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Comparison of Digital Image Segmentation Techniques- A Research Review

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ABSTRACT: *Reviewing previous work is always an important part of developing interest and understanding the depth of topic in interest. Image Segmentation is one of the methods in image processing that deals with the portioning of images into different parts or segments to extract the information. The objective of this paper is to explain and understand the various techniques of segmentation. Segmentation is very versatile method that helps to find region of interest in a particular image. In this survey paper we are addressing various segmentation techniques that used in the image analysis with their pros and cons.*

Keywords – *Threshold, Edge Detection, Clustering, Region, Neural Network*

I. INTRODUCTION

Digital analysis of images is an exciting research area that requires a synergy between technical, engineering, and (bio-) medical and various other disciplines [12]. Segmentation is an operation that is used to apportioning the images according to similarity, discontinuity or by determining the edges to explore the information. The main objectives of studying of image segmentation techniques is to have a best recognition of objects of interest and to observe the features in a particular image that can be separated from its background. This is followed by the clustering the pixel corresponding to region, texture, boundary etc. This whole process termed as Segmentation [1]. The various methods that comes under segmentation includes Thresholding based Segmentation, Edge based

Segmentation, Region based Segmentation [2], Clustering Methods and Artificial Neural Networks. Aim of writing this paper is to arrange the detailed information in this field. The paper is planned in to three sections further; section II includes the detailed discussion about various image segmentation techniques. Section III describes the comparison between segmentation techniques along with their advantages and disadvantages and section IV Concludes the overall study.

II. Image Segmentation Techniques

Image segmentation is to partition an image into significant provinces. Image segmentation, is vital step in image analysis, object recognition, Feature extraction, representation, visualization, and many other image processing tasks.

A Thresholding based Segmentation

Thresholding technique is used to convert a multilevel or a grey scale image into a binary image with the help of histogram of the image [3]. Thresholding refers to an amount or a level. Histogram is the graphical representation of an image having diverse intensities values. To apply Thresholding a preset threshold value T is used to compare the intensities of the pixels at the peaks, if the pixel are dark it growing darker or white it become whiter.

$$T=T[x,y,P(x,y),f(x,y)]$$

Where x and y are the pixels, $P(x, y)$, $f(x, y)$ are the points of gray level image. If T depends on $f(x, y)$ then it is known as Global thresholding and if it depends upon, $P(x,y),f(x,y)$ it is called Local thresholding and if it depends on $x,y, P(x,y),f(x,y)$ is known as Adaptive thresholding. The drawback of Thresholding method is that it needs peaks if there is flat portion it is not able to describe about the object and the background. Determining correct threshold value is another crucial factor.



Fig. 1 Gray scale image

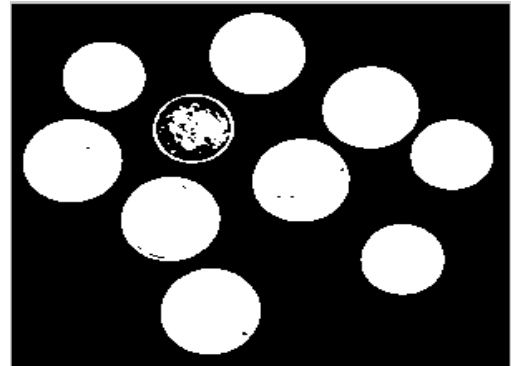


Fig. 2 Resultant image after thresholding

B Edge Based Segmentation

In this method the images are partitioned by identifying the edges or pixels of rapid transition in intensity [2]. Edge Based approach is done by first detecting the edges or pixels between the different region that have change in intensity and linked those pixels to form closed boundaries [10]. The edges identified by this segmentation technique are often disconnect and to segment the pixel there should have closed connect boundaries. Boundaries are connected by using various morphological operations. These techniques are less immune to noise and if more than two edges have to be determined then it doesn't work well.

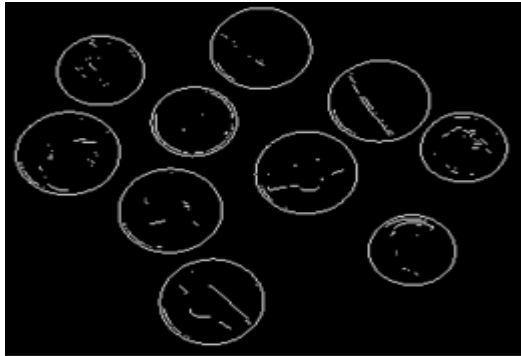


Fig. 3 Edges detection



Fig. 4 edges with closed connected boundaries

C Region Based Segmentation

In region based segmentation technique the similar subset or pixels of an image based upon some criteria are grouped together to form image region. Image regions are constellation of connected pixels with similar belongings[18].

So Region is an image consists of a group of pixels having similar properties. This method is simple and more immune to noise. Edge based technique partition an image into region that is dissimilar set of predefined criteria. This method consists of Region Growing, Region Merging and Region Splitting. Region Growing involves the selection of seed points that means select the entire path where intensity is high and then determine the range of threshold and mark the strongest light point in the respective image. Region Merging refers to merge the entire similar region and Splitting refers to split uncommon region in an image.

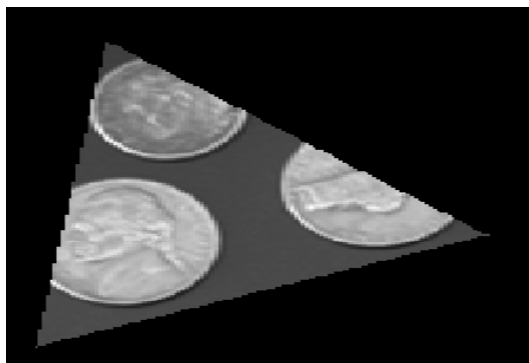


Fig 5 Region Based segmentation resultant images

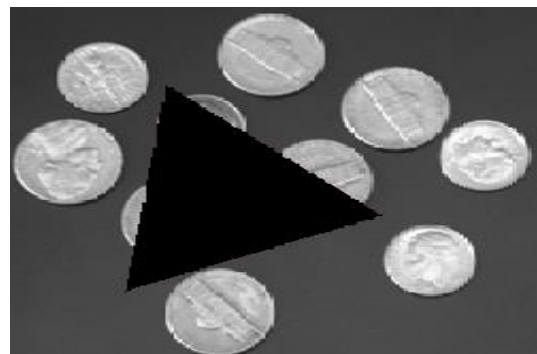


Fig 6 Region Based segmentation resultant images

D Clustering

Clustering Method refers to the pixels having similar properties grouped together known as clusters. Grouping is based on maximizing the similarities, if inter class similarities are increased then the quantity of clusters are automatically increased to get the optimum results. There are two types of clustering methods, first is called k means

clustering and second is fuzzy method. K means method can be done through the particular value of k and the fuzzy techniques by using the different level segmentation of the images [5,8]. In the K Means Clustering the letter K is referred to the number of clusters that is to be decided in the starting of the algorithm. In this we have to define the K centers, one center for each cluster. The center should be far from the others so that the distance could be calculated easily and the data points could predict their clusters very precisely. Then distance between each data point and the clusters centers is calculated. Then data points are assigned to the cluster whose distance from the cluster center is lowest. The distance can be calculated with the help of conventional mathematical perpendicular concept. After this mean is calculated and now for this iterative process the same data points are chosen before and [7].The distance is calculated and those data points are assigned which are too nearer to cluster. This process is repeated till we observe the shifting in the center of the cluster. The main drawback having this method is to determine the number of clusters in an image. In the below figure results are taken by considering the value of k as 3.

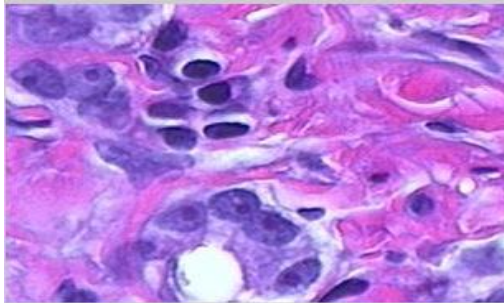


Fig 7 Tissue

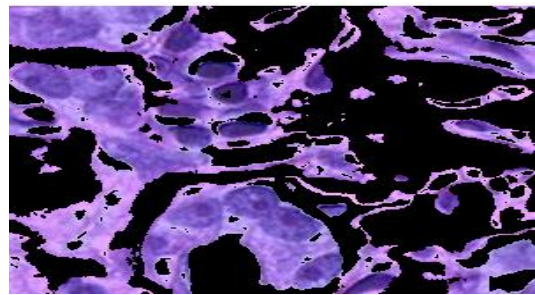


Fig 8 objects in cluster one

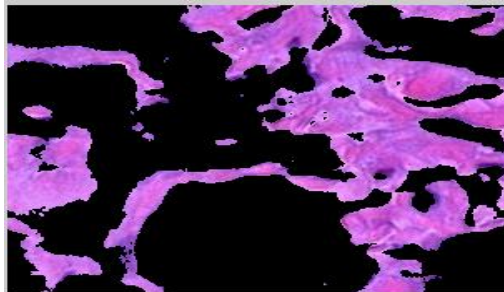


Fig 9 Objects in Cluster two

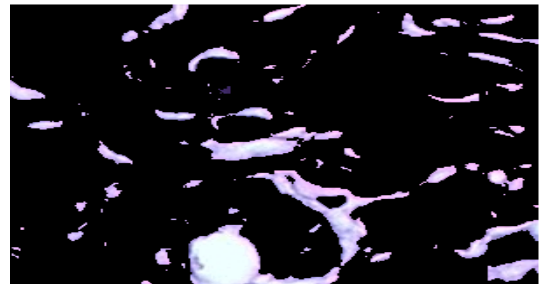


Fig 10 Objects in Cluster three

E Artificial Neural Networks

Artificial Neural Network is the imitation representation of a human brain that tries to simulate its learning process. It consists of a large number of parallel nodes and each node can perform some basic computing. Neural network can also reduce the requirements of expert during the image segmentation method. The neural network is trained with training sample set in order to determine the connection and weights between the nodes. This process can be transferred through node and the main disadvantage of this technique is that it utilize more time.

III. Comparison between Segmentation Techniques

TABLE I

Segmentation Technique	Method Description	Advantages	Disadvantages
Thresholding Method	Depends on the histogram of an image	A simple approach in which there is no any requirement of prior knowledge of image. It is a first step to segmentation method.	It doesn't work well if too many edges are present or not fit for flat valleys.
Edge Detection Approach	Based on discontinuity of pixels or pixels having different intensities.	Easily detection of the edges	This method is less immune to noise and not work if the edges are not defined perfectly.
Region Based Method	Grouping of pixels having similar properties and form the region.	Work well when the region homogeneity criteria are easily defines and more immune to noise.	This technique consists of dual segmentation which takes time and memory.
Clustering Method	Grouping the pixels having similar properties and defines the cluster values according to their visible intensities.	Easily detection and implementation.	Needs to define the value of cluster i.e. K
Artificial Neural Network	It uses the neural network consist of nodes.	Use training data to solve complex problem and easily detect errors.	Training process consumes more time and it required over training.

IV. Conclusion

In this survey paper we have briefly explained the various segmentation techniques with their output results including advantages and disadvantages. The image segmentation methods that mentioned in this review paper are used in many technologies including face recognition, pattern recognition as well as for the medical image analysis .

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