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Research Paper

Betel Plant Leaf Age and Disease Detection using K-mean Clustering

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Key Words – *Image Acquisition, Preprocessing, Features Extraction, Segmentation, K-Mean Clustering, Graph plot etc.*

Abstract

This paper deal with the estimation of age and detection of disease of betel leaf based on the image processing.the leaf age having its complete lifecycle and has several bacterial, fungal infections so the identification of the plant leaf detection is the major thing for preventing the losses in the yield and quantity of the agricultural product. The monitoring of the plant infected with disease is quite difficult manually, so it required enormous amount of work, expertness in the plant disease and it also require an excessive processing time.in the absence of proper care causes serious effects on the lifecycle of the plant which is proportional to product quality, quantity or productivity. In the area of plant science and research the measurement of feature of plant is a fundamental element which is useful for its application in plant growth modeling agricultural research and on form production. Few of the traditional methods have been developed which aresimple and reliable in nature but they are time consuming. Through this paper we proposed a methodology for the analysis and detection of plant diseases using digital image processing techniques. This paper is divided into two parts. First is betel plant leaf age estimation for leaf maturity. Second is betel plant leaf disease detection for cure of bacterial infection.

Introduction

India is well known for agricultural country wherein about 70% of the population depends on agriculture. Farmers have wide range of multiplicity to select suitable crops for their farm. However, the cultivation of these crops for optimum yield and quality produce is mostly *technicalwhichcan* be improved by the help of technological support. The management of perennial crops requires closer controlling especially for the management of diseases that may affect production significantly and afterword the post-harvest life of crops.The image processing is best technique used in agriculturalapplicationsfor following purposes.First part is estimate the life age for better maturity. We can decide the production stage of our crop. Second part predictplant disease from image of plants. The existing method for plant disease detection is simply naked eye observation by experts through which identification and detection of plant diseases is taken in account. This process is tedious, time consuming. So There is need for designing a system that automatically recognizes, classifies and quantitatively detects plant disease symptoms. In case of plant disease the disease is known as any impairment of normal physiological function of plants which produce characteristicsymptoms.

A symptom is a reality accompanying something and is observed as evidence of its existence. Mostly *diseases* are seen on the leaves on plants or stems of the plant. Hence to develop a computer vision system to detect, recognize and classify disease affected leaves comes in the era of current technology so Automatic detection of leafdiseases become the mostimportantresearchtopicasitmayprove gain in monitoring large fields of crops and thus automatically detect the diseases from the symptoms that present on the plant leaves. The system provides an approach that facilitate Capture image, process it and get result through image processing.

Methodology

We have divided Methodology in two parts.

First part is leaf age estimation. It has following stages:

1. Image acquisition of betel leaf sample.
2. Line shape insert for petiole remove.
3. Resize of desire leaf image.
4. RGB to gray scale conversion by otsu's segmentation.
5. Binarization of image and remove noise.

6. Calculation of area and mean of color.
7. Graph is inserted using basic RGB conversion.

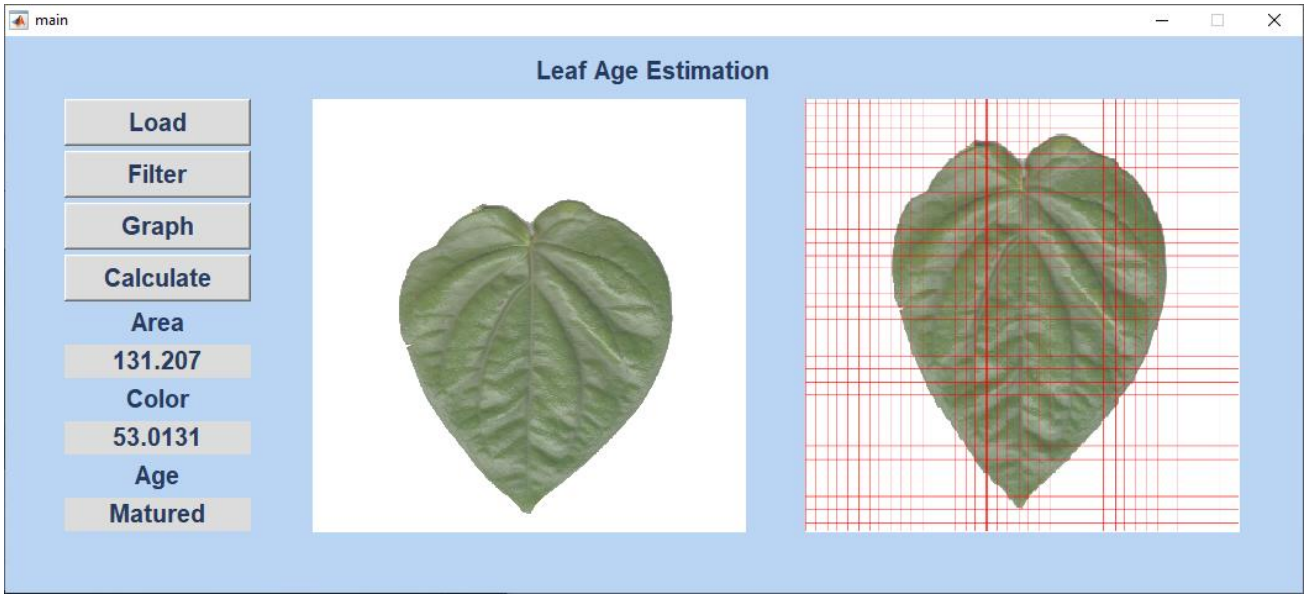

Fig1: GUI of Leaf Age Estimation

Second part is leaf disease classifier detection. It has following stages:

1. Image acquisition of betel leaf sample.
2. Filter of background portion using image subtraction.
3. Resize of desire leaf image.
4. RGB to gray scale conversion by Otsu's segmentation.
5. Apply K-mean clustering and got 10 clusters for deferent color group.
6. Select appropriate cluster for desired disease.
7. Apply selected cluster on original image and got infected area.
8. Calculation of number of rots and spots in infected image.

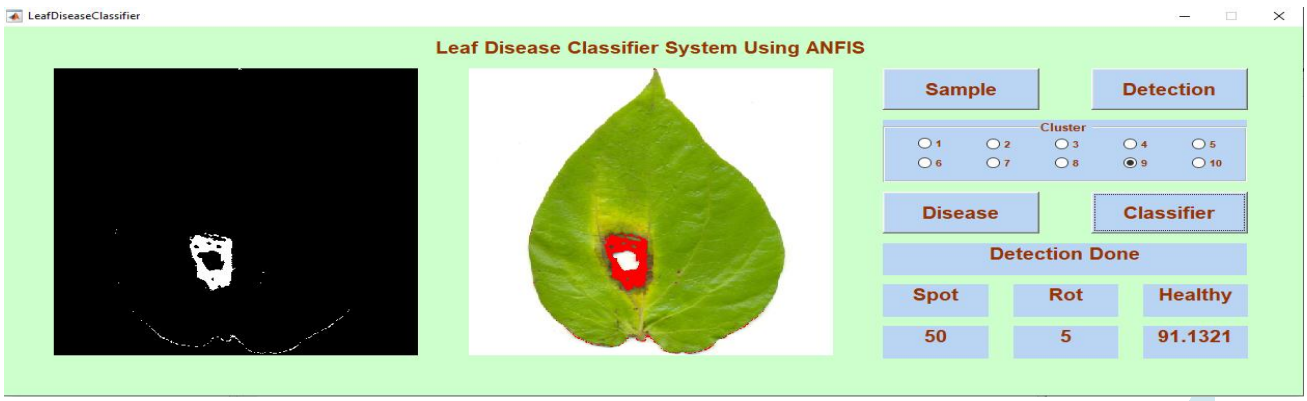

Fig2: GUI of Leaf Disease Classifier Using ANFIS

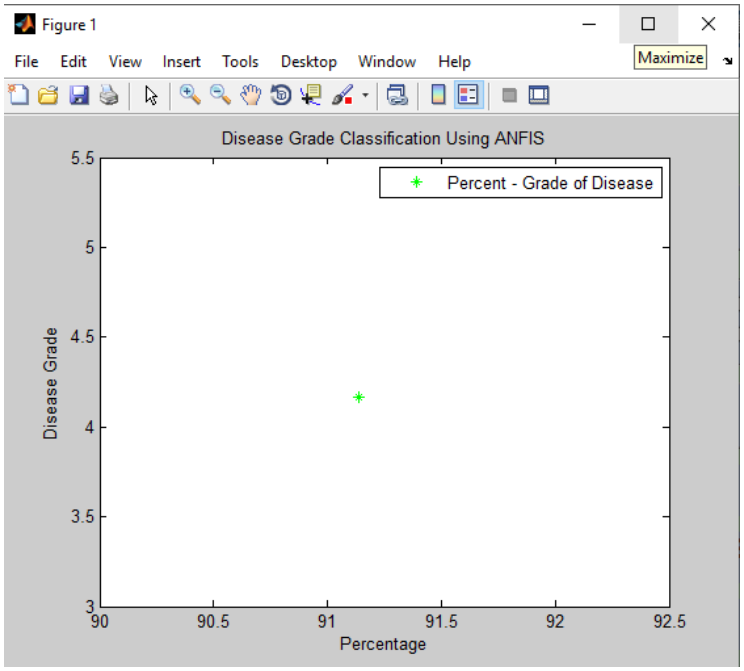

Fig3: Disease Grade Classification Using ANFIS

A. ImageAcquisition

Image acquisition is the process of collection of images and saving it to the database of the computer.

The betel leaf images either can be scene or can be taken images via a digital camera.TheTotally54numbers of imagesarecollectedwhichincludes both healthy and diseases affected betelleaves.the horizontal and vertical resolution of the images are 600dpi with bit depth 24 which produce the RGB digital colour image.

B. Image Preprocessing

There are different preprocessing techniques are available for the removing noise from the image or object.Adapthisteq is the function that perform contrast limited adaptive histogram in which hasteq works on the entire image adapthisteqoperatessmall regions in the image that is commonly called as tiles.Adapthisteq enhance the contrast to each tile so that the histogram of the output region approximately matches a specified histogram, after performing the equalization adapthisteqcombines neighboring tiles using bilinear interpolation to eliminate artificially induced boundaries. To avoid amplifying any noise that might be present in the image, we can use adapthisteq optional parameters to limit the contrast, especially in homogeneous areas.

When we convert an RGB image to grayscale, we have to take the RGB values for each pixel and make as output a single value reflecting the brightness of that pixel. One such kinds of approach is to take the average of the contribution from each channel of the colour: (R+B+C)/3, but the result of the output will not good However, since the perceived brightness is often dominated by the green component, a different, more "human-oriented", method is to take a weighted average.

$$X = 0.3R + 0.59G + 0.11B$$

C. FeaturesExtraction

In the proposed technique there are several types of feature extraction from the leaves namely entropy, standard deviation mean intensity and uniformity

D. Segmentation

for classification of object based on a set of features into K number of classes The K-means clustering is used.in which The classification of object is done by minimizing the sum of the squares of the distance between the object and the corresponding cluster. The algorithm for K –means Clustering:

1) Pick center of K cluster, either randomly or based on someheuristic.
2) Assigning each of the pixel in the image to the cluster that minimizes the distance between the pixel and thecluster center.
3) Againcomputetheclustercentersbyaveragingallofthe pixels in the cluster. And Repeat steps 2, 3 until is convergenceattained.

The objective function is:

$$J = \sum_{i=1}^{m} \sum_{k=1}^{K} w_{ik} \|x^i - \mu_k\|^2 \qquad (1)$$

Wherewik=1 for data point xi if it belongs to cluster k; otherwise, wik=0. Also, where µk is the centroid of xi's cluster.

It's a minimization problem of two parts. We first minimize J with respect towik and treat µkas fixed. Then we minimize J with respect to µk and treat wik as fixed. Now We differentiate J with respect to wik first and update cluster assignments (E-step). Then we differentiate J with respect to µk and recomputed

the centroids after the cluster assignments from previous step (M-step). Therefore, E-step is:

$$\frac{\partial J}{\partial w_{ik}} = \sum_{i=1}^{m} \sum_{k=1}^{K} \|x^i - \mu_k\|^2$$

$$\Rightarrow w_{ik} = \begin{cases} 1 & \text{if } k = argmin_j \|x^i - \mu_j\|^2 \\ 0 & \text{otherwise.} \end{cases} \quad (2)$$

In another words, assign the data point xi to the closest cluster judged by its sum of squared distance from cluster's centroid.

And M-step is:

$$\frac{\partial J}{\partial \mu_k} = 2 \sum_{i=1}^{m} w_{ik}(x^i - \mu_k) = 0$$

$$\Rightarrow \mu_k = \frac{\sum_{i=1}^{m} w_{ik} x^i}{\sum_{i=1}^{m} w_{ik}} \quad (3)$$

Which translates to re-computing the centroid of each cluster to reflect the new assignments.

Results & Discussion

Age estimation using area and color value have following sample and its result:

Sample 1 Sample 2 Sample 3 Sample 4 Sample 5

Fig 4 sample of betel leaf

Sample	Area	Color	Age
1	74.44	33.77	Startup
2	92.85	39.76	Growing
3	106.22	53.01	Established
4	109.77	30.92	Matured
5	115.77	29.27	Exit

Table number 1 output of the input sample

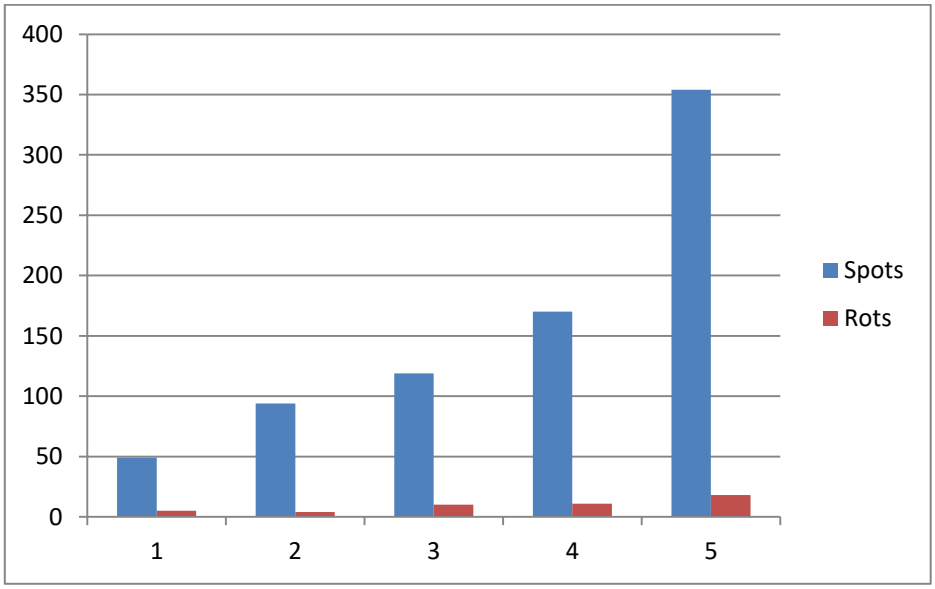

Fig:5 Area and color classification for Age estimation

We have five age estimation level for maturity of leaf. We have classified using area and color.

k-means clustering algorithm is most popular that's way proposed in this segmentation processes. Original image is given as the input to the segmentation process. In this algorithm K-means clustering transformation technique worked on the gradient of that image was employed to reduce the over segmentation of the K-means clustering algorithm.Number of spots, rots and healthy percentage of input sample as showing below.

Sample 1 Sample 2 Sample 3 Sample 4 Sample 5

Fig :6 sample of betel leaf

Sample	Spots	Rots	Percentage
1	49	5	91.14
2	94	4	93.00
3	119	10	90.67
4	170	11	82.98
5	354	18	96.85

Table number 2 output of the input sample

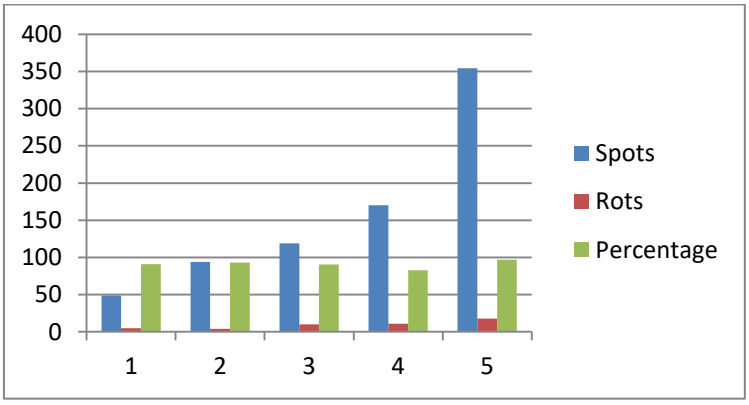

Fig5: Number of spots, rots and healthy percentage

Conclusion

Main approach of our paper is to recognize age and diseases on the leaf. At first preprocessing is done which include area and color calculation. Second stage is feature extractions that include various features .Third stage is k-means based Image segmentationwhicheventuallydoesimageanalysis.Thegoal of this analysis work is to develop advance automatic data processing system which will determine the affected apart of a leaf spots by segmentation the image analysis technique. Through this projected system the farmers' burden has been reduced and saves their life, perform better than others. Accuracy of detection can be increased when using SVM classifier with more number of features included toit.

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