

A Color Image Segmentation algorithm Based on Region Growing

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Abstract- Image segmentation is a classic subject in the field of image processing and also is a hotspot and focus of image processing techniques. With the improvement of computer processing capabilities and the increased application of color image, the color image segmentation are more and more concerned by the researchers. Color image segmentation methods can be seen as an extension of the gray image segmentation method in the color images, but many of the original gray image segmentation methods can not be directly applied to color images. This requires to improve the method of original gray image segmentation method according to the color image which have the feature of rich information or research a new image segmentation method it specially used in color image segmentation. This article proposes a color image segmentation method of automatic seed region growing on basis of the region with the combination of the watershed algorithm with seed region growing algorithm which based on the traditional seed region growing algorithm.

Keywords-Color image segmentation; watershed algorithm; seed region growing algorithm.

I. INTRODUCTION

People are only interested in certain parts of the image in the research and application of the image. These parts are frequently referred as a target or foreground (other part is called background), they generally correspond to the image in a specific and unique nature of the area. It needs to extract and separate them in order to identify and analyze object, on this basis it will be possible to further use for the target. Image segmentation is a technique and process which divide the image into different feature of region and extract out the interested target. Here features can be pixel grayscale, color, texture, etc. Pre-defined targets can correspond to a single region or multiple regions. To illustrate the level of the image segmentation in image processing, we have introduced "image engineering" concept, it bring the involved theory, methods, algorithms, tools, equipment of image segmentation into an overall framework [1]. Image Engineering is a new subject for research and application of image field, its content is very abundant. According to the different of the abstract degree and research methods, it can be divided into three levels: Image processing, image analysis and image understanding. As shown in Figure 1

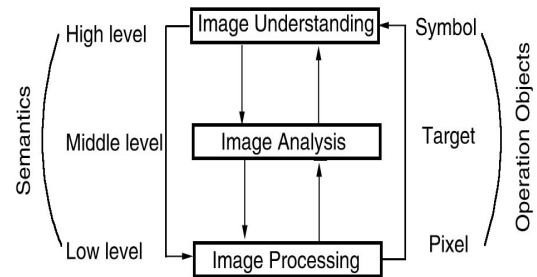


Figure 1. The three-level diagram of image engineering

Image processing is emphasis on the transformation between the images and improves the visual effects of image. Image analysis is mainly monitor and measure the interested targets in the image in order to get its objective information as a result build up a description of the image, the key point of the image understanding is further study on the nature of each target and the linkage of each other as well obtain an explanation of objective scenario for original image as result guide and plan to action.

Image processing, image analysis and image understanding have different operational, refer to Figure 1. Image processing is relatively low-level operations; it is mainly operated on the pixel-level. Then image analysis enters the middle-level, it focuses on measuring, expression and description of target. Image Understanding is mainly high-level operation, essentially it focus on the operation and illation of data symbol which abstracts from the description [13].

Image segmentation is a key step from the image processing to image analysis, it occupy an important place. On the one hand, it is the basis of target expression and has important effect on the feature measurement. On the other hand, as the image segmentation, the target expression based on segmentation, the feature extraction and parameter measurement that converts the original image to more abstract and more compact form, it is possible to make high-level image analysis and understanding.

In the actual production life, the application of image segmentation is also very wide and almost appeared in all related areas of image processing as well as involved various types of image [12]. For example, satellite image processing in the application of remote sensing; the brain MR image analysis in the applications of medicine; the plates of illegal vehicle region segmentation in the traffic image analysis; the image region of interest extraction in the object-oriented image compression and content-based image retrieval.

In these applications, image segmentation is usually used for image analysis, identification and compress code, etc.

The accuracy of regions extraction will directly affect the effectiveness of following task, the method and accuracy of segmentation is very important.

II. THE STUDY OF COLOR IMAGE SEGMENTATION

Because 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 [8]. 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 [9]. 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.

A. *The Methods for Color Image Segmentation*

Human eyes can distinguish thousands of colors but can only distinguish 20 kinds of grayscale, so we can easily and accurately find the target from the color images. However, it is difficult to find out from the gray-scale image. The reason is that color can provide more information than grayscale. The color for the pattern recognition and machine vision is very useful and necessary [10]. At present, specifically applied to the color image segmentation approach is not so much as for the gray-scale images, most of proposed color image segmentation methods are the combination of the existing grayscale image segmentation method on the basis of different color space. Commonly used for color image segmentation methods are histogram threshold, feature space clustering, region-based approach, based on edge detection methods, fuzzy methods, artificial neural network approach, based on physical model methods, etc.

B. *Regional Growing and Domain Decomposition*

The basic idea of region growing is a collection of pixels with similar properties to form a region. First, we need to find a seed pixel as a started point for each of needed segmentation. And then 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. These new pixels as a new seed pixel to continue the above process until no more pixels that satisfy the condition can be included, and then the region has grown. In the practical application of this method we need to address three questions: first, chose or determined a group of seed pixel which can correctly

represent the required region; second, fixed the formula which can contain the adjacent pixels in the growth; third, made rules or conditions to stop the growth process [15,11]. The advantage of region growing algorithm is easy to complete and compute. Similar to the threshold, the region growing methods are rarely used alone; it is often used with other segmentation methods. The practical method of this subject combines the watershed algorithm and region growing algorithm for color image segmentation. The disadvantage of region growing: first, it needs human interaction to obtain the seed point, so that the user needs to implant a seed point in every region which needs to extract; second, The patterns of regional growth are also sensitive to noise as result the extracted region has empty or links the separate region under the case of local effect [2]. This article according a certain rules to automatic select seed pixels as well as effective solve the first question. We carry on the regional growing on the basis of the watershed segmentation algorithm; this method effectively solved the second questions. Domain decomposition technique makes seed region continually split into four rectangular regions until the internal of every region is similar. Region merging is often combines with the region growing and domain decomposition in order to merge the similar sub-region into a domain as large as possible. The disadvantage of domain decomposition technique may cause destruction of the border.

III. SEED REGION GROWING ALGORITHM AND WATERSHED ALGORITHM

A. *The Basic Principle of Seed Region Growing 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: First, we need to find a seed pixel as a started point for each of needed segmentation. And then 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. These new pixels as a new seed pixel to continue the above process until no more pixels that satisfy the condition can be included.

In the practical application of this method we need to address three questions:

- a) Chose or determined a group of seed pixel which can correctly represent the required region;
- b) Fixed the formula which can contain the adjacent pixels in the growth;
- c) Made rules or conditions to stop the growth process.

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

- a) The first order of dependence occurs when the number of pixels has the same difference ratio as their vicinity.
- b) The second order of dependence occurs when a pixels has the same difference ratio as their vicinity [7].

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 [3,14]. The method in this paper is combines the watershed algorithm on the basis of Frank and Shouxian Cheng's as well proposes a new seed region growing method. The selection of growth criteria not only depends on the specific issues themselves, but also depends on the type of practical image data. For example, when the image is a colorized, the graphic will be effect by utilize monochrome criteria. Therefore, we carry on seed selection and regional growth according to the hue and saturation in the color image in this paper.

B. Watershed Image Segmentation Methods

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 [4]. Watershed algorithm is an iterative adaptive threshold algorithm. The idea of watershed algorithm is from geography (shown in Figure 2), 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.

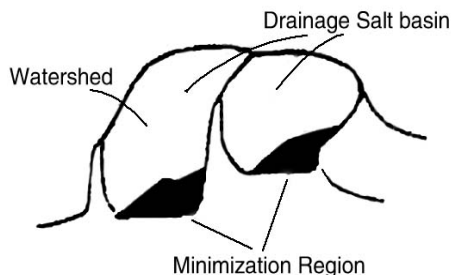


Figure 2. The Schematic diagram of watershed algorithm

IV. REGION-BASED SEED REGION GROWING ALGORITHM

A. The Overview of Seed Region Growing Algorithm

Seed region growing (SRG) is an image segmentation method which proposed by Adams and Bischof, this method is begun with a set of "seed" point and attached the adjacent pixels which has the similar properties with the seed (such as the grayscale or the specific range of color) to every seed on the growth of the region [5]. This article proposes a new region growing algorithm on the basis of traditional seed region growing algorithm, and then started from the region which formed by watershed algorithm, automatically selected some regions as seed region to carry on the growth of region according to certain rules.

Figure 3 is an algorithm flowchart of methods we used. First, we use the watershed algorithm to initialize segmentation for the image as well as form segmentation results; secondly, according to a certain rules, automatically select the part of the region as a seed region; on this basis, engage in regional growth. Finally, the regional merged.

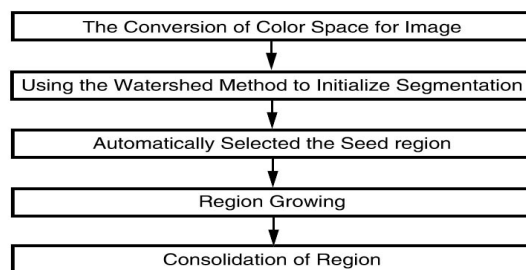


Figure 3. the flow chart of algorithm

B. Experiment Results

The following diagram shows a simple example which illustrates the process of color image segmentation.



Figure 4. using the method of this paper to refine pieces of color images and the results of image segmentation

Figure 4 is image segmentation results which use the method of this paper for a set of different types of color image. It can be seen that using the method of this paper can obtain better segmentation results. Traditional seed region growing algorithm is commonly used pixel points as a seed and the basic elements of growth. In this paper, we combined the region growing algorithm with watershed algorithm on the basis of traditional seed region growing (SRG) and used the watershed algorithm to generate region as the seed selected object in the seed region growing algorithm. Compared with traditional algorithms, our approach has advantage in two aspects: First, from the view of algorithm complexity, the region growing step in the traditional seed region growing (SRC) method, the time complexity is $O(m \log n)$, where n is the number of pixels in the original image; thus the watershed algorithm generate region as a seed with method of this paper, time complexity is $O(m \log m)$, " m " is the number of region which generated by watershed algorithm. Clearly the number of " m " is much smaller than the number of " n " pixels in the original image [6]. In addition, the region contains the amount of information content which relative to the pixel from the segmentation effect, it is good for the growth of region so it can achieve a better segmentation results.

V. CONCLUSION

The application of image processing has widely applied in our life, in which the digital image processing technology is widely used in all aspects of life. Image segmentation is a key step for transition to the image analysis as low-level processing in digital image processing. For a long time, all kinds of image segmentation methods are dedicated to the study of the gray image, with the improvement of computer processing capabilities and the increased application of color image, the color image segmentation are more and more concerned by the researchers [9]. Color image segmentation methods can be seen as an extension of the gray image segmentation method in the color images, but many of the original gray image segmentation methods can not be directly applied to color images. This requires to improve the method of original gray image segmentation method according to the color image have the feature of rich information or research a new image segmentation methods which specially used in color image segmentation, and thus it is a goal of researcher to make it have the advantage of universal property and good treatment effect.

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