opportunities remain to develop working algorithms with other crops. The application also recognized that since this algorithm is implemented in JAVA, this application can be implemented in Windows phone as well. This creates possibilities to develop the application to be used in windows phone.

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