A COMPARATIVE OVERVIEW OF DIFFERENT IMAGE SEGMENTATION TECHNIQUES

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ABSTRACT

Images have become a very important part of our life because images are used to visualize things easily. Now-a-days we can use images mainly for research purpose. In computer science we have to convert images in digital form and perform some operations. This process is called Image Processing. Image Segmentation is a crucial component in processing image. Segmentation is an operation or a process or method by which we partition an image into distinct regions. In this paper we analysis some important techniques of Image Segmentation for research purpose, and we perform a comparative analysis.

KEYWORDS: Segmentation, Edge detection, Thresholding, Clustering, Region Growing

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1.INTRODUCTION

Digital image processing has many recent applications in the field of medicine, photography, remote sensing, film and video production and security control areas. New innovative technologies appear in the field of image processing, especially in the field of image segmentation.

We can perform a series of tasks such as improving visual information of human perception and image processing for machine-independent application, storage and efficient transmission.

Image segmentation is often used to identify images and contours (lines, curves, etc.). More precisely, the process of assigning a label to each pixel in the image is the image segmentation, so pixels having same label share some visual properties. Thus result of the image segmentation is a set of sections that consist of a complete picture or a

Series of outlines derived from the image. Every pixel in the image are some distinct or light features, such as colour, intensity, or design. Image processing is any input signal process, an input image, photographs or video frames in computer vision. The effect of image processing could be an image or an image of parameters. Additionally, segmentation refers to the process of dividing digital imagery into multiple sections (also known as pixel sets, super pixels). Image segmentation is often utilized to identify images and contours (curves, lines etc.).

Simplifying and changing the representation of the image into something more meaningful and makes analysis easier, which is the objective of segmentation. Image segmentation is typically used to define objects and constraints on images.

The most studied version of the group in artificial vision is the division of images. Techniques of image splitting can be divided into two large families: (1) area and (2) contour-based methods (tip). Area-based methods attempt to find pixel segments of series- images in accordance with consistent image properties such as colour, illumination and texture. The profile-based approach generally begins with the first level detection step and the next linking process attempts to use the continuity of the curvilinear. The interactive image segmentation has attracted significant attention in recent years. Image splitting process can be found in two (2) sections. The first category is aimed at dividing the image on basis of sudden variations in the intensity of the edges. In the second section, its background is aimed at distinguishing the so-called picture limit. Other examples in this section include area growth and fragmentation and fusion of the area.

2. DIGITAL IMAGE PROCESSING

Digital Image Processing (DIP) by a digital computer by interested in getting a digital image and treating it. We can perform a particular series of tasks such as improving Image processing for machine-independent application, storage and efficient transmission of information and analyse image to gather visual information needed in categorizing image. Under human perception, the following applications of Digital Image Processing are: medical imaging, atmospheric study, weather forecasting, remote sensing and astronomy. Under machine vision, the following applications of Digital Image processing are: automated inspection, boundary information and video sequencing processing. Finally, image compressions are useful for storage and transmission. There are following steps that are used on images in image processing:

- A. **Acquisition of Image :** Image sensor and possibility of digitizing the sensor signal.
- B. **Image pre-processing:** Improves image quality, filtering and contrast enhancement.
- C. **Image segmentation:** To divide the input image into parts or components.
- D. **Image representation:** Converts input data to an appropriate form to process the computer.
- E. **Image description:** Extract features that lead to quantitative and qualitative information of interest or basic functionality to distinguish a category of objects from other.
- F. **Image recognition and Interpretation:** Customize a label based on the information gathered through various descriptors of image like colour, shape or texture and assign the meaning to a set of recognized objects.
- G. **Information base:** This helps to deal effectively as well as the cooperation unit.

3. IMAGE SEGMENTATION

The way of dividing an image [5] into several smaller regions (termed as a set of pixels) is called image fragmentation. Divide the image by dividing or separating the image into zones with a similar property.

Segmentation of images is the primary compression or front-end of images. The efficiency of the segmentation process is its speed, good fit and better form of connectivity with its segmentation result. Splitting up the images means the process of identifying and separating the surface and area of a digital image corresponding to the structural components. The interruption depends on many functions included in the image. It can be in colour,

shape or texture.

Figure 1: Image Segmentation Techniques

4.SEGMENTATIONALGORITHM

Segmentation algorithms have been developed to divide images; they are based on two basic characteristics, breakdown and similarity. In partition based on discontinuity and subdivision is done on basis on abrupt alterations in level of intensity or grey level of an image. In this method our interest focuses mainly on the identifying isolated lines, points and edges. In the group based on similarity, those pixels that are similar in some way include approaches such as thresholding, regional growth, and division and merging of regions.

5.CLASSIFICATION OF SEGMENTATIONTECHNIQUE

Segmentation can be classified into the following categories.

- A. Segmentation via Edge detection
- B. Segmentation via Thresholding
- C. Segmentation via Region
- D. Segmentation via Clustering
- E. Segmentation via Watershed
- F. Segmentation via PDE
- G. Segmentation via AAN

A. SEGMENTATION VIA EDGE DETECTION

In the process of image segmentation, the initial step is the edge detection. Divide an object into an object and its background. The image splits via observing intensity in the edge detection image or changing the pixel. Two main ways to find edges are in the grey histogram and gradient image decomposition. Edge Detection Operators are divided into two sections. It is the first-order derivative operator and second-order product managers. Second-order

operators provide reliable results. Effective Edge Detector is the second product manager.

a) SOBEL EDGE DETECTION

The method for detecting Sobel edges is represented by Sobel in 1970. Sobel calculates not only the size of the edges, but also their direction. The operator uses the 3x3 model horizontally and then vertically. One core just rotated 90°.

-1	-2	-1
0	0	0
+1	+2	+1

G_x

-1	0	-1
-2	0	+2
-1	0	+1

G_y

Figure 2: Sobel Convolution Masks

b) Canny Edge Detection

Initially, an image is captured and segmented using the smart edge detection method. To do this, the image is initially converted to grey from RGB. In this initial step of filter noise in the original image before trying to locate and detect the edges. The Canny algorithm utilizes Gaussian filter. It can be calculated utilizing a simple mask.

After eliminating the noise and levelling the image, the next step is determining the edge resistance by taking the image gradient. Thus, the approximate resistance of the edge of the magnitude of the absolute gradient at each point is determined by estimating the gradient in the columns of the x direction, and the other, the estimation of the gradient in the lines of the y-direction.

After finding the edge resistance, the edge direction is determined using the xy direction gradient. Not the maximum deletion is used to draw along the edge to the edge and suppressing any pixel value that sets it to 0, which is not considered an edge. In the output image, it will give a thin line.

The hysteresis is utilized as a means of eliminating the bands. Corrugation is an interruption of the edge boundary caused by the operator's exit, which oscillates above and below the threshold. To prevent the border from appearing as a dotted line, the hysteresis employs two thresholds, one high and one low. Therefore, the image is segmented using edge detection.

B. SEGMENTATION BY THRESHOLDING

One of the easiest approaches to image segmentation is based on level of intensity and therefore called a threshold. It can be implemented locally or globally. The global thresholds distinguish the pixels of the background and the object when compared to the selected threshold value and use the binary separation for image segmenting. The local threshold is also termed the adaptive threshold. In this method, the threshold value alters depending on the image based on the characteristics of the divided areas. The histogram threshold is used to segment this image. There are some pre and post processing methods necessary for segmenting the threshold. The main methods for determining

the thresholds proposed by the various researchers are the mean value method, the P mosaic method, the histogram-dependent method, the edge maximization method and the visual method.

C. SEGMENTATION BY REGION

The growth zone modes are mainly based on the assumption that neighbouring pixels have the same values in the region. Comparing a pixel with a neighbourhood is the usual way. If similar criteria are met, the pixel can be configured so that the cluster matches one or more neighbours. The standard choice of comparison is important, and sound effects are affected in all cases.

Thus, the pixels for a single object are divided into divisions. The intersection technique is related to division based on this area. The area detected for the section should be closed. Depending on the region, division is also called comparison based division. There is no room in this area-based division for the absence of edge pixels, edges are marked for separation. After recognizing a change in colour and design, the flow of the border becomes a vector. From this map further show up for division.

D. SEGMENTATION BY CLUSTERING

Clustering strategies are techniques that section a clustered image that have pixels with comparable attributes. Data gathering is a strategy that isolates data components in clusters, with the goal that the components of a cluster are more like each other than others. There are two primary classifications of collection techniques: the multileveled strategy and the section-based strategy

The multileveled strategies rely upon the idea of trees. For this situation, the main node of the tree interacts to the whole database and the inward hubs interact to the clusters. Then again, section-based strategies utilize iterative enhancement techniques to limit target work. Between these two techniques there are various calculations for cluster search. There are two primary sorts of collection of data:

- 1) **Hard clustering:** Hard clustering is an easy to implement type of cluster method that actually fragments the image into a small set of groups so only one the pixel remains in one cluster group. These methods used solely depend on membership functions that have values of 1 or 0 for its appropriate working. These functions check whether one of the pixels belongs to a certain group or not. For instance, a procedure that works based on hard clustering is rely on k-means clustering known as HCM. In this technique, the centres are first calculated and then each pixel is assigned to the nearest centre. It stands out in minimizing the equality between clusters while maximizing the intra cluster similarity
- 2) **Soft grouping:** soft grouping could be considered a natural type of grouping as realistically, exact division is impossible due to noise. Therefore, soft cluster techniques are more useful in segmenting images in which the division isn't strict. Example of this type of technique is diffuse c-means clustering. In this technique, the pixels are divided into Clusters on basis of partial membership, that is, a pixel, can belong to one or more clusters and this degree of belonging is explained by the membership values. Therefore, current technique is more flexible as compared to other techniques.

E. SEGMENTATION BY WATERSHED

The watershed idea is topography based. It was suggested for the first time as a possible method of image segmentation. It

is a type of morphological system of image segmentation use the concept of topological interpretation. In this, the intensity represents the basins that have a hole in their minimum from where the water spills. When the water reaches the edge of the basin, the adjacent basins merge. To maintain the separation between basins, dams are required and therefore, are the edges of the segmentation region. The dams in question are constructed using dilation. Basin methods consider the gradient of the image as a topographic surface. Pixels having more gradient are represented as limits that are continuous.

F. SEGMENTATION BY PDE

The techniques based on the fractional differential condition are the quick strategies for segmentation. These are proper for real time based applications. There are two essential strategies for PDE: non-straight isotropic dispersion channel (used to improve edges) and non-quadratic raised variety reclamation (used to take out commotion). The after effects of the PDE technique are fluffy edges and limits that can be moved utilizing close-by administrators. The fourth-request PDE strategy is utilized to lessen image commotion and the second-request PDE technique is utilized to all the more likely distinguish edges and limits.

G. SEGMENTATION BY ANN

Segmentation techniques based on counterfeit neural systems recreate the learning procedures related to the human mind so as to Decision making. These days, this technique is chiefly utilized for the segmentation of therapeutic images. It is utilized to isolate the required image of the foundation. A neural system comprises of a large number of associated hubs and every association has a specific weight. This strategy is autonomous of PDE. In this, the issue progresses toward becoming issues those are comprehended utilizing neuronal net. This method is divided into two steps feature extraction and segmentation by neural network.

Table 1: Comparison of Various Segmentation Techniques

Segmentation method	Main idea	Merits	Demerits
Edge Based Method	Detecting discontinuity on edges.	Good method for images, improves contrast between objects	It is not useful, if too many overlapping edges are present
Thresholding Method	On basis of the histogram peaks of the image to identify particular threshold values	Easy to perform, user friendly, no prerequisites.	relies on peaks, spatial details are ignored
Region Based Method	On basis of partitioning image into homogeneous segments	resilient to noise, can be optimized by defining similarity criteria	cumbersome method, when time and memory are taken into account
Clustering Method	Pixels are clubbed together on basis of criteria defined by user	Fuzzy logic takes into account partial membership criteria, therefore giving more real time output	In this membership function computed for analysis of data is complex
Watershed Method	On basis of topology interpretation of pixels	In this, results are more accurate and boundaries detected are continuous	Computing gradients is more tedious
PDE Based Method	Output generated using differential equations	Very less time complexity, thus used in real time critical applications	space complexity is high

ANN Based Method	Decision making is done by simulating neural learning algorithms	Hard and complex programs not required	For training data sets, time is consumed
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6.CONCLUSIONS

Image segmentation is a crucial part of Image Processing in computer science. Image processing widely used in research areas. In image processing we have many techniques to segment and process images. Here we studied the different types of Image Segmentation technique, in which we decided to use Edge based Image Segmentation Techniques to segment images by identifying edges of objects in image and perform a comparative analysis of them.

In a computer vision (an application of Artificial Intelligence), segmentation means the method of dividing an image into several parts (group of pixels, also called super pixels). This document attempts to study some categories of image segmentation in Image Processing.

In this review, paper of segmentation techniques of images, are explained briefly and compared. All these techniques are suitable for checking object and boundaries, Medical field, Object detection, Face Recognition, Pattern Recognition fields. But from the researches we can say that it is clear for each image there is no single method, and every method isn't applicable to a particular type of image. As there is need for image segmentation in many disciplines, the future is complex.

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