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A SURVEY ON DIFFERENT IMAGE SEGMENTATION TECHNIQUES

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ABSTRACT

The image segmentation plays an important role in image processing. Basically Image segmentation is the process of subdividing an image into constituent parts or objects. The level of segmentation is application dependent. Segmentation should stops when the objects of interest in an application have been isolated. Image segmentation is mainly required when we want the computer to make decisions. It will make image smooth and easy to evaluate. Image segmentation is most of judging or analyzing function in image processing and analysis. Image segmentation refers to partition of an image into different regions that are homogenous or similar and inhomogeneous in some characteristics. Image segmentation results have an effect on image analysis and it following higher order tasks. Image analysis includes object description and representation, feature measurement. Hence our main objective in this paper is to make image more simple and meaningful and this is possible by using different image segmentation techniques.

Keywords: Image Segmentation, Edge Detection, Thresholding, Region Growing, Region Splitting & Merging.

I. INTRODUCTION

Image Segmentation is the process of partitioning a digital image into multiple regions or sets of pixels. Actually, partitions are different objects in image which have the same texture or color. The result of image segmentation is a set of regions that collectively cover the entire image, or a set of contours extracted from the image. All of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristics [1]. Image segmentation algorithms generally are based on one of two basic properties of intensity values: discontinuity and similarity. Images are considered as one of the most important medium of conveying information, in the field of computer vision, by understanding images the information extracted from them can be used for other tasks. Now there is a need of a method, with the help of which, we can understand images and extract information or objects, image segmentation fulfill above requirements. Thus, image segmentation is the first step in image analysis. Some time image denoising is done before the segmentation to avoid from the false contour selection for segmentation to segment the image without loss of information for medical diagnosing purpose is a challenging job [2]. Image segmentation means assigning a label to each pixel in the image such that pixels with same labels share common visual characteristics. It makes an image easier to analyze in the image processing tasks. There are many different techniques available to perform image segmentation. In

human vision, the complex image is immediately segmented into the simple objects on the basis of color, texture, patterns, shapes, etc. Image segmentation refers to the process of partitioning a digital image into multiple segments i.e. set of pixels, pixels in a region are similar according to some homogeneity criteria such as color, intensity or texture, so as to locate and identify objects and boundaries in an image. This same thing isconstructed with the help of the image segmentation techniques in the computer vision system. We could segment the digital image on the basis of these features, so that the task of understanding of image could be done in a simple and humanly way. [1]. The choice of a segmentation technique over another and the level of segmentation are decided by the particular type of image and characteristics of the problem being considered [4]. In recent years, a lot of research is done in the field of image segmentation process. There are currently thousands of algorithms, each doing the segmentation process slightly different from another, but still there is no particular algorithm that is applicable for all types of digital image, fulfilling every objective. Practical application of image segmentation range from filtering of noisy images, medical applications (Locate tumors and other pathologies, Measure tissue volumes, Computer guided surgery, Diagnosis, Treatment planning, study of anatomical structure), Locate objects in satellite images (roads, forests, etc.), Face Recognition, Finger print Recognition, etc. Many segmentation methods have been proposed in the literature. The choice of a segmentation technique over another and the level of segmentation are decided by the particular type of image and characteristics of the problem being considered. Thus, algorithm development for one class of image may not always be applied to other class of images.

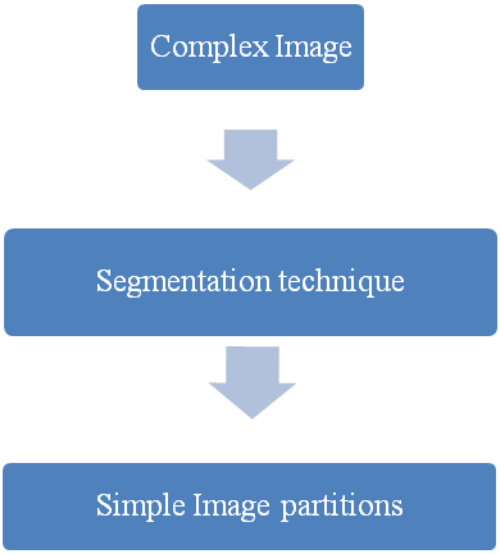

Fig. 1 Segmentation Procedure

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II.IMAGE SEGMENTATION TECHNIQUES

Basically image segmentation algorithm based on two basic approaches:

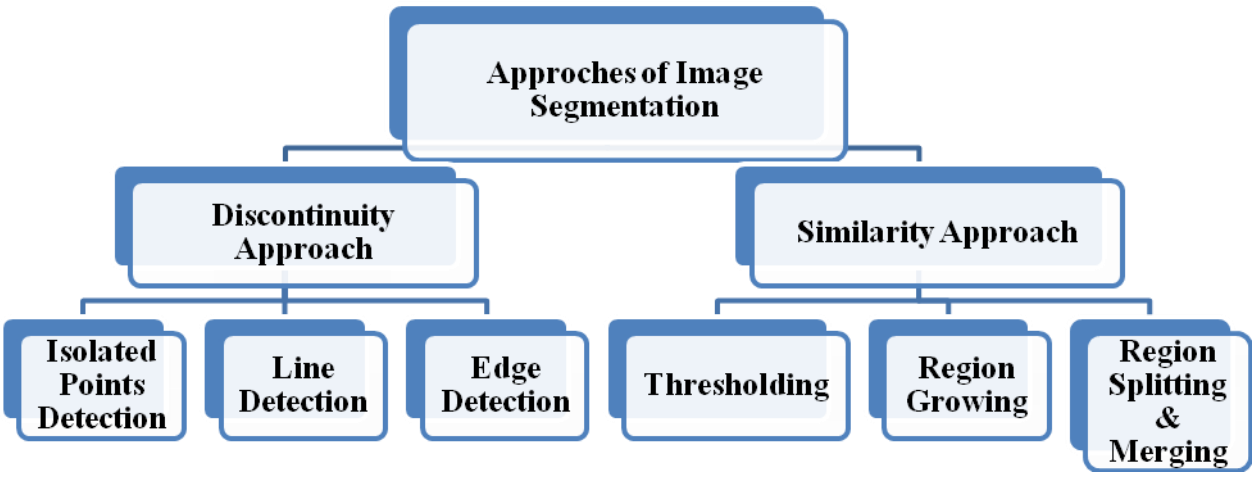

Fig2: Classification of Segmentation Techniques

2.1Discontinuity Approach

In this partition or subdivision of an image is carried out based on abrupt changes in intensity or gray levels of the image. In this major interest in identification of:

2.1.1 Isolated Points detection

In this we use mask through an image and for this we set a threshold value i.e.

$$|R| \geq T \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (i)$$

2.1.2 Line detection: Lines can be detected in any direction & for detection of these lines we need different masks.

−1	−1	−1
2	2	2
−1	−1	−1

Horizontal

−1	2	−1
−1	2	−1
−1	2	−1

Vertical

−1	−1	2
−1	2	−1
2	−1	−1

+45°

2	−1	−1
−1	2	−1
−1	−1	2

−45°

2.1.3 Edge detection: It has ability to measure gray level transitions. Edge is boundary between two regions in an image having distinct intensity levels. Edges occur because of variations in brightness, poor illumination & presence of noise and these represents discontinuities. These are detected by derivative approach.

- 1st order Derivative
  - Robert operator
  - Prewitt operator
  - Sobel operator

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- 2nd Order Derivative
  - Laplacian operator
  - Zero crossing operator

Robert operator: It implements a 1st order derivative at point Z_5 gradient in x & y direction is using mask

Z_1	Z_2	Z_3
Z_4	Z_5	Z_6
Z_7	Z_8	Z_9

$$G_x= (Z_9- Z_5) \quad \& \quad G_y= (Z_8- Z_6) \ldots\ldots\ldots\ldots \qquad (ii)$$

So mask for G_x & G_y is given as:

−1	0
0	1

G_x

0	−1
1	0

G_y

Prewitt operator: It is implemented as:

$$G_x= (Z_7+Z_8+ Z_9) - (Z1+Z2+ Z_3) \quad \& \quad Gy= (Z3+Z6+ Z_9) - (Z_1+Z_4+ Z_7) \ldots\ldots\ldots.. \qquad (iii)$$

−1	−1	−1
0	0	0
1	1	1

G_x

−1	0	1
−1	0	1
−1	0	1

G_y

Sobel operator: It is implemented as

$$G_x= (Z_7+2Z_8+ Z_9) - (Z1+2Z2+ Z_3) \quad \& \quad Gy= (Z3+2Z6+ Z_9) - (Z_1+2Z_4+ Z_7) \ldots \qquad (iv)$$

−1	−2	−1
0	0	0
1	2	1

G_x

−1	0	1
−2	0	2
−1	0	1

G_y

Laplacian operator: It implements 2nd order derivative at Z_5 i.e. Laplacian has zero order crossing which joins the extreme positive and negative of second derivative.

$$Del^2f= (Z_2+Z_4+ Z_6+Z_8) -4\ Z_5 \ldots\ldots\ldots\ldots\ldots \qquad (v)$$

0	1	0
1	−4	1
0	1	0

2.1.4 Experiment and Result

Fig.3 Edge detection using Robert, Sobel & Prewitt operator

2.2 Similarity Approach

It is also known as region based segmentation technique. In this we tried to group pixels in the image which are similar in some sense.

2.2.1Thresholding: Threshold technique is one of the most used techniques in image segmentation. This technique can be expressed as:

T=T[x, y, p(x, y), f(x, y] …….. (vi)

Where: T is the threshold value [11]. x, y are the coordinates of the threshold value point. p(x,y) f(x,y) are points the gray level image pixels.

Threshold image g(x,y) can be define [12]:

$$g(x,y)= \begin{cases} 1 & if \quad f(x,y) > T \\ 0 & if \quad f(x,y) \le T \end{cases}$$

Given original image & Thresholding of the give original image is

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7	4	3
2	1	1
0	6	5

Original image

1	1	0
0	0	0
0	1	1

Threshold image

2.2.2 Experiment and Result

Matlab Program:

```
clc;
clear all;
close all;
x=imread('cameraman.tif');
subplot(1,3,1)
imshow(x)
title('original image')
th=128;
subplot(1,3,2)
imshow(x)
title('thresholded image')
```

Fig.4 Thresholding of an original image

2.2.3 Region Growing: It is a process which groups the pixels or sub regions into a larger regions based on some predefined criteria (predicate). A region based technique takes the opposite approach, of edge detection by (*e.g.*) starting in the middle of an object and then "growing" outward until it meets the object boundaries i.e. we start from a single point and try to find out what are the other points that can be grouped into the same group which predicate is true. Region growing can be processed in four steps:-

(i) Select a group of seed pixels in original image [6].

(ii) Select a set of similarity criterion such as grey level intensity or color and set up a stopping rule.

(iii) Grow regions by appending to each seed those neighboring pixels that have predefined properties similar to seed pixels.

(iv) Stop region growing when no more pixels met the criterion for inclusion in that region (i.e. Size, likeness between a candidate pixel & pixel grown so far, shape of the region being grown) [5**].** Selection of seed points are application dependent and once

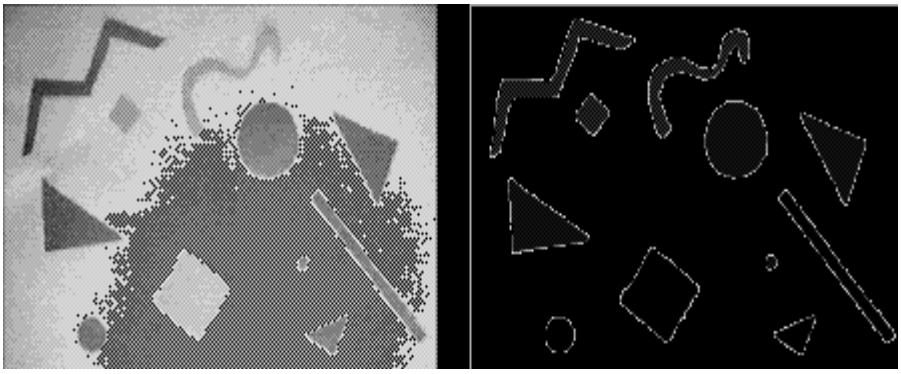
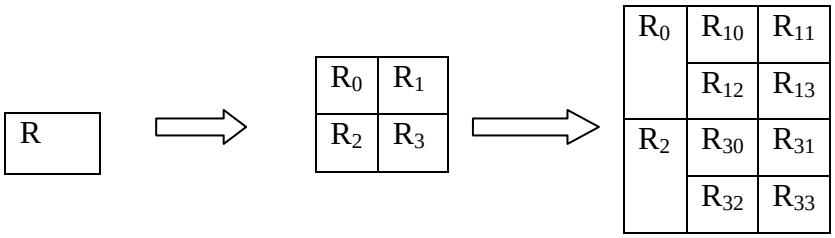


Fig 5. Region based segmentation [6]

2.2.3 Region Merging and Splitting: It is based on homogeneity. If gray levels in region R_0 similar then we leave the region as it is otherwise we split the region. Rather than choosing seed points, user can divide an image into a set of arbitrary unconnected regions and then merge the regions in an attempt to satisfy the conditions of reasonable image segmentation.



Region splitting and merging is usually implemented with theory based on quad tree data [4].

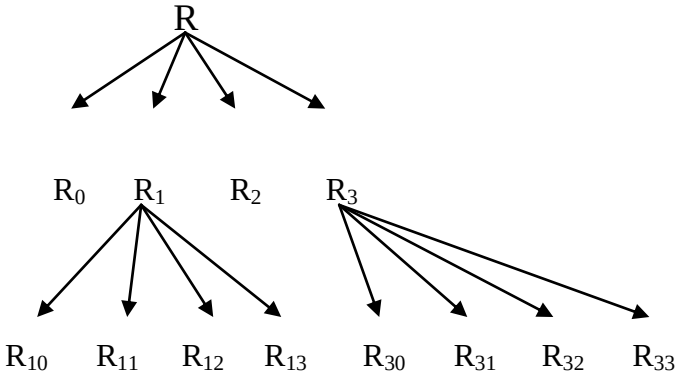


Fig 4. Quad Tree

III.CONCLUSION

In this paper we have discussed different image segmentation techniques. Image segmentation techniques have a promising future ahead since they are the basis of digital image processing. After the analysis of different image segmentation techniques, it is observed that a hybrid solution for image segmentation consists of two or more techniques is being the best approach to solve the problem of image segmentation and also enhance the quality of image.

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