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Image Segmentation Techniques: A Survey

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Abstract— The process of image segmentation is defined as the technique via which a given image is segmented into several objects, in order to further analyze objects present in the image [9]. The popularity of image segmentation is because of its importance in the area of image processing. The prime task of the researchers working in the field is to develop a method for efficient and better image segmentation. There are certain factors that affect the process of image segmentation like the intensity of image to be segmented, color, type and the noise present in the image [12]. No algorithm has been developed till date that could keep a look at all the above listed factors and then segment the image effectively so that all the problems that can come in the way of image segmentation can be avoided. This paper presents a review of some of the techniques developed for image segmentation.

Keywords—Image segmentation ,Techniques ,Visualization.

I. INTRODUCTION

Because of research and various application of image processing people often interested in only some parts of an image. These parts are the target of image processing, with specific features and unique nature in image. Hence image segmentation is used to divide or partition an image into different region according to their characteristics and then extract the region in which we are interested [1].

Visualization, image compression, medical image diagnosis, etc these are different image processing technique which use image segmentation as their basic work [2]. Principle of image segmentation is to represent the image in form of physically connected regions. Image segmentation aim is often get by analysing different features of an image e.g. colour, brightness, edge, texture. Image segmentation is used to differentiate the different regions of an image based on their intensity, colour and other geometric properties [3].To recognize objects in an image is the task .

To extract useful information from images without human assistance is the objective of segmentation. The rest of the image is background. The target of image segmentation is the independent domain partition of the image into a set of regions which are distinct visually and uniformity based on low level information, such as gray level, texture or color. For high level processing such as object recognition, scene analysis etc., we can have used this as an input.

Generally, each segmentation methods have two basic properties of the pixels in relation to their local neighborhood: discontinuity and similarity. The methods which have some discontinuity property of the pixels are called boundary based methods, whereas methods which have some similarity property are called region-based methods.

Unfortunately, it is often failed to produce accurate segmentation results using these two method [2]. For all application, a single method cannot produce expected result. Reason behind is that the images have different property and some other factors also like noise, brightness etc. put impact on the images, and it is not possible to apply a single segmentation method and also a single evaluation technique for all types of imagery.

Well-known techniques of image segmentation which can be still being used by the researchers are side Detection, Threshold, Histogram, region based totally methods, and Watershed Transformation. Since pictures are divided into two types on the idea of their color, i.e. gray scale and shade photographs. Consequently image segmentation for coloration pictures is absolutely exclusive from gray scale images, e.g., content based totally image retrieval. Additionally which set of rules is robust and works properly is depends at the form of picture [3]. The assets of a pixel in an image and statistics of pixels close to that pixel are two fundamental parameters for any image segmentation algorithm.

It is difficult to predict whether one algorithm produces more accurate segmentations than another, whether it be for a particular image or set of images, or more generally, for a whole class of images. A variety of attempts have already been made by many researchers to end of this. Until a satisfied

result is achieved, the iteration of algorithm selection, image segmentation and segmentation evaluation will not stop. However, till now, there is still no universally accepted method of evaluation of segmentation result, which makes evaluation-based algorithm selection hard to apply to real applications. As a matter of fact, the most straightforward and effective solution is to select different algorithms to segment different images.

II. IMAGE SEGMENTATION TECHNIQUES

1. Pixel based direct classification

It's the simplest approach. In this method, segmentation is done on the basis of pixels. It is similar to the processing of language, where a single word may have multiple meaning, unless the context is not given. The principle is same for image. If very small portion of image is shown, it became difficult to tell about image. If contextual portion of image is increase, then it will become easy to recognize image.

2. **Global knowledge based segmentation**

This segmentation identifies a threshold value from a grayscale or color histogram that represent an image.

This threshold behaves like a splitting boundary that segment image into foreground and background part. If image is of low contrast then obtaining optimal threshold become difficult. [5]

a. Global Thresholding: Global Thresholding can be used, When the pixel values of the components and that of background are fairly consistent in their respective values over the entire image.

If g(x, y) is a threshold version of f(x, y) at some global threshold T,

$$g(x,y) = \begin{cases} = 1, iff(x,y \geq T \\ =0, \quad otherwise \end{cases}$$

b. Local Thresholding: When we have uneven illumination due to shadows or due to the direction of illumination, a single threshold will not work well.

Threshold function T(x, y) is given by

$$g(x,y) = \begin{cases} = 0, iff(x,y) < T(x,y) \\ =1 \ \ iff(x,y) \geq T(x,y) \end{cases}$$

Where T(x, y) =f (x, y) + T

c. Adaptive Thresholding: It will take a grayscale or color image as input and, in the simplest implementation, outputs a binary image representing the segmentation. The drawback of this method is that it is computational expensive and, therefore, is not appropriate for real-time applications.

3. **Edge based segmentation**

An edge based segmentation approach can be used to avoid a bias in the size of the segmented object without using a complex thresholding scheme. Edge-based segmentation is based on the fact of the first-order derivative that is position of an edge is given by an extreme. It is used for line detection application such as text recognition.

Various popular edge detectors are: canny edge detector, prewitt and sobel operator. Edge detector alone is not good for segmentation because it does not form the closing boundary which is important to form a separate segment. [15]

a. Roberts Edge Detection: Using this technique, we can perform a simple, quick to compute, 2-D spatial gradient measurement on an image. Here input is a grayscale image which is same as to the output is the most common usage for this technique.

b. Sobel Edge Detection: Where the gradient is highest within the edges, at those point it will proceed. Purpose is to find the estimated absolute gradient magnitude at each point in n input grayscale image.

c. Prewitt Edge Detection: It will be estimated in the 3x3 neighborhood for eight directions. We have to calculate all the eight convolution masks. One complication mask is then selected, namely with the purpose of the largest module. It is slightly simpler to implement computationally than the Sobel detection, but it tends to produce somewhat noisier results.

d. Canny Edge Detection: It is a very important method to find edges by separating noise from the image before find edges of image. Unlike Roberts and Sobel, this operation is not very susceptible to noise. If this detector worked well it would be superior.

4. Region based segmentation

Region based methods are robust because they cover more pixels than edges and thus you have more information available in order to characterize your region.

Graph partitioning is a region based method, used for complex image segmentation. It can't be applied in the real time system, because of the algorithm complexity. [16]. In this technique, there is a newly developed mathematical morphology segmentation method which is called watershed transform. Watershed transform does not require any parameter for the termination condition. [8]

5. Cluster based segmentation

In cluster based segmentation a given set of data is divided into groups. This is the most popular method that used in segmentation for making cluster. We can define the number of cluster that we want to form. In each cluster there is a center and according to that center values from data set are assigned to the clusters. [17]

III. LITERATURE SURVEY

A. ***DibyaJyoti Bora et al. (2014) [7],*** In this paper image segmentation is stated as a vast topic of research and choice of large number of researchers by the author. The segmentation done using approaches of clustering are considered good for image segmentation.

The advantage of using approaches of clustering in image segmentation is that this is a wide area and can be employed in

other areas of engineering too. In this paper the author has developed a new technique for image segmentation keeping clustering as a base. K-mean algorithm is employed and distance parameter is considered for deciding the performance. The distance measure „cosine" is employed in this paper. Sobel filter is then used for filtering and the results are obtained using Marker Watershed algorithm. The performance parameters that are taken into consideration by the author in this paper are Mean Square Error and PSNR. Equations

B.Suganya,Menaka (2014), In this paper the various image segmentation techniques are explored and understand the different segmentation. The author says that segmentation refers to the process in which a digital image is divided into multiple segments(sets of pixels,). texture.

This paper surveys the different segmentation methods used for segmenting satellite images. Image segmentation can be used to find out boundaries and objects (lines, curves, etc.)in these images. The result of segmentation of image is considerably depends on the accuracy of feature measurement.

C.Rajiv Bansal, Sona Kajla (2016)[**13]** In this paper, author has given a survey of different clustering algorithm in various application of image segmentation. Mainly image segmentation is used in medical science to locate disease, tumour, cancer and many other problems.

D.*Muhammad Waseem Khan et al. (2014)* [11], In this paper the author states that image segmentation is an integral part of image processing. The author says that the steps of image segmentation are necessary when it comes to area of image processing.

The task of image segmentation is dividing the image into numbers of regions so that image could be analyzed easily. The numbers of objects in the image are also recognized easily when segmentation of image is done.

To ease the process of evaluating and analyzing images various image segmentation techniques have been developed till date. In this paper the author has reviewed the techniques that have been developed till date for image segmentation and has also developed a new technique for image segmentation using the recent technology.

E.*Swapan Samaddar, Dr. A RamaSwamy Reddy(2018)[14],* The author says that one of the fundamental approaches of digital image processing is image segmentation.The objective of image segmentation is to partition an image into meaningful regions with respect to a particular application.

This paper presents a review on the different techniques of image segmentation and comparison of it related to chronic kidney diseases**.**

IV. PARAMETERS FOR COMPARISON

The parameters used for comparison of the Segmentation techniques are:

1.Mean: The standard definition of mean states Average or mean value of array. The Image is in form of a matrix

2.Variance: The Variance computes the unbiased variance of each row or column of the input, along vectors of a specified dimension of the input, or of the entire input. The Variance block can also track the variance of a sequence of inputs over a period of time.

The block computes the variance of each row or column of the input, along vectors of a specified dimension of the input, or of the entire input at each individual sample time, and outputs the array y. Each element in y is the variance of the corresponding column, row, vector, or entire input.

3.Standard deviation :Standard deviation (represented by the symbol sigma, σ) shows how much variation or dispersion exists from the average (mean), or expected value.
A low standard deviation indicates that the data points tend to be very close to the mean; high standard deviation indicates that the data points are spread out over a large range of values. A useful property of standard deviation is that, unlike variance, it is expressed in the same units as the data. The measurements with percentage is unit, the standard deviation will have percentage points as unit.

4.SNR (Signal to noise ratio): Signal-to-noise ratio (often abbreviated SNR or S/N) is a measure used in science and engineering that compares thelevel of a desired signal to the level of background noise. It is defined as the ratio of signal power to the noise.

5.Power: A ratio higher than 1:1 indicates more signal than noise.

V. CONCLUSION

Image segmentation is of utmost importance in the area of image processing and computer vision [12]. In this an image is divided into multiple segments for analyzing the image [4]. Numbers of techniques and algorithms have been developed for image segmentation. We have reviewed and summarize some existing methods of segmentation through this paper. On color segmentation, there is not so much rich literature survey. The development for effective image segmentation algorithm is still a big research that will take place in the area of image processing.

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