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Plant Leaves Image Segmentation Techniques: A Review

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Abstract: - Segmentation is the process of dividing a digital image into number of parts of interest. The goal of segmentation is to rearrange and additionally change the representation of an image into something that is more significant and less demanding to study. The aftereffect of picture segmentation is an arrangement of areas that all things considered cover the whole picture, where every pixel in a region is comparative concerning some trademark or registered property, for example, color, intensity, or texture. This paper discusses and reviews the various segmentation techniques like Edge Based, Threshold, Region Based, Clustering and Watershed segmentation used in leaves analysis. This paper shows how different techniques of segmentation used in different application of image processing. Comparative analysis of different methods shown in table and concluded with advantages and disadvantages of segmentation techniques in plant leaf analysis. Edge based and Thresholding techniques are used usually with gray image of plant leaves and Region Based, Clustering and Watershed segmentation technique used with color image of leaves.

Keyword: - Image Segmentation, thresholding, clustering, Region Based, Clustering, Watershed segmentation, plant leaves

I. Introduction

Image segmentation is the most significant job in many image processing systems, such as pattern recognition, image retrieval and small surveillance. The outcome of segmentation is mainly used for image content understanding and visual entity recognition through the identification of region of interest. Image segmentation is the process of isolating an image in to more significant representations. Image segmentation classified into following types:-

- 1) Edge Based
- 2) Threshold
- 3) Region Based
- 4) Clustering
- 5) Watershed

Edge Detection Technique:-This technique is intended for locating boundaries of leaf within image. It segments the image by identifying the difference between intensities at border. Sobel, Canny, Laplacian, and fuzzy logic are the some of the techniques used for edge detection.

Threshold Technique:-Threshold is the simplest method of segmentation. This method based on threshold value calculated by converting image to binary image. Thresholding methods includes Global and Local thresholding, which having methods like Otsu global thresholding and Adaptive local thresholding.

Region Based :- The main purpose of this method is to partition an image into different same types of regions. Pixels of same type identified and grouped together into same type of regions. The Main types of Region based Segmentation are Region Growing, Region Splitting and Region Merging.

Clustering Segmentation:- Clustering is the technique used for segmentation, in which image is first converted into histogram and then clustering is performed on it. One of the basic clustering algorithms is K-means, which is intended for segmentation in textured images. It clusters same pixels to segment the image.

Watershed based Segmentation:- The watershed based method uses the concept of topological analysis. In this the intensity represents the basins. The watershed methods think about the gradient of image as topographic surface. The pixels having more gradient are represented as boundaries which are unbroken.

In this paper, we studied different segmentation techniques applied to segment leaf from image. Plant identification, Nutrients analysis, Disease identification and many more application needs to process plant leaves images. After image acquisition of plant leaves, preprocessing is done to remove noise and then leaves segmented from background to process further.

II. Related Work

In [1], they utilized a fuzzy numerical morphology calculation to distinguish the edge. An effectiveness of edge recognition in light of the fuzzy mathematic morphology was demonstrated by contrasting and the results of alternate calculations, for example, Sobel and binary morphology, the edge identification calculation proposed by this paper have pointed of interest like no threshold required, high invulnerability to noise, extraction of texture and the vein. Additionally, research is to figure the area of tobacco leaf and the length of a vein in light of the consequence of edge recognition.

In [2], they proposed an algorithm which made out of three primary steps. To begin with, to extricate the undifferentiated from ailment spots (disease spots and stems) from green plants. Second, some uncommon attributes are distinguished in a gray histogram; a while later change the divided image into 8-bit grayscale images in light of single thresholding. At last, contrast the diseased spots' range and stems' and after that segmented paired images by utilizing area thresholding. The test comes about demonstrate that this calculation is compelling in dividing cotton malady spots; the normal right extraction rate of the calculation can achieve 94.79%.

In [3], they show another color image segmentation strategy, in light of multilevel thresholding and information combination procedures which go for consolidating diverse information sources related to a similar color image with a specific end goal to build the data quality and to get a more dependable and exact division result. They proposed segmentation approach which is thoughtfully extraordinary and investigates another technique. Rather than considering just a single picture for every application, this system comprises in consolidating numerous acknowledge of a similar image together, keeping in mind the end goal to build the data quality and to get an ideal fragmented image. For division, they continue in two stages. In the initial step, they start by distinguishing the huge pinnacles of the histogram. For this reason, an ideal multi-level thresholding is utilized in view of the two-arrange Otsu streamlining approach. In the second step, the confirmation hypothesis was utilized to combine a few pictures spoken to in various shading spaces, so as to get a last dependable and precise division result. The idea of mass capacities, in the Dempster-Shafer (DS), prove a hypothesis, is connected to the Gaussian appropriation, and the last division is accomplished, on an information picture, communicated in various shading spaces, by utilizing the DS blend administer and choice. The calculation was shown through the division of therapeutic shading pictures. The grouping precision of the proposed strategy was assessed and a relative review, as opposed to existing procedures, is exhibited. The trials were led on a broad arrangement of shading pictures. Palatable division comes about got

demonstrating the adequacy and predominance of the proposed strategy.

In [4] they used Region Based segmentation techniques to find out the disease regions. Out of the three basic Regions based segmentation techniques such as Region Growing, Region Merging and Region Splitting they derived methodologies which is used to select the best one. Based on timing analysis and Quality Metrics, it was found that Region growing had the maximum peaks representing distinct regions with least discrete entropy and highest grey level energy as compared with mean-shift segmentation methods. Hence it was derived that Region Growing Segmentation can be utilized as the segmentation strategy for further processing.

In [5] they show a clustering strategy called Spatial FCM (SFCM) to distinguish the pest and the disease. Likewise, the execution of proposed strategy is contrasted and other grouping systems, for example, K-means, Fuzzy C-Means (FCM), Kernel-based FCM (KFCM) and Spatial FCM (SFCM). At that point, the elements, for example, color, texture are removed from unhealthy leaf picture and then compared with normal leaf image. The neural network technique is utilized to arrange the bug and Disease in products. The assessment parameters considered for correlation of spatial FCM with other bunching strategies are as per the following: Specificity, Sensitivity, Accuracy, Area of influenced leaf, Percentage of illness contamination, and so on. The neural system arrangement strategy is utilized to order the sort of infection and the pathogen or bug that causes that disease.

In [6] depicts the strategy of wavelet transform used for elements extraction related with individual image pixels and joining this technique with a utilization of the k implies grouping system. For the image deterioration and feature extraction, Haar change has been connected as a fundamental device utilized as a part of the wavelet change. A particular piece of this paper is clarified about the decay and recreation grids. The strategy portrayed is utilized for a depiction of the entire framework empowering flawless picture remaking. The proposed calculation of the Haar wavelet picture deterioration incorporates picture include based division with k implies bunching calculation. Singular techniques have been checked for standard pictures and afterward connected for preparing of chose constant plant leaf pictures. In this paper, a proposed approach that makes utilization of wavelets and K implies grouping is connected for leaf pictures. Through wavelets, high pass picture is extricated and to improve edge points of interest further disintegration is connected, which gives fine upgraded edge subtle elements with wavelet highlights like vitality and entropy. The wavelet highlights and the k means are joined in this strategy which gives better exactness comes about.

In [7] a near investigation of thirteen strategies for segmentation connected to an issue of extraction of tree leaves in Smartphone pictures. They broke down the commitments of two pre-handling steps: the utilization of shading separation maps and the communication application/client through an info stroke. This examination highlighted the significance of the decisions made for the separation outline (worldwide separation and neighborhood shading), and the enthusiasm to interface with the client, both for the GAC strategy and for all different methodologies. This work is at present in progress through the improvement of their site, which will give a versatile benchmark, devoted to the examination and approval of division instruments.

In [8] proposed an unsupervised, programmed K-means clustering algorithm to play out the division assignment of wheat leaf scab image in view of the Lab color space. The investigations on wheat leaf images with three basic sicknesses demonstrated the acceptable execution of their technique as far as precision, productivity, and robotization. They find that the expanded precision in the division will help with taking after procedures, (for example, include extraction and distinguishing proof) for automatic disease detection and investigation of a wheat leaf.

In [9] they proposed an algorithm in view of fuzzy edge and clustering segmentation for various plant investigations. Segmentation of the plant from foundation items was a testing undertaking for various plant leaf acknowledgments and grouping. Before applying the proposed strategy pre-preparing procedure like picture change, commotion diminishment by middle channel, morphological operation lastly wavelet change has been handled. The proposed strategy gave great outcomes in light of fluffy limit and grouping systems for discovery of most homogeneity district in plant leaf pictures. The relative execution of the traditional and proposed strategies was assessed utilizing Variation of Information, Energy, Entropy and Evaluation Time. It demonstrated that the proposed strategy gives reasonable outcomes for effective grouping and acknowledgment.

In [10] proposed a hearty and precise strategy for segmenting specular articles procured under approximately controlled conditions. They concentrated on leaves since leaf segmentation assumes a significant part for plant distinguishing proof, and precisely catching the neighborhood limit structures is basic for the accomplishment of the acknowledgment. Well, known methods depend on Expectation-Maximization and gauge the shading appropriations of the foundation and forefront pixels of the information picture. They found that such methodologies endure in the nearness of shadows and reflections in this way promoting wrong recognized shapes. Arrangement based strategies are more strong in light of the fact that they can abuse earlier data, notwithstanding they don't adjust to the particular catching conditions for the

information picture. Strategies with regularization terms are inclined to smooth the portions limits, which is undesirable. In this paper, they have seen that they can outdo the EM-based and grouping based techniques by first portioning the pixels around the leaf limit, and utilize them to instate the shading circulations of an EM improvement. They demonstrate that this straightforward approach brings about a hearty and exact technique.

In [11] presented the idea of texture gradient and has utilized it to create a successful watershed segmentation strategy for common images in light of intensity and texture boundaries. Moreover, a novel marker choice calculation has been executed to check the issue of over-division while holding key slope limits giving no little lingering districts. Utilizing this marker choice plan with a typical picture slope will regularly prompt powerful division for non-surface pictures. Be that as it may, the incorporation of a surface angle in view of the genuine recurrence substance of the picture (utilizing a mind-boggling wavelet parcel change) will guarantee that distinctively finished districts will be fragmented successfully. Utilizing markers removed from the created least district, moving edge and locale developing strategy, homogeneously finished areas can be distinguished. This marker extraction technique utilizes a similar inclination picture as the along these lines executed watershed change. All little scale inclination elements are consequently safeguarded regularly making a more powerful division.

III. Comparison

Table 1. Shows Comparison between different techniques

<i>Segmentation Technique</i>	<i>Advantages</i>	<i>Disadvantages</i>
Edge Based	Good for images having better contrast between objects.	Not suitable for wrong detected or too many edges
Threshold	Does not require prior information of the image. Fast and simple for implementation	Depends on peaks, spatial details are not considered, Highly noise sensitive
Region Based	More immune to noise, useful when it is easy to define similarity criteria, Works well for images having good contrast between regions.	Time and memory requirement is more so expensive method.
Clustering	For small values of k, k-means is computationally faster. Eliminates noisy spots. More homogeneous regions are obtained.	Difficult to predict k with fixed number of clusters. Computationally expensive.
Watershed	Results are more stable, detected boundaries are continuous.	complex calculation of gradients

IV. Conclusion

The result of image segmentation is a set of regions that collectively cover the entire image, where each pixel in a region is similar with respect to some characteristic or computed property, such as color, intensity, or texture. Segmentation method discussed in this paper use various segmentation techniques for leaves analysis. We can conclude that segmentation is an important step in leaf analysis to separate out different regions of leaves.

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