

# A brief review of image segmentation techniques

**Shashi Bala and Ajaya Kumar**

**Abstract**— Image processing is the common matter in today's era, when we work with computer vision. Image processing is useful for advanced information extraction in: authentication and identification of the owner, recognition of cancerous cells, navigation of robots. In these cases there is a need of a method which helps to understand images and extract information or objects and this is accomplished by image segmentation. Segmentation is the process of dividing a digital image into no. of segments. Segmentation is basically is the process of assigning a label to every pixel in an image such that pixels with the same label share certain properties. And also this paper gives a brief outline about some segmentation techniques used in image processing like region based, model based, edge based, clustering etc.

**Index Terms**—Image processing, Image segments, Image segments techniques, MRF (Markov random field).

## I. INTRODUCTION

### 1.1 Image Processing

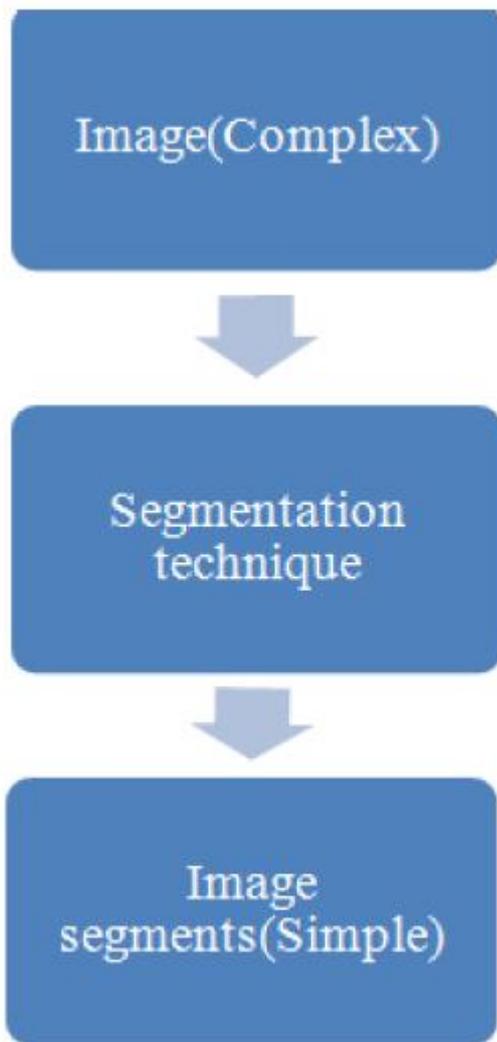
Digital image processing is a present day subject in computer history. Image processing is the general issue in today's era, when we are working with computer vision. Itself it is a broad view to be considered [1]. In digital image processing, we use algorithms to perform image processing. Actually digital image processing has several advantages as compared to the analog image processing; firstly high number of algorithms given by it to be used with the input data, second some processing problems can be avoided such as creating noise and signal distortion during signal processing. In 2000s, fast computers are available for signal processing and thus digital image processing has become the popular form of image processing. And that's why signal image processing became versatile method, and also cheapest.

### Applications

1. Satellite imagery
2. Wire photo standards conversion
3. Medical
4. Imaging
5. Videophone
- 6 .character recognition and
7. Photo enhancement [2]

### 1.2 Image Segmentation

Image segmentation is an important technology for processing of image. A lot of applications whether on fusion of the objects or computer graphic images require precise segmentation. Segmentation divide an image into different parts consisting of each pixel with similar attributes [3]. Efficient image segmentation is one of the most typical tasks in automatic image processing. Image segmentation has been interpreted differently for various applications. For example, in applications of machine vision, it is regard as a bridge between high level and low level vision subsystems, in medical imaging as a tool to delineate anatomical structure and other regions of importance whose deduced knowledge is generally available and in statistical analysis, it is posed as a stochastic estimation problem, with supposed prior distributions on image structure, which is widely used in remote sensing. In remote sensing, it is usually viewed as an aid to landscape change detection and land use/cover classification. Fore mentioned examples express that image segmentation is present in every kind of image analysis. This constitutes a lot of literature on the image segmentation [4].



**Fig1. Segmentation technique**

[1]

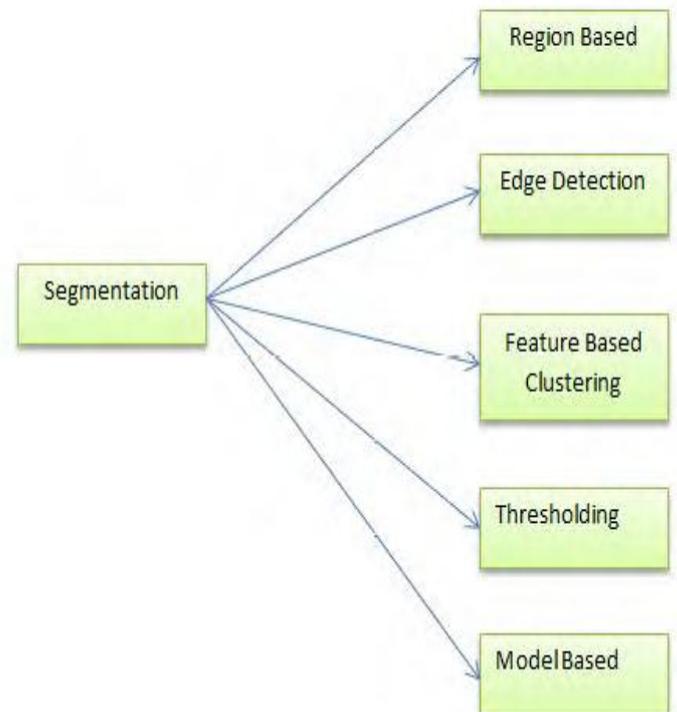
In Image segmentation each pixel assigned a label in the image such that pixels with same labels share common visual properties [1].

### 1.3Image Segmentation Technique

Segmentation can be classified as:

- Region Based
- Feature Based Clustering
- Edge Based
- Threshold
- Model Based

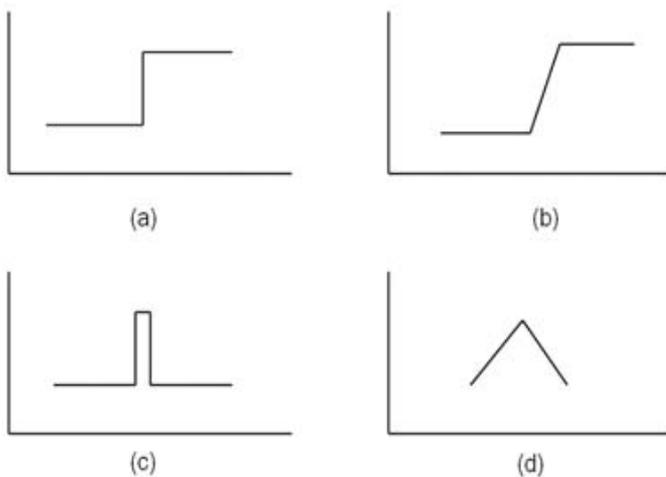
The classification is given in Fig 2 [5]



**Fig 2.Various types of segmentation [5]**

#### 1.3.1Edge-Based Segmentation: -

Edge detection techniques convert images to edge images aid from the changes of grey tones in the images. Edges show lack of continuity, and ending. As an output of this transformation, image of edge is procure without facing any changes in physical qualities of the main image. Objects comprise of lots of parts of different color levels. Image with different grey levels, despite a clear cut change in the grey levels of the object, image shape can be distinguished in Figure 3 [6].



**Fig. 3. Type of Edges (a) Step Edge (b) Ramp Edge (c) Line Edge (d) Roof Edge [6]**

### 1.3.2 Region Based Method: -

This method works on the principle of uniformity by considering the fact that the adjacent pixels inside a region possess similar features and are not similar to the pixels in other regions. The purpose of region based segmentation is to produce a uniform region which is bigger in size and results in very few regions in the image. The regions although treated as similar in nature but there are provision to note any significant changes in the characteristic of the neighboring pixels. Region based methods are fundamentally divided as

1. Methods of Region growing
2. Method Region split and merge [7].

### 1.3.3 Feature Based Clustering:

Clustering is also used for Segmentation. They followed a different procedure, where mostly directly apply the technique to the image but in it. The image is converted into histogram and then clustering is done on it. For segmentation Pixels of the color image are clustered using an unsupervised technique Fuzzy [5]. There are various clustering techniques used, the frequently used are K-means algorithm and fuzzy C-means algorithm. The Clustering methods are partitioned into partitional algorithms and hierachical algorithms.

#### 1.3.3.1 Agglomerative clustering:

It is a hierarchical method and it starts grouping by calling each data point a separate cluster, and then merges the appropriate clusters into single clusters.

Algorithm: Agglomerative Hierarchical clustering

1. Select the greatest similarity value from the input similarity matrix  $S_i, S_j$ , combine and form its composition  $S_{i,j}$ .
2. Form a matrix with  $S_{i,j}$ .
3. Find out the cell value of matrix as Similarity ( $S_{i,j}, S_k$ ) =  $\min \{ \text{similarity}(S_i, S_k), \text{Similarity}(S_j, S_k) \}$
4. Repeat second step until there is single cluster in matrix cell.

#### 1.3.3.2 Partitional clustering

Partitioned clustering form one single partition of the image.

##### i. K-means algorithm

Near to the centroid this algorithm clusters the point.

##### ii. FCM (Fuzzy C-Means) Algorithm:

In this algorithm the test pixel with different membership coefficient is allowed to be member of two or more clusters. FCM (Fuzzy C-Means) algorithms have iterative nature and form fuzzy partition matrix and also needs cluster centre along with objective function [7].

#### 1.3.4 Threshold based segmentation:

Thresholding is most commonly used technique for segmenting an image. Depending upon the selection of threshold value two types of threshold methods exist.

##### 1.3.4.1 Local Threshold:

Local threshold depends on the average gray value and intensity value of input image. This method divide input image into several subregions and for each sub region selects different Threshold value

##### 1.3.4.2 Global Threshold:

only on Gray level values Global threshold value depends and the threshold value entirely associated with the quality of pixel. Threshold segmentation technique comprises of five methods.

- Mean Method
- Histogram Dependent Technique

- Ptile Method
- Edge Maximization Technique
- Visual Technique [9].

### 1.3.5 Model Based Segmentation

**1.3.5.1 Markov Random Fields Model:** - segmentation based on Markov Random Field (MRF) is called as Model based segmentation. An built in region smoothness constraint is used in MRF which is used for color segmentation. Part of of the color pixel tuples are supposed as independent random variables for furthermore processing. With edge detection MRF is combined for identifying the edges accurately. Markov Random Field (MRF) has constraint of spatial region smoothness and among the color components there are correlations [10].

#### 1.3.5.2 Object-background Model:

Object Background are histogram thresholding based models. They are original models for image segmentation. They follow a concept that there is a background is uniform and objects are placed irregularly on this background. They are mainly based on shadowy properties. Shadowy variation is represented by image histogram [4].

### Literature Review

**Sujata Saini et al. [2014]** Image segmentation is an vital step for image processing , and it is used everywhere if we want to analyze internal part of the image. Image segmentation provides the significant objects of the image. This paper represents the various image segmentation methods that could be used in the segmentation algorithm. Every time we work with the image, first step is to segment the image so as to remove its complexity . The segmentation of images is the first thing for understanding the images. It is used in the Image processing applications like Computer vision, etc. this paper, two categories are mentioned: Edge and region based Segmentation, which furthermore includes their respective techniques.

**Ashraf A. Aly et al. [2011]** Assessing the previous study is an essential part of advances segmentation methods for the

image analysis techniques. The objective of this paper is to present a review of digital image segmentation techniques. The problems of digital image segmentation illustrate great challenges for computer vision. The broad range of the problems of computer vision may make good use of image segmentation. In this paper different methods for segmentation techniques are evaluated. We discuss the tendency of each algorithm with their approaches, advantages and disadvantages. This study is useful for determining the accurate use of the image segmentation methods and for upgrading their accuracy and performance and also for the main objective, which designing new algorithms.

**Shanaz Aman et al. [2015]** image segmentation is the process of dividing a picture into different types of regions and in classes of specific geometric shape. It can said that each class has normal distribution with specific variance and mean, so the picture called as Gaussian Mixture Model. In this paper, first study h related with the Gaussian-based HMRF (hidden Markov random field) model and its EM algorithm. Then we generalize it to - hidden Markov random field based on Gaussian mixture model. In MATLAB R20013a this algorithm is executed. And also apply this algorithm to color image segmentation problems.

**V. Dey et al. [2010]** as the research on image segmentation progresses, it has become important to categorize the research results and readers are provided with an overview of the existing segmentation techniques in each category. Different image segmentation methods applied on optical remote sensing images are investigated in this paper. Papers are selected on the basis which includes sources from image processing journals, books, dissertations and thesis out of more than 3000 journals, books. The conceptual details of the techniques are explained and for simplicity mathematical details are avoided. Broad and detailed classifications of examined segmentation techniques are provided. The state of research on each category is provided with image properties used by them and emphasis on developed technologies. The categories mentioned are not always commonly independent. Hence, their interdependence is also stated. So final

conclusions summarizing frequently used techniques and their complexities in application.

**R. Yogamangalam et al. [2013]** new technologies are appearing in the field of Image processing, especially in the domain of segmentation in day-to-day life. Quick description on some of the most common segmentation techniques like thresholding, Edge detection, Clustering, Model based etc., defining its advantages as well as the drawbacks presented in this paper. Few of them techniques are suitable for noisy images. Among them Markov Random Field (MRF) is the strongest method of noise cancellation in images whereas the simplest technique for segmentation is thresholding .

**N. Senthilkumaran et al. [2009]** Soft Computing is an emerging field that consists of compatible elements of fuzzy logic, evolutionary computation and neural computing. Soft computing techniques have found broad applications. One of the most important methods for image segmentation is edge detection. Image segmentation is the process of dividing a digital image into sets of pixels or multiple regions. Edge is a boundary between two homogeneous regions. Edge detection define the process of identifying and locating sharp asymmetry in an image. this paper stresses on the survey of theory of edge detection for image segmentation using Fuzzy logic based soft computing approach, Neural Network and Genetic Algorithm.

**A. M. Khan et al. [2013]** Image segmentation is the basic and essential step to inspect images and extract data from them. It is the field which is widely researched and still facing various problems for the researchers. This paper tries to put light on the methods used to segment an image. This paper stresses on the aim behind the basic methods used. Image segmentation can be mainly categorized as semi-interactive approach and fully automatic approach. The algorithms developed in one of these approaches. Image segmentation is a essential step as it exactly effects the total success to understand the image.

**Sandhya et al. [2015]** Segmentation is having its significance in various object identification and selection applications. On accurate feature selection or segmentation the accuracy of these applications depends. In this paper, in a

generalized way a study to the segmentation approach is presented. Here the segmentation approaches are classified as edge based, threshold based and region based segmentation. The paper also explored most effective clustering approach used for segmentation. Different types and aspects of clustering approaches are explained here. The paper is presented as a study to define the importance of segmentation approaches.

**Smriti Pathak et al. [2016]** in computer vision, to get a perfect display, Processing of image takes several stages. It involves processing an image in to the elementary components in order to expand statistical data. Every single one Image Processing operation mainly focuses at a better recognition of object under consideration. The main point behind is to find suitable local feature that can be noticeable from other objects and also from the background. Previous researches shown many efficient techniques to make effortless and better noticeable image or data. This paper throw light an overview of their efficient work in the appropriate field in order to understand their feasibility and realization.

**Manikannan et al. [2015]** in recently innovative technologies are coming out trends in the field of Image processing. A comparative study in region based and model based segmentation of image is the most unreliable functions in image processing and analysis. Segmentation is the technique to Simplify and/or to change the view of any image either region based and model based segmentation into that image that is more meaningful and easy to analyze. Region based segmentation is used to find out objects and boundaries in images. image segmentation consequences influence all the coming processes of analysis of image such as object description and illustration, characteristic dimension, This paper gives a outline about the various techniques of segmentation used in image processing techniques such as region based, Model based, Edge based, clustering etc. giving its advantages as well as drawbacks.

Ref. No.	Parameters used	Year	Methods Used	Conclusions	Neural Network	segmentation		
1	Image segmentation, edge based methods, region based methods	2014	Different segmentation methods	Single method or technique would not provide better results.	7	2013	Different segmentation methods	Method of segmentation should be selected according to type of image
2	Boundary detection, image segmentation	2011	Various segmentation methods	Accuracy, complexity, interactivity and efficiency of a segmentation method all should be considered factors.	8	2015	feature based segmentation	segmentation approaches independent to the application and the dataset
3	EM Algorithm, Map estimation, color image segmentation	2015	HMRP and its EM Algorithm	HMRP segmentation results are much more smooth than the results of direct K means clustering.	9	2016	Segmentation techniques	Depending on the type of image we need to use distinct algorithm.
4	Object-background model, Markov Random Field Model, Multi-resolution Model	2010	Different segmentation models.	For highly textured image MRF model is the good choice	10	2015	Different segmentation techniques	To find a appropriate segmentation algorithm type of inputted image is very important.
5	Threshold, Clustering, MRF, Edge Detection	2013	Various segmentation techniques	As compared to other methods, thresholding is the simplest and fast method.	<p><b>A. References</b></p> <p>[1] Sujata Saini and Komal Arora, "A Study Analysis on the Different Image Segmentation Techniques", volume 4, Number 14 (2014).</p> <p>[2] Ashraf A. Aly, Safaai Bin Deris, Nazar Zaki, "RESEARCH REVIEW FOR DIGITAL IMAGE SEGMENTATION TECHNIQUES", IJCSIT, Vol 3, No 5, Oct 2011.</p>			
6	Image Segmentation, Genetic Algorithm,	2009	Soft computing approaches	The soft computing approaches is applied on a real life example image of nature scene and show the efficiency of image				

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## Conclusion

Image segmentation is important step for image processing and it is used everywhere when the internal part of the image is to be analyzed. To remove the complexity of image segmentation process is required. This paper represents different segmentation methods. Different papers suggested many points about segmentation techniques that are: Single method or technique would not provide better results. Segmentation can be applied to any type of image. Comparing to other methods thresholding is the simplest fast method. 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. Segmentation techniques are categorized on the basis of detection of discontinuity and similarity of the image. Also Markov random field impose strong spatial constraints on the segmented regions, while segmentation based on clustering only considers pixels intensities, therefore HMRF segmentation results are much smoother than the results of direct K-means clustering.

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