ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 3, Issue 1, pp: (63-69), Month: January - March 2015, Available at: www.researchpublish.com

An Assessment on Detection of Plant Leaf Diseases and Its Severity Using Image Segmentation

[1]K.Muthukannan, [2]P.Latha, [3]P.Nisha, [4]R.Pon Selvi

[1]Associate Professor, Einstein college of Engineering, Tirunelveli, India
[2]Associate Professor, Government college of Engineering, Tirunelveli, India
[3, 4] PG Student, Einstein college of Engineering, Tirunelveli, India

Abstract: **Diseased plant leaf image segmentation is a basic pre-processing task to separate leafs from the background and detects the disease affected portion. Although many methods are proposed, it is still difficult to accurately segment the affected portion and to measure the severity of disease in a leaf image. In this survey paper, some segmentation techniques are illustrated to segment the spots of lesion regions in leaves and the measurement of severity of disease affected in a leaf.**

Keywords: **detection, segmentation, colour edge extraction, hybrid techniques, severity measurement.**

I. INTRODUCTION

Plants exist everywhere in this world, detecting the plant leaf diseases plays a vital role in the agricultural field. Plant diseases degrade the quantity and quality of agricultural products. Diseases, insects and pests are the major problems that threaten any plant cultivation, which leads to heavy loss in production. Plant leaf disease detection is important research topic, which automatically detects the causes of diseases in unhealthy leaves as soon as they appear.

In this survey paper the diseased leaf segmentation techniques and severity measurement techniques are described. The main step in image processing is image segmentation, where the image is subdivided into number of meaningful segments. The segmented parts give some information in the form of colour, texture or intensity. And also it's important to extract the boundaries of an image. Still there is no perfect method for image segmentation because each image has its own properties. Some the famous image segmentation is Edge based segmentation, Fuzzy theory based segmentation, Artificial Neural Network (ANN) based segmentation, threshold based image segmentation, and Region based image segmentation. This paper mainly focus on some hybrid segmentation techniques such as discrete wavelet transform and k-means clustering, colour edge extraction and seeded region growing technique, image edge detection technique and threshold based segmentation. And plant leaf diseases can be measured in many ways based on intensity, incidence, prevalence and disease severity. Disease severity can be measured by the absolute area of the sampling unit which shows the symptoms of a disease. Today there is no any standard to calculate the severity of a disease affected leaf image. The steps involved in severity measurement include image acquisition, diseased leaf area calculation, total leaf area calculation and calculation of disease severity. This is used for early prediction of plant leaf diseases and reduces the loss in agricultural productions by using appropriate insecticides and to increase the crop yields.

II. REVIEW OF LITERATURE

Evaluation of Cotton Leaf Spot Disease Detection Using [1] The paper titled Advance Computing Enrichment Image Edge Detection by P.Revathi and M.Hemalatha describes about the image edge detection segmentation techniques to segment the disease affected cotton leaf. Here Image analysis purposes are to detect the diseased leaf, to measure the affected area by disease, to find the boundary of the affected area, to determine the colour of the affected area, to identify the diseased spot correctly. Here they have used image edge detection segmentation and advance computing techniques.

The segmented image is filtered by using the Gabor wavelet, which helps to analyse the colour features of the affected portion more efficiently. In this the diseases are also classified by using a Homogeneous pixel Counting Technique for Cotton Diseases Detection (HPCCDD). And suitable pests are recommended to the farmers by using advance computing system. This is time consuming and accuracy is improved.

[2]The paper titled Leaf Image Segmentation Based on the Combination of Wavelet Transform and K means clustering by N.Valliammal and Dr.S.N.Geethalekshmi, describes the combined segmentation algorithm techniques. It focuses on Discrete Wavelet Transform and K means clustering for the leaf image segmentation. They have used the Wavelet Transform for feature extraction and combined with the K means clustering. Here they used Haar transform as a basic tool for feature extraction. The segmentation performance are also analysed by jaccard, dice, variation of index and global consistency error method. It also verified with the real time plant leaf samples. When compared to the existing method, this combined technique will provide better convergence result.

[3] The paper titled Automatic Image Segmentation by Integrating Colour-Edge Extraction and Seeded Region Growing by Jainping Fan, David. K. Y. Yau, Ahmed.K. Elmagarmid and Walid G. Aref say new automatic image segmentation by combining an improved isotropic edge detector and a fast entropic thresholding technique. In this thresholding technique, it obtains good segmentation of images, which neglects all other spatial relationship information and blur in an image. Boundary based technique is used to extract the boundary region of an image by using the edge detector operators such as canny, sobel and Roberts operator. In region based technique, the image is split into regions and then merged. Here seeded region growing technique is used, which is controlled by a number of initial seeds. This tries to find accurate segmentation of image into regions. They combined both boundary based technique and region growing technique to occur more accurate segmentation result. This paper also proposes a new hybrid technique by integrating colour-edge extraction and seeded region growing for automatic segmentation.

[4] The paper titled Leaf Disease Severity Measurement Using Image Processing by Sanjay B. Patil, Dr. Shrikant and K. Bodhe tells that, to measure the severity of disease affected in a leaf. The affected area is segmented by using simple threshold and triangle thresholding method. Simple threshold method is used to segment the leaf area and triangle threshold method is used to segment the disease affected area of a leaf. In this sobel operator is used to find out the edge. And disease colour, leaf shape changes are measured by HSV colour space, Speeded up Robust Features (SURF) and Scale Invariant and Feature Transform (SIFT). The disease severity is measured in three ways such as, visual rating, Image analysis and hyper spectral Imaging. In this severity is calculated by the ratio of diseased leaf area to the total leaf area. In this complexity is less and it achieve 98.6 accuracy.

III. IMAGE SEGMENTATION TECHNIQUES

Many image segmentation techniques have been developed by scientists and researchers, some of the vital techniques and latest used hybrid image segmentation techniques are shown in Figure 1.

1. Edge based image segmentation:

The elementary step for image segmentation processing is edge detection. It splits an image into object and its background. Based on the changes in the intensity or pixel value of an image, the image is divided using edge detection. The two main methods of edge detection for image segmentation are Gray histogram and Gradient. In edge detection several operators are used. Some of them are Classical edge detectors, Laplacian of Gaussian (LOG), Zero crossing and colour edge detectors. After the edge detection, Gaussian technique is used for smoothing. Its result shows more information about the edge detection. Region growing is used to find edge pixels in an image. The hybrid method of image segmentation based on edge detection and region growing aids the segmentation process to avoid errors.

For image segmentation, Wesolkowsk [5] used the Markov Random Fields for edge and region based hybrid colour image segmentation. Initially, using edge detection algorithm, line process is implemented. to detect edges Vector angle measure is used. In [1] segmentation techniques are to segment the disease affected cotton leaf. Here Image analysis purposes are to detect the diseased leaf, to measure the affected area by disease, to find the boundary of the affected area, to determine the colour of the affected area, to identify the diseased spot correctly. Here they have used image edge detection segmentation and advance computing techniques. The segmented image is filtered by using the Gabor wavelet, which helps to analyse the colour features of the affected portion more efficiently. In this the diseases are also classified by using

a Homogeneous pixel Counting Technique for Cotton Diseases Detection (HPCCDD). And suitable pests are recommended to the farmers by using advance computing system. This is time consuming and accuracy is improved.

Advantages:

- Time consuming.
- Accuracy is improved.

Disadvantages:

- In this the noise may result in an erroneous edge.
- Discontinuous edge or over segmentation occurs.

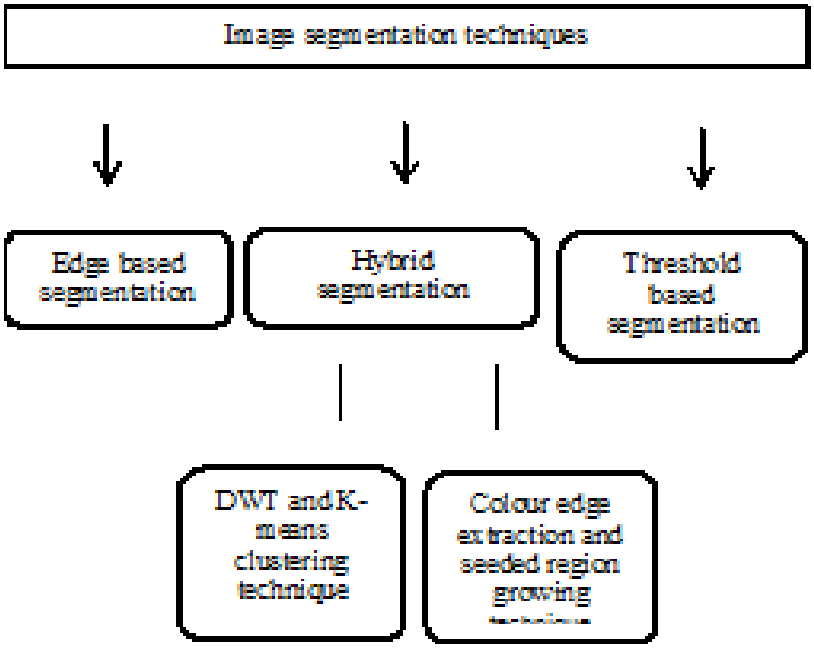

Fig1: Various image segmentation techniques

2. Hybrid segmentation:

(A) DWT and k-means clustering:

In [2] this hybrid method, the wavelets and K means clustering is applied for leaf images. The high pass image is extracted through wavelets and to enhance edge further decomposition is applied, which provides good wavelet features like entropy and energy. The wavelet features and the k means are combined in this method to give better accuracy results. The wavelet transform (WT), a linear integral transform which maps L2 (R) →L2 (R2), has emerged for decomposition and analysis of images and signals at multi-resolutions. The region-based systems use wavelet transform is divided into the three classes according to the space units and feature values for segmentation are calculated;

• A hierarchical block

• A moving window

• A pixel

In signal processing k-means clustering is a method of vector quantization. That is widely used for cluster analysis in data mining. K-means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. It tends to find clusters of comparable spatial extent, while the expectation-maximization mechanism allows clusters to have different shapes. K-means algorithm is also referred to as Lloyd's algorithm. The flow chart of k-means clustering algorithm is given below.

ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 3, Issue 1, pp: (63-69), Month: January - March 2015, Available at: www.researchpublish.com

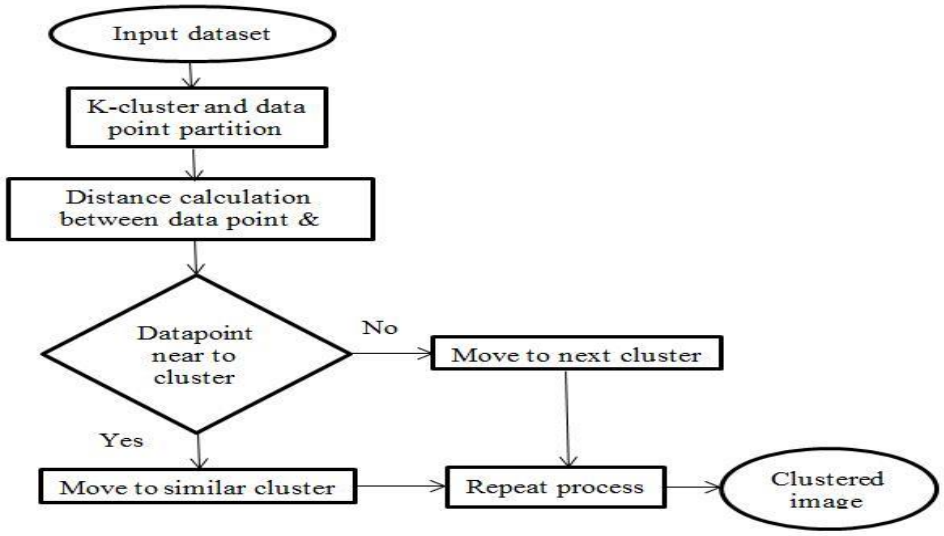

Fig 2: Flowchart for k-means Algorithm

Figure2 shows the k-means clustering algorithm flowchart for known k-mean value.

In this Hybrid method six step processes is explained.

1. In an input Plant Leaf image Wavelet transform is applied to get wavelet decomposed image resulting in twelve sub bands, that represent approximation, vertical, horizontal and diagonal components in the form of coefficients. LL sub band contains low level and the other three (LH, HL, and HH) contain high level details.

2. Using average filter and Global thresholding noise is removed. To separate the leaf from background Otsu's method is applied.

3. To obtain a high pass image inverse wavelet transform is applied. The resulting level-3(L3) image is obtained.

4. To get a sharpened image L3 is added to the Original image.

5. K means clustering algorithm is applied in step (3), to segment the images into an optimal number of clusters. Same set of data points belong to one cluster and different data points belong to different clusters. This algorithm accounts for variability in cluster shapes, cluster densities and the number of data points in each of the subsets. But this cannot work well in noisy plant leaf images. So the combination of wavelet and K means provides better results.

6. Finally using the Sobel operator the image is enhanced.

Advantages:

- Computational cost is low
- Low flexibility

Disadvantages:

- It won't work well in noisy images.

(B) Color edge extraction and seeded region growing:

In [3] this hybrid technique the colour edge extraction and seeded region growing segmentation is explained. The colours of neighbouring pixels and brightness values are different. An isotropic edge detector is used for identifying geometric structures of an image. This image is improved by integrating the results with the SRG. There are two categories of isotropic edge detectors, they are

1) Radiant operators

2) Second derivative operators.

The gradient operators such as prewitt, Roberts, and sobal operators are used to detect the edges of the luminance of an image. The second derivative operators such as Marr-hildreth and Marr-poggio operators to find the edges. Initially in an image the chrominance components (U and V) are explicitly separated from the luminance component(Y) in the YUV model. Then the gradient value is calculated using pattern based gradient calculation. Then the edges are detected using thresholding based edge detection. In colour edge extraction there is discontinuous and over detected problem may occur. And in region based segmentation it does not provide accurate result, so both the techniques are combined to form a new hybrid technique. In seeded region growing separate texture, colour, intensity etc... Data's are taken and processed to get segmented output image. The region seeded growing flow chart is given below.

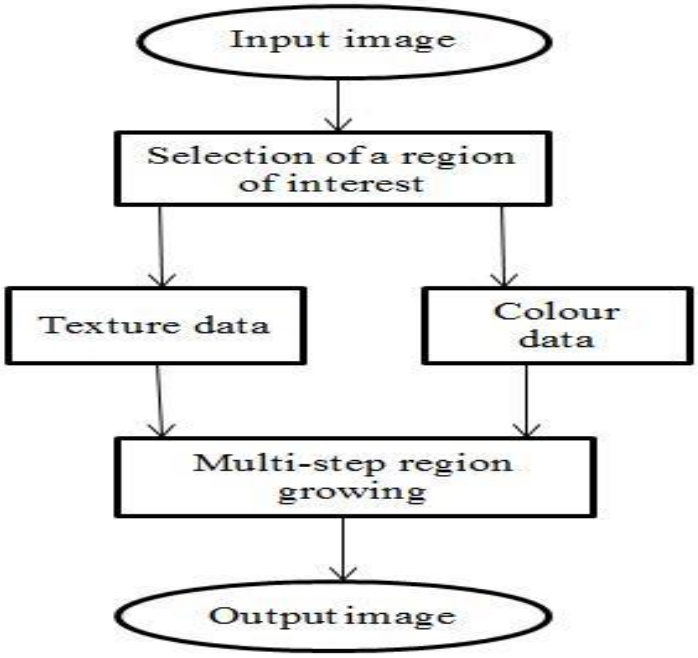

Fig 3: Flow chart for region seeded growing

The advantage of seeded region growing can be exploited to select the suitable seeds for more meaningful region growing. These two techniques are combined together to provide good result. This combined technique will provide more accurate image segmentation results.

Advantages:

- Segmentation results can have coherent regions, linking edges, no gaps from missing edge pixels.
- It provides more accurate image segmentation results.

Disadvantages:

- Decisions about region memberships are often more difficult than those about edge detections.

3. Threshold based image segmentation:

The simplest method of image segmentation is Threshold based image segmentation. In [4] this thresholding technique can be used to create binary image from the gray scale image. The important step in image segmentation is to separate the different regions with special significance in the image and these regions do not intersect with each other. Each region should meet the reliability circumstances in exact regions. To calculate the severity of two different segmentation techniques are implemented.

1) Simple threshold method

2) Triangle threshold method

These two methods are used to segment the total leaf area and lesion region area. The Input image is transformed into gray scale image. And some pre-processing techniques are undertaken to avoid the extra noise present in the leaf image.

Then the image is separated from the background. It makes great difference in gray values of two groups i.e. object and background. The leaf region is obtained by region filling and eliminating holes in the white region after image segmentation. Scan the image from top to bottom and from left to right which is used to count the pixels in total leaf. Disease severity can be measured in three different ways that are Visual Rating, Image Analysis and Hyper spectral Imaging. Disease severity can be calculated by the area affected in a leaf image. It is expressed as proportion or percentage. It is measured by the lesion area and leaf area ratio. Using image processing method it is given by

Severity extent = Ad / Al (1)

= P Σ1 / P Σ1

(x, y) Є Rd (x, y) Є Rl

= Σ1 / Σ1

(x, y) Є Rd (x, y) Є Rl

= Pd / Pl (2)

Where, P-Unit pixel value, Ad-Diseased leaf area, Al- Total leaf area, Rd- Diseased Region, Rl-Leaf region, Pd-Total pixels in diseased area, Pl-Total pixels of leaf.

In digital image each pixel denotes the same size. The severity can be calculated by counting pixels of total leaf area and lesion leaf area in the binary image. The accuracy of the algorithm is estimated by the percentage of known standard area covered by shapes like Circle, triangle, rectangle and Square drawn by using a tool. (e.g.) paint.

To calculate Percentage of Accuracy (A) and Deviation (D), the estimated values are compared with the actual area. Where,

D= (SM – EM) × 100 / SM.

A= 100 – D

Where,

SM- Standard Measurement, EM- Experimental Measurement

This algorithm has given an average accuracy of leaf disease severity is 98.60 %.

Advantages:

- Complexity is less.
- Accuracy may be of 98.60%

IV. RESEARCH POSSIBILITIES

High resolution camera can be used.

1. More number of input image data base can be used.
2. Hybrid techniques can be used to detect and segment the diseased leaf to get better and accuracy segmentation result.

V. CONCLUSION

In this survey paper, various image segmentation techniques has been deliberated, the summary of edge based segmentation, hybrid segmentation such as wavelet transform and k-means clustering, colour-edge extraction and seeded region growing technique and for the leaf disease severity measurement, threshold based segmentation technique is presented in this paper. After the analysis of different techniques of image segmentation, it is observed that a hybrid solution consists of two or more techniques for image segmentation is being the best method to solve the problem of image segmentation and to provide better accuracy result in disease severity measurement.

ACKNOWLEDGEMENT

I sincerely thank my guide Dr.K.Ramar for his full support and encouragement for preparing this paper.

REFERENCES

[1] P. Revathi and M. Hemalatha, "Classification of Cotton Leaf Spot Diseases Using Image Processing Edge Detection Techniques", 2012 - International Conference on Emerging Trends in Science, Engineering and Technology.

[2] N.Valliammal and Dr.S.N.Geethalakshmi.,"Leaf Image Segmentation Based On the Combination of Wavelet Transform and K Means Clustering", (IJARAI) International Journal of Advanced Research in Artificial Intelligence, Vol. 1, No. 3, 2012 .

[3] J. Fan and D. K. Y. Yau, "Automatic image segmentation by integrating color-edge extraction and seeded region growing," IEEE on Image Processing, 10, vol. 10, no. 10, pp. 1454-1466,2001.

[4] Sanjay B. Patil et al., "Leaf Disease Severity Measurement using Image Processing", International Journal of Engineering and Technology Vol.3 (5), 2011, 297-301.

[5] S. Wesolkowski and P. Fieguth, "A Markov random fields model for hybrid edge-and region-based colour image segmentation," in Proc. Canadian Conference on Electrical and Computer Engineering,. 2002.

[6] Gao ronghua et al., "Nearest Neighbor recognition of cucumber disease images based on kd-tree", Information technology journal 12(23) : 7385-7390,2013.

[7] Al-Bashish, D., M.Braik, and S. Bani- Ahmad.2011."Detection and classification of leaf diseases using K-means-based segmentation and neural networks based classification". Information Technology Journal, 10(2): 267-275

[8] Al-Hiary, H., Bani-Ahmad S., M. Reyalat, M. Braik, and Z.AlRahamneh. (2011). "Fast and accurate detection and classification of plant diseases". International Journal of Computer Applications, 17(1): 31-38.