

# Segmentation: Digital Image Processing

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## ABSTRACT

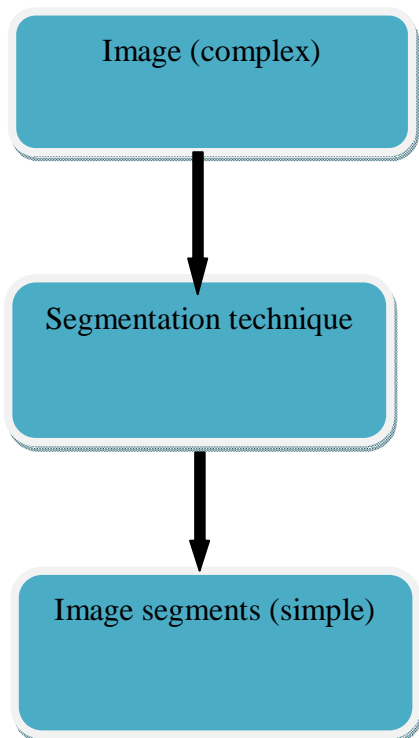
Image Segmentation has been an area for a long time which is providing a research work. Image segmentation is an important image processing step, or it is used everywhere if we want to analyze what is inside the image. Image segmentation; basically provide the meaningful objects of the image. The segmentation of images is the basic thing for understanding the images. The problems of digital image segmentation represent great challenges for computer vision. The wide range of the problems of computer vision may make good use of image segmentation. Digital media image widely exists in many fields, such as education, video, advertisement, and so on. Process digital media image is an important part of image processing. We propose a new algorithm for digital media image segmentation, and it is also can be used in the image processing. Image segmentation techniques need comparative analysis for further development and modifications for continuous and consistent improvement. One of the most important applications is edge detection for image segmentation. The process of partitioning a digital image into multiple regions or sets of pixels is called image segmentation.

**KEYWORDS**Digital Media, Image Segmentation, Edge-Based Technique, Region Based technique, Image.

## 1. INTRODUCTION

Digital media image processing technology is an interdisciplinary field. This continuous development of computer science and technology, image processing and analysis gradually formed the scientific system, and so do the digital media image. Digital media image is widely used in the society, such as education, advertisement, video, film, and so on. The digital media image has become an effective tool in the research for the scholars study on visual perception psychology, physiology, computer science and other fields. Digital media image processing has great demand in the, remote sensing, meteorological and other large applications. Digital media image segmentation will divide the image into a number of regions with specific and unique natures, and propose the technique and process for the target of interest. We propose a new algorithm for digital media image segmentation, and it can also be used in the image processing [1]. A digital image is a numeric representation of a two-dimensional image. A digital image is composed of a finite number of elements, each of which has a particular location and value, are called picture elements, pels and pixels [2]. There are generally two types of image- raster type and vector type. Raster images are images having a finite set of digital values which are represented in a fixed number of rows and columns of pixels where these pixels are stored in memory as a two-dimensional array. Digital images are

usually referred as raster images. Vector images are images generated from mathematical geometry known as vector which have points having both magnitude and direction. 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.



**Figure 1** Segmentation technique [3]

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. 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 [3]

### 1.1.Digital media

Digital media image is widely used in the society, such as education, advertisement, video, film, and so on. Processing algorithm for the digital media image is also quite important for us to get vivid image. So, many treatment methods have been emerged. Although its history is not long, it attracts concern of various researchers. Firstly, the vision is the most important means of human perception and the digital media image is the basis of vision. Therefore, the digital media image has become an effective tool in the research for the scholars study on visual perception psychology, physiology, computer science and other fields. Secondly, digital media image processing has great demand in the, remote sensing, meteorological and other large applications.

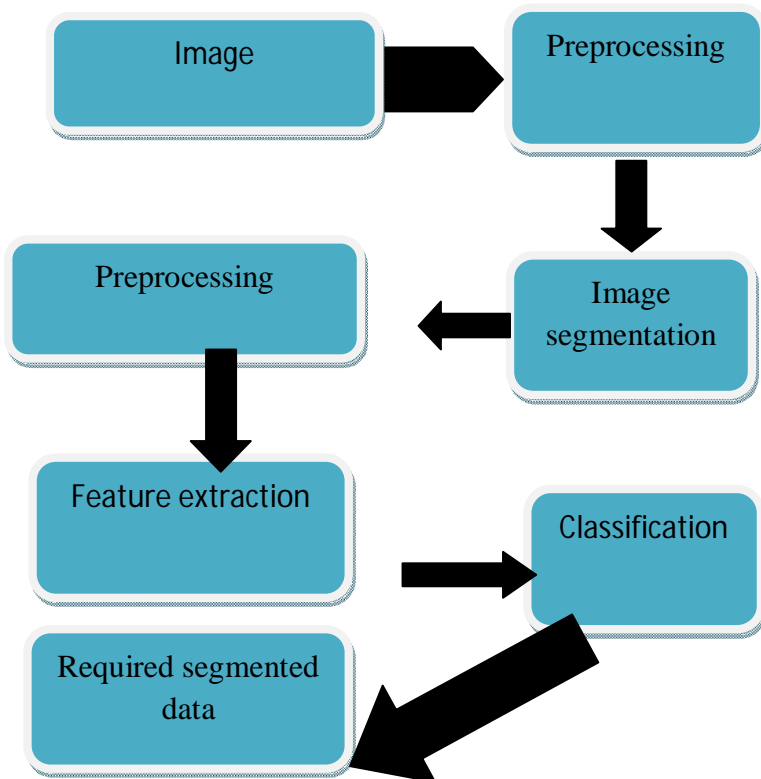
In digital media image analysis, target part is often required to extract from the image. Image segmentation can be described as that a particular region is separated and extracted from the other parts of the image. That is to say that the digital media image segmentation will divide the image into a number of regions with specific and unique natures, and propose the technique and process for the target of interest. It is the fundamental step from image processing to image analysis [1].

### 1.2 IMAGE SEGMENTATION

Image segmentation is the foundation of object recognition and computer vision [4]. Image segmentation is the process of subdividing a digital image into multiple regions or objects consisting of

sets of pixels sharing same properties or characteristics which are assigned different labels for representing different regions or objects. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze [4]. Image segmentation is used to locate objects and boundaries in images. Segmentation is done on basis of similarity and discontinuity of the pixel values. There are two types of segmentations- soft segmentations and hard segmentation. Segmentation that allows regions or classes to overlap is called soft segmentation. Hard segmentation forces a decision of whether a pixel is inside or outside the object [5].

The following computational steps have to apply for image segmentation process on the image taken as input to get the required segmented data



**Figure 1.2.** Computational step for image segmentation [4, 5, 6, 7]

### 1) Preprocessing

The main aim of the preprocessing step is to determine the area of focus in the image. As the input image may have a certain amount of noise in the images, it is necessary to reduce or remove the noise [6].

**2) Image Segmentation** The preprocessed image is segmented in its constituent sub-regions.

### 3) Post Processing

To improve the segmented image, further processing may be required which is performed in post processing step.

### 4) Feature Extraction

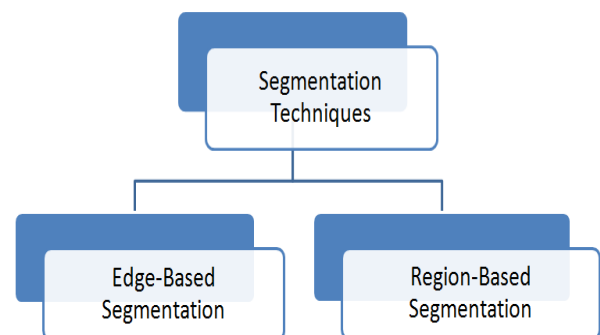
Feature extraction is the method in which unique features of an image are extracted. This method helps in reducing the complexity in classification problems and the classification can be made more efficient. Different kind of features present in an image can be intensity-based, textural, fractal, topological, morphological, etc. [7].

### 5) Classification

The aim of the classification step is to classify the segmented image by making use of extracted features. This step uses statistical analysis of the features and machine learning algorithms to reach a decision [6].

### 1.3. Image segmentation techniques

There are two categories of segmentation techniques: Edge-Based, Region Based Segmentation.



**Figure 1.3.**Image segmentation techniques [3]

### **1.3.1 Edge-Based Segmentation**

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 can be done using either of the following methods. Edges are local changes in the image intensity. 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.

### **1.3.2 Region-Based Segmentation**

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. Compared to the edge detection method, segmentation algorithm based on region are relatively simple and more immune to noise [8, 9]. 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 [10, 11].

## **1.4. Methods of Image segmentation**

There are much knowledge based approaches to segment an image and can be listed as:

1. Intensity based methods
2. Discontinuity based methods
3. Clustering methods
4. Graph based methods
5. Pixion based methods
6. Hybrid methods

### **1.4.1 Intensity based methods**

One of the simplest approaches to segment an image is based on the intensity levels and is called as threshold based approach. Threshold based techniques

classifies the image into two classes and works on the postulate that pixels belonging to certain range of intensity values represents one class and the rest of the pixels in the image represents the other class.

### **1.4.2 Discontinuity based methods**

These methods are based on the principle of intensity variations among the pixels. If the image consists two or more objects boundaries exists and hence can be applied to segment the image. The boundaries of the objects lead to formation of edges. There are four different edge types that may be present in the image (a) step-edge (b) ramp edge (c) ridge edge and (d) ramp edge.

### **1.4.3 Clustering based methods**

Clustering a process of organizing the groups based on its attributes. The objective of clustering techniques is to identify bunch in data. A cluster usually contains a group of similar pixels that belongs to a specific region and different from other regions. The term data clustering as synonyms like cluster analysis, automatic classification, numerical taxonomy, botrology and typological analysis Images can be grouped based on its content. In content based clustering, grouping is done depending on the inherited characteristics of the pixels like shape, texture etc.

### **1.4.4 Graph based methods**

Graph based methods for image segmentation has several good features in practical applications. It explicitly organizes the image elements into mathematically sound structures, and makes the formulation of the problem more flexible and the computation more efficient.

### **1.4.5 Pixion based methods**

The pixion method is a nonlinear image reconstruction method that has decision

levels as pixons instead of pixels. This method increases linear spatial resolution by few factor and sensitivity by the order of magnitude. Another advantage of pixon based method is computational fastness compared to other methods. The pixon based method has three steps:

1. Achieve a pseudo image with same resolution as the observed image.
2. Filter using anisotropic diffusion filter to achieve pixon.
3. Use hierarchical clustering algorithm to extract pixons [12].

#### **1.4.6 Hybrid methods**

Hybrid methods combine one or more of the basic segmentation methods. These algorithms inherit the good quality of several approaches and gives better performance compared to its parent approach. The combination of threshold based and clustering methods [13] are used in medical image segmentations along with the region-edge based approaches [14], region-deformable models, region-edge-based with morphological watershed [15]. Hybrid methods rely on morphological operations performed on images. The widely used techniques are watershed segmentation, variable-order surface fitting and active contour methods. The watershed algorithm uses concept from edge detection and mathematical morphology to partition image into homogenous regions [16].

#### **1.5. Application of image segmentation**

A facial recognition system is a computer application capable of identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database. It is typically used in security systems and can be compared to other biometrics such as fingerprint or eye iris

recognition systems. Recently, it has also become popular as a commercial identification and marketing tool.

##### **1.5.1 Fingerprint recognition**

Fingerprint recognition or fingerprint authentication refers to the automated method of verifying a match between two human fingerprints. Fingerprints are one of many forms of biometrics used to identify individuals and verify their identity.

##### **1.5.2. Iris recognition**

Iris recognition is an automated method of biometric identification that uses mathematical pattern-recognition techniques on video images of one or both of the irises of an individual's eyes, whose complex random patterns are unique, stable, and can be seen from some distance.

##### **1.5.3. Video surveillance**

Closed-circuit television (CCTV), also known as video surveillance, is the use of video cameras to transmit a signal to a specific place, on a limited set of monitors. It differs from broadcast television in that the signal is not openly transmitted, though it may employ point to point (P2P), point to multipoint, or mesh wireless links. Though almost all video cameras fit this definition, the term is most often applied to those used for surveillance in areas that may need monitoring such as banks, casinos, airports, military installations, and convenience stores.

##### **1.5.4. Medical imaging**

Medical imaging is the technique and process of creating visual representations of the interior of a body for clinical analysis and medical intervention, as well as visual representation of the function of some organs or tissues (physiology). Medical imaging seeks to reveal internal structures hidden by the skin and bones, as well as to diagnose and treat disease.

Medical imaging also establishes a database of normal anatomy and physiology to make it possible to identify abnormalities. Although imaging of removed organs and tissues can be performed for medical reasons, such procedures are usually considered part of pathology instead of medical imaging.

#### **1.5.5. Machine vision**

Machine vision (MV) is the technology and methods used to provide imaging-based automatic inspection and analysis for such applications as automatic inspection, process control, and robot guidance in industry. The scope of MV is broad. MV is related to, though distinct from, computer vision.

#### **1.5.6. Pedestrian detection**

Pedestrian detection is an essential and significant task in any intelligent video surveillance system, as it provides the fundamental information for semantic understanding of the video footages. It has an obvious extension to automotive applications due to the potential for improving safety systems [17].

### **1.6. Advantages of segmentation:**

#### **1.6.1. Focus of the company**

Segmentation is an effective method to increase the focus of a firm on market segments. If you have better focus, obviously you will have better returns. Numerous automobile companies have started focusing on small car segments. This is nothing else but a company changing its focus for better returns.

#### **1.6.2. Increase in competitiveness**

Once your focus increase, your competitiveness in that market segment will increase. If you are focusing on youngsters, your brand recall and equity with youngsters will be very high. Thus market segmentation

also increase competitiveness of a firm from a holistic view.

#### **1.6.3. Market expansion**

Geographic segmentation is one type of segmentation where expansion is immediately possible. If you have your market strategy on the basis of geography then once you are catering to a particular territory. Segmentation plays a crucial role in expression. You cannot expand in a territory when you have no idea of which segment of customer you will be meeting.

#### **1.6.4. Customer retention**

Customer retention can be encouraged through the cycle of a customer. Example the automobile and the airlines segment. Customer life cycle segmentation in the hospitality segment whether they be hostels airlines, or hospital.

#### **1.6.5. Increase profitability**

Segmentation increase competitiveness, brand recall, brand equity, customer retention, and communications. Thus if it is affecting so many factors of your business then definitely it affects the are in fact targeting segment which have no need of bargaining or negotiation. Thus their profitability is high [18].

## **2. IMAGE**

A digital image is a numeric representation of a two-dimensional image. A digital image is composed of a finite number of elements, each of which has a particular location and value, are called picture elements, image elements, pals and pixels. Pixels are the smallest individual element in an image, holding finite, discrete, quantized values that represent the brightness, intensity or gray level at any specific point. There are generally two types of image- raster type and vector type. Raster images are images having a finite set of

digital values which are represented in a fixed number of rows and columns of pixels where these pixels are stored in memory as a two-dimensional array [19].

### 3. CONCLUSION

In this paper we discussed that digital media image processing technology is an interdisciplinary field. It is widely used in the society, such as education, advertisement, video, film, and soon. Image segmentation is the process of partitioning an image into, multiple segments, so as to change the representation of an into something that is more meaningful and easier to analyze. The vision is the most important means of human perception and the digital media image is the basic of vision. Image segmentation is the foundation of object recognition and computer vision. The goal of segmentation is to simplify and change the representation of an image into something that is more meaningful and boundaries in image. Edge based segmentation is the problem of fundamental importance in image analysis. So at end we conclude that these techniques act as a good support to image segmentation process.

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