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Review of image segmentation techniques

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ABSTRACT

Image segmentation is considered to be one of the most important image processing processes. Image segmentation is the process of dividing or partitioning an image into parts called segments. It's most useful for applications like image compression and object recognition, because processing the entire image is inefficient in these cases. As a result, image segmentation is used to separate the image's parts for further processing. Several image segmentation techniques exist, which divide an image into multiple parts based on image features such as pixel intensity value, colour, texture, and so on. The segmentation method is used to categorise all of these techniques. The various image segmentation techniques are reviewed in this paper.

Keywords: *Image Segmentation, Edge Detection, Thresholding, Clustering, Region Growing.*

I. INTRODUCTION

An image is a graphic representation of something that contains a wealth of information. Understanding the image and extracting information from it in a way that does not affect the image's other features in order to complete some tasks is a critical application in digital image technology. The most important step in meeting this requirement is image enhancement. After you've removed the noise from the image, you can do whatever you want with it. The first step in comprehending image processing is to understand image segmentation. In practise, it is frequently only interested in a few specific areas of the image that share similar characteristics. In image processing, computer vision, and image recognition, image segmentation is a critical component. It is based on a set of criteria that divides an input image into a number of categories of the same nature in order to extract the area of interest to people. Image segmentation is essential for feature extraction and image recognition. This paper presents a review of the literature on image segmentation techniques [1] [2].

2. IMAGE SEGMENTATION

The process of dividing an image into multiple segments is known as image segmentation. The main goal of this procedure is to identify the object in a photograph. As an example, if a person wants to cross the street, the first thing he will do is look to his right, then to his left. If no vehicle approaches, the person will attempt to cross the road. In addition, the person will inspect the area for any electric poles, dogs, or holes in the ground, among other things. The point is that he's detecting objects first, then crossing the road.

We'll train our machine to do the same thing, but it won't be able to recognise things as humans do. We must first train the model, for which we will use image segmentation. This step is commonly used to recognise objects or other relevant data.

In image processing, image segmentation is very important. The splitting of an image into multiple chunks facilitates subsequent processing, and the image will be re-joined after the operations are completed. Segmentation improves the accuracy of object recognition in images and reduces loss. Semantic segmentation and instance segmentation are two types of image segmentation that can be used depending on the problem [1] [3].

3. CLASSIFICATION OF SEGMENTATION TECHNIQUES

The various types of segmentation are listed below.

A. Segmentation by Edge Detection
B. Segmentation by Thresholding
C. Segmentation by Region based

A. Segmentation by Edge detection

For image segmentation, edge detection is a critical tool. The changes in grey tones in the image benefit edge detection methods, which transform original images into edge images. Edge detection is a technique used in image processing, particularly in computer vision, to locate significant variations in a grey level image and to detect the physical and geometrical properties of scene objects. It is a basic process that detects and outlines an object as well as the boundaries between objects and the background in an image. The most common method for detecting significant discontinuities in intensity values is edge detection. Local changes in image intensity are referred to as edges. Edges are typically found at the intersection of two regions. The main features of an image can be extracted from the edges. For image analysis, edge detection is a crucial feature.

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Advanced computer vision algorithms make use of these characteristics. Object detection using edge detection is used in a variety of applications such as medical image processing, biometrics, and so on. Edge detection is a hot topic in research because it makes higher-level image analysis easier. In the grey level, there are three types of discontinuities: point, line, and edges. All three types of discontinuities in an image can be detected using spatial masks. For image segmentation, there are numerous edge detection techniques in the literature. This section examines the most widely used discontinuity-based edge detection techniques. Robert's edge detection, Sobel edge detection, Prewitt edge detection, Kirsh edge detection, Robinson edge detection, Marr-Hildreth edge detection, LoG edge detection, and Canny edge detection are examples of these techniques [1] [4][6].

i.Canny edge detector

Edge sleuth extraordinaire An image is first taken and then segmented using a clever edge detection technique. To do so, the image is first converted from RGB to grayscale. The first step is to remove any noise from the original image before attempting to locate and detect any edges. A simple mask can be used to compute the Gaussian filter, which is used in the canny algorithm. The image's gradient is used to determine the edge strength after it has been smoothed and noise has been removed. Then, by estimating the gradient in the x-direction columns and the gradient in the y-direction rows, the approximate absolute gradient magnitude edge strength at each point is determined. After determining the edge strength, the edge direction is determined using the gradient of the x and y directions. Non greatest concealment is utilized to follow along the edge in the edge course and smother any pixel esteem that isn't viewed as an edge by setting it equivalent to 0.This will result in a thin line in the final image. Hysteresis is a technique for preventing streaking. The operator output fluctuating above and below the threshold causes streaking, which causes an edge contour to break up. Hysteresis employs two thresholds, a high and a low, to avoid the appearance of a dashed line at the edge. As a result, edge detection is used to segment an image [5].

Fig 3.1

Figure 3.1 shows the result of edge detection it segments the very fine features from the image.

B. Segmentation by thresholding

Threshold based segmentation is one of the simplest approaches to segmenting an image based on intensity levels. Thresholding can be done on a global or local level. Global thresholding separates object and background pixels by comparing them to the threshold value set and segmenting the image with binary partition. Adaptive thresholding is another name for local thresholding. The threshold value in this technique varies across the image depending on the local characteristics of the image's subdivided regions. Histogram thresholding is used to segment a given image; threshold segmentation necessitates the use of certain pre- and post-processing techniques. Mean method, P-tile method, Histogram dependent technique, Edge Maximization technique, and visual technique are some of the major thresholding techniques proposed by different researchers. [1][5][6].

i. Segmenting Using Adaptive Thresholding

Adaptive thresholding is used to segment the original image. The image is first converted to grayscale from RGB. The maximum and minimum of mean methods are used to set threshold values in this method of local adaptive segmentation. This image's row and column sizes can be found. The initial threshold value is then calculated by taking the average of the image's maximum and minimum pixel sizes. The initial threshold value is the resultant value. The image is then segmented using the basic thresholding technique, with pixels within the threshold following one segment and others following another. The process is repeated until the threshold value no longer corresponds to the pixel value. The threshold values are also obtained for each segment on a regular basis. As a result, the adaptive thresholding technique is used to segment an image. [1][5].

Fig 3.2.1 Original image Fig

Fig 3.2.2Segmentation using Thresholding

Figure 3.2.2. shows the thresholding result, which segments the image's exact features. It divides the image into two parts, one in the foreground and one in the background. The results of thresholding are, for the most part, reasonable.

C. Segmentation by Region based

When compared to edge detection, region-based segmentation is simpler and more noise resistant. In region-based methods, an image is divided into similar regions based on a set of predefined criteria. The three main parts of region-based segmentation methods are region growing, region splitting, and region merging. Using predefined seed pixels, growing criteria, and stop conditions, region growing is a region-based sequential technique in which neighbouring pixels are scanned and added into larger regions. Splitting an image into disjoint regions that are coherent within themselves is known as region splitting. After each split, a region merging process compares adjacent regions and merges them if necessary [1][6].

i. Single Seeded Region Growing

The input image is segmented once more using the single seeded region growing technique. A single seed is used in this technique. A single seed or pixel is chosen, and the region is formed by all the pixels that are related to this seed. The image reading function is used to read the input image. The seed point's position is specified; if it is not specified, it is chosen at random. The maximum intensity distance is set to 0.2 in this implementation.

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By comparing all unallocated neighbouring pixels to the region, the region is iteratively grown. A measure of similarity is the difference between a pixel's intensity value and the region's mean. The region is assigned to the pixel with the smallest difference measured. A measure of similarity is the difference between a pixel's intensity value and the region's mean. The region is assigned to the pixel with the smallest difference measured. When the intensity difference between the region means and the new pixel exceeds a certain threshold, the process stops (t). Finally, both regions are combined to create the output image. As a result, a segmented image with a single seed region grows [5].

3.3.1original image

3.3.2 segmentation using region based

Figure 3.3.2 shows the result of region growing; it segments features of the image into two parts.

4.CONCLUSION

Image segmentation, as the universal segmentation algorithm, has a bright future ahead of it and has become the focus of recent research. As a result, image segmentation is influenced by a variety of factors, including image homogeneity, image continuity spatial characteristics, texture, and image content. In this paper, various image segmentation techniques are discussed, as well as an overview of some related image segmentation techniques. The most common image segmentation algorithms and classifications are discussed. The overview of various segmentation methodologies used in image processing is briefly explained in this study.

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