Leaf Disease Detection Using Image Processing Techniques

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Abstract

The study of Plant Diseases refers to the studies of visually observable patterns of a particular plant. Nowadays crops face many diseases. This paper provides a method to detect disease by calculating leaf area through pixel number statistics. The method studied is for increasing throughput and reducing subjectiveness arising from human experts in detecting the leaf disease. Leaf spots can be indicative of crop diseases, where leaf batches are examined manually and subjected to expert opinion. In this paper an Image Processing system is developed to automate the inspection of these leaf spots.

Keywords— Digital Photographs, Matlab, Image Processing

1. Introduction

India is an agricultural country; wherein about 70% of population depends on agriculture. However, the cultivation of these crops for optimum yields and quality produce is highly technical. It can be improved by aid of technological support. The management of plants requires close monitoring especially for the management of disease that can affect production significantly and subsequently the post-harvest life. The naked eye observation of experts is the main approach adopted in practice for detection of plant diseases. However this requires continuous monitoring of experts which might be prohibitively expensive in large farms. 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. Therefore looking for fast, automatic, less expensive and accurate method to detect disease by calculating leaf area through pixel number statistics.

The image processing can be used in agricultural applications for following purposes:
1. To detect diseased leaf, stem, fruit
2. To quantify affected area by disease.
3. To find shape of affected area.
4. To determine colour of affected area.
5. To determine size & shape of fruits.
   Etc.

The leaf area monitoring is an important tool in studying physiological features related to the plant growth, photosynthetic & transpiration process. Also being helpful parameter in evaluating, damage caused by leaf diseases and pastes, to find out water and environmental stress, need of fertilization, for effective management and treatment.

Leaf area determination can be done by direct methods, which involves the measuring of all the individual leaf areas or indirect methods, which are based on the relation of some plant characteristics with the true leaf area obtained in destructive tests. Present leaf area measuring methods are grid counting method which has simple principals and high accuracy, but time consuming. In Paper weighing method leaf outline is cut out from graph paper, which is called paper sample weight (W) is weighed in electronic analytical balance. Standard graph paper weight is weighed in electronic analytical balance and it is known (S), so paper weight per unit area is D=G/S then the area formula of paper weighing method is S=G/D, this is also time consuming method. But In this method, leaf area is determined by using digital photographs and Matlab tool to process the digital images.

2. Proposed Methodology

When a leaf area is to be measure in field condition, it is difficult to keep cameras optical axis vertical with leaf plane. So the plane of CCD is not superposition with image plane and the leaf image is distorted because of some geometric distortions. This will affect the measurement precision of leaf area. So the leaf is separated and placed horizontally on white background to take the photograph.

A. Image Processing Method

1) Principle: In image processing method leaf area is calculated through pixel number statistic. Unit pixel in the same digital images represent the same size hence from known reference area and pixel count, unit pixel size can calculate, so that it is easy to calculate leaf area by counting total pixel in leaf area region.

$$Pc = \Sigma 1 \qquad ....(1)$$
$$(x , y) \in Rc$$
$$Ac = \pi \ (d/2)_2 \ ....(2)$$

Hence,
$$Ap = Ac/Pc \qquad .... (3)$$
And
$$Pl = \Sigma 1 \qquad .... (4)$$
$$(x, y) \in Rl$$

Hence,
$$Al = Pl*Ap \qquad ....(5)$$

Where,

Ac- Area of coin region,
Al- Area of leaf region,
Ap- Unit pixel value
Rl- Leaf region,
Rc- Coin region

B.MATLAB Based Processing Method

Matlab is a high performance language for technical computing where problem and solutions are expressed in familiar mathematical notation. The Matlab processing is a semi automatic method to calculate leaf area for more users easily.

i)Algorithm

1. Read the image.
2. Convert RGB image to Gray Scale image.
3. Convert the Gray scale image into Binary image.
4. Remove noise using " imfill" instruction.
5. Calculate the total green leaf area & total Leaf Area using "Regionprops" instruction.
6. Infected area in percentage by subtracting Total Green leaf area from Total Leaf area.

ii) Photograph Acquisition & Processing

The leaf whose infected area is to be measured is placed on the white background, without any light reflection, with one rupees coin as a known area object. The camera is held horizontally to the plane of the leaf. The photograph distance is neither too close nor too far; it is adjusted such a way that the photograph is covering only background, leaf and known area reference object as shown in fig1.

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Before applying the function "*regionprops'*, the actual image converted into a grayscale image as shown in fig.2.
The formula of graying the collected RGB color image is:
$$I = 0.3R + 0.59G +0.11B$$

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Then a global threshold is computed that can be used to convert an intensity image to a binary image. i.e. image is segmented into two groups object & background.

A function *bwbounderies*, is used to trace the boundary of a selected region in an image, this labeled region will be represented in a two dimensional array of non integers. However due to plant diseases, removes some area from the leaf or make the color of this area different from healthy leaf, results in pixel count that will less than the true pixel count of the selected region as shown in fig.3.

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These dark patches inside the image are holes that can be easily identified and filled. The Matlab function imfill is used to fill any holes.A hole is a set of background pixels that cannot be reached by filling in the background from the edge of the image. The function *regionprops* in Matlab is used to measure area of a selected region of an image in pixel count. Function *regionprops* can be used to estimate

area enclosed. The area is the actual number of pixels in the selected region.

iii) Determination of Area

The pixel count of the processed image depends on the distance between the camera and the object when the picture is taken. As smaller the distance, larger is the pixel counts. Hence a reference object is needed to be able to translate the pixel count area. The reference object is nothing but object with known area.

One Rupees coin is chosen as reference object whose area is,

$$\text{Area of coin (Ac)} = \pi(d/2)^2$$

Where "d" is diameter of the coin

$$= \pi \left(2.5cm/2\right)^2$$

$$= 4.9063 \text{ cm}^2$$

The pixel count of the coin from the image is 1799
Hence, For the green area of leaf ,

1 pixel value (Ap) = Area of coin (Ac) /coin pixel count (Pc)
$$= 4.9063/1799$$
$$= 2.7272 cm^2$$
For Leaf, the green pixel count (Pl) is 5695 pixels.
Hence,
Total Green area (Al) = green pixel count (Pc) × 1 pixel value
$$= 5695 \times 2.7272$$
$$= 15.5392 \text{ cm}^2$$
Similarly for the whole Leaf, the total leaf pixel count (Pl) is 10626 pixels.
Hence,
Total Leaf area (Al) = total pixel count (Pc) ×1 pixel value
$$= 10626 \times 2.7272$$
$$= 28.9938 \text{ cm}^2$$

4)Determination of Infected Area :
Infected Area= [(Total Leaf Area –Total Green area) /
Total Leaf Area] × 100
$$= [(28.9938 \text{ cm}^2 - 15.5392 \text{ cm}^2) / 28.9938 \text{ cm}^2]$$
$$\times 100$$
$$= 46.4299 cm^2$$

3.Results

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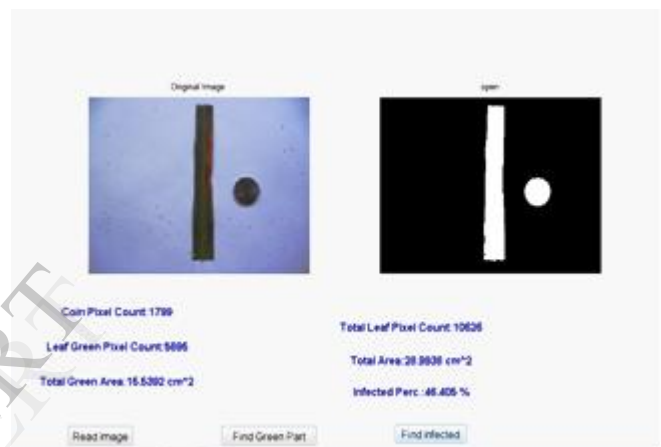
3.Conclusion

The naked eye observation gives poor accuracy, & it is subjective which will vary person to person. Hence image processing method is used to obtain high precision & accuracy whether leaf with the maximum dimensions.It will consume less time compare to any manual interfere as well as it can be easy to process if images are stored. This algorithm will help to detect amount of disease present on the leaf, by means of presence of holes & changes in the color. It will be easy to go for the severity measurement of disease.

4.References

[1] Sanjay B. Patil, Dr.Shrikant K.Bodhe LEAF DISEASE SEVERITY MEASUREMENT USING IMAGE PROCESSING, International Journal of Engineering and Technology Vol.3 (5), 2011.

[2] Sanjay B. Patil, *IMAGE PROCESSING METHOD TO MEASURE SUGARCANE LEAF AREA,* International Journal of Engineering Science and Technology.

[3] Mr. V. A. Gulhane & Dr. A. A. Gurjar, *Detection of Diseases on Cotton Leaves and Its Possible Diagnosis,* International Journal of Image Processing (IJIP), Volume (5) : Issue (5) : 2011.

[4] H. Al-Hiary, S. Bani-Ahmad, M. Reyalat, M. Braik and Z. ALRahamneh, *Fast And Accurate Detection and Classification of Plant diseases,* International Journal of Computer Applications (0975 –8887),Volume 17– No.1, March 2011.

[5] Sanjay B. Patil, Dr. S.K.Bodhe,”*Betel leaf area measurement using image processing,*” IJCSE,2011,pg.2856-2660.

[6] Rafael C, Gonzalez, Richard E. Woods, Steven L. Eddins, “*Digital Image Processing Using MATLAB,*” Pearson Publication,2008.

[7] Chaohul Lu,Hui Ren (et.al) “Leaf area measurement based on image processing,”IEEE,2010,580-582.