

# A Review on Image Processing and Image Segmentation Techniques based on Regions

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**Abstract-** Processing (or Analysis) of an image is performed to obtain information/knowledge. It consists of various steps; image segmentation occupies the utmost priority as its results influence the next process of image analysis in understanding the representation, measurement, classification, interpretation and compression. The selection of features or attributes used for image partition and how well the attributes tolerate the noise, illumination and other effects influence the accuracy of the segmentation. This paper reviews image processing stages and frequently used techniques of segmentation like Thresholding, Region Based, and so on, also their pros and cons. Medical images are crucial in health care as they provide information for treatment, diagnosis, pathology, computer aided surgery, etc. For medical images, segmentation is of utmost priority as it forms the basic step of Medical Image Analysis (MIA).

**Keywords-** Image Processing, Region Based, Image Segmentation, Thresholding.

## I. INTRODUCTION

Images provide information with more clarity for human analysis and to process the image data for storage. Importance of these images is increased and there is an enormous increase in the number and availability. They play a significant role in fields of science, technology and social sciences as varied as medicine, journalism, design, education, entertainment, etc to make important decisions. Images are reviewed as a part of the major principal channel of fetching information, in computer vision, by grasping images.

The word image segmentation itself reveals that the image is partitioned. Any image is segmented into objects to retrieve information. The purpose of segmentation is dependent on the application for which the image is to be partitioned. Image segmentation has its importance in many areas like medical image, real-time visual tracking, Finger print Recognition, Face recognition, analyzing satellite images.

## II. IMAGE PROCESSING

Image processing; a method that enriches unprocessed images received from different applications like day-to-day pictures, satellite images, etc. Image processing is a step by step process that includes various modules as shown in the below figure.

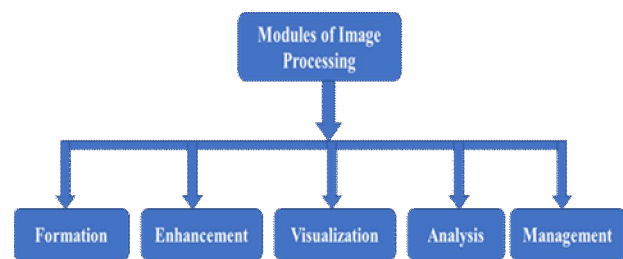


Figure: Modules of Image Processing

Figure 1.

In every module of image processing, various steps are involved in which output of each module is the input of next module, also the output at each stage gives some information. The steps involved are mentioned in the below table.

Table 1.

Module	Steps Involved	
Formation	Acquisition	
	Digitization	
Enhancement	Calibration	
	Optimization	
	Transformation	
	Filtering	
Visualization	Surface Reconstruction	
	Illumination	
	Shading	
	Display	
Analysis	Segmentation	

	Feature Extraction	
	Classification	Interpretation Measurement
Management	Compression	
	Archiving	
	Retrieval	
	Communication	

**III. IMAGE PREPROCESSING**

The aim of pre-processing is an enhancement of the image data that would smoothes unnecessary distortion/enhances few image features that are significant for further processing. Right choice of image preprocessing method is fundamental. Methods of preprocessing are different as the same is dependent on the source of image and image application. In few cases, pre-processing of an image such as corrections and enhancements are necessary to correct problems that would affect feature description.

**Corrections:** Pre-processing of an image may include objects in the images that need to be corrected before feature measurement and its analysis.

**Enhancements:** Enhancements are used for optimizing particular feature measurement, rather than fixing problems. Commonly used enhancements consist of either sharpening or color balancing, or both.

Pre-processing enhancements / corrections are dependent on the descriptor using the images, and the application.

Balu Santhanam et al has proposed a segmentation algorithm which is based on novel Markov Random Field (MRF)[11].

Various correction and enhancement candidates are mentioned in the below table.

Table 2.

Corrections	Sensor	Dead pixels, geometric lens distortion
	Lighting	Rank filtering, equalizing histograms, and LUT remap.
	Noise	NL-Mean denoising, MRF

	Geometric	Helpful to correct the rotated perspective geometry prior to feature description
	Color	Redistribution of color saturation or correct illuminated objects in the intensity channel.
Enhancement	Scale-space pyramids	Process to apply Gaussian blur filter to the sub-sampled images, which removes the sharp objects.
	Illumination	Global illumination - LUT remapping, operations on pixel point and equalized histograms, and remapping of pixel. Local illumination - gradient filters, equalization of local histograms, and rank filters.
	Blur & focus Enhancements	At pre-processing stage various filtering methods can be used for blurring and sharpening.

**IV. IMAGE SEGMENTATION TECHNIQUES**

Image segmentation has no generalized method that is suitable for any kind of image as it depends on the image type [10].Image segmentation is the process of splitting an image into either multiple significant regions or pixel set depending on the application [1]. Acquiring information for the easy analysis is the main objective of segmentation. In case of color image, transforming the color image to a grayscale image require more knowledge [2] and it is the most beneficial image processing approach applied in various fields.

Image segmentation methods are classified as below:

- A. Region Based
- B. Edge Based
- C. Feature Based Clustering
- D. Threshold

E. Model Based

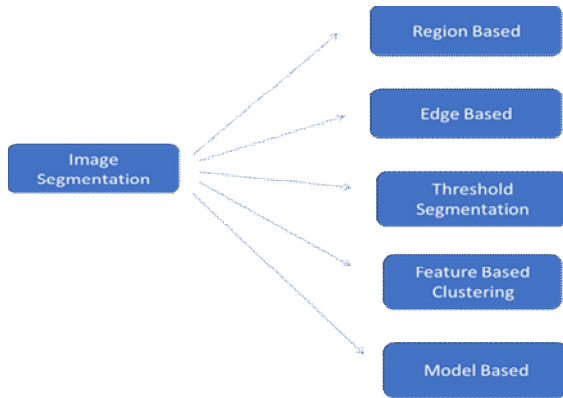


Figure: Classification Methods for Image Segmentation

Figure 2.

V. REGION BASED SEGMENTATION

In this segmentation technique, related pixels of an object are grouped. Partitioning is done by using grey values of the image pixels. It is also referred as “Similarity Based Segmentation” [3]. Basic techniques of region based segmentation are as shown in below figure.



Figure: Methods of Region Based Segmentation

Figure 3.

1. Region Growing

It is the segmentation technique that clusters similar pixels into bigger region which is based on predefined criteria. In this method, pixels are combined with a centre seed that grows to corresponding regions by appending the seed points of the neighboring pixels which exhibit same properties such as texture, shape, color, grey scale and so on.

Region based segmentation algorithms are comparatively manageable and more immune to noise. The step by step process is- [6]

- 1) Seed pixels in the image are selected.
- 2) Region is grown from every seed pixel.

- a) Region prototype for the seed pixel is set;
- b) Region prototype and candidate pixel similarities are calculated;
- c) Candidate pixel and its similar adjacent neighbors are considered;
- d) Aggregate the candidate in case if both similarity measures are higher than experiment set thresholds;
- e) Later new principal component is calculated to update the region prototype;
- f) Finally move to the next pixel to be examined.

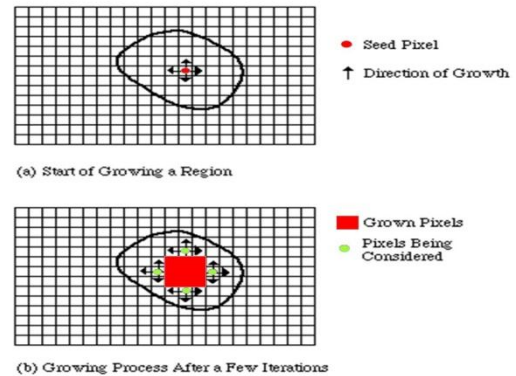


Figure 4.

**Pros:** Simple, Identified regions are thin and connected, noise tolerant.

**Limitation:** Over segmentation for noisy or various intensity images. Real image shading cannot be distinguished. It is time consuming [4].

2. Region Splitting and Merging

Region splitting is a top-down approach. In region splitting, the whole image is considered as a single region which is then split into disjoint sets of regions which are logical within themselves. Merging technique is used after every split and merged after comparing with the adjacent regions. It begins with smaller regions and merges into larger regions that possess same characteristics such as grayscale, variance, etc.

Two Parts [4]: 1.Firstly, the entire image that is viewed as a single region is split repetitively until there are no more possible splits, Quad tree is one of the splitting data structure.

2. Adjacent and similar regions are merged; merging is repeated till there is no merging possible.

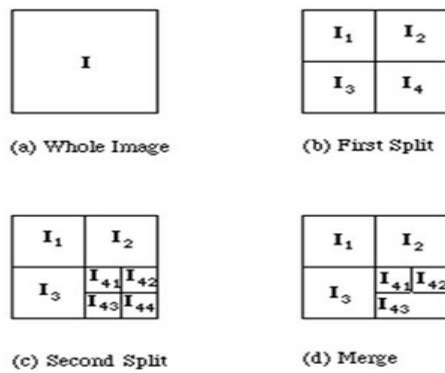


Figure 5.

**Pros:** Guarantees regions that are connected and lengthy neighbor problems during merging are reduced by IQM.

**Cons:** Results in over segmentation (more regions) by splitting due to regular division. Normalized cuts method addresses this limitation.

### 3. Clustering

Clustering techniques combine similar patterns into an object. K-Means Clustering is the region growing segmentation approach. Histograms help in obtaining the surface and cluster is detected as thresholding [8].

Seeded Growing Region (SRG) is used for segmentation. Labeling the sorted pixel is a setback. Boundary oriented parallel pixel labeling technique is used to overcome the same [8]. Sharp boundaries between clusters are presumed in hard clustering [9]. Fuzzy Clustering algorithm is a shape-based segmentation technique.



Figure 6.

**Applications:** Security systems and Medical imaging purposes.

**Pros:** Segmentation is based on shape.

**Disadvantages:** Continuous areas are not guaranteed. Split and Merge method is used to overcome the same.

### 4. Threshold Method

This technique is based on the attributes of the image. It separates object from the background into non overlapping regions. The threshold segmentation methods can be grouped into local, global, split & merge [5].

In local method, the properties of local and the neighboring pixels are considered. In global, information acquired from histograms and textures are considered. In Split, merge and growing, homogeneity and nearness of pixels are considered.

**Pros:** Implementation is easy and faster.

**Cons:** Noise sensitive.

## VI. CONCLUSION

This review provides a synopsis of processing of an image and different preprocessing methods that can be applied for a digital image is explained briefly. The study also presents various methodologies that are applied for image segmentation and various research issues in this field. This paper summarizes the different methods of region based image segmentation along with their applications, advantages and limitations. Medical Image Analysis needs more methods and techniques for analyzing a digital image to acquire proper information/ knowledge for further interpretation that helps in many areas of healthcare. As there are no particular techniques for segmentation, segmentation methodologies vary which ultimately must provide better results.

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