IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-7, Issue-5, May 2019 E-ISSN: 2347-2693

Diseased area Detection & Quantification of Betel-vine leaves, Affected by Leaf rot disease

Sannihita Pattanaik[1*], Chandra Sekhar Panda[2]

[1]Dept of Computer Science & Applications, Sambalpur University, Sambalpur, Odisha , India
[2]Dept of Computer Science & Applications, Sambalpur University, Sambalpur, Odisha , India

*Corresponding Author: sannihitapattanaik@gmail.com Tel.: +91-8763407098

DOI: https://doi.org/10.26438/ijcse/v7i5.573577 | Available online at: www.ijcseonline.org

Accepted: 07/May/2019, Published: 31/May/2019

Abstract With natural calamities, plant disease also plays a major role in severe damage of agricultural product. Hence it is very much important to prevent the crop from being affected by different type of diseases. Likewise betel-vine which is also known as "the green gold of India" is affected by different kind of diseases during its short life period. But leaf rot disease affects the plant all over the year, which is a great loss to the farmer, as twenty million of people of our country make their livelihood directly or indirectly from betel vine. Here I proposed two methods to detect the affected area and quantify the area exactly in betel vine leaf so that, leaves can be protected from severe damage by applying exact amount of pesticides as needed in time and this is the novel aim behind this research work. Hence two methods are simulated namely Otsu's global thresholding and K-means clustering to get the ROI clearly after segmentation and finally made a comparison to know, which one is giving better result. By applying Otsu's methodology (PM-1), it is evident from table that the precision of (PM-1) is very high, but the recall value is low, as the average recall value is only 52%. But experimental results shown that K-means is better one with very high precision and high recall value where, the average recall value is 0.9366 or 93.66%.

Keywords— Segmentation, ROI, Detection, Quantify, Precision, Recall

I. INTRODUCTION

The main factors that affect the crops and farm land may include water logging, fertilizers, pesticides and the quality of yield, where, most of the crops or plantations are getting damaged either due to natural calamities like earthquake, floods, droughts, famine etc or due to pathogens. Research says, 98% of the destruction is caused by pathogens and only 2% of the destruction happens due to natural calamities [1,2]. Most of the time, it is found that the quality as well as the quantity of the agricultural products get reduced by the diseases affecting the plants and crops. In a developing country like India, the farmers in rural areas needs to be trained for properly detecting the diseases in crops so that the production can be increased.

Betel vine is an important crop in India, having heart shaped deep green leaves. The scientific name of Betel leaf is *Piper betel* [4, 5]. The betel vine leaves are used as medicines as, vitamin B and vitamin C are highly available in it. It is also used as a refresher. The fresh juice of betel vine leaves are used in a tonic to the brain, liver and heart for human [4, 6]. There are 70 varieties of betel vines that are cultivated in the world, among them 40 varieties are cultivated in India only [5]. In India 20 million people make their livelihood directly or indirectly from betel vine by producing, by transporting or by marketing. So Betel vine are also known as "The Green gold of India". But the total life span of this Green gold is only 2-3 years [2]. During this short life period it is very much affected by different diseases like Powdery mildew, foot rot, leaf rot, leaf spot etc. But leaf rot disease affects the plant all over the year and the outcome is a big loss to the farmers as well as to country's economy.

However, for accurate detection of disease affected area in plants as well as the type and quantity of pesticides that can be applied in cereal crops by measuring the extent to which the diseases cause potentially harm to the crops, the techniques of image processing can be used in an efficient way. Hence, image processing can be better explained as a procedure to convert images in a digital way or either goes for image enhancement or extraction of some useful information. In that sense, a form of digitally processed images, called digital image processing, makes efficient use of algorithms to process the image in a better way.

Detecting and quantifying the disease affected area plays an important role in the revolution of plant existence. As in the modern age, we people are applying much more pesticides than needed. That may be due to lack of awareness or may be due to more expectation of outcome. But here it has been seen that the result is very pathetic. Either it affects the creature who consumes it or it affects the existence of plant. Hence, the aim of this paper is to detect and quantify the exact area affected by leaf rot disease in Betel-vine leaves. This system take leaf images as input and detects the affected area accurately and quantify it. And rest of the paper is organized as follows. Section I contain the introduction of diseased area detection and quantification in betel-vine leaves, Section II contain some related work already done by some great researchers on betel-vine leaves affected by some other diseases, Section III describes the flow of methodology along with the datasets on which both the methods are applied, Section IV describes about the performance measures, results and discussion of result of both the method by comparing them on some certain measures, Section V concludes research work and contain some aspect of future work.

II. RELATED WORK

Amar Kumar Dey et.al.[2] in their article, proposed a method “Otsu thresholding based on Image Processing algorithm for segmentation of leaf rot diseases in betel vine leaf. Here the commonly used color models are RGB, HSV (Hue, Saturation, Value), and YCbCr (luminance and chrominance). But this paper represents that hue component of the HSV color model gives the clear perception of rotted leaf. It marks the background and rest of the leaf area. But, there is lack of separability near the edges of betel vine Leaf.

Monica Jhuria et.al [1] Uses image processing for detection of disease and fruit grading in their paper. They have used artificial neural network[10] for disease detection. They have created two separate databases – one for training of already stored disease images and other for the implementation of query images. Back propagation is used for the weight adjustment of training databases. The authors have considered three numbers of feature vectors i.e. color, texture and morphology. They have found that morphology gives better result than the other two.

Moreover, J Vijaykumar et.al [3] proposed a method for detecting the powdery mildew disease on betel vine leaves. Here after collecting the images, some preprocessing task and image analysis are done using image processing tool box in mat lab. Again RGB encoding techniques are used for separating red, green and blue components, which forms the pattern of various healthy leaves.

P. Tamilsankar et.al [4] described how the captured image is filtered by using median filter for removing noise. Again color transformation is done by using CIELAB space model. The author used watershed segmentation on ‘L’ component image to segment the image by gradient factor. HOG feature is extracted for affected betel leaf image. The minimum distance classifier is used to classify the types of disease in betel vine leaves.

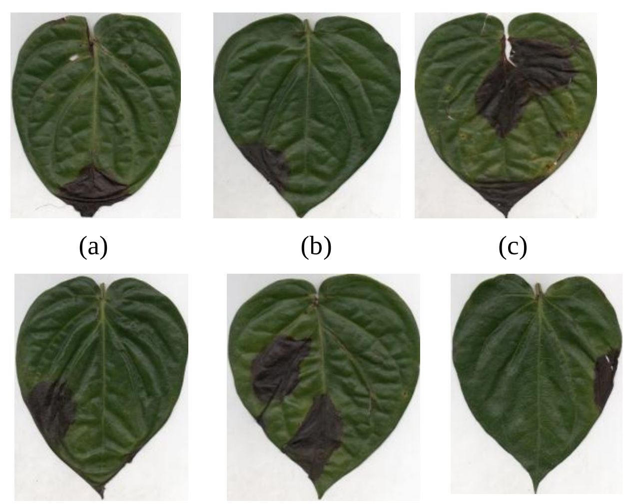
J.Vijaykumar et.al [5] proposed another method for identifying powdery mildew disease in Pachaikodi variety of betel vine leaf. The author has used the image processing tool box in matlab for analysis of the image of betel vine leaves. Again the author plotted histogram of gray scale image and used back propagation neural network algorithm for identifying the percentage of correct classification.

III. METHODOLOGY

The input images used for detection and quantification of disease affected area has been collected from the cultivation field. The experiments are carried out in Intel(R) core(TM) i3-3227U CPU@ 1.90GHz, 4GB RAM with 64 bit operating system by using Matlab 9.2.0 538062 (R 2017a).

Betel-vine leaves Dataset:

The real-time datasets are taken for experiment. Samples are collected from a village Raghunathpur under Jagatsinghpur district of Odisha. For this experiment 15 Betel vine leaves (Piper bitle L.) of Bangla Desi variety are choosen. And all of the leaves are found to be infected by leaf rot disease on different position of leaf and of different size. The collected leaves are scanned by using Canon Scanner with resolution (300 DPI) and 24 bit color depth. But the scanned sample leave images contain more background as compared to the leaf area. So it will require high disk storage space and requires more CPU time during segmentation process. So the sample leave images are cropped into a size of 16*20 cm sq. After this pre-processing step, disk storage space must be saved and CPU processing time also increases. Some of the sample images are given below in fig 1.



(a) (b) (c)

(d) (e) (f)

Fig.1 Some Input Images

The methodological analysis of the work "diseased area detection and quantification" has been shown as below

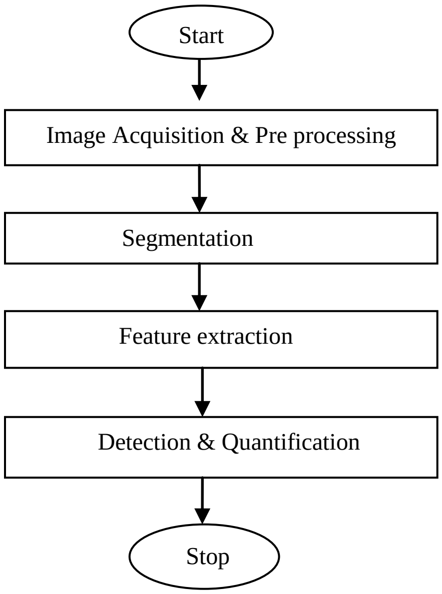


Fig.2 Flowchart for Disease detection and quantification

3.1 Image Acquisition and Pre processing

In this paper, real-time datasets are collected for performing the experiment. Samples are collected from Raghunathpur village under Jagatsinghpur district of Odisha. For the experiment, 15 Betel vine leaves (Piper bitle L.) are chosen and all of the leaves are found to be infected by leaf rot disease on different parts of the leaf and are of different size. My collected samples consist of 50% of leaf area and more than 40% of background. Since the unnecessary background requires more memory space as well as CPU time, there was also a chance that, these issues may affect the calculations and result of my proposed work. So the leaf samples have been cropped into a smaller dimension of size 16*20 cm^2.

3.2 Image Segmentation

It is the process of partitioning a digital image into constituent regions. The result of image segmentation is a set of regions that collectively cover the entire image. In a single region all the pixels are similar with respect to color, texture & intensity [2,9]. Adjacent regions are different from each other with respect to some feature [4]. Image segmentation changes the representation of image into something that is more meaningful and easier to analysis. As here in my work two methods are involved so, I have named them as Proposed Method 1(PM 1) and Proposed Method2 (PM 2). In PM 1, actually I have extracted individual component of different color models like RGB color model, HSV color space, YCbCr color space. But I have found that green component of RGB color model is showing the diseased area more clearly as compared to others. So I have taken the green component image as input for my experiment. Then the green component image is converted into binary image. Otsu's global thresholding is applied on the binary image to segment the affected regions and unaffected regions. Then morphological operation is applied on threshold image for accurate detection. Likewise in PM-2 K-Means clustering is applied in the input image for segmentation in which the RGB image is converted into L*a*b* color space by using two different functions namely makecform and applycform. Then colors has been classified in a*b* space using k-means clustering. Then that we can found the images with individual clusters. Again clusters are converted into binary images. Then morphological operations are applied to find out the diseased area clearly.

3.3 Rotten leaf area Calculation

Finally the resultant segmented image consists of only white pixels which represent the rotten area. To get the total number of pixels, the number of white pixels is counted by multiplying the matrix element. Again to get the rotten area in cm^2 a known calibration factor is multiplied with the total number of white pixels.

IV. Results and Discussion

Here Fig.3 (a) and Fig.3 (b) is showing the input image and the resultant rotten part of the leaf by applying Otsu's Global thresholding method (PM-1). Again Fig.4 (a) and Fig.4 (b) is showing the input image and the resultant leaf image by applying K-means clustering (PM-2) as below.

Fig.3 (a) Input Image

Fig.3 (b) Resultant Image

Fig. 4(a) Input Image

Fig. 4 (b) Resultant Image

Again, here precision and recall are used as performance criteria. Precision and Recall of all the input images are calculated by using the factors like Correctly detected rots, Totally detected rots, Total rots The Precision and Recall are defined by the following equations which, are brought from the refered paper [2] written by A K Dey et.al. And the equations are as follows.

$$\text{Precision} = (\text{correctly detected rots}) \div (\text{totally detected rots})$$

$$\text{Recall} = (\text{correctly detected rots}) \div (\text{total rots})$$

Table 1: Comparison of performance criteria of Proposed Method-1 & Proposed Method-2

Sample	Otsu's Thresholding (PM-1)		K-means Clustering (PM-2)	
	Precision	Recall	Precision	Recall
1	1	1	1	1
2	1	1	1	1
3	1	0.2	1	0.8
4	1	0.33	1	1
5	1	0.25	1	1
6	1	0.5	1	1
7	1	0.33	1	1
8	1	0.33	1	1
9	1	0.33	1	1
10	1	0.25	1	0.75
11	1	0.33	1	1
12	1	0.5	1	1
13	1	0.5	1	1
14	1	0.5	1	0.5
15	1	1	1	1

The above table represents a clear comparison of both of the methods by taking the precision and recall value of all the input images as criteria. Here from the table it is clearly visible that in Otsu's thresholding (PM-1), precision is very high but the recall value fluctuate that, in some cases it's 50%, in some cases it's 33% and in some of the cases it's only 25%. But the average recall is 52%. But in K-means clustering (PM-2) precision is high in all the cases, as well as the recall value is also very high. In one case only the recall value is 50% but in all other cases it is very high, which is approximately 0.9366 or 94%.

V. CONCLUSION AND FUTURE SCOPE

Two robust mechanisms K-means and Otsu's thresholding algorithm have been applied in this thesis for detecting and quantifying the diseased area of affected betel vine leaves. Identifying the disease affected portion correctly, pose a challenge as it cause a serious problem in segmenting and extracting the affected area. The proposed Otsu mechanism (PM-1) is based on image thresholding method in which the method is applied on G component of RGB color space. Here G component of RGB color space is taken as experimental input image because in this, diseased area and normal area are visible in naked eye. In the second proposed method (PM-2), RGB color space is converted into L*a*b* color space for identifying the affected area. Through simulation, it is concluded that the (PM-2) K-means clustering algorithm displayed better result in terms of precision and recall, as compared to Otsu's thresholding mechanism. For a successful cultivation the disease affected area detection and quantification is very much important.

And this paper is a small contribution towards the novel work.

REFERENCES

[1] M Jhuria, A kumar and R Borse, "Image processing for Smart farming, detection of Disease and Fruit Grading," Proceedings of the 2013 International Conference on Image Information processing, pp. 521-526, 2016

[2] A K Dey, M Sharma, M.R.Meshram, "Image Processing Based Leaf Rot Disease, Detection of Betel Vine", Proceedings of the 2016 International Conference on computational Modeling and Security, CMS, pp.748-754 , 2016

[3] J. Vijaykumar, S. Arumugam, "Early Detection of Powdery mildew Disease for Betel vine plants Using Digital Image Analysis", International Journal of Modern Engineering Research, vol.2.Issue 4, pp. 2581-2583, 2012

[4] P.Tamilshankar, Dr.T.Gunasekar,"Computer Aided Diseases Identification for Betel Leaf", International Research Journal of Engineering Technology ,Vol 2, Issue 9, pp. 2577-2581, 2015

[5] J.Vijayakumar, "Powdery mildew disease Identification in Pachaikodi variety of Betel vine plants using Histogram and Neural Network based Digital Imaging Techniques, International Research Journal of Engineering Technology, Vol 3, Issue 2, pp. 145-1152, 2016

[6] Abdullah NE, Rahim AA, Hashim H, Kamal MM "Classification of Rubber tree leaf diseases using multilayer Perceptron neural network", Proceedings of IEEE 2007 5th Student Conference on Research and Development. , pp 16.

[7] M Bhange, H.A.Hingoliwala, "Smart Framing: Pomegranate Disease Detection Using Image Processing", Proceedings of 2015 International Symposium on Computer Vision and Internet (VisionNet'15),pp. 280-288

[8] Ehsan Kiani, Tofik Mamedov, " Identification of Plant Disease Infection using soft-computing : Application to modern botany",9th International Conference on Theory and application of Soft Computing ,Computing with Words and Perception, pp. 24-25 ,2017

[9] Riddhi H. Shaparia, Narendra M.Patel, Zankhana H.Shah "Flower Classification using Different Color Channel", International Journal of Scientific Research in Computer Science and Engineering, Vol.7, issue 2,pp. 1-6, 2019

[10] V. Davis, S. Devane, "Diagnosis of Brain Hemorrhage Using Artificial Neural Network", International Journal of Scientific Research in Network Security and Communication, Vol.5, Issue.1, pp.20-23, 2017

Authors Profile

Mrs Sannihita Pattanaik pursed BCA from Utkal University of Odisha, India in the year of 2014 & Master of Science from VaniVihar, Utkal University in 2016. She has also appeared Master of Philosophy in Dept of CompSc & Application in Jyotivihar, Sambalpur University.

Mr C S Panda is currently working as a reader in JyotiVihar, Sambalpur University in Dept of Computer Science & Applications. And his area of intrest is Digital Image Processing.