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A Study Of Image Segmentation Algorithms For Different Types Of Images

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Abstract

In computer vision, **segmentation** refers to the process of partitioning a digital image into multiple segments (sets of pixels, also known as superpixels).Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics.The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image . Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture.Due to the importance of image segmentation a number of algorithms have been proposed but based on the image that is inputted the algorithm should be chosen to get the best results. In this paper the author gives a study of the various algorithms that are available for color images,text and gray scale images.

Keywords: *image segmentation , region growing, marker*

1. Introduction

All image processing operations generally aim at a better recognition of objects of interest, i. e., at finding suitable local features that can be distinguished from other objects and from the background. The next step is to check each individual pixel to see whether it belongs to an object of interest or not. This operation is called *segmentation* and produces a *binary image*. A pixel has the value one if it belongs to the object; otherwise it is zero. Segmentation is the operation at the threshold between *low-level image processing* and *image analysis*. After segmentation, it is known that which pixel belongs to which object. The image is parted into regions and we know the discontinuities as the boundaries between the regions. The different types of segmentations are

Pixel-Based Segmentation: Point-based or *pixel-based segmentation* is conceptually the simplest approach used for segmentation.

Edge-Based Segmentation: Even with perfect illumination, pixel based segmentation results in a bias of the size of segmented objects when the objects show variations in their gray values .Darker objects will become too small, brighter objects too large. The size variations result from the fact that the gray values at the edge of an object change only gradually from the background to the object value. No bias in the size occurs if we take the mean of the object and the background gray values as the threshold. However, this approach is only possible if all objects show the same gray value or if we apply different thresholds for each objects. 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 that the position of an edge is given by an extreme of the first-order derivative or a zero crossing in the second-order derivative.

Region-based methods focus attention on an important aspect of the segmentation process missed with point-based techniques. There a pixel is classified as an object pixel judging solely on its gray value independently of the context. This meant that isolated points or small areas could be classified as object pixels, disregarding the fact that an important characteristic of an object is its *connectivity*.If we use not the original image but a feature image for the segmentation process, the features represent not a single pixel but a small neighborhood, depending on the mask sizes of the operators used. At the edges of the objects, however, where the mask includes pixels from both the object and the background, any feature that could be useful cannot be computed. The correct procedure would be to limit the mask size at the edge to points of either the object or the background. But how can this be achieved if we can only distinguish the object and the background after computation of the feature? Obviously, this problem cannot be solved in one step, but only iteratively using a procedure in which feature computation and segmentation are performed alternately. In the first step, the features are computed disregarding any object boundaries. Then a preliminary segmentation is performed and the features are computed again, now using the segmentation results to limit the masks of the neighborhood operations at the object edges to either the object or the background pixels, depending on the location of the center pixel. To improve the results, feature computation and segmentation can be repeated until the procedure converges into a stable result.

Model-Based Segmentation : All segmentation techniques discussed so far utilize only local information. The human vision system has the ability to recognize objects even if they are not completely represented. It is obvious that the information that can be gathered from local neighborhood operators is not sufficient to perform this task. Instead specific knowledge about the geometrical shape of the objects is required, which can then be compared with the local information. This train of thought leads to *model-based segmentation*. It can be applied if we know the exact shape of the objects contained in the image.

2. Color Image Segmentation algorithm

The human eyes have adjustability for the brightness, which we can only identified dozens of gray-scale at any point of complex image, but can identify thousands of colors. In many cases, only utilize gray-Level information can not extract the target from background; we must by means of color information. Accordingly, with the rapidly improvement of computer processing capabilities, the color image processing is being more and more concerned by people. The color image segmentation is also widely used in many multimedia applications, for example; in order to effectively scan large numbers of images and video data in digital libraries, they all need to be compiled directory, sorting and storage, the color and texture are two most important features of information retrieval based on its content in the images and video. Therefore, the color and texture segmentation often used for indexing and management of data; another example of multimedia applications is the dissemination of information in the network. Today, a large number of multimedia data streams sent on the Internet, However, due to the bandwidth limitations; we need to compress the data, and therefore it calls for image and video segmentation.

2.1 Seed Region Growing Algorithm And Watershed Algorithm

The basic idea of region growing method is a collection of pixels with similar properties to form a region. The steps are as follows:

- **(i)** find a seed pixel as a starting point for each of needed segmentation.
- **(ii)** Merge the same or similar property of pixel (Based on a pre-determined growing or similar formula to determine) with the seed pixel around the seed pixel domain into the domain of seed pixel.
- **(iii)** These new pixels act as a new seed pixel to continue the above process until no more pixels that satisfy the condition can be included.

The seed region growing algorithm is proposed by Adams and Bischof, Metmert and Jackway[10] further described the dependency relationship between pixels in the seed growth:

- **(i)** The first order of dependence occurs when the number of pixels has the same difference ratio as their vicinity.
- **(ii)** The second order of dependence occurs when a pixels has the same difference ratio as their vicinity

Frank and Shouxian Cheng applied the automatic seed selection method, they selected seed which can represents needed segmentation region based on certain similarity criteria and proposed a strategy to solve the above two pixels dependence [1]. The watershed algorithm is more representative in the application of mathematical morphology theory for image segmentation. Watershed algorithm is a region-based segmentation techniques image that uses image morphology [2]. Watershed algorithm is an iterative adaptive threshold algorithm. The idea of watershed algorithm is from geography, it see gradient magnitude image as a topographic map, the gradient magnitude in correspond with altitude, the different gradient in correspond with the peak and basin in valley in the image. It sees every object of image (including background) as a separate part and requested there must have one tag at least in the each object (or seed points). Marker is knowledge about the object based on application-oriented; it is selected by the operator manually or by automatic process. The objects can use watershed algorithm to transform and develop regional growth after maker.

3. Gray-scale Image Segmentation

The segmentation of image raster data into *connected* regions of *common* gray-scale has long been seen as a basic operation in image analysis. In texture analysis, just this type of segmentation is possible after individual pixels in an image have been labeled with a numeric classifier. In preparing images for used in geographic information systems (GIs) this segmentation is usually followed by the production of a vector representation for each region. The original algorithm for segmentation, developed by Rosenfeld-pfaltz[3], described a two pass 'sequential algorithm' for the segmentation of binary images. The key feature of the Rosenfeld-pfaltz algorithm is that the image is raster-scanned, first the forward direction, from top left to bottom right, then backwards. During the forward pass, each pixel is located a region label, based *on* information *scanned* through; the regions so demarcated may have pixels with more than one label therein. During the backwards pass, a unique label is assigned to each pixel. Hence this classic algorithm *can* be described as a two pass algorithm. In a previous paper Cohen [4] presented a one-pass algorithm was presented for the segmentation of gray-scale images. Cohen's single pass algorithm proceeds to label pixels *on* a forward pass, exactly as in Rosenfeld-Phltz, except that during the same forward pass, a look-up-table is prepared, that reveals the connectivity of pixels that have different labels. For most purposes, the labeling of the pixels found the first pass, combined with the look-up-table, provides a complete segmentation, but to actually output an image with unique pixel labels in each region, a pass through the image using the look-up table is required. A new parallel region segmenting and labeling algorithm is available, that is applicable to gray-scale images, and is appropriate to coarse scale parallel programming. The key feature of this algorithm is the geometric splitting of the image into rectangular blocks, with one pixel overlap at joins. Then using Cohen's one pass algorithm, each region is separately labeled. Then by examination of the overlap regions, the connectivity of different region labels is determined, through connectivity tables, and finally the overall image is completely segmented into connected domains of common gray-scale. The parallelizable algorithm for the segmentation of gray-scale images involves performing the one-pass algorithm *on* rectangular sub-images, with a single row or column overlap. What is thus produced is a label for each image pixel, together with a connectivity LUT for each region. Then, from the overlap rows and columns produce overlap tables, showing how labels in each region are related.

4. Text Segmentation : It is well known that text extraction, including text detection, localization, segmentation and recognition is very important for video auto-understanding. In this paper, we only discuss text segmentation, which is to separate text pixels from complex background in the sub-images from videos. Text segmentation in video images is much more difficult than that in scanning images. Scanning images generally has clean and white background, while video images often have very complex background without prior knowledge about the text color. Although there have been several successful systems of video text extraction, few researchers specially study text segmentation in video images deeply. The used strategies could be classified into two main categories: (1) difference (or top-down) and (2) similarity based (or bottom-up) methods. The first methods are based on the foreground-background contrast. For example, fixed threshold value method [2], Otsu's adaptive thresholding method [5], global & local thresholding method [2], Niblack's method [6].

In general, they are simple and fast, but fail when foreground and background are similar. Alternatively, the similarity based methods cluster pixels with similar intensities together. For example, Lienhart uses the split & merge algorithm [7], Wang et al. combine edge detection, watershed transform and clustering [8]. However, these methods are unstable, since they exploit many intuitive rules about text shape. As an alternative, Chen et al. convert text pixel clustering to labeling problem using Gibbsian EM algorithm [9]. This method is effective but too time consuming. The main problem of most existing methods is that they are sensitive to text color, size, font and background clutter, since they simply exploit either general segmentation method or some prior knowledge. To overcome these problems a new algorithm based on stroke filter is available which discovers the intrinsic characteristics of text and design a robust algorithm specially for text segmentation. In this algorithm stroke filter (SF), describes the intrinsic characteristics of text in terms of scale, orientation and response, a stroke feature based text polarity determination method is available and local region growing method for segmentation refinement based on stroke features and global & local statistic similarities.

5. Conclusion

Image segmentation has become a very important task in today's scenario. In the present day world computer vision has become an interdisciplinary field and its applications can be found in any area be it medical , remote sensing , electronics and so on . Thus, to find a appropriate segmentation algorithm based on your application and the type of inputted image is very important. In this paper the author has explained and suggested a few application specific segmentation algorithm which also take into consideration the type of image inputted like color, gray scale and text.

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