

Image Segmentation Technology and Its Application in Digital Image Processing

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Abstract—In recent years, the level of science and technology in China has been significantly improved. Digital image processing technology is the product of the times with the rapid development of science and technology, and has been applied in many fields. Digital image processing technology includes many practical technologies, and image segmentation technology is one of them. At present, the widely used pattern recognition technology is realized by image segmentation technology. Based on this, this paper mainly studies the application of image segmentation technology in digital image processing. This paper first introduces the methods of image segmentation, including threshold segmentation, clustering segmentation and edge detection segmentation. Secondly, according to a need to extract a road image for image segmentation, and achieved very good results. Finally, this paper mainly analyzes the application of image segmentation in digital image processing. It is found that image segmentation has good application in automatic license plate recognition, biomedical engineering, remote sensing engineering and fire prevention and detection.

Keywords—Digital image, Image segmentation, Pattern recognition, Remote sensing engineering

I. INTRODUCTION

In recent years, with the development of computer technology, the development of computer vision has made great progress. Computer vision has also brought advanced technology for digital image processing. Digital image processing has developed from such disciplines as data processing and automatic control to the field of image acquisition research, such as image transmission, storage, conversion, display, understanding and development into a new discipline [2,3]. According to the different stages of digital image processing, digital image processing can be divided into three stages: image processing, image analysis and image understanding [4].

Image segmentation technology is a key step in the process of digital image processing, and plays an important role in image processing technology [5]. On the one hand, it can extract the object in the image, which has a very important impact on image recognition [6]. On the other hand, based on the segmentation, recognition, characterization and measurement of statements, the target statement can transform the original image into the abstract form of the image, so as to analyze and understand the high-resolution image [7]. So far, thousands of image segmentation methods have been developed. Image segmentation technology is also widely used in document processing, object recognition, remote sensing image and

biomedicine and many other aspects [8]. In the factory automation production, also played a very important role. As long as the measurement image and the target extraction need to be extracted, image segmentation technology is needed [9].

Digital image segmentation technology is mainly based on the similarity of some aspects and functions of the image itself to reshape the image. In the process of image segmentation, planning at a certain rate can improve the clarity of image pixels, and the image quality can be significantly improved [10]. In addition, it is important to establish a proper connection for the segmented image, and on this basis, it cannot be accessed and repeated. At the same time, it is important to ensure that the segmented image is highly consistent and the image will not change. Image segmentation and feature extraction transform the original image into abstract form for advanced image analysis and understanding, which lays a good foundation for better application of image segmentation technology.

II. THE METHOD OF IMAGE SEGMENTATION TECHNOLOGY

A. Threshold Segmentation Method

Threshold segmentation is widely used in image segmentation technology. The principle of this method is to process the image to be segmented by determining the threshold value. When objects with the same pixel are encountered, they are segmented uniformly, which can improve the efficiency of image segmentation. The threshold segmentation method is actually the following transformation from the input image f to the output image g :

$$g(i, j) = \begin{cases} 1, & f(i, j) \geq T \\ 0, & f(i, j) < T \end{cases} \quad (1)$$

Where T is the threshold value; for the image elements of the object, $g(i, j) = 1$, and for the image elements of the background, $g(i, j) = 0$.

It can be seen from the above formula that the threshold segmentation method is mainly to determine the threshold. Once the threshold is determined, the target extract in the image can be extracted according to the threshold segmentation method. The steps of threshold segmentation method include: firstly, analyze the gray value of the image, compare the gray value of the pixel with the threshold value,

then binarize the image, and finally extract the object in the image according to the binarization result of the image.

B. Clustering Segmentation Method

The difference between clustering segmentation method and threshold segmentation method is that the clustering allocation method mainly displays different regions of the image according to the image set, and the same region and the same chroma are well fused between the color image and the gray image, and then the image segmentation is realized. The main purpose of clustering segmentation method is to perform effective aggregation analysis and real-time image segmentation to transform image segmentation into automatic pattern recognition.

C. Edge Detection and Segmentation Method

The principle of edge detection and segmentation method is to detect the most edge of the image, and connect the pixels of the edge of the image to form an independent region. When observing an image, the most easily detected part is the edge of the image. The characteristics of image edge: the most intense change of image information is the edge. Image edge not only represents the end of the image, but also represents the beginning of the image. In the detection of image edge, the most commonly used method is to use Sobel operator to judge the image edge. Sobel operator is found according to the gray difference between the upper and right adjacent regions, and reaches the maximum value at the edge. Edge segmentation method can provide smoother and more accurate direction information. The following formula can be used to combine the horizontal and vertical axis approximations of each pixel in the image.

$$G = \sqrt{G_x^2 + G_y^2} \quad (2)$$

The gradient direction can then be calculated by the following formula:

$$\theta = \arctan\left(\frac{G_y}{G_x}\right) \quad (3)$$

Among them, G_x is the horizontal template for detecting the horizontal edge, and G_y is the longitudinal template for detecting the vertical flat edge.

$$G_x = \begin{bmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{bmatrix}, G_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ +1 & +2 & +1 \end{bmatrix} \quad (4)$$

III. EXPERIMENTAL BACKGROUND AND PARAMETER SETTING

People regard the specific part of the image that needs to be extracted as the target, and other areas of the image are called the background image. In order to better identify the target in the image, the target is separated from the image. Therefore, in the image segmentation technology, it is very important to distinguish the object from the image. Gray

histogram threshold segmentation method is widely used in various image segmentation. The image selected in this experiment is a picture of a road. The purpose of the experiment is to take the road in the picture as the extraction target and segment the road. The image in this paper needs to be denoised before clustering, and then the image is segmented. The experimental parameters of this experiment are shown in Table I.

TABLE I. PARAMETER SETTING

Parameter name	
Experimental tools	MATLAB
T	130
Number of clusters	3
Gray value	[0,1]
input image	$f(i, j)$
Output image	$g(i, j)$

IV. DISCUSSION

A. Gray Value of Image

Gray histogram threshold segmentation method is widely used in various image segmentation methods. In the use of this segmentation method, we must deal with these factors, such as noise and illumination, to avoid the influence of these factors as far as possible; otherwise it will cause great adverse effects on the image segmentation results. The specific steps of this segmentation method are as follows: first, determine the image histogram to be processed; second, calculate the histogram correctly; third, determine the gray value according to the calculation results; fourth, test the results. The characteristics of this segmentation method are: wide range of application, various industries are using this segmentation method; the method is simple, does not need too high technical requirements; when the main image in the image is very different from other places, this method is more convenient to use.

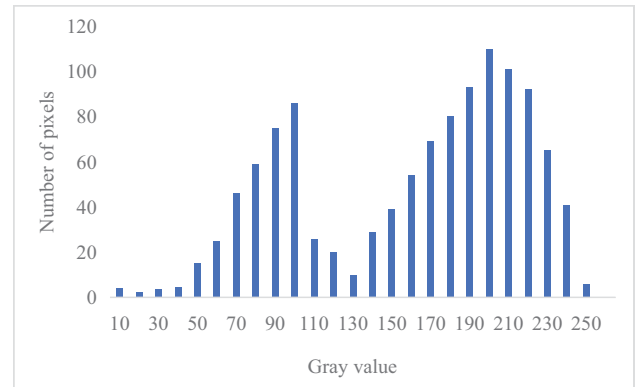


Fig. 1. Image gray histogram

In this experiment, a picture with a road is selected. The purpose of this experiment is to segment the road in the picture and extract the road in the picture. The gray value range of the image is [0256]. From the gray histogram shown in Figure 1, it is obvious that there are two peaks and one trough. If the threshold is used for segmentation, the threshold value should be around 130.

B. Fuzzy Clustering Image Segmentation

Take the gray histogram of the denoised image, and

transform the abscissa (gray value) into $[0,1]$ interval for clustering. Because the image to be segmented mainly consists of pixels, which are mainly concentrated in three intervals, the gray histogram is classified by taking the number of clusters as 3, and the minimum value of gray value of maximum clustering is taken as the threshold value of pixel gray value, and then the image is segmented by fuzzy clustering.

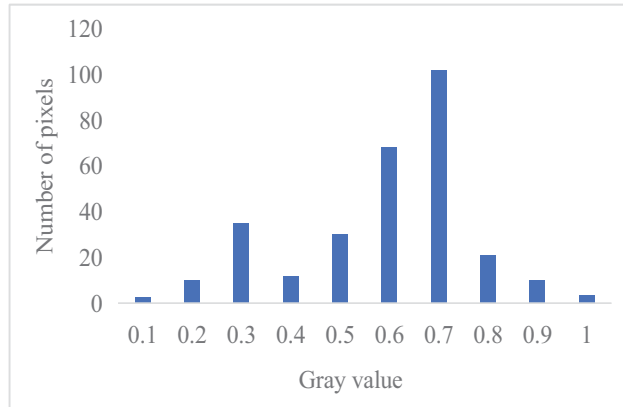


Fig. 2. Fuzzy clustering results of image histogram

According to the gray histogram shown in Figure 2, after the gray value $[0, 1]$ is changed into $[0, 0.3]$, it is a cluster, $[0.4, 0.7]$ is a cluster, and $[0.8, 1]$ is a cluster to segment the image. Therefore, selecting 3 for the clustering value to classify the gray histogram can better segment the objects in the image.

After the gray value of the image and the image denoising, the image can be segmented. In this experiment, the fuzzy clustering algorithm is used. According to the image histogram fuzzy clustering results, the road in the picture can be segmented, and the ideal effect is achieved. For the image without denoising, the histogram does not show the expected peak and trough of the Dido value. If fuzzy clustering is used directly, there will still be a lot of noise, which leads to poor segmentation effect. Therefore, it is necessary to denoise the image in the early stage.

C. Application of Image Segmentation Technology

1) Application in license plate recognition

In digital image processing, digital image segmentation technology is mainly to identify the license plate installed on the vehicle. In order to ensure the safety of people's lives and property, there are detection devices at the entrance of each community to ensure that the vehicles entering the community are the vehicles of residents in the community. In the process of getting in and out of the vehicle, the monitoring system can accurately identify the vehicle license plate and determine whether it is the vehicle in the community. If the car is the car of the community, the door will open automatically to avoid other irrelevant people entering the community. The device used to detect the vehicle is to distinguish the vehicle according to the recognition of the license plate. It is generally decided whether to open the door to let the vehicle enter after the detection. Many units also use license plate recognition devices to identify vehicles. The characteristics of the system: it can improve the speed and accuracy of vehicle recognition, and can identify all vehicle license plates that have been entered in advance.

2) Applications in Biomedical Engineering

Image segmentation technology is also used in biomedicine, and image segmentation technology plays an important role in biomedical field. Many hospitals and research departments use image segmentation technology can improve the accuracy of work, and help to solve some problems. GVF model image is the most common medical image. Using image segmentation technology to process and analyze it can avoid the mistakes of traditional processing methods, and the segmentation is simple and efficient. The specific process: firstly, expand the range of the image model to be segmented, then detect the image, and then operate the model. The characteristics of this method are: high processing speed, good effect and good quality of the model after segmentation. After using GVF, the problem of boundary error can be effectively solved by using GVF model image segmentation method, so that a larger range of new models can be saved after GVF search. The implementation of perfect GVF framework can improve the image quality, which plays an important role in the development of Biomedical Engineering in China.

3) Application in remote sensing engineering

In the application of remote sensing engineering, image segmentation technology can realize oil depot target location and detection. There are some differences in analyzing the optical image of oil tank. Basically, the shape of the fuel tank is oval and the color is the same. Therefore, the oil tank can be used to identify the ellipse in the remote exploration oil storage area, and then the ellipse shape obtained by the ellipse classification by allocation method can be identified. Experimental results show that the developed regional clustering algorithm can increase the probability of oil barrel location. The growing region clustering method uses the fuel tank as the pixel to accurately locate the ellipse shape and distribute the ellipse image, recognize the growth principle of the surrounding area, and then use the growth principle of the region to identify it. The growing region clustering method can accurately locate the oil tank, and then determine the location of the oil tank. In addition, it can filter the false oil reserves with high precision and high speed.

The gray features and linear features of each band of the airport runway are used to divide the airport subdivision image. The basic principle of image segmentation technology is to first carry out gray image of the whole runway, and then make binary analysis of gray image, and then do Hough transform. After Hough transform, statistical analysis is carried out to provide the images of the main traffic runway and aircraft of the airport, and the subsidiary areas of the airport can also be segmented. The practice shows that the image segmentation technology is feasible and feasible for airport runway segmentation.

4) Application in fire prevention and detection

With the development of science and technology, there have been some fire prevention methods in recent years, such as installing some sensors that can detect the temperature change, sensors that can detect the change of smoke concentration in the air, or sensors that can sense the light intensity. However, in public areas, many sensors need to be installed to work, which requires a lot of money. This problem can be solved by using image segmentation technology. The application of image segmentation technology can produce many detection devices, just like human eyes, which can observe the changes of environment

in real time.

V. CONCLUSIONS

With the development of science and technology, image processing technology in China is more and more mature, and has been applied in many fields. In conclusion, image segmentation technology in digital imaging has good applications in transportation, biomedical, remote sensing engineering, fire prediction and detection. Image segmentation technology plays an important role in the development of related fields in China. However, there are some problems in the application of digital image segmentation technology, such as wide frequency, low compression data and limited processing speed. Therefore, it is very important for relevant researchers to better implement the digital image segmentation technology, because there are often some problems in the analysis of digital image processing technology, so it is particularly important to find out the problems and take effective measures to solve the existing problems. In some fields, digital image segmentation technology plays an important role in promoting China's economic development.

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