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A BRIEF REVIEW ON IMAGE SEGMENTATION AND ITS VARIOUS MECHANISMS

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ABSTRACT

Image segmentation is a method for dividing an image into multiple segments. This method helps to smooth the image in an easy way. The segmentation process is also utilized to find areas of interest of a specified image. The main purpose of this mechanism is to make image simpler and provide more information. In this paper, a survey of various segmentation techniques is provided. Several general algorithms and mechanisms for image segmentation have been developed. Since there is no universal solution to the problem of image segmentation, Therefore, these techniques must often be combined with other techniques such as optimization or deep learning to effectively solve the problem of image segmentation in the difficulty zone.

KEYWORDS: Image segmentation, thresholding, edge detection, clustering, morphology, region based.

1. INTRODUCTION

One of the main goals of image processing is to recover the information needed from a known image so that it does not affect other features of the image [1]. Enhancing an image is the most important step required to meet this requirement. The processing of an image becomes easy, after the removal of noise components from the test image. Image segmentation is the essential process performed in image processing, where input image is divided into multiple segments [2]. Every segment contains information related to the image in terms of color, intensity etc. Therefore, it is important to segregate the boundaries of any image in the form of its segments. This segmentation process will allocate a unique value to each image pixels in order to distinguish different regions of any image. The distinction among different image segments is done based on the three attributes of the image, namely the color, intensity and texture of the image. Therefore, the choice of any image segmentation technique is depends upon the problem observed in the image. The significance of Image segmentation cannot be ignored because it is mainly used to provide an noise-free image, So that the developer can process the image and extract the exact and optimal features of the given image. Image segmentation finds application in various image processing schemes such as medical field, industry, satellite image military, image retrieval and so on [3]. It is experiential that there is no perfect scheme utilized for the segmentation of an image because each image itself is different. Finding a segmentation method for a particular type of image is also a very difficult task. A method applied to an image cannot be guaranteed that the same process is successful in other images, so segmentation methods can be divided into different types [4].

2. SEGMENTATION TECHNIQUES

The image segmentation techniques are mainly classified as per the behaviours of the segmentation process into five types as shown in figure 1.

A. Region-based approach

Zone-based segmentation is simpler than any other segmentation methods. This method is noise durable. It separates a picture into different areas based on predetermined criteria, such as color, intensity, or object. This method is divided into two main categories: the region's growing, and region splitting a shown in figure 1[5].

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i. Region's growing approach

As the name indicates, the region growing is a mechanism through which those pixels are grouped into larger domain on the basis of color and intensity.

The approach begins with defining reference points. There may be a possibility to select more than one reference points. The same set of features is calculated in every pixel that is used to set pixels to the growing regions.

ii. Region splitting

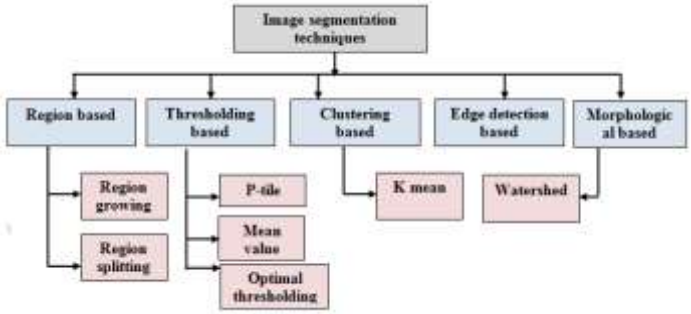

Figure 1: Classification of image segmentation techniques

The homogeneity of a test image may be varied with this algorithm. Four tree concepts are used to understand this algorithm. If any region is not homogenous, the quadratic regions presented as nodes of the fourth tree are broken down into sub-zones. In addition, any sub-region is divided into four parts if it is sensitive to one another. If there is approximately the same homogeneity in these regions, they are united into one region. The regions should not be adjacent to this method. The algorithm is shown in figure 2 [6].

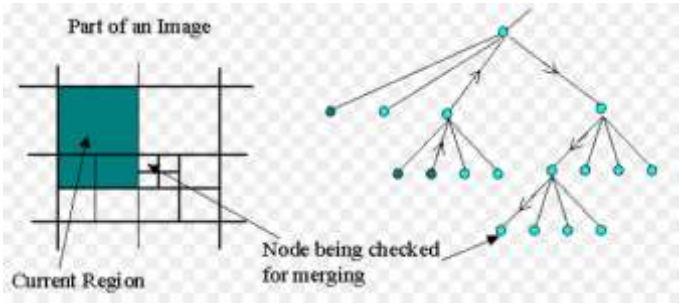

Figure 2: Splitting and merging algorithm

The pixels are merges having same or equivalent properties, whereas in the splitting algorithm the large image region which is non-uniform is broken into small regions that might have similarity among the pixels.

B. Thresholding

This approach can be utilized to segment objects as well as backgrounds. Let an input image is represented by f(p,q) which is converted into an output image (binary) denoted by g (p,q) depending upon the following expression.

$$g\ (p,q) = 1, f(p,q) \geq T$$
$$= 0, f(p,q) < T$$

If $f(p,q) \geq T$, then the image pixels are taken into the image, else the pixels are considered as background pixels [7].

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i. P-tile approach

This technique works on gray level histograms and assumes that the intensity of objects is higher than the background. The threshold level is compared with the gray level.

ii. Mean value

The average value of the entire pixels is computed and is used as the threshold value. This scheme is beneficial in case if half of the pixels are well-suited to objects, and the other half of the background [8].

iii. Edge maximize technique

This approach is used to segment the image having homogeneous regions or a small variation in the luminance. This technique can suffer from the disadvantage that a few pixels of the objects are merged with the background pixels [9].

C. Clustering technique

Clustering methods assembled the elements of an image into some common features. In clustering, K-mean is the most commonly used approach. In this scheme, the image is divided into k number of groups. The procedure followed by K-mean clustering is written below:

a. Select the cluster and place the centres at random or in a heuristic-based solution.
b. The image has been assigned to the nearest centre, each pixel centre.
c. The average of the pixels is calculated and then the cluster centre is assigned as per the value obtained.
d. The steps depicted in b and c is repeated until none of the pixels changes their groups [10,11].

D. Edge Detection-Based Methods

This method is utilized to determined boundaries on the basis of texture and gray levels. The boundary borders where spaces are formed on the edges are a regular difficulty found in detecting the edge. This can be corrected using the Hough transformation with the help of which edges can be coordinated. The results obtained by applying various edge detection schemes are shown in figure 3 [12].

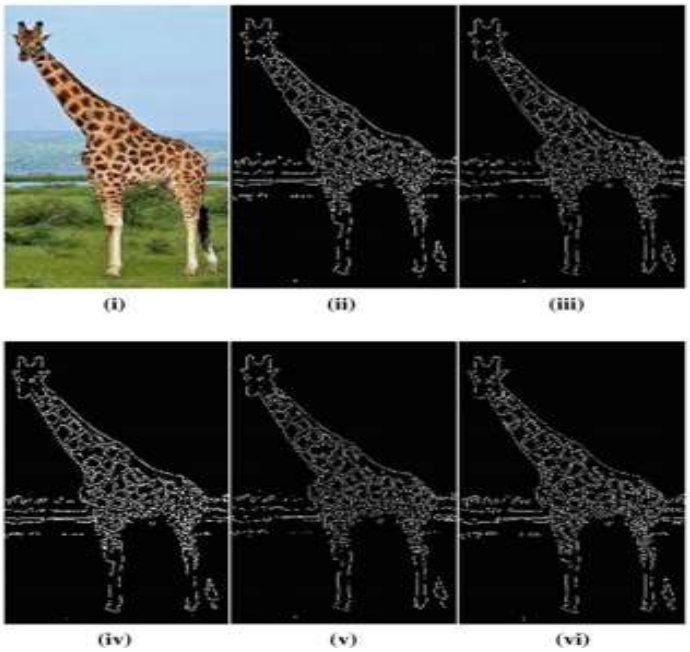

Figure 3: (i)Test image, (ii) Canny edge detector, (iii) Sobel edge detector, (iv) Roberts edge detector, (v) Prewitt edge detector, (vi) Log detector [13]

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E. Morphological Segmentation

Morphological Segmentation is the process that integrates morphological actions like as expanded minimization and morphological gradient along with watershed algorithms to divide grayscale images in 2D and 3D images[14].

Table 1: Comparative analysis of existing segmentation schemes

Constraint	Morphological algorithm	Edge-based	Region-based	Threshold-based	Clustering based
Spatial connection among pixels	be present	Not present	present	Not present	present
Noise immunity	High	Low	Higher than the edge method	Low	Low
Speed	Medium	Medium	Slow	High	Slow
Accuracy	Low	high	high	Average	Intermediate

3. RELATED WORK

This section depicts the work performed by various researchers in the image segmentation approaches with the applied approach and performance obtained after examining the results.

Table 2: State-of-art

References	**Authors**	**Segmentation technique**	**findings**
[15]	Girshick et al. (2016)	Region-based Convolutional neural network	The algorithm performs more than 50 % compared to the SVM algorithm
[16]	Niu et al. (2017)	Region-based	Segmentation accuracy up to 85 % has been obtained
[17]	Brejl et al. (2000)	Edge-Based Image segmentation	root mean square edge location errors lies between 1.1–1.6 pixels
[18]	Naidu et al. (2018)	Thresholding segmentation, Fuzzy entropy, Shannon entropy, PSO (particle swarm optimization with BA (Bat algorithm)	The performance of the proposed work has been measured in terms of PSNR, computation time, misclassification error, structural similarity index. It has been observed that Fuzzy algorithm provides better PSNR than Shannon algorithm.
[19]	Nida et al. (2019)	Fuzzy C means clustering with Convolutional	From the experiment the pixel accuracy up to 94.8 %.

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		neural network has been used.	
[20]	Yu-qian et al. (2006)	Edge detection approach with morphological operation has been applied on lungs of images.	It has been experienced that morphological operation with edge detection performs better compared to Gaussian and Sobel operation.
[21]	Rajab et al. (2004)	Region-based and edge detection algorithm along with neural network has been used to solve the problem of skin lesion image segmentation	The mean error with respect to signal to noise ratio has been measured and it has been observed that the mean error of proposed iterative segmentation is very small compared to the neural network edge detection method

4. CONCLUSION

In this article, we have talked about several important image segmentation techniques. We also introduced and discussed some recent research work proposed by various researchers in different fields based on these technologies. After observing these techniques separately, we conclude that the hybrid solution for image segmentation consists of two or more technologies and is the best way to solve the image segmentation problem. From the above discussion, it has been observed that if K-mean (clustering based segmentation) scheme is used with other deep learning techniques then the image segmentation scheme can perform well in terms of different parameters such as PSNR, mean error, segmentation accuracy etc.

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