Review on Image Segmentation Techniques and its Types

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***Abstract*: This paper is discussing on the subject of Image segmentation method, techniques and its classifications. Segmentation is the phase where a noteworthy commitment is made during automated study by delineating structures of interest and discerning them from background tissue. Image segmentation is useful in Image Compression, Image Extracting and Image Display. This paper is very valuable for the improvement and progress of new techniques of Segmentation.**

Keyword: Segmentation, Manual, Semi-automatic and Automatic, Region-based, Thresholding and Active Contour, Model based, Edge-based.

I. INTRODUCTION

Image Segmentation [1] is a process in which we can divide or partitioning the digital image into different region. For example when we divide the whole text into different paragraph, word, character is called segmentation. Commonly we can divide the segmentation into two broad categories i.e. Region based segmentation and Edge based Segmentation. There are various segmentation techniques depending upon the classification of various techniques.

I. Manual, Semi-automatic and Automatic Segmentation
II. Region-based Segmentation
III. Thresholding and Active Contour based Segmentation
IV. Model based Segmentation
V. Edge-based Segmentation

1.1 MANUAL, AUTOMATIC AND SEMI-AUTOMATIC SEGMENTATION

1.1.1 Manual Segmentation

Manual segmentation refers to the process whereby an expert transcriber segments and labels a speech file by hand over, referring only to the spectrogram as well as waveform. The manual method is assumed to be more accurate. Also, the employ of a human transcriber ensures that the segment boundaries and labels are perceptually legitimate.

1.1.2 Automatic Segmentation

Automatic segmentation refers to the course of action whereby segment boundaries are assigned without human intervention by a program. This will almost certainly be an HMM-based speech recognizer that has been given the correct symbol string as input. The output boundaries may not be entirely precise, especially if the training data was sparse.

1.1.3 Semi-Automatic Segmentation

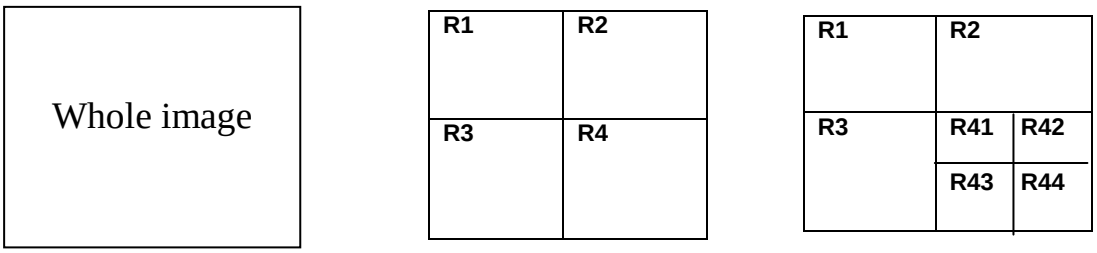
Techniques like Livewire or Intelligent Scissors are worn in this category of segmentation. **Livewire**, also acknowledged as **Intelligent Scissors**, is a segmentation method which allows a user to opt for regions of interest to be extracted swiftly and perfectly, using simple mouse clicks. The user sets the starting point clicking on an image's pixel, recognized as an anchor. Then, as he starts to alter the mouse over other points, the smallest cost path is haggard from the anchor to the pixel where the mouse is in excess of, changing itself if the person moves the mouse. If he needs to pick the path that is being displayed, he simply clicks the image again. One can effortlessly see in the right image, that the spaces where the client clicked to outline the desired region of interest are marked with a small square. It is also clear-cut to see that the livewire has snapped on the image's borders.

2.1 REGION-BASED SEGMENTATION

Region Based segmentation includes: Region splitting, Region merging and Region growing.

2.1.1 Region splitting

In region splitting, image is broken into a set of disjoint regions, which are coherent within themselves. Here a whole image is taken as an area of interest. Now check that all the pixels in the region of area of the interest fulfill the similarity constraint. The area of interest will corresponds to the entire region of image if it is true otherwise it will split the area of interest. This process of region splitting will proceed until no further splitting will occur.



(a)Whole image **(b) First split** **(c) Second split**

2.1.2 Region Merging

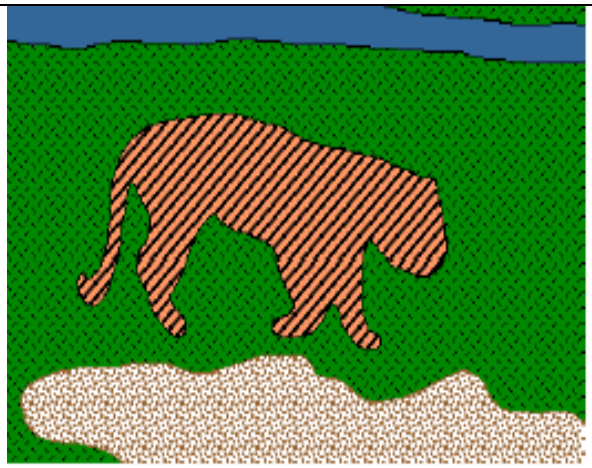
In region merging, firstly the image is segmented using 2x2, 4x4, and 8 x 8 pixels. After those region descriptions is done on the basis of statistical gray level properties. Adjacent region's description is compared with region description. If they match, they are merged into a larger region and a new region description is computed. But if they don't match then the region will marked as non-matched.

2.1.3 Region Growing

In region growing segmentation [1], regions are determined directly. Region growing method is easy to complete and compute. Firstly we start with a single seed and then select set of seed points. Seed is also called pixel. Seed points are selected with the help of some criteria. For e.g. we select seed by checking the neighboring pixels and if the pixels are similar then add them to region. Region growing helps in

providing good segmentation results of an image with clear edges. This method performs well with respect to noise.

(a)Original image



(b)Segmented image

Figure 1 : Region Growing Method Results

3.1 THRESHOLD SEGMENTATION

In threshold segmentation, an image is splitted into smaller segments or junks. Image is partitioned with the help of intensity value. Thresholding is based on the notion that regions corresponding to different regions can be classified by using a range function applied to the intensity values of image pixels. Here image boundary is defined by using at least one color or grayscale value. In grayscale image, threshold may have 40% of gray color. The pixels that are 40% darker than gray belong to one segment and all other to the second segment.

A threshold image is defined as

g(x,y) = 1 if *f*(x,y) > T
else
g(x,y) = 0 if *f*(x,y) > T

Where **T** is threshold, **1** corresponds to objects and pixels and **0** correspond to the background.

(a) Image of a Finger Print with light background

(b)Image later than Segmentation

Figure 2: Threshold segmented outcome

Threshold segmentation is classified into following categories:

- Global Thresholding
- Adaptive Thresholding
- Local Thresholding

3.1 Global Thresholding

It is based on the histogram of an image. Using a single global threshold, image histogram is partitioned. The success of this technique very strongly depends on how well the histogram can be partitioned.

3.2 Adaptive Thresholding

An approach to handling situations in which single value thresholding will not work is to divide an image into sub images and threshold these individually.In view of the fact that the threshold for each pixel depends on its location within an image this technique is said to adaptive.

3.3 Local Thresholding

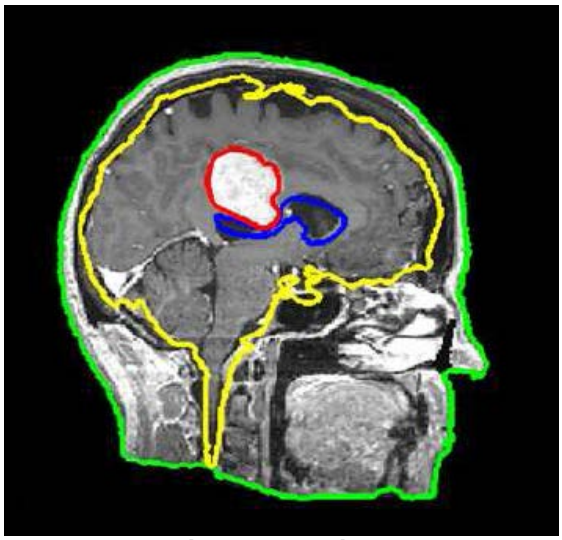
Thresholding may be viewed as an procedure that involves tests in opposition to a function T of the form:

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

Where $f(x,y)$ is the gray level , and $p(x,y)$ is some local property. If T depends on mutually f(x,y) and p(x,y) in that case this is referred to a Local Thresholding.

ACTIVE CONTOUR SEGMENTATION

Active contours also called snakes are curve that are computer generated. These curves move within images to find object boundaries. To detect and locate objects, and to describe their shape, active contour used in computer vision and image analysis. It minimizes the energy. Active contour helps in solving image processing problems such as light detection, dark lines and edges. For example snakes helps in detecting an organ in a medical image or identify character from a letter or paragraph. From any preliminary point, subject to definite constraints, a snake will distort into alignment with the nearby relevant feature in an image; such features match up to neighboring minima in the energy generated by dealing out the image. Snakes are constantly active; changes in high-level elucidation can therefore influence the energy minimization progression, and even in the nonexistence of such changes the models will counter to moving figure features.



Active contour image

4.1 MODEL BASED SEGMENTATION

The human vision system has the capability to identify objects even if they are not entirely represented. It is apparent that the information that can be gathered from local region operators is not adequate to achieve this task. Instead precise knowledge with reference to the geometrical form of the objects is requisite, which can after that be compared with the local information. This instruct of consideration leads to model-based segmentation. In manual segmentation, the structure of organs or interest has monotonous form of geometry. It involves (i) registration of the training examples to a common pretense, (ii) probabilistic depiction of the variation of the registered samples, and (iii) statistical inference flanked by the model and the image.

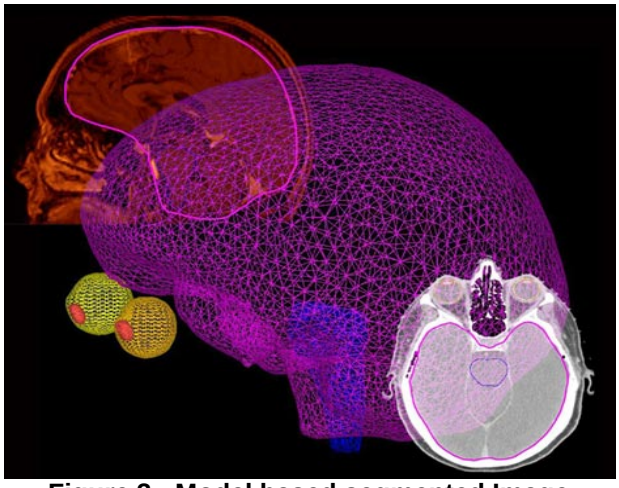


Figure 3 : Model based segmented Image

5. EDGE DETECTION BASED SEGMENTATION

Edge detection plays prominent role in image analysis. In edge detection process, identification of sharp edges is done and then locating the sharp discontinuous in an image. Detecting edges is very useful in a amount. of contexts. Edge detection is difficult in noisy images, seeing as together the noise along with

the edges enclose high frequency content. For instance in a distinctive image perceptive job such as object recognition, an vital step is to segment an image into diverse regions corresponded to dissimilar items in the scene. Edge detection is the first tread in image segmentation. The main generally used edge detection techniques are Gradient-based and Laplacian based Edge Detection. In order to achieve edge detection we follow these steps below:

1) Filtering – Filter image to improve performance of the Edge Detector with respect to noise.
2) Enhancement – Emphasize pixels having significant change in local intensity
3) Detection – Identify edges - thresholding
4) Localization – Locate the edge accurately and estimate edge orientation.

Edge detection has been applied in enhancement of noisy images – satellite images, x-rays, medical images like cat scans, text detection, mapping of roads, video surveillance, etc.

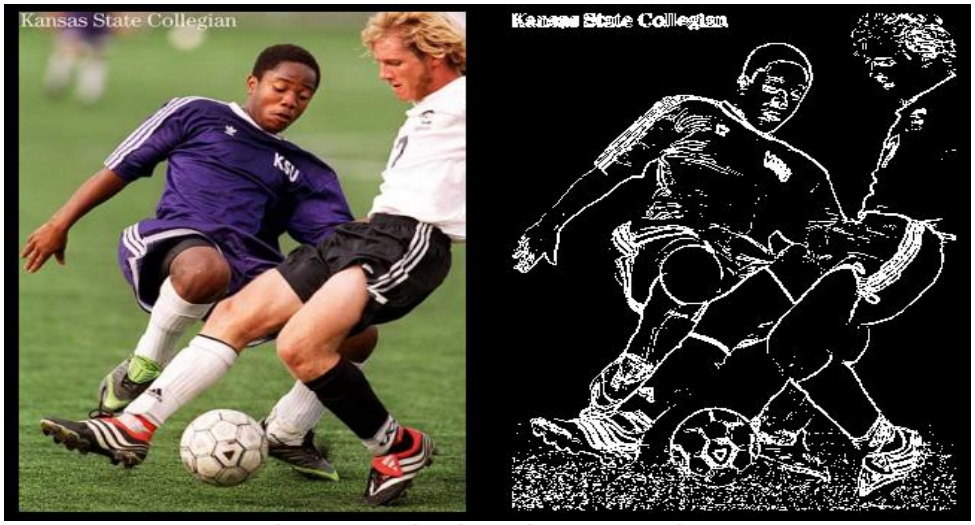


Figure 4 : Edge based segmentation

Conclusion: This paper presented a review of different segmentation techniques and methods. Image segmentation has wide verity of applications to the researcher to prefer one of the areas of his concern. Lots of research findings are published but lots of research areas are still untouched. In future, we plan to devise a novel approach for region growing and active contour.

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