

A Study Analysis on the Different Image Segmentation Techniques

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ABSTRACT

Image segmentation is an important image processing step, and it is used everywhere if we want to analyze what is inside the image. Image segmentation, basically provide the meaningful objects of the image. This paper represents the various image segmentation techniques that could be used in the segmentation algorithm. Whenever we work with the image in any application, initial step is to segment the image in order to solve its complexity. The segmentation of images is the basic thing for understanding the images. It is used in the Image processing applications, Computer vision, etc. In this paper, two categories are emphasized: Edge based and region based segmentation, which further includes their respective techniques.

Keywords: Image segmentation, Edge-Based Technique, Region Based technique, Watershed transformation

INTRODUCTION

Image processing is the general issue in today's era, when we work with computer vision. It is in itself, a broad view to be considered. In order to process the image, we need to segment it so that it would become easier for the computer to understand. Image segmentation is the process of segmenting the image into various segments, that could be used for the further applications such as: Image understanding model, Robotics, Image analysis, Medical diagnosis, etc. Image segmentation is the process of partitioning an image into multiple segments, so as to change the representation of an image into something that is more meaningful and easier to analyze. Segmentation technique, basically convert the complex image into the simple image as shown in the fig 1.

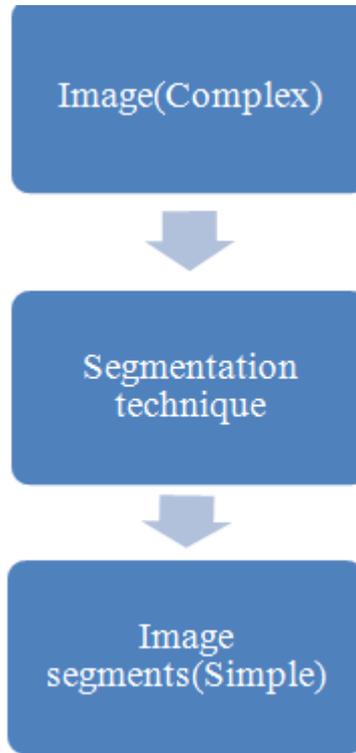


Fig1. Segmentation technique

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. Our motive is to implement almost the same concept as we humans try to implement, while understanding the image which we visualize. In human vision, the complex image is immediately segmented into the simple objects on the basis of color, texture, patterns, shapes, etc. This same thing is constructed 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.

On the basis of these defined features, there are several image segmentation techniques which would provide the segmented results. 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 [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..

IMAGE SEGMENTATION TECHNIQUES

Basically, there are two categories of segmentation techniques: Edge-Based, Region-

Based Segmentation, based on the discontinuities or similarities as shown in fig 2.

Detecting Discontinuity

It means to partition an image based on abrupt changes in intensity [1], this includes image segmentation algorithms like edge detection.

Detecting Similarity

It means to partition an image into regions that are similar according to a set of predefined criterion [1]; this includes image segmentation algorithms like thresholding, region growing.

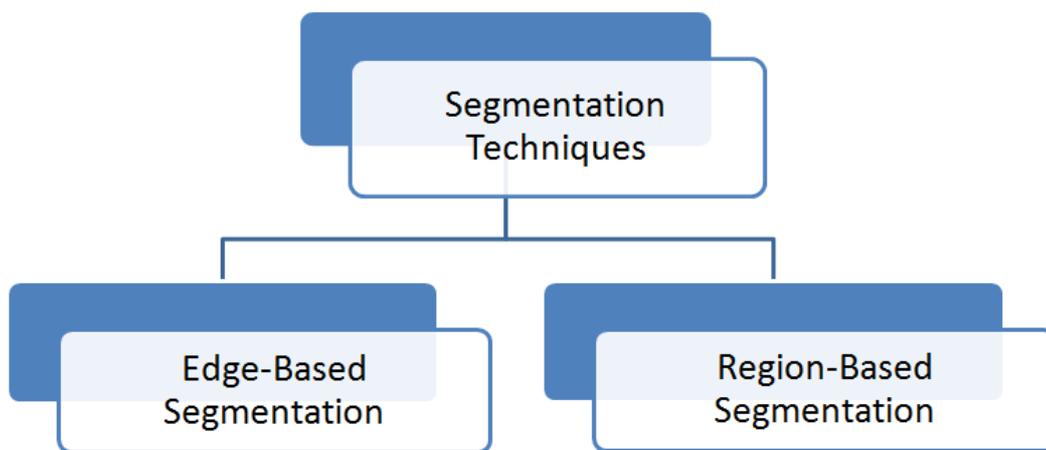


Fig2: Classification of segmentation Techniques

Edge-Based Segmentation

Segmentation Methods based on Discontinuity find for abrupt changes in the intensity value. These methods are called as Edge or Boundary based methods. Edge detection is the problem of fundamental importance in image analysis. Edge detection techniques are generally used for finding discontinuities in gray level images. Edge detection is the most common approach for detecting meaningful discontinuities in the gray level. Image segmentation methods for detecting discontinuities are boundary based methods. Edge detection can be done using either of the following methods. Edges are local changes in the image intensity. Edges typically occur on the boundary between two regions. Important features can be extracted from the edges of an image (e. g., corners, lines, curves). Edge detection is an important feature for image analysis. These features are used by higher-level computer vision algorithms (e. g., recognition). Edge detection is used for object detection which serves various applications like medical image processing, biometrics etc. Edge detection is an active area of research as it facilitates higher level image analysis. There are three different types of discontinuities in the grey level like point, line and edges. Spatial masks can be used to detect all the three types of discontinuities in an image.

All the edge detection operators are grouped under two groups as

- 1st order Derivative
 - Prewitt operator
 - Sobel operator
 - Canny operator
 - Test operator

- 2nd Order Derivative:
 - Laplacian operator
 - Zero-crossings.

Region-Based Segmentation

Region based methods are based continuity. These techniques divide the entire image into sub regions depending on some rules like all the pixels in one region must have the same gray level.

Region-based techniques rely on common patterns in intensity values within a cluster of neighboring pixels. The cluster is referred to as the region, and the goal of the segmentation algorithm is to group the regions according to their anatomical or functional roles. Compared to edge detection method, segmentation algorithms based on region are relatively simple and more immune to noise [3, 4]. Edge based methods partition an image based on rapid changes in intensity near edges whereas region based methods, partition an image into regions that are similar according to a set of predefined criteria [5, 1].

Segmentation algorithms based on region mainly include following methods:

Region Growing

Region growing is a procedure that group's pixels in whole image into sub regions or larger regions based on predefined criterion [7]. 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).

Region Splitting and Merging

Rather than choosing seed points, user can divide an image into a set of arbitrary unconnected regions and then merge the regions [2, 4] 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.

Watershed Transformation

Watershed Transformation belongs to the category of the region based similarities. Watershed model is a mathematical morphological approach and derives its analogy from a real life flood situation [8]. It transforms image into a gradient image. Then, image is seen as a topographical surface where grey values are deemed as elevation of the surface at that location. Then, flooding process starts in which water effuses out of the minimum grey value. When flooding across two minimum converges then a dam is built to identify the boundary across them. This method is essentially an edge based technique [9]. The original watershed algorithm was susceptible to over segmentation so a modified marker-controlled based watershed algorithm was proposed by Beucher (1992). Watershed algorithm produces over-segmentation because of noise or textured patterns. The application of watershed algorithm on remote sensing imageries is relatively recent than other models. Next few paragraphs describe several modifications on marker controlled watershed algorithm to reduce over-segmentation problem. Traditionally watershed algorithm was applied with median filter to eliminate noise and preserve contours (Carleer et al., 2005; Sun and He, 2008). Chen et al. (2006) stated that median filter fails to encounter high imagery texture, generally present in high resolution imagery. They proposed a modified technique to encounter this problem. They used a non-linear filter named Peer group filtering for removal of noise and image smoothing. Then, a floating point based rainfall algorithm for watershed transformation was applied for initial segmentation. Then, a multi-scale region merging algorithm was applied based on spectral, shape and compactness feature for final segmentation. Watershed algorithm is new segmentation approach with relatively less application in remote sensing image segmentation than other described models. However, it may be good for initial segmentation in a multi-scale resolution as it produces an over-segmentation. Over-segmentation elimination is also a problem associated with this method which needs further research.

LITERATURE SURVEY

This section introduces the related work of the image segmentation by various authors with different perceptions regarding to the segmentation techniques.

Satish Kumar et. al[12], in his survey explained the various applications that uses the concept of the image segmentation which includes, computer vision, medical, scanning, recognition, etc.

P. Sravani et al.. [13], in their survey, an overview of different segmentation methods and clustering are studied. Though many techniques are developed, not all types are useful for all types of images. Segmentation segments the image and clusters according to some similarity. Distance metric is a similarity measure and has direct impact on the clusters formed. In this, Fuzzy is powerful unsupervised clustering method which is widely used for robust segmentation of real time images. Traditional FCM and many other algorithms use Euclidean Distance metric.

H. P. Narkhede[14], in his review of image segmentation study, has described various methodologies and issues regarding to digital image processing used in various recognition patterns.

Rajeshwar Dass et al. [15], In this paper they classifies and discussed main image segmentation algorithms and concluded that the methods are classified on the basis of the features as: homogeneity of images, spatial characteristics of the image continuity, texture, image content.

Nikita Sharma et al. [16], in their study, reviewed out that the performance assessment and comparison is not easy for the various segmentation techniques or methodologies. They have mentioned the evaluation techniques so that researchers could use while opting any segmentation method.

PunamThakare[17], in her paper describes the various image segmentation techniques and discusses in detail the edge detection techniques and their evaluation. It gives an algorithm which is a combination of detection and evaluation of the edge detectors. The results show that the recognition rate depends on the type of the image and their ground truths.

Dey et. al. [18], in the paper summarized the segmentation methods with the help of modeling approach. Image segmentation methodologies were categorized in three stages. At first stage comes model driven approach and image driven approach (mainly based on statistical analysis). The second stage corresponds to homogeneity based measure, and final category corresponds to mode of operations on an image, e. g. edge detection, region growing/splitting. The selection of segmentation approach depends on what quality of segmentation is required. Further, it also depends on what scale of information is required.

N. Senthilkumaran and R. Rajesh[19], in their paper, mainly focused on the study of soft computing approach to edge detection for image segmentation. The soft computing approaches namely, fuzzy based approach, Genetic algorithm based approach and Neural network based approach is applied on a real life example image of nature scene and the results show the efficiency of image segmentation.

CONCLUSION

In this paper, a study based representation of different segmentation approaches is defined. Throughout this study of the various techniques, we concluded out various facts:

- First, the image segmentation is the crucial part of the image understanding/image processing model.
- Second, the segmentation technique of the image could be used as per the required application or the usage as image is segmented on the basis of different features.
- Third, the segmentation techniques are broadly categorized on the basis of detection of discontinuity and similarity of the image.
- Fourth, Opting a single technique or method would not provide better optimized results.
- In our future work, we will use the watershed technique along with the edge detector operator (1st derivative) to get the improved technique for the segmentation purpose. It would help to detect the segments in a quite simple and enhanced way.

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