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Detection of Disease Affected Region of Plant Leaf Using Image Processing Technique

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ABSTRACT:
Plant diseases cause major economic and production losses in the agriculture industry. It is very important to detection of plant diseases in early stage and in substantial improve in quality of the product. In existing research several methods have been used for disease detection of the plant. These methods have not implemented in an onsite field. In the present work initially, capturing the image of citrus plant leaf through the camera and identifying the symptoms like changing color, showing the spots on a leaf and curled boundary of the leaf. The experimental results for early recognition of disease in plants leaf from visual symptoms in an onsite field and successfully detecting amount of diseased leaf area.
Keywords: *image processing, image segmentation, clustering*

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I. INTRODUCTION:

There are many reasons responsible for reducing yield, economic losses like plant diseases insect attacks, changing environment condition. Mostly, changing environmental condition is favorable to spreading diseases in plant. It is very important to diagnose plant diseases accurately and timely. The studies of plant disease refer to the visually observable patterns on the citrus plant leaf .There are different ways to detect plant diseases like molecular process, thermography, polymerase chain reaction (PCR) and flow cytometry (FCM) methods .These methods are very costly, time-consuming and overwhelming [1] .The best approach to overcome the increasing diseases in plant through digital images combined with image processing, pattern recognition, classification techniques [2]. In agriculture, the image processing technology supports to the farming sector and helps the farmers to improve the efficiency and productivity of agriculture. The major types of plant diseases based on fungal, viral, and bacterial. Some general diseases seen are yellow and brown spots, early and late scorch etc.

In digital image processing exploring and detecting the various diseases of plant leaf through available capturing devices and to get an enhanced image or providing the required information in the form of images. In vision-based plant disease detection system, segmentation plays an important role. Image segmentation is a process segment the image into a different part of the image [3] and ensures the simplification of a problem by changing the representation of an image from a composite one to a more analytical and easier form. Segmentation process mainly depends on several features found in the image like color, textures, shape [3].

The paper is organized into three sections. Section I gives the introduction and the necessary theoretical background of digital image processing. Section II represents the literature survey III experimental work for disease detection, IV conclusion.

II. LITERATURE SURVEY

Crop disease detection systems available in the literature are explained in this section. Haiguang Wang et al. [4] focused on this paper image recognition of plant diseases based on back propagation networks. They have selected two plants to recognize and classify the disease such as grapes and wheat. Automatic diagnosis of plant disease and improve the accuracy of image recognition of plant disease by using the image processing and pattern recognition method. The system divided into four steps, in the first step captures the data samples of grapes, wheat disease and then preprocessed the data samples. After the preprocessing k-means clustering algorithm segment the image of grapes and wheat disease. Next feature extracted from the diseased image like 24 color feature, 4shape, 25 texture features respectively. Lately, back propagation network used to as a classifier to classify the disease of grapes and wheat plant. Optimal recognition result for grapes fitting accuracy 100%, prediction accuracy was 97.14% and wheat fitting accuracy, prediction accuracy both are 100%.John William orillo et al. [5] described Identification of Diseases in Rice Plant (Oryza Sativa) using Back

Propagation Artificial Neural Network. They accurately identify the three common diseases in rice plant such as rice blast, bacterial leaf blight, the brown spot in Philippines farmlands and removing the subjectiveness of manual inspection of disease using digital image processing. The 134 diseased database images added to the network. Back propagation artificial neural network used to increases the accuracy and performance. Pushpa Rani M.K. et al. [6] paper presented detection and analysis of plant leaf diseases using image processing. They have also discussed 50% ayurvedic medicine plants are a risk of extinction. So it is very necessary to need for ayurvedic plant protection to various diseases. To implemented classification of plant diseases are using the Probabilistic Neural network and data processing technique. 12 leaf features extracted and 30 leaves classify, trained by using the PNN. Classification accuracy is greater than 90% and algorithms execution is a fast easy implementation.

III. EXPERIMENTAL WORK FOR DISEASE DETECTION

The experimental work has three vital stages; in the initial stage, the image acquisition through which the real plant sample image is recorded in digital form using digital camera. In the next stage, the image is subjected to image preprocessing tools, which reduces image size and complexity. The precise digital information is used to segmentation process which separates the diseased portion of the leaf samples. Finally, the area of the segmented part of leaf calculated using image processing algorithms.

Image acquisition:

Image acquisition is the first step that requires capturing an image with the help of a digital camera. The images are taken from different lightning condition in garden or fields. Total of 100 images of citrus diseased leaf have been collected for current work. The captured citrus diseased leaf image is shown in fig.1 (a)

Preprocessing:

In the pre-processing of image, remove the undesired distortion of these images. It is reshaped to 256× 256 pixels size and enhance the contrast of some images [10].The fig.1 (b) &(c) shows resized citrus leaf image and contrast enhanced image, this resulting image used for further operations like creating clusters in segmentation process.

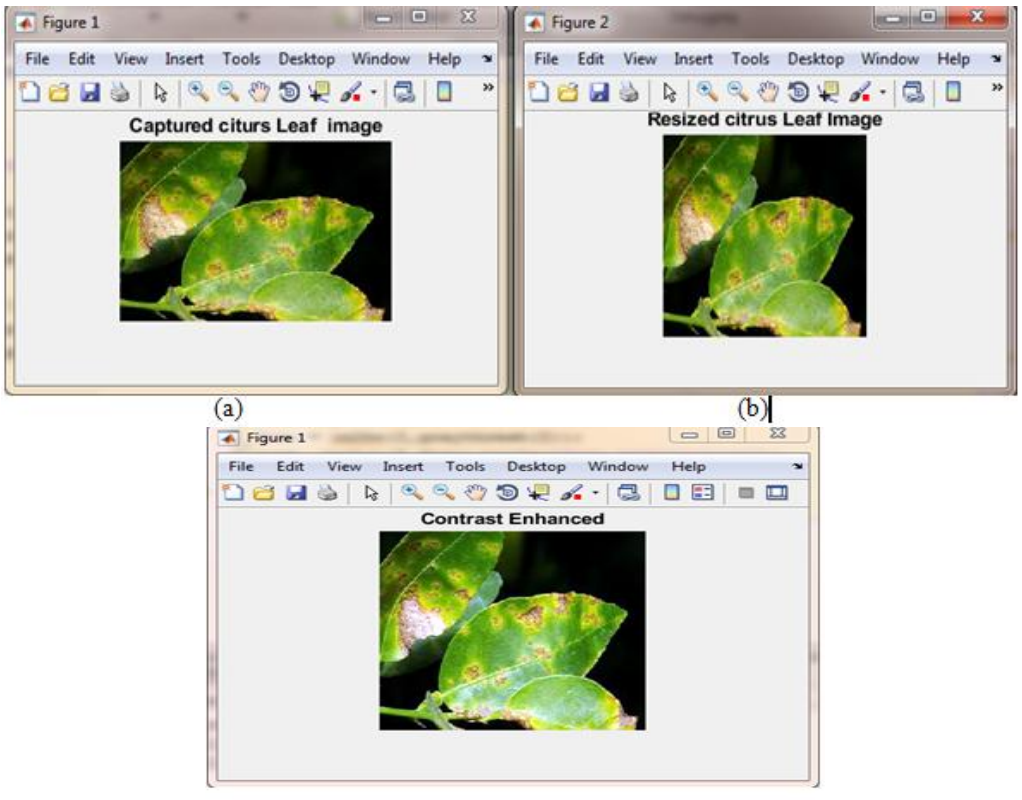


Fig. 1 (a) captured citrus leaf image (b) Resized citrus leaf image(c) contrast enhanced citrus leaf image

Image segmentation:

Image segmentation is a method for conversion of digital image into multiple segments and depicting an image into for easier analysis. Image segmentation is used for identifying the objects and relevant information for boundary line of that image. OTSU and K-means clustering method is used for segmentation.

The OTSU method generally classifies the image data into a group of pixels. But it does not work properly with variable illumination and fails to recognize the required region for image. An OTSU method limitation overcomes using color based k-means clustering unsupervised learning method. For segmenting of images into clusters in which one part of cluster contain image with major area of diseased part.

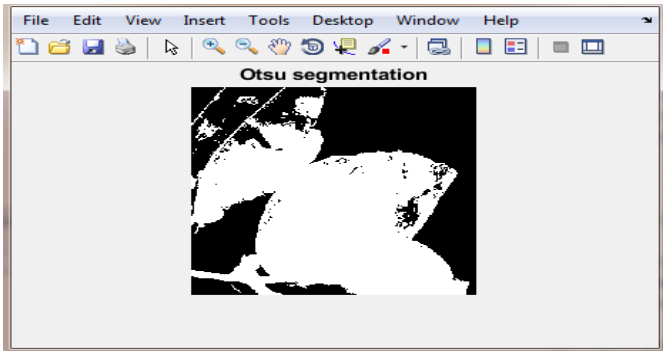
The k-means clustering algorithm is used to classified the image objects into K number of clusters according to set of image features. The partitioning is done by minimizing sum of square of Euclidian distances between data objects and the corresponding cluster index.

Euclidean distance in n-space can be represented mathematically as equation (1)

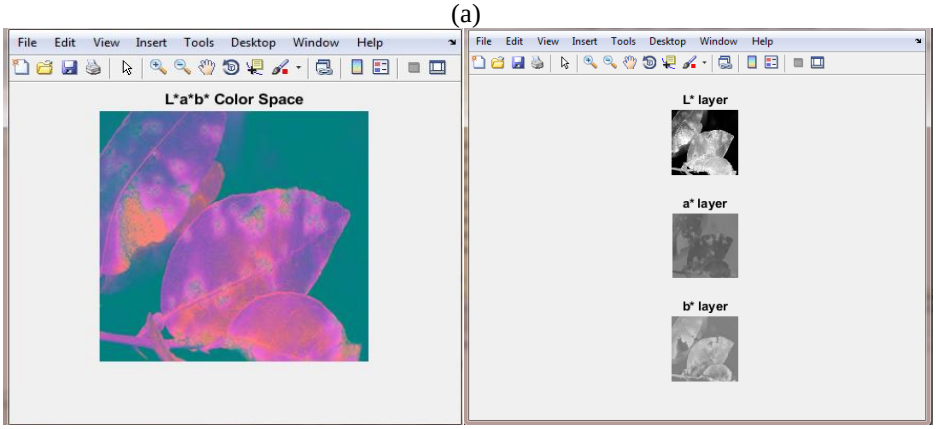
$$D(x, y) = D(y, x) = \sqrt{\sum_{i=1}^{n} (yi - xi)2} \quad (1)$$

Where, x (x_1, x_2, x_3……x_n) and y (y_1, y_2, y_3……y_n) points are representing a color space.

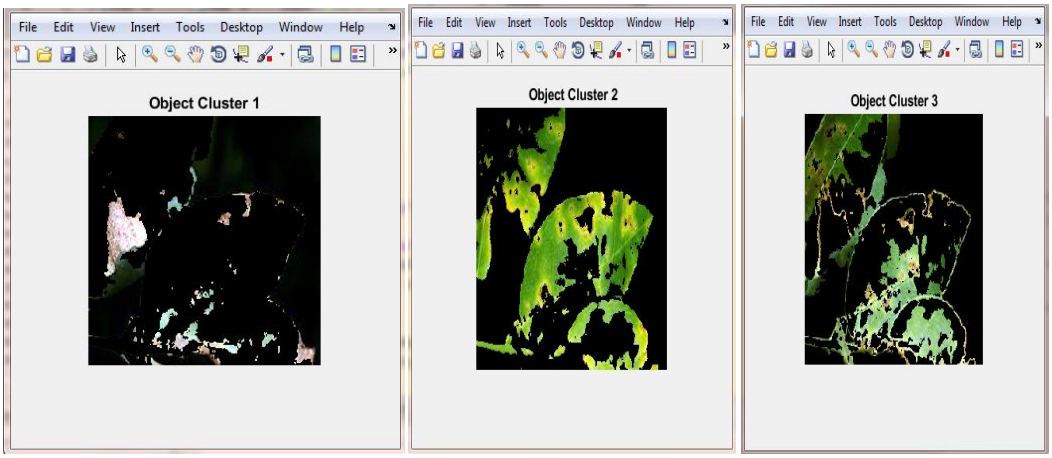
The image is converted from RGB Color Space form to L*a*b* Color Space form. The L*a*b* color space consists of a luminosity layer 'L*', chromaticity-layer 'a*' and 'b*'.The color information is represented by 'a*' and 'b*' layers and classified the colors in 'a*b*' space using K-Means clustering. Labeling of every pixel in the image is done using results of K-means, also resulting segmented images into three clusters are produced which contain diseases [11].The percentage for affected leaf area calculated using region and image properties. Fig. 2(a) shows OTSU segmentation of diseased leaf and fig. 2 (b) &(c) shows L*a*b* color space leaf and leaf image segmentation with three clusters by using K-means clustering method.



(a)



(b)



(c)

Fig.2 (a) OTSU segmentation of citrus diseased leaf, (b)L*a*b* Color Space leaf and separate layer of color space (c)leaf image segmentation with three clusters by using K-means clustering method.

Calculation for Affected area:

The three cluster objects formed after the color image segmentation containing the diseased spots/ cluster objects selected for calculating the diseased area (A1).The resulting contrast enhanced leaf image is converted to binary image. The total number of pixels is considered for calculating the total leaf area (A2).The fig.3 (a) & (b) shows area of the diseased region (A1) and total leaf area (A2).

Affected area of citrus leaf is calculated using region and image properties.

The percentage infection area is calculated by using the following equation

Affected area= (A1 /A2) × 100 (2)

Where, A1- represents the diseased area of the leaf

A2 - represents the total leaf area

The fig.3 shows the diseased area as percentage of total area of leaf.

```
>> ans

ans =

    'Area of the disease affected region is : 1573'

fx >>
```

(a)

```
>> ans

ans =

     ' Total leaf area is : 169248'

fx >>
```

(b)

```
ans =

    'Affected Area is: 15.9294%'

fx >>
```

(c)

Fig.3 (a) area of the diseased region pixels (A1), (b) total leaf area pixels (A2), (c) shows the diseased area as percentage of total area of leaf.

IV. CONCLUSION:

The naked eye observation of plant diseases gives miserable accuracy, & it is very subjective which will change person to person. In this paper, image processing method is used to obtain accuracy in detection of plant leaf disease. Disease detection of citrus leaf is performed by use of k-mean clustering algorithm. The percentage for affected leaf area calculated using region and image properties. That is the beneficial to farmer, reduces exactly amount of pesticides necessary for cover the infected area.

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