Analysis and Estimation of Rust Disease in Bengal gram Based on Thresholding and RGB Extraction using Image Processing.

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Abstract*— Plant diseases can cause significant reduction in both quality and quantity of agricultural products. Automatic detection of plant diseases is an essential research topic as it may prove benefits in monitoring large fields of crops, and thus automatically detect the symptoms of diseases as soon as they appear on plant leaves. Relying on pure naked-eye observation to detect and classify diseases can be expensive and inaccurate. The proposed system provides a software solution to tradition methods which are incorporated in detection of Bengal gram plant diseases using image processing technique .The system helps the farmers to take precautions in order to prevent disease spread . It also provides accurate results against naked eye observations. The process begins with capturing Bengal gram leaves from the field. The captured images are preprocessed using filtering techniques, and then the green pixels are masked and removed using specific threshold value. Based on the result, the total area on the leaf affected by a disease and healthy area are calculated. Finally texture features are extracted.

Keywords-Rust,Image processing,Bengal gram leaves, Chickpea Rust,Plant disease.

I. INTRODUCTION

India is an agricultural country; wherein about 70% of the population depends on agriculture. Farmers have wide range of diversity to select suitable Fruit and Vegetable crops. However, the cultivation of these crops for optimum yield and quality produce is highly technical. It can be improved by Te aid of technological support.

In case of plant the disease is defined as any impairment of normal physiological function of plants, producing characteristic symptoms. A symptom is a phenomenon accompanying something and is regarded as evidence of its existence. Disease is caused by pathogen which is any agent causing disease. In most of the cases pests or diseases are seen on the leaves or stems of the plant. Therefore identification of plants, leaves, stems and finding out the pest or diseases, percentage of the pest or disease incidence, symptoms of the pest or disease attack, plays a key role in successful cultivation of crops.

Gram commonly known as 'chick pea' or Bengal gram is the most important pulse crop in India. Chick pea occupies about 38 per cent of area under pulses and contributes about 50 per cent of the total pulse production of India. It is used for human consumption as well as for feeding to animals.

All above ground parts of the plant are infected. On leaf, the lesions are round or elongated, bearing irregularly depressed brown spot and surrounded by a brownish red margin. Similar spots may appear on the stem and pods. The spots on the stem and pods have pycnidia arranged in concentric circles as minute block dots. When the lesions girdle the stem, the portion above the point of attack rapidly dies. If the main stem is girdles at the collar region, the whole plant dies.

Chickpea rust develops in cool and weather conditions although rain is not essential for its development. The symptoms usually become conspicuous later in the growing season although epiphytotics may occur earlier in the season when conditions are favorable.

First rust symptoms appear initially on the leaves as small, round or ellipsoidal, cinnamon-brown, powdery Pustules. Pustules can occasionally be seen on stems and pods especially when infection is severe. Severe infection results in premature defoliation and possible death

In biological science, sometimes thousands of images are generated in a single experiment. These images can be required for further studies like classifying lesion, scoring quantitative traits, calculating area eaten by insects, etc. Almost all of these tasks are processed manually or with distinct software packages. It is not only tremendous amount of work but also suffers from two major issues: excessive processing time and subjectiveness rising from different individuals. Hence to conduct high throughput experiments, plant biologist need efficient computer software to automatically extract and analyze significant content. Here image processing plays important role. The following figure 1 shows Rust affected areas in Chickpea (Bengal gram) leaves.

Figure 1: Rust affected in Chickpea leaves

II. LITERATURE SURVEY

S.Arivazhagan and team [2] have proposed a software solution for automatic detection and classification of plant leaf diseases. The developed processing scheme consists of four main steps, first a color transformation structure for the input RGB image is created, then the green pixels are masked and removed using specific threshold value followed by segmentation process, the texture statistics are computed for the useful segments, finally the extracted features are passed through the classifier.

A leaf which is infected by bacterial disease is given as input to the algorithm. Color transformation structure on the input image is performed. Then the green pixels are masked and removed using a specific threshold value. Then the R, G, B components are mapped to the thresholded image. After mapping the R, G, B components of the input image to the thresholded image, the co-occurrence features are calculated. The co-occurrence features for the leaves are extracted and compared with the corresponding feature values stored in the feature library. The classification is first done using the Minimum Distance Criterion. The SVM classifier is used to enhance data accuracy which is a set of related supervised learning methods used for classification and regression.

Anand.H.Kulkarni and team [1] have designed and developed a methodology for detecting plant diseases early and accurately, using diverse image processing techniques and artificial neural network (ANN). In the proposed method, captured images filtered and segmented using Gabor filter. Then, texture and color features are extracted from the result of segmentation and Artificial neural network (ANN) is then trained by choosing the feature values that could distinguish the healthy and diseased samples appropriately. Experimental results showed that classification performance by ANN taking feature set is better with an accuracy of 91%. An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process the information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems.

Tushar H Jaware and team [3] have proposed a method that makes us of K-Means clustering technique is a well-known approach that has been applied to solve low-level image segmentation tasks. In this approach, a color transformation structure for the RGB leaf image is created, and then, a device-independent color space transformation for the color transformation structure is applied. Then images at are segmented using K-Means segmentation. After that, based on specified and varying threshold value that is computed for these pixels using Otsu's method, these mostly green pixels are masked. The other additional step is that the pixels with zeros red, green and blue values and the pixels on the boundaries of the infected cluster (object) were completely removed. In the next step infected cluster was then converted from RGB format to HSI format. The SGDM matrices were then generated for each pixel map of the image for only H and S images. From the SGDM matrices, the texture statistics for each image were generated. Finally, the recognition process was performed to the extracted features through a pre-trained neural network.

A. PROPOSED SYSTEM :

Collect the samples of leaves and capture the image under uniform illumination. Rust affected percentage is calculated from manual process in the laboratory which becomes the reference for the development of proposed system. Image is preprocessed and texture features are extracted. Next the image is converted to gray scale for GLCM calculation. The image is resized to form a square matrix. GLCM is calculated. Next all the texture feature values are calculated using the formulae mentioned above. All these texture feature values are loaded into a matrix. The same procedure is followed on a number of leaves and all the texture and color feature values are loaded into a single matrix. Next we take a test image and find its texture feature values using a similar procedure. We are using MATLAB software for the implementation of our algorithm. The reason for the choice of software is it provides a good number of tools for image processing which can be easy to use. Thresholding is done using RGB value extraction and from the values extracted rust affected area and its percentage are determined. Proposed system allows user to load image of size 512 X 512. User can view percentage of rust affected along with the report generated.This helps farmers to plan for fertilization.

III. METHODOLOGHY

The proposed method Block diagram is as shown in the following figure 2.

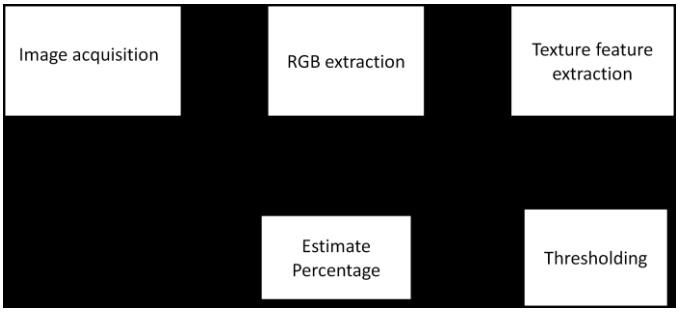

Figure 2: Block diagram of Pathometric System.

A. Image Acquistion

Images of Bengal gram (Chickpea Rust) both healthy and rust affected are captured using Digital Camera (DSLR) having resolution of 16 mega pixel connected to intel i3 processor having 3gb Ram.

B. RGB Extraction

The Red, Green and Blue content of an image is extracted pixel by pixel. The green pixels are masked and only the red pixels i.e. rust part (affected part) is displayed. It provides the information about the affected area.

C. Texture Feature Extraction

Texture features like Intensity, correlation, homogeneity, energy, entropy and contrast are extracted along with color features.

a . Contrast

Contrast is the difference in luminance and/or color that makes an object (or its representation in an image or display) distinguishable.

Contrast is calculated using the formula below

$$\sum_{i,j} |i-j|^2 \mathrm{p(i,j)}$$

b. Entropy

E = entropy(I) returns E, a scalar value representing the entropy of gray scale image I. Entropy is a statistical measure of randomness that can be used to characterize the texture of the input image.

Entropy is defined as sum (p*log2 (p))

c. Correlation

Correlation is a measure of gray level linear dependence between the pixels at the specified positions relative to each other.

Correlation is calculated using the formula below

$$\sum_{i,j} \frac{(i-\mu i)(j-\mu j)p(i,j)}{\sigma i \sigma j}$$

d. *Homogeneity*

Homogeneity Returns a value that measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal. Range = [0 1] Homogeneity is 1 for a diagonal GLCM.

Homogeneity is calculated using the formula below

$$\sum_{i,j} \frac{p(i,j)}{1+|i-j|}$$

D. Thresholding

A separate threshold for different RGB components is provided as the condition to extract the red, green and blue pixels count. Based on thresholding values pixel count (area) is calculated.

Algorithm for Thresholding : To display the Rust affected area on the leaf.

1. Read the image to be processed.

2. Calculate the mean red pixels by enabling only red channel.

3. Convert the image to gray using rgb2gray.

4. Calculate the difference and the bwarea (estimates the area of the objects in binary image).

5. Estimate the affected area by multiplying only the red pixels with bwarea.

6. Affected red part i.e. rust is displayed.

E. Estimation of Percentage

The red and green pixels are calculated using Thresholding. The percentage of rust affected is calculated using

Rust % = (red pixels/leaf area) * 100

Leaf area = red pixels + green pixels.

Algorithm to calculate the Percenatge of Rust in Chickpea leaf.

Input: Image samples
Output: Percentage of affected area
Start
Step1: Accept image samples both normal and affected by anthracnose
Step 2: Identify the area affected using segmentation techniques
Step 3: Estimate the percentage of affected area.
Step 4: If (percentage < 1)
Display 'normal'
Else if (percentage<=25)
Display 'partially affected
Else if (percentage<=50)
Display 'Moderately affected'
Else
Display 'Unhealthy'
Stop.

IV. RESULT AND DISCUSSION

The texture features of image are extracted using the formulae as discussed above. We have tested it for few sample leaves of Chickpea. Result analysis for Chickpea leaves are shown in Table 1 and 2. In Table 1 , texture features like Contrast, Correlation, energy and Homogeneity are tested for various input samples.

Table 1: Image and its respective Texture Feature

Image i/p	Contrast	Correlation	Energy	Homogeneity
	0.0217	0.9967	0.5950	0.9927
	0.0749	0.9862	0.1661	0.9626
	0.0247	0.9940	0.4155	0.9877
	0.0071	0.9967	0.8028	0.9964
	0.0289	0.9938	0.4531	0.9855

The Percentage of Rust affected is calculated using the Rust % formula i.e. (red pixels/leaf area) *100. Test is done for few samples. The rust percentage for various input leaves are shown in Table 2.

Table 2: Image and its percentage of Rust affected.

Image Input	Red Pixels	Green Pixels	Leaf Area	Rust Percentage
	1753	240737	242490	0.73%
	12406	23854	36260	52.008%
	0	55178	55178	0%
	1945	24350	26295	7.99%
	61809	653317	715126	9.45%

V. CONCLUSION

Proposed system is an automated technique to estimate the percentage of rust in Chickpea leaves. System finds the percentage of rust affected along with report generation that gives information about whether the input leaf is rust affected or healthy. It gives proper suggestion based on the result and report generated. Use of image processing makes it accurate and error free. Process consumes less time than existing system and is Accurate giving instant results for users. Economical and consumes less number of sample leaves for testing.

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