



## Image Segmentation Methods: A Review

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**Abstract**— Segmentation is having its significance in various object identification and selection applications. The accuracy of these applications depends on accurate feature selection or segmentation. In this paper, an exploration to the segmentation approach is presented in a generalized way. Here the segmentation approaches are classified in edge based segmentation, region based segmentation and threshold based segmentation. The paper also explored most effective segmentation approach called clustering. Here, different types and aspects of clustering approaches are explained. The paper is presented as a study to explore the importance of segmentation approaches.

**Keywords**— Segmentation, Clustering, Region Based, Edge Based

### I. INTRODUCTION

Image segmentation is a process of dividing the given image into multiple parts. Segmentation is performed on the basis of some characteristics like, intensity, threshold value, color, etc.

Image segmentation has its application in the area of computer vision. Segmentation forms a set of homogenous and meaningful region [9] in such a way that pixels which have same characteristics are grouped together [2]. Main aim of performing segmentation on a given image is to extract maximum information from image. To remove noise from image some filters are used like Gaussian filter, median filter, etc [4]. This avoids data loss during the segmentation and helps in providing region of interest [3].

### II. IMAGE SEGMENTATION

The term image segmentation refers to the partitioning of an image into a set of regions that cover it. The goal in many tasks is for the regions to represent meaningful areas of the image, such as the crops, urban areas, building areas and forests of a satellite image. Image segmentation varies from filtering of noisy images, medical applications (locating tumors and other pathologies, planning of treatments, diagnosis, etc.), locating objects in satellite images (Beach, building, river, forest, etc.), face recognition etc.[1].

### III. SEGMENTATION TECHNIQUES

Image segmentation is an important stage in image processing. There are several segmentation approaches exist now a days. All segmentation approaches are based on two principle given below:

1. Discontinuity principle: In this, subdivision of images is carried out on the basis of abrupt changes in intensity or gray levels of an image [2].
2. Similarities principle: In this, subdivision of images is carried out on the basis of similarities in intensity or gray level of an image [2].

Image segmentation methods are as follows:

#### A. Edge based segmentation

Edge detection is well developed field in image processing. Edge represents boundaries of an object. Edge detection is used in image segmentation for detection of object boundaries. Edges are detected when there is an abrupt change in intensity or change in brightness of image [1][2][3].

Methods for edge based segmentation are:

##### 1. Gray histogram Method:

The quality of edge detection will depends on fitness of T (threshold value ). In this method segmentation depends on selection of maximum and minimum threshold value and this selection of threshold is very difficult because the gray histogram is uneven for the images which are effected by noise[1][2][4].

##### 2. Gradient Based method:

Gradient method is used to detect the edge with the help of local maxima and local minima. To find local maxima and local minima we use first derivative and gradient is first derivative of image[2][4][5].When there is sharp change in

intensity and there is some image noise, Gradient based method works well, and the result of segmentation is adaptive to the direction of gradient[4]. There are mainly three edge detection operator Laplace operator, canny operator, and laplacian of Gaussian (LOG) operator canny operator gives best result [3].

### **B. Region based segmentation:**

This method is based on continuity. Regions of an image are group of number of connected pixels with same gray level [6][7]. In region based segmentation, each pixel is assigned to a particular region. In this method pixels belonging to an object are grouped together [7]. This method divides the whole image into sub regions on the basis of common patterns (i.e intensity value) [6]. Region based segmentation is simple then edge based segmentation. This type of segmentation is kind of iterative algorithm [4].

Region based segmentation basically includes following methods:

#### **1. Region growing method:**

As it is suggested by its name, region growing is a procedure that groups pixels into sub region or sub regions into large regions based on some predefined criteria [4]. The procedure for this method is as follows:

1. Select a set of seed particles in original image [2].
2. Select a set of criteria for determining similar seeds based on properties such as grey level intensity or color and then set up a stopping rule [2].
3. After selection of seeds, grow regions by appending each seed to its neighboring pixels that have similar properties of the seed (such as intensity, gray level or color) [4].
4. Stop the region growth when no more pixels satisfy the similarity criteria.

#### **2. Region Splitting and Merging :**

Region splitting and merging method is opposite of region growing method. It is top down approach[8]. It basically divides an image into a set of arbitrary, unconnected regions and then merge and/or split 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].

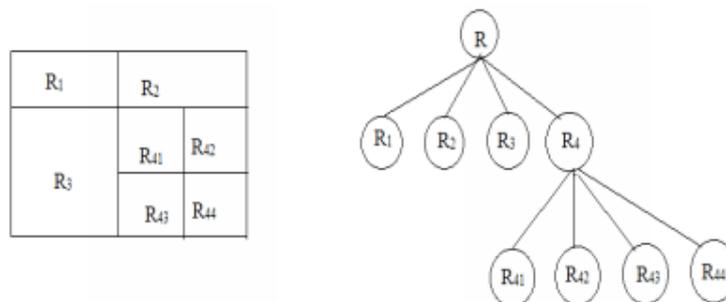


Fig. 2. Quad tree [8]

### **C. Thresholding based segmentation:**

This method of segmentation is very powerful method. This method is used to segment foreground or an object from background. This method depends on the properties of an image. For proper detection either foreground is lighter then background or vice-versa. To find an object from background is basically done by selecting a threshold value (i.e. T). Let us take a pixel(x, y) ,

- a) If pixel(x, y)'s value is greater than or equal to threshold value i.e.  $f(x, y) \geq T$  then object is considered as foreground.
- b) If pixel(x, y)'s value is greater than or equal to threshold value i.e.  $f(x, y) \leq T$  then object is considered as background [3].

#### **1. Global thresholding:**

This method is used when the intensity distribution between objects of foreground and background is different [2]. That is, this method uses a fixed threshold value T. Based on T foreground and background pixels are identified when the foreground and background objects are distinct [2][3].

#### **2. Local thresholding:**

Local thresholding is used when global thresholding does not work. That is, in this method image is divided into sub images and each sub image is thresholded separately. In this method various thresholds are selected one for each sub image [3].

### **D. Special theory based segmentation:**

Theory based segmentation includes number of algorithms that includes derivatives from distinct fields. Theory based segmentation includes fuzzy based segmentation algorithms, clustering based algorithm, neural networks based algorithm, wavelet based algorithm and etc.

1. Clustering technique:

Clustering is unsupervised technique because it does not use training data in fact it uses the available data to train themselves [9]. Clustering is basically a process of grouping the pixels into number of clusters based on class. Clustering method is basically used for segmentation when classes are known in advance [8]. A criteria for similarity of pixels is defined and after that pixels are grouped into clusters[1]. Clustering methods are classified as hard clustering, fuzzy clustering, k-mean clustering etc.

a) Hard clustering segmentation:

Hard clustering assumes that pixel of an image belongs to one and only one cluster and also that there exists sharp boundaries between each cluster [2][9]. Well known hard clustering algorithm is K-mean algorithm, it assigns n pixels into k number of clusters with  $k < n$ . The pixel assignment to a particular cluster is done on the basis of some characteristics like gray level intensity, distance between pixels [3].

b) Fuzzy clustering segmentation:

In real time application one of the most difficult task in image processing is to assign a particular pixel to a cluster when there is no clear boundaries between different objects in the image [2]. In such cases fuzzy clustering is used. It assigns image pixel to a cluster on the basis of similarity criterion. Similarity criterion can be distance, connectivity, intensity, etc. Advantage of this clustering is that, it is easy to understand [1] because it uses fuzzy set [4]. Most commonly used fuzzy clustering algorithms are Possibilistic c-means (PCM) and Fuzzy c means (FCM) algorithm, GK (Gustafson-Kessel), GMD (Gaussian mixture decomposition), FCV (Fuzzy C varieties), AFC, FCS, FCSS, FCQS, FCRS algorithm and etc [1].

c) Neural network based clustering:

Neural network is based on simulation [8]. Neural network is artificial representation of human brain that tries to simulate the learning process[7]. In this method firstly image is mapped into neural network in which each neuron represents a pixel[4]. After mapping, this neural network is trained with sample data to determine connection and weights between the nodes [1]. Neural network segmentation have two main steps:

1. Feature Extraction: This step determines input data of neural networks which will help in segmentation[3].
2. Image segmentation: This step performs segmentation based on the features of an image[2].

### III. CONCLUSION

The paper has identified the significance of segmentation approaches independent to the application and the dataset. The paper first presented the scope of segmentation in various application areas and later on provided the detail description on various segmentation approaches. The main stress of paper in feature based segmentation which is presented here using different approaches. The paper is helpful to identify the appropriate segmentation approach for any classification or feature extraction application.

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