Automatic Color Image Segmentation Based on Visual Characteristics in Cloud Computing

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Abstract. Aiming at the problems existing in traditional color image segmentation methods, namely, image noise and image quality are poor, a color image automatic segmentation method based on visual characteristics is proposed. The method first analyzes the human visual characteristics, then uses the weighted average method to grayscale the color image, then uses the histogram equalization method to enhance the image, and then detects the edge of the image through the binary wavelet, and finally in the image. Image segmentation based on edge detection. The results show that compared with the traditional image segmentation method, the segmented color image of this method has a SNR of 5.3 dB, less noise and improved image quality.

Keywords: Visual characteristics · Color image · Segmentation method

1 Introduction

Image segmentation is a major problem in image processing and an important part of the field of computer vision and pattern recognition [1].Image segmentation is the first step in image processing in image engineering. The result of image segmentation directly affects the subsequent image processing. In the past forty years, black and white images have been widely used, so there are many studies on black and white image algorithms. However, with the advancement of technology and the reduction of various hardware costs, color images have achieved undoubted protagonist status in the new century. Color images are in line with human visual characteristics and rich color information. It plays an important role in daily life and technology applications. However, because color images are widely used in a short period of time, color image processing methods and research are not as good as the system specifications for gray images, resulting in color image processing effects that are not as good as black and black. The image is white, noisy, and the image segmentation quality is poor. Aiming at the above problems, a method of automatic segmentation of color images based on visual characteristics under cloud computing is proposed. The method is mainly divided into four steps: color image graying, image enhancement, image edge detection, image segmentation [2].

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Finally, it is verified that the image signal-to-noise ratio of the segmentation method is much higher than that of the traditional image segmentation, and the image segmentation quality is improved, which solves the problems of the traditional method.

2 Automatic Color Image Segmentation Method Based on Visual Characteristics

Image segmentation is an important pre-processing process in the early stage of image processing. Its definition is to divide a complete image into several different connected domains. The pixel characteristics in each region are similar, that is to say, the region is homogeneous and heterogeneous compared with other adjacent regions. Image segmentation is the first step in graphic analysis and pattern recognition. In the system of image analysis and pattern recognition, image segmentation is an important and necessary part. It is the most difficult part in the process of image processing and determines the quality of the final result of image processing [3].

2.1 Visual Characteristics

Nowadays, there are many applications in color space. RGB model is the most widely used model for pictures taken by digital cameras. Human eyes rely on three types of cone cells for color sensing, namely red cone cells, green cone cells and blue cone cells. Among them, the human eye has the weakest sensitivity to red, followed by blue, and the strongest sensitivity is green. In other words, in a digital image with the same 8bit depth of 8 bits, the human eye can perceive the color with the most difference as green. RGB model can be described by Cartesian coordinate system[4]. In this model with a cube shape, the transformation from black to white is expressed as a zero point to a diagonal point, and each one-dimensional coordinate axis represents the transformation of the brightness of the color from small to large. Taking a digital image with a 8bit depth of 8 bits as an example, when the origin is R = O, G = O, B = O, the color represented at this time is black. The diagonal points of its cube are R = 255, G = 255, B = 255, and the color represented by this point is white. According to this model, each color image can be decomposed into three independent planes for calculation [5].

Now, according to the different sensitivities of human eyes to the common red, green and blue colors, automatic color image segmentation is carried out. The specific flow is shown in Fig. 1.

As can be seen from Fig. 1, the automatic color image segmentation method based on visual characteristics is mainly divided into the following steps: firstly, the original color image is input into a computer, then the color image is grayed out, then image enhancement and image edge detection are carried out, and finally image segmentation is realized.

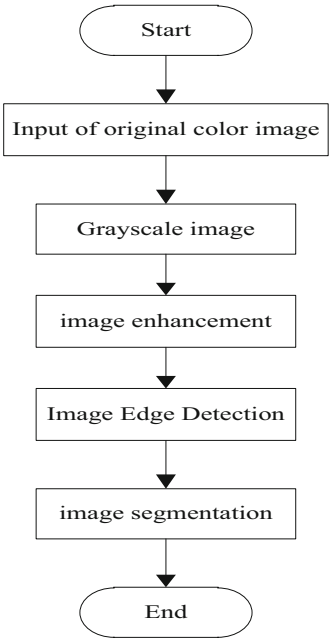


Fig. 1. Flow of automatic color image segmentation method

2.2 Color Image Grayscale

Color images are composed of multiple colors. If contour features are extracted directly from color images, the extraction effect will be blurred due to the influence of colors, so it needs to be grayed out [6].

Image graying refers to a series of processing of color images with multiple colors to produce corresponding gray images containing only black, white and different shades of gray. The pixels of each color in a color image are determined by the components of R(red), G(glass) and B(blue), and the value range of each component is [0,255]. However, all the different pixel points in the grayed color image become the same value, which is called the gray value of the pixel point, and the gray value $\in$ [0,255]. Generally, there are four methods to gray color images: component method, maximum value method, average value method and weighted average method. Among them, the weighted average method is the most commonly used, it is based on the importance and other indicators, the components of the three colors are weighted average with different weights, the formula is as follows:

$$\begin{aligned} Grayg(x,y) = {} & 0.299R(x,y) + 0.578G(x,y) \\ & + 0.114B(x,y) \end{aligned} \tag{1}$$

In the formula, $Grayg(x, y)$ is a gray image; $R(x, y)$, $G(x, y)$ and $B(x, y)$ represent the component values of R, G and B of the pixels coordinated (x, y) in the gray image respectively.

2.3 Image Enhancement

After the image is grayed out, the target person in the image will be weakened to a certain extent. Therefore, according to the theory of human visual characteristics, human eyes are more sensitive to bright colors, while the graying of the image weakens the sensitive characteristics of human eyes. Therefore, in order to ensure the quality of the automatically generated portrait sketch, it is necessary to perform image enhancement processing on the target portrait in the grayed-out image, that is, to compensate for the weakened part in the portrait, and to compensate the sharpness and contrast of the portrait. Portraits increase, and the difference between the features of the target and other objects in the image becomes larger, thereby enhancing the computer's interpretation and recognition of the image.

In order to make the image clearer, the purpose of image enhancement can be achieved by adjusting the proportion of brightness of each part. This method is called histogram adjustment. Histogram adjustment methods include histogram equalization and histogram matching. The histogram of an image is based on statistical principle and reflects the relationship between gray level and its occurrence probability. Usually, when performing histogram processing, the histogram normalization is generally performed first, and the formula is as shown in (2):

$$P(r_k) = n_k/N, (k = 0, 1, \ldots, 255) \tag{2}$$

In the formula, r_k is the k-level gray value; r_k is the normalized number of pixels whose gray value is r_k; n_k is the number of pixels whose gray level is r_k; N is the number of pixels in the image.

Histogram equalization, also called histogram equalization, combines the histogram of the image with the gray level corresponding to the histogram, and then maps the corresponding gray level to a new gray level through a certain mapping, so that The transformed image becomes a uniform probability density distribution. This transformation can not only expand the effective gray level of pixels, but also improve the frequency of occurrence of each gray value, thus improving the contrast of the image and achieving the purpose of image enhancement.

The following calculation steps for histogram equalization are given:

1) calculating a histogram of an image;
2) normalizing the histogram of the image;
3) calculating a new gray value of the image;
4) replacing the corresponding gray value with the gray value calculated in step 3 in the original image to form a new image.

The implementation process of histogram equalization image enhancement method is relatively simple. After equalization, each gray level of the new image is more balanced and closer to our desired ideal result. When histogram equalization is used to enhance an

image with a relatively small gray scale range, the gray scale range of the image can be effectively expanded, and the information of the new image obtained after equalization becomes clearer and more useful. When histogram equalization is jointly applied to image edge detection methods, the histogram equalization image enhancement method enlarges the gray difference between various factors of the image and enhances the gray contrast of the image so as to detect useful detail edges of the image. Therefore, this method has great practical effect and value in the process of image edge detection [7].

2.4 Image Edge Detection

The most basic feature of an image is the edge. The so-called edge refers to the set of pixels with contrast changes in the gray intensity of surrounding pixels. It usually exists between the target and the background, the target and the target, the region and the region, and the primitive and the primitive. Therefore, it is the most important feature on which image segmentation depends, and it is also the important information source of texture features and the basis of shape analysis.

Edge detection is one of the most classical research topics in the field of image processing and computer vision. It has a long research history and has achieved great results. There are many methods of edge detection, but in summary, they all use differential operators to find out the abrupt change points of gray scale. Among the existing edge detection algorithms, the commonly used algorithms are primary differentiation, secondary differentiation, template operation, surface fitting, etc. In recent years, with the deepening of wavelet research, the application of binary wavelet in edge detection is also increasing [8].

When the image is decomposed by dyadic wavelet, the noise of the image is decomposed into high-frequency sub-images, so the low-frequency sub-images obtained by the original image by dyadic wavelet decomposition can effectively remove the noise when performing edge detection. In order to effectively remove noise and realize edge detection in more details of the image, this paper proposes an image edge detection method based on binary wavelet transform, i.e. the low-frequency sub-image obtained by binary wavelet decomposition of the original image is enhanced by histogram equalization, and then edge detection is performed by the modulus maximum point method of binary wavelet transform. These processes are implemented by programming with Matlab7.04. The specific steps are as follows:

Step 1: The quadratic spline function is selected as the wavelet function, and the original image is subjected to one-layer binary wavelet decomposition to obtain a low-frequency sub-image of the original image.
Step 2: The low frequency sub-image is enhanced by histogram equalization.
Step 3: Edge detection is carried out on the enhanced low-frequency sub-image by adopting a dyadic wavelet transform modulus maximum point method to obtain an edge image, namely, the modulus value and the amplitude angle of the dyadic wavelet transform are obtained first, and then the local maximum point of the modulus value along the amplitude angle direction is obtained from the modulus value and the amplitude angle of the dyadic wavelet transform. The positions of these dyadic wavelet transform modulus maxima points give the edge of the image.

2.5 Image Segmentation

Image segmentation based on edge detection is a typical method. Human vision is very sensitive to the edge of the image. In general, when observing objects with edges, the first thing people perceive is the edge. In theory, the definition of edge is: the abrupt position of data such as structure or gray value, which is called edge. It is the cut-off of one part and the start of another part. According to this visual imaging characteristic of human beings, image segmentation can be performed [9, 10].

Edge detection is a very important step in image processing technology. When detecting the edge of the target, firstly roughly detect its contour points, then connect the detected contour points according to a certain principle, and test and link the missing contour points, at the same time remove the wrong boundary points. However, there is noise in real target signals, and their edges are also composed of many different types of edges and their blurred parts, so the processing process is quite complicated, so edge detection is also a difficulty in image processing technology[11, 12].

Image segmentation refers to the process of subdividing an image into multiple image sub-regions. At present, the commonly used segmentation methods are based on threshold, region, edge and specific theory. Since the image edge extraction has been completed in the above section, in order to reduce the workflow. This section performs image segmentation based on the above image edge detection. The specific flow is shown in Fig. 2.

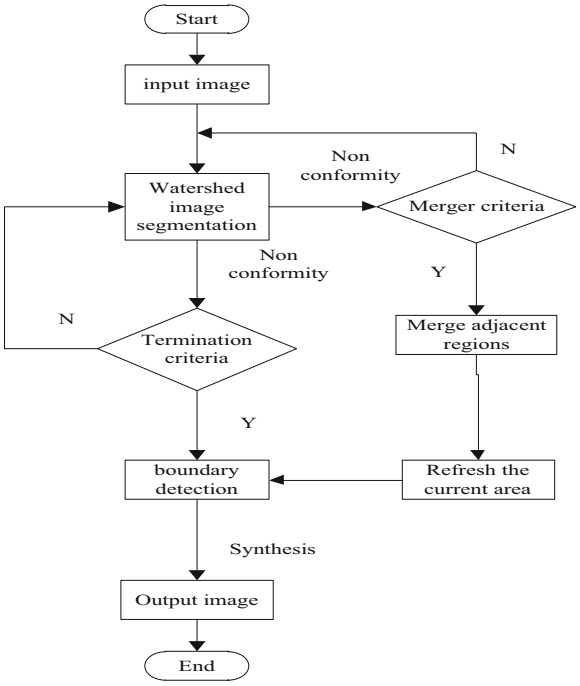


Fig. 2. Image segmentation implementation flow

3 Simulation Test

For color image segmentation algorithms, the quality of segmentation results depends on many factors, such as consistency, spatial compressibility, continuity, smoothness, and so on. The use of a single metric does not include all of the factors, so the quality of the segmentation should be based on whether it is used for evaluation in a particular application area.

The main solution of this research is that the traditional image segmentation technology has a lot of noise, which leads to the problem of poor image quality after segmentation. Therefore, the simulation results are mainly used to verify the segmentation effect of this method and traditional methods. Figure 3 below shows the image to be segmented (the yellow area is the target to be extracted).

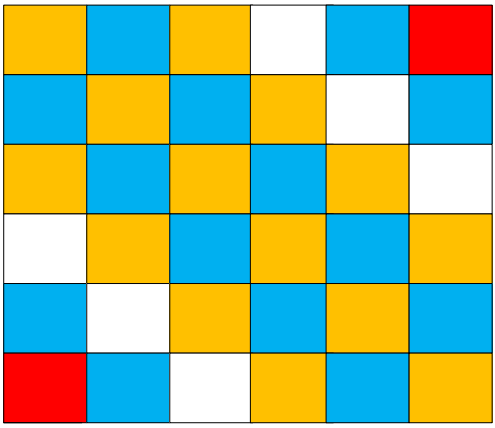


Fig. 3. Image to be segmented

Now, the yellow area in Fig. 3 is segmented with this method and the conventional method, and the signal-to-noise ratio after image segmentation is shown in Table 1 and Table 2 below.

Table 1. The SNR/DB after image segmentation of this method

Number of iterations	This method
1	23.5
2	21.4
3	22.8
4	23.4
5	22.7
6	20.6
7	22.5
8	22.9
9	23.5
10	27.1

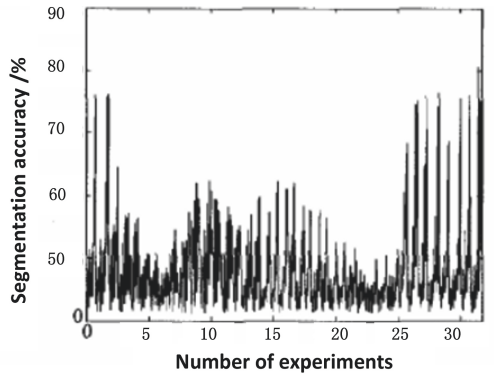
Table 2. SNR after image segmentation by traditional method/db

Number of iterations	Traditional method
1	18.2
2	11.2
3	11.2
4	15.6
5	14.7
6	15.6
7	19.2
8	19.4
9	19.8
10	17.0

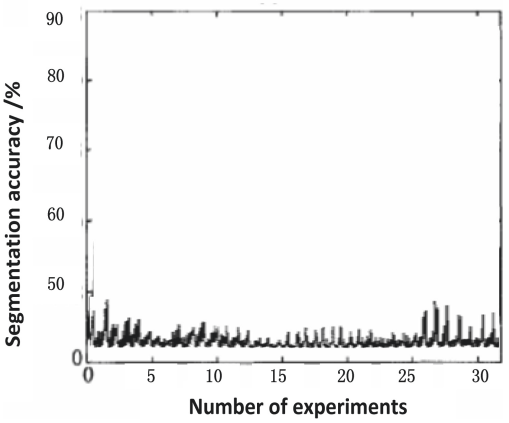
It can be seen from Table 1 that the color image in Fig. 3 is segmented by the method, and the image-to-noise ratio of the segmented image is 27.1 dB, which is 10.1 dB higher than that of the conventional image. It can be seen that the image segmentation method has better performance and the image quality after segmentation is higher.

In order to verify the effectiveness of the method in this paper, the color image segmentation accuracy of the cloud computing color image automatic segmentation method and the traditional color image automatic segmentation method is compared and analyzed, and the comparison results are shown in Fig. 4.

According to the data in Fig. 4, the color image segmentation accuracy of the cloud computing color image automatic segmentation method based on visualization features can reach 80%, while the color image segmentation accuracy of the traditional cloud computing color image automatic segmentation method is only 50%. Based on visualization The color image segmentation accuracy of the feature-based cloud computing color image automatic segmentation method is higher than that of the traditional color image automatic segmentation method, which shows that the color image segmentation effect of the cloud computing color image automatic segmentation method based on visual features proposed in this paper is better it is good.



(a)Segmentation accuracy of automatic segmentation method of color image based on Visualization



(b)The segmentation precision of traditional cloud computing color image automatic segmentation method

Fig. 4. Comparison of image segmentation accuracy

4 Conclusion

In summary, in view of the problems existing in color image segmentation, the color image segmentation technology based on human visual features is studied. The research process includes image graying, image enhancement, image edge detection and image segmentation. It is verified that the method solves the problem of the traditional color image segmentation technology, that is, the signal-to-noise ratio is improved, which lays a foundation for the development of color image processing technology. However, this study does not study the mechanism of human visual segmentation, so the method needs to be further improved. Subsequent in-depth research should be conducted on edge detection and segmentation in order to propose new reference methods.

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