Asian Journal of Applied Science and Technology (AJAST)
Volume 1, Issue 8, Pages 143-146, September 2017

Survey on Agriculture Image Segmentation Techniques

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Article Received: 06 August 2017 *Article Accepted: 19 September 2017* *Article Published: 24 September 2017*

ABSTRACT

Agriculture is significant in human life. World population is directly reliant on cultivation for food. As population increasing by exponentially, we required to increase the productivity of agriculture outcome to cater the need of society. But now productivity of agriculture is decreasing because of reasons like various kinds of fungal infection, mineral deficiency etc. Quality of food is also not like earlier days. Manually monitoring agriculture field is very time consuming and required more and more experienced human resource. Hence current research computer science is going on application of advanced image vision techniques for agriculture. Because advanced methods like matlab, 3D image processing tools, communication techniques, mobile communication, Embedded techniques used in agriculture, decisions are generated by computer system which lead to proper utilization of human recourses and decisions are quicker with increased accuracy. Image segmentation techniques plays major role in identifying affected area of the image. Several general-purpose algorithms, techniques, operator have been developed for image segmentation. This paper presents a comparative study of the image segmentation and Image classification.

Keywords: K- Means, Otsu, Thresholding, Watershed, ANN and GLCM.

1. INTRODUCTION

Digital image processing is a recent subject in computer history. In digital image processing, Actually digital image processing has several advantages over the analog image processing; first it gives a high number of algorithms to be used with the input data, second we can avoid some processing problems such as creating noise and signal distortion during signal processing. The digital image processing can be used in agricultural or following purposes:

1. To detect diseased leaf, stem, fruit
2. To identify the affected area.
3. To determine colour of diseased area
4. To determine weed presented in forms

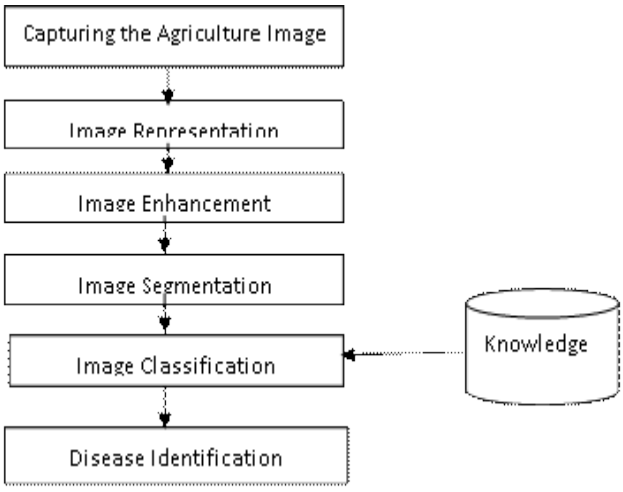

Fig 1: Crop disease identification framework

In paper we discuss image processing framework for crop disease identification in section I. we discuss the various segmentation techniques used in agriculture image processing. Later the best algorithm is selected for the purpose of achieving the better results in section II. We discuss the comparative study of various segmentation algorithms.

2. STEPS IN DISEASE IDENTIFICATION

2.1 IMAGE ENHANCEMENT

Image enhancement is the process of adjusting digital images so that the results are more suitable for display or further image exploration. This process removes noise, sharpen, or brighten an image, making it easier to identify key component. Preprocessing of image can be done in two domains spatial and frequency domain. Spatial domain: as the name suggests in this approach different methods are used, which will affect the manipulation of pixel values of an image. Frequency domain: in this method first a Fourier transform of the image is computed and then different operations are performed on them and finally results are obtained by getting the inverse Fourier transform of the image. Image Enhancement techniques are filtering with morphological operators, Histogram equalization, Noise removal using a Wiener filter , Linear contrast adjustment, Median filtering.

2.2 IMAGE SEGMENTATION

Image segmentation falls in to the group of extracting image features of an original image. Segmentation divides an image into different objects. For efficient feature extraction (color, area, shape, texture) image segmentation is required. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. Each of the pixels in a region is similar with respect to some characteristic or computed property, such as color, intensity, or texture.

2.3 IMAGE CLASSIFICATION

Image classification refers to the task of extracting information classes from a multiband raster image. The resulting raster from image classification can be used to

create thematic maps. Depending on the interaction between the analyst and the computer during classification, there are two types of classification: supervised and unsupervised.

3. Image Segmentation Techniques

3.1 Otsu's Method

This method [2] is used to automatically perform cluster-based image thresholding, or, the reduction of a gray level image to a binary image. The algorithm [6] assumes that the image contains two classes of pixels following bi-modal histogram (foreground pixels and background pixels), it then calculates the optimum threshold separating the two classes so that their combined spread is minimal, or equivalently so that their inter-class variance is maximal.

3.2 Advanced K means clustering

Advanced K -means clustering algorithm is an unsupervised algorithm and it is used to extract the interest area from the original image. But before applying *K* -means algorithm, first partial stretching pre-processing is applied to the image to improve the quality of the image. Then clustering method is data clustering method where it generates the centroid based on the potential value of the data points. So subtractive cluster is used to generate the initial centres and these centres are used in *k*-means algorithm for the segmentation of image. Then finally medial filter is applied to the segmented image to remove any surplus region from the image.

3.3 Watershed segmentation

Watershed segmentation [7] also called, as watershed method is a powerful mathematical tool for the image segmentation. It is a morphological gradient based segmentation technique. Segmentation by watershed embodies many of the concepts of the three techniques such as threshold based, edge based and region based segmentation. Watershed algorithms based on watershed transformation have mainly two classes. The first class contains the flooding based watershed algorithms and it is a traditional approach whereas the second class contains rain falling based watershed algorithms. Many algorithms have been proposed in both classes but connected components based watershed algorithm shows very good accuracy compared to other techniques. It comes under the rain falling based watershed algorithm approach. It gives very good segmentation results, and meets the criteria of less computational complexity for hardware implementation.

3.4 Edge detection

Edge detection [1] includes a variety of mathematical methods that aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. There are many methods for edge detection, but most of them can be grouped into two categories, search-based and zero-crossing based. Three most frequently used edge detection methods are used for comparison. These are (1) Roberts Edge Detection, (2) Sobel Edge Detection and (3) Prewitt edge detection. Senthil Kumaran N discussed soft computing approaches like Fuzzy, Neural Network and Genetic algorithm approaches to edge detection. Finally discussed efficiency of various approach in Matlab.

3.5 Histogram thresholding using Fuzzy

Fuzzy C-means hybrid (HTFCM) approach that could find different application in pattern recognition as well as in computer vision, particularly in color image segmentation. The proposed approach applies the histogram thresholding technique to obtain all possible uniform regions in the color image. Then, the Fuzzy C-means (FCM) algorithm is utilized to improve the compactness of the clusters forming these uniform regions. Experimental results have demonstrated that the low complexity of the proposed HTFCM approach could obtain better cluster quality and segmentation results than other segmentation approaches that employing ant colony algorithm.

3.6 Adaptive FCM

Adaptive FCM [7] to overcome the FCM's sensitiveness to the cluster number by introducing a novel cluster number approximation module before the standard FCM clustering. The most important object in this estimation module is to accurately determine cluster number with minimal computation cost. Usually, feature vectors used in the FCM segmentation algorithm are extracted for each pixel. For an image with a typical size, hundreds of thousands of vector data will have to be processed if we directly do clustering at the pixel level. In fact, the belief of the region is well defined at the level of our visual perception, and the human eyes and brain are able to define regions that exhibit common spatial patterns, i.e., texture.

3.7 Kernel Measure FCM

Kernel methods [8] have been recently applied to image segmentation. The kernel methods consist in: inducing a class of robust non-Euclidean distance measures for the original data space to derive new objective functions and thus clustering the non-Euclidean structures in data; enhancing robustness of the original clustering algorithms to noise and outliers, and still retaining computational simplicity. The proposed approach for clustering unlabelled data is experimented UCI machine learning Repository. The accuracy of algorithm is 90% compared to FCM, BCFCM

3.8 GRAY-Level Co-Occurrence Matrix

Statistical method of examining texture that considers the spatial relationship of pixels is the gray-level co-occurrence matrix (GLCM), also known as the gray-level spatial dependence matrix. The GLCM functions characterize the texture of an image by manipulative how often pairs of pixel with specific values and in a specified spatial relationship occur in an image, creating a GLCM, and then extracting statistical measures from this matrix. M.Harsha vardhan [14] proposed and implemented a novel FPGA based architecture for real time extraction of four GLCM features. A 128*12 8 size gray level image is taken for feature extraction. The Digital image structures were extracted using statistical second order method. In this thesis Gray Level Matrix is considered to extract features, which is a statistical method based on the gray level value of pixels. This algorithm was proposed by Haralick. These features are further used in Image segmentation, which are used to classify the regions which are like and different of sub images. Using this statistical method we attained the image extraction in gray

scale level analysis which can be further prolonged to different algorithms represented theoretically in feature extraction of images.

3.9 ANN

ANN was defined with back propagation learning algorithm and supervised training in all experiments. ANN application can be parameterized in various aspects, the mains are: Amount layers, neurons in the hidden and out layers, quantity and data types of entries, learning rate, constant momentum, activation function type and stopping criterion. Several trainings were performed for determine suitable parameters to ANN targeting a more optimized structure. Furthermore, the amount of ANN layers are three with a hidden layer and its neurons quantity varied in 3, 4, 5, 6, 7, 8, 12 e 16. ANN training is achieved with images inputs and desirables and finished according to stopping criterion. Input image (f(x,y)) is included in the ANN after normalization (f'(x,y)) of the values in the interval between [0:1].

TABLE 1: ADVANTAGE AND DISADVANTAGES OF SEGMENTATION TECHNIQUES

DESCRIPTION	ADVANTAGES	DISADVANTAGES
Edge Based Method	good for images having better contrast between object	not suitable for wrong detected or too many edges
Clustering Method	Fuzzy uses fractional membership Therefore more useful for real problems	determining membership function is not easy
Watershed Method	results are more stable, detected boundaries are continuous	composite design of gradients
GLCM	The co-occurring pairs of pixels can be spatially related in various orientations with reference to distance and angular spatial relationships, as on seeing the relationship between two pixels at a time	it ignores the spatial relationship between the texture designs and searching towards image noise.
THRESHOLDING METHOD	no need of previous information simplest method	highly dependent on peaks, spatial details are not measured
ANN	No need to design multipart function	Training is mandatory , which need more time

4. CONCLUSION

This paper attempts to study and provides brief information about the different image segmentation techniques used in agriculture image processing .We discuss the present methods and summarize their features. Also each method has its appropriate application fields, and scholars should combine the application background and practical requirements to design proper algorithms. Accuracy, complexity, efficiency and interactivity of a segmentation method should all be the considered factors. This paper provides a survey on the various segmentation techniques, and the main tendency of each method with their principle technique, parameters used are discussed.

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TABLE 2: COMPARATIVE STUDY OF SEGMENTATION ALGORITHM

TECHNIQUE	PERFORMANCE	YEAR	PARAMETER
Edge detection [1]	Image processed by Log_Sobel operator is better than those operators, including Roberts algorithm, Prewitt algorithm and Sobel algorithm, proposed by predecessor.	2009	Logarithm of luminosity
Unsupervised segmentation [9]	A novel active contour based model segments the protein spots in two dimensional images with critical issues such as noise, streaks and multiplets	2011	Volumetric error
Advanced K means [8] .	It detects the range and shape of diseases in leaf images and allows the accurate detection, reproducible and less execution time	2012	Infected area
Histogram Thresholding FCM [4]	The histogram thresholding techniques extract the uniform regions of an image and FCM used to evaluate the compactness of clustering of uniform regions.	2011	Algorithm Efficiency Intensity value
Adaptive FCM [7]	Classical FCM employs the gain field model to correct the intensity in homogeneities by microscope imaging system. Gain field also regulates the centre of cluster	2012	Correct detection rate False detection rate . Cost function α decided based noise
Otsu Method [2]	Otsu is one of the most powerful methods for image segmentation. Calculation is very simple	2013	Pixel values
Kernel measure FCM [8]	Kernel distance measure and trade off fuzzy weight factor estimates the extent of neighbouring pixels. The objective function incorporates the kernel distance measure to improve the robustness to noise	2014	Entropy based evaluation function Layout entropy
Watershed segmentation [7]	Watershed algorithm is a powerful mathematical morphological tool for the image segmentation. It is more popular in the fields like biomedical, medical image segmentation. Useful in low contrast image	2014	PSNR, MSE, RMSE
Grey Level Co-occurrence Matrix (GLCM) [14]	In application of gray level co-occurrence matrix (GLCM) to extract second order statistical texture features for motion estimation of images.	2013	Entropy, Inverse Difference Moment, Angular Second Moment and Correlation.
ANN[16]	Segmentation with ANN Appropriate in the identification of nutrient deficiency in cotton crop.	2014	PHM,MSE, PSNR,QI