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Leaf Disease Detection Using Image Processing

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Abstract
As we know, India is one of the most agriculture practicing country across the world. From cold-dry zones to the hot-humid ones , from gangetic plains to Himalayan hills, India has most uniquely diverse locations. Maybe that diversity brings huge range of different crops in every season . Production of crops has never been easy task for farmers due to uneven climatic conditions such as rainfall, rise & fall of temperature, etc. Also, diseases caused by fungi, algae, bacteria, nutritional deficiency affects crops & farmers severely and overcoming these problems was even harder. Previously, instruments like spad meter or other expert systems were used to detect various diseases in crops. But now this is no more a problem as pre-processing algorithms have made disease detection simpler using MATLAB. It makes identification of disease possible at early stage without the usage of any chronic method.

Keywords
image processing, k-mean clustering, leaf disease prediction, MATLAB, image segmentation, SVM

I. Introduction

Agriculture production plays a great role in maintaining the economy of any country. Basically, we can say that our graph of economy varies with respect to the production in agriculture and hence is quite a necessary factor in every aspect. Also, agriculture struggles to deal with drastically increasing population where plant disease is a major threat to quality & quantity of food. Deficiency of nutrients, fungi, algae are some of the disease causing factors which makes identification of plant disease necessary through an expert system or various expensive instruments. Hence, wastes so much of time, effort and cost. So, to make things much simpler we have used image processing technique for plant disease detection with the help of some MATLAB tools.

Literature Survey

Various methods are illustrated in some papers for detection of plant disease as shown below:

- Two phases are included to detect affected parts of leaf. Firstly edge detection is done through image segmentation followed by image analysis and then classification of diseases. This work includes input of images using RGB pixel counting values and identify the disease.
- This paper includes three steps to detect leaf disease:

1. Identification of infected part using k-mean clustering.
2. Texture analysis via extraction of features of infected parts by method of color co-occurrence.
3. This one classifies leaves into two parts i.e. infected class and non infected class.

- Color models are compared namely CIELAB, HSI, YCbCr color space and at the end a component of CIELAB color is used.
- In this one regression and classification is done through SVM (support vector machine) which improves accuracy of the system.

Equations Used

Function hsi = rgb2hsi(rgb)
Rgb2hsi simply converts an RGB image in to HSI.
HSI = RGB2HSI(RGB) converts an RGB image to HSI.
The input image is assumed to be of size M-by-N-by-3, where the third dimension accounts for three image planes: red, green, and blue, in that order. If all RGB component images are equal, the HSI conversion is undefined. The input image can be of class double (with values in the range [0, 1]).

The output image, HSI, is of class double, where:
hsi(:,:,1) = hue image normalized to the range [0,1] by dividing a
all angles value by 2*pi
hsi(:, :, 2) = saturation image, in the range [0, 1]
hsi(:, :, 3) = intensity image, in the range [0, 1]

Extract the individual component images:
rgb = im2double(rgb);

r = rgb(:, :, 1);
g = rgb(:, :, 2);
b = rgb(:, :, 3);

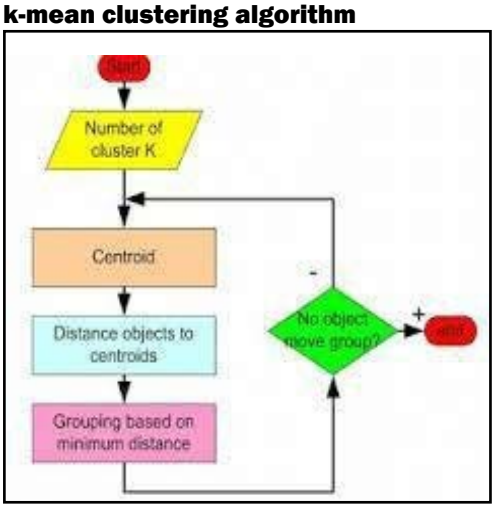
Implement the conversion equations:
num = 0.5*((r - g) + (r - b));

den = sqrt((r - g).^2 + (r - b).*(g - b));
theta = acos(num./(den + eps)
Combine all three results into an hsi image: hsi = cat(3,H,S,I);

II. Proposed Methodology

Image Acquisition: This one is the first most step which captures the image of leaf to upload the snapshot in the system for further processing.
Image Pre-processing: It is carried out to improve the quality of image. Basically, it removes the noise from the image and converts RGB image into grey scale image.
Image Segmentation: segmentation of image makes image more meaningful and brings more clarity. It converts digital image into various segments, also called super-pixels.It successfully represents the boundary line of image.
Feature extraction in image: In this particular step features of leaf like color, texture, morphology, structure etc are considered to detect plant disease. It uses the color co-occurrence and coverts RGB image of leaf into HSB color space representation.
Classification: It is done for interpretation of region affected by disease . In short, it helps in identification of leaf disease.

k-mean clustering algorithm



K-mean clustering flowchart

This algorithm is essentially used to divide the distinct object points based on the features and characteristics of the leaves into k number of groups/clusters.

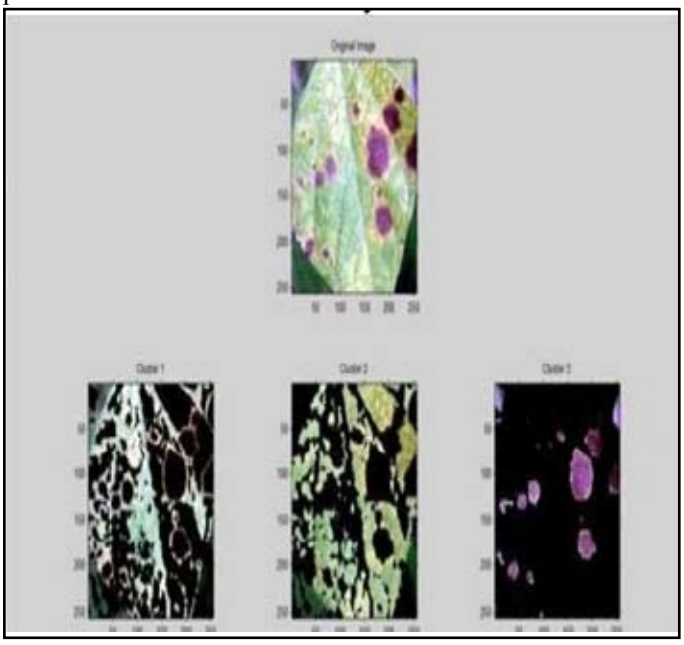
This is performed by using the Euclidean distance metric. The algorithm of k means is explained below:

Initialization: In this algorithm, "k" means the number of groups or clusters that can be formed, the image is therefore classified in to k number of clusters.The user is required to select the valid value of k.

Working: Each and every pixel of the image is assigned according to its nearest centroid (k).

The placement or position of the centroid is modified and changed by the means of data values assigned to the group.

The centroid then eventually moves to the centre, of its assigned points.



III. Experimental Result Analysis

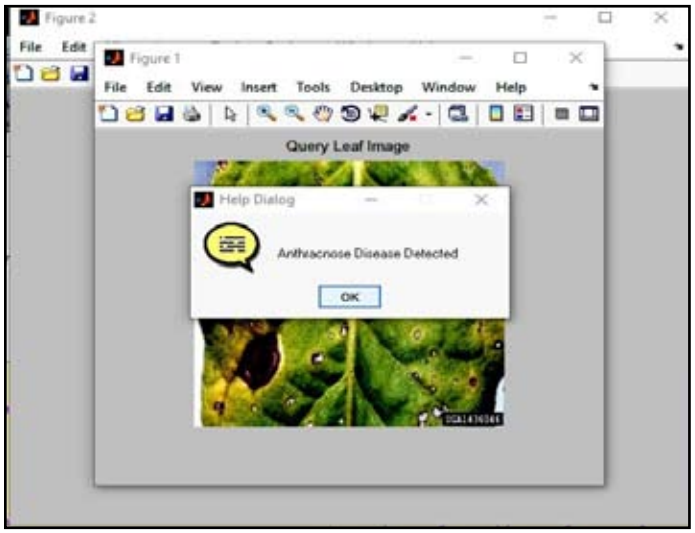
As a part of our experimental result analysis, we took an image of the defected leaf along with different pre- processing algorithms, which we used for the process. The several pre-processing algorithms we utilized for leaf disease prediction includes Grey scale conversion, Gaussian blurring , cropping , median filtering, boundary detection, thresholding etc.

The grey scale conversion, simply transforms a RGB image into gray scale image, for this purpose we took the average of R, G, B i.e.(R+G+B)/3 . The easiest and simplest thresholding methods eventually replace an image with a black pixel, only if the image intensity is less than a fixed constant T (i.e. I(i,j)<T) or a white pixel if the image intensity is greater than T.

Cropping is referred to as the removal of the exterior parts of an image to boost framing, change the aspect ratio or accentuate the subject matter.

Edge detection often includes a wide variety of mathematical methods that aim at distinguishing and analyzing points in a digital image at which the image brightness fluctuates sharply or, more formally, has discontinuities. Further, by using different tools in MATLAB we bring into consideration the features of defected leaves.

These features are thereafter compared with the features of small pixels having diseases like bacteria, rust etc which is saved prior as a database. Distribution, grouping and comparison of diseases is done solely with the help of Neural Networks.



Artificial neural networks (ANN) can be defined as a computational system whose entire concept is derived from the biological neural networks. An ANN comprises of several highly interconnected processing elements that transform a set of inputs to a set of desired outputs. The conclusion of transformation is resolved by the peculiarity and characteristics of the elements and the weights that are associated with the interconnections among them.

All of the above pre-processing steps can be displayed on the screen through the GUI(Axes) tools in MATLAB. When the successful

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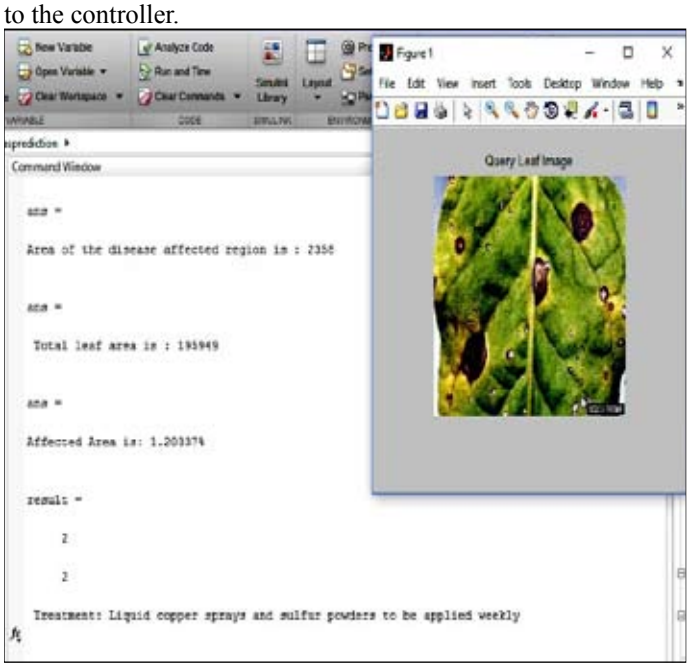
comparison is done, the software responds with the calculated affected area and the category of the disease on the leaf.
In this project, disease caused is illustrated in the form of percentage, so that it is accurate and helpful for us to analyze, understand and estimate the amount of fertilizer required to overcome the disease.
In this way we can successfully identify the disease on any specific leaf by using image processing in MATLAB. Later, after the detection of the disease, data in the binary form is forwarded to the controller.



IV. Conclusion

The present study deals with automatic disease identification of plant leaf using image processing technology using MATLAB as discussed above. It involves steps like imsge acquisition, pre-processing, image segmentation, feature extraction and sums up with the last step called classification.
The process is based on latest technology which helps farmers by identifying disease in plant leaves at early stage thus, minimizes the probability of occurance of more possible damages within the plant. Using this method makes damage detection way simpler and calculates affected area of respective leaf just in seconds. Hence, these few steps can replace old equipments , time consuming methods & wasteful attempts of a farmer with more accuracy and in lesser time.

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