A STUDY ON SEGMENTATION AND CLASSIFICATION TECHNIQUES IN IMAGE PROCESSING

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Abstract : **Due to the wide spread use of computer technology, image processing techniques have become largely important. In designing of systems, very often for the interpretation or manipulation of image data, there is need to perform an operation on image, called segmentation, where the image is partitioned on the basis of various parameters. Segmentation finds the boundaries, objects as well as other relevant data from an image. From the segmented image features can be extracted which are color, texture, intensity. The two Broad categories of segmentation techniques are edge-based and region-based. The techniques involved in above mentioned categories are: K-means, Fuzzy C-means, thresholding which consists of global thresholding and variable thresholding, KNN, greedy algorithm etc. Soft computing approaches like fuzzy logic, genetic algorithm and neural network are also used in segmentation of various images. Classification techniques are used for categorizing the target or labeling them which involves techniques like K-Nearest Neighbor, Support Vector Machine. This paper consists of a study of the various image segmentation and classification techniques**

IndexTerms **– Thresholding, greedy algorithm, k-means, Fuzzy C-means, Neural network.**

I. INTRODUCTION

In most image studies where operations need to be carried out, the objects need to be divided from the image individually, so the further the details of those objects will be transformed in a proper structure for processing by computer. For many computer vision based algorithms as well as image processing, segmentation of image is a highly important step. It is observed that over a large spectrum of topics it has applications. Some examples are analyzing the various regions of a remote sensed photo for understanding land or plant distribution. The object of interest extraction from the image's background is important in order to build intelligent machines like factory automation systems [1].

Image segmentation can be seen as a basic task, which is responsible for separation. Segmentation function is to divide image to sub regions that are disjoint, and are identical considering their properties like color, intensity as well as quality. The algorithms of segmentation are based on sub-regions discontinuity, like edges, or within sub region equality. Advances in technology for techniques in segmentation of image have large growth in its theory as well as practical application. Techniques of image segmentation have been used in widely in classification of images and pattern recognition as well as in many areas like agricultural, forensic and medical. Researches show that in image processing segmentation is one of the largely critical task as the result of the entire remaining process will be based on the quality of segmented image.

II. SEGMENTATION TECHNIQUES

There exists a variety of segmentation methods in the literature. Here the focus on main ones, which are described below. Initial edge segmentation methods began in the 70s which was on the basis of thresholding gradients and histograms. The methods rely on the reduction of a grayscale image into a binary image and for some, on the assumption that it contains only two classes of pixels. The aim is to determine an optimal threshold to separate foreground and background classes.

1. K- Means

K-means is algorithm which partitions the data in to 'k' clusters. It requires a parameter that represents number of clusters. Before going to the cluster analysis it is necessary to identify the parameter value apriori which has to be fixed.. Gavhale et al. [4], proposed framework where model is divided into different parts of image processing like color space conversion from RGB to other, enhancement of image; region of interest segmentation with K means clustering algorithm to determine the defect as well as identify plant leaves areas severity, extraction of features and classification. The texture features are extracted using the statistical method of GLCM and color feature using mean values. Basic clustering k-means algorithm is used for segmentation in textured images. K-means clustering algorithm is used for pixels classifying based on features set. The classification achieved by minimizes the sum of squares of distances of the objects and the corresponding cluster. However, K means clustering is used to separate the leaf image into different clusters if a leaf contains more than one disease.

2. Fuzzy C-Means

Considering some problems with K-Means to overcome them, Fuzzy C means was introduced. Fuzzy C Means is an algorithm for fuzzy data clustering where objects are not only cluster members but are multiple clusters members. By such way, the object on

boundaries are not compelled to belong to a particular cluster fully, rather it can become member of multiple clusters with the membership degree between 0 and 1which is partial [5]. Fuzzy C means is said to highly efficient in analyzing fuzzy data.Young won lim and sang uk lee [6], proposed method that has a coarse-fine concept for reducing the computing burden required for Fuzzy C Means. Using the technique of thresholding, the segmentation stage used here segments coarsely. By application of the scale space filtering to histograms, the number of search regions and thresholds are to be identified automatically which is essential to the success of the FCM. Pixels not segmented by a coarse segmentation are segmented using the Fuzzy C means in the fine segmentation stage. Because of this strategy, large computational burden on the FCM is significantly saved. The proposed algorithm produced accurate segmentation of the test images.

3. Thresholding

The popularly used traditional clustering as well as thresholding techniques in segmentation are Fuzzy c-means (FCM) and Otsu. The two methods were not able to give good quality areas segmented because of complex background of images captured and illumination which is not uniform, under the natural environment. Hence, a method for segmentation based on thresholding is integrated with inverse technique that can correctly partition natural images. On fruit images, three segmentation techniques have been implemented and their performances were evaluated. Segmentation becomes challenging process on natural images of the illumination which is not uniform and highly complex background. Though segmentation based thresholding can be used to separate image from its background, another technique is necessary for segmenting images that are captured in natural environment. In the natural light illumination, Objects having bright surface area like yellow or green usually appear clear. But objects having darker surface colors mix with its own shadow in background. So, techniques such as modified thresholding based inverse technique need to be applied.

Jun Pang and Bai [8], proposed a method, Local Threshold and Seeded Region Growing which segmented the disease images by integrating the two. Due to the uneven leaf and disease spots colors and overlapping grey levels using a threshold that is fixed in order to find uncertain objects in leaf images accurately is tough. For improving the segmentation accuracy of crop leaf spot disease, an adaptive algorithm for segmentation is proposed integrating local threshold and seeded region growing (LTSRG). The algorithm uses the pixels of which the R-channel gray level is more than the G-channel gray level as initial seed points (pixels). The adapted segmentation method is satisfactory and highly efficient to separate disease spots from normal part of corn leaves. The complex images shot in field environment can be segmented effectively and can get a better consistency of the region, and the results of disease spot image segmentation are consistent with human visual habits. Above all, the algorithm is more efficient than threshold-based Otsu and clustering-based EM segmentation algorithm and can be used for crop disease image segmentation efficiently and accurately.

4. Border Segmentation

Wan Mohd Fadzil et al. [9], discussed a disease detection method for orchid plant leaves. The orchid plant leaflet images are received the usage of digital camera. The algorithm makes use of an aggregate of various strategies inclusive of border segmentation method, morphological processing and filtering technique used for categorizing input images into two disease class as black leaf spot and solar scorch. The techniques applied to the images were morphological processing and filtering techniques which only can distinguish for two different types of orchid leaf diseases. For classification other types of orchid leaf disease, new or other segmentation technique have to develop. This is because there need many combination of the processing technique to find robust for border segmentation technique. The obtained results show that accuracy of border segmentation is 86.36%. Therefore a border segmentation system is moderate accuracy to classify the types of orchid leaf disease.

5. Snake and Greedy Algorithm

The greedy snake model [10] is a fast iterative model, which works on the principle of feedback control theory to handle concave convex contours and enable it to deform towards its target object to deform from a given contour. It is the most suitable for the leaves segmentation because of fast, easy to implementation and accuracy. The greedy algorithm is a fast iterative method and the theory behind the algorithm is the starting points are plotted near the feature of interest to be extracted and generate predefined number of points. Later by iterative process the points are moved and energy function for each point in the local neighborhood is calculated. It will move to pixel with lowest energy function. The same thing to be repeated for every point iteratively until it meets required iterations count or point's positions stability is reached.

Kass et al. [11], introduced the snakes concept or active contours. Snakes are splines that minimize energy which is guided by external constraint forces and is also influenced by the image forces that pull them to features like the lines and edges. The leaf segmentation of different plant such as Jackfruit, Banana, Cotton and etc. have been experimented using greedy snake algorithm and it is compared with the M Kass snake algorithm[12]. From the comparison, it is observed that greedy algorithm is faster and efficient than the Kass algorithm in terms of iterations obligatory to get the desired contour of an image. The proposed algorithm has been applied to the database of more than 80 images of different leaves of different species tree of 224 by size depending on the aspect ratio. The results of the proposed algorithm are compared with the M Kass snake model. From the results, it is concluded that greedy algorithm is faster and efficient in terms of a number of iterations required to segment the object from an image than the M Kass algorithm.

III. CLASSIFICATION TECHNIQUES

1. K- Nearest neighbour

N.Krithika et al[15], proposed classification of grape leaf diseases with the leaf identification. At first, the leaf skeletons are identified on the basis of grape images. For estimating the positions and directions of the leaves leaf skeletons are used. For

Segmenting algorithm using Tangential Direction (TD) was proposed for retrieval of skeletons. When images of grape leaves are classified, the histograms of H color space and 'a' color channels are produced. Healthy and unhealthy tissues are distinguished on the basis of pixel values. Here, extraction of features and classification is done using the KNN algorithm for identifying the leaf diseases.

2. Artificial Neural Networks

Ismail El Massi et al [16], proposed approach which combines two kinds of classifiers in parallel, one of them is a neural network classifier that uses color, texture as well as shape feature in order to distinguish among symptoms and damages, another one SVM classifier which uses texture as well as shape feature. To design system some existing approaches are considered as base which adopt a single classifier. The tests were performed out on 6 classes that include the damages done by three pests (Leaf miners, Thrips and Tuta absoluta) as well as symptoms of occurrence of fungal diseases. The results show more efficiency of the approach compared to the existing approaches and has the high recognition rate.

3. Support Vector Machine

Adil Salman et al [17], proposed an approach extracts 15 features from leaf using Canny Edge Detector and is used to classify 22 different types of plants using SVM classifier. The 22 classes' leaves were considered and a classifier was implemented as well as tested using 220 leaves of different classes from the dataset. The overall accuracy of the system is 85% to 87% when the worst case is considered.

Xi-zhaowang et al [18], proposed One of the methods of solving multi category problems of pattern recognition is with support vector machines. The knowledge of ambiguity which is associated with membership of the samples is used by it, for a given class and the relative location of the samples to the origin. In Comparison with the existing SVMs, the FMSVM uses L2-norm in its objective function and has the improvement aspects of classification, accuracy and reducing the effects of noises and outliers. The drawback of this algorithm specifically, is its time complexity which is large. And it is expected practically to give improved version along with reduction of time complexity.

IV. CONCLUSION

In this study, an overview of various image segmentation and classification techniques is presented. The segmentation methods are applied in order to identify the required area. The methods help to separate required region from its background. Based on threshold value, gray scale image, Color image the segmentation methods vary. The clustering segmentation techniques, K-means is described. K-means is sensitive to noisy data outlines. Hence, Fuzzy C means is used to overcome its drawback. The image thresholding techniques like local threshold and seeded region growing prove more efficient than Otsu's method. Furthermore, M-Kass snake model and Greedy algorithms are compared where greedy method proves more efficient .

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