The Image Retrieval Based on the Hybrid Algorithm of the Primary Color and Color Layout Descriptor

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Abstract: The image retrieval technology based on content is become a hot research field with the images used widely. The primary color and color layout are both the characteristic in the international standard.Each characteristic factor has its advantages and disadvantages. In this paper, image retrieval based on the hybrid algorithm is proposed in order to avoid their shortccomings. The experimental results show that the better retrieval effect is obtained by using the hybrid algorithm.

INTRODUCTION

Although there are a lot of colors in an image, the experimental results show that most of images can be used by several or a dozen colors to describe the local color features. The primary color descriptor based on the above ideas is proposed. A set of representative color is specified in the area of any shape, and it is the application based on color. The area can be a whole image or an arbitrary area.

The primary color descriptor and the color layout of the standard are utilized comprehensively in this paper. The image retrieval system contained 300 sample is verified[1-2]. The results show that good retrieval effect is obtained by using the color and the texture feature[3-5].

PRIMARY COLOR DESCRIPTOR

HSV model can be better reflected the perception and the identification ability to color. The H is tone, S saturation, V brightness in the model. The change of each color component can be sensed by HSV model, therefore image similarity comparison based on color is suitable very much. The image in RGB space can be conversed easily to HSV space by a certain formula.

The color of HSV space is quantified usually in order to reduce the amount of calculation. The 166 d or 72 d quantization is used in accordance with human visual perception. The formula is such as (1) below:

$$q = \begin{cases} 0, & v \le 0.1 \\ g(h,s,v), & s < 0.1 \,\&\, v > 0.1 \\ f(h,s,v), & otherwise \end{cases} \tag{1}$$

Here, $g(h,s,v)$ is such as (2) below:

$$g(h,s,v) = \begin{cases} 1, & s < 0.1 \,\&\, 0.1 < v \le 0.5 \\ 2, & s < 0.1 \,\&\, 0.5 < v \le 0.8 \\ 3, & s < 0.1 \,\&\, 0.8 < v \le 1.0 \end{cases} \tag{2}$$

The rest of the HSV space is divided by the function $f(h,s,v)$. Among them, $h \in [0,360^0]$, $s \in [0.1,1]$.

The hue is divided into 18 intervals evenly at 20 degrees. The saturation and value are both divided into three parts at 0.3 for the interval. The full image can be represented by

166($18*3*3=166$) colors after quantization. Similarly, the hue is divided into 8 intervals evenly, and that is 72 d color quantization.

A few of the dominant colors are extracted from 72 d or 166 d histograms, one way is to choose the larger value as the dominant color to represent the whole image. But the flexibility of this method is inflexible.

The method of cumulative percentage is adopted in this paper to solve above problem. The quantitative colors are sorted in descending order by their corresponding percentage. The dominant color is obtained according to the sequence. The obtaining of dominant color is stopped when the sum of the percentage is greater than a certain threshold. The dominant color descriptor composed of the main color and the corresponding percentage can be written as (3) below:

$$F=\{\{c_i,p_i\};i=1,\cdots,N;p_i\in[0,1]\} \tag{3}$$

Here, the c_i is the quantitative color, and the p_i is the percentage, N is the number of the dominant color.

The similarity measure is solved by calculating the distance between the two dominant colors in this paper. Assume that the two dominant colors are F_1 and F_2 respectively. That is as below:

$$F_1=\{\{c_{1i},p_{1i}\};i=1,\cdots,N_1;p_{1i}\in[0,1]\} \tag{4}$$

$$F_2=\{\{c_{2i},p_{2i}\};i=1,\cdots,N_2;p_{2i}\in[0,1]\} \tag{5}$$

The distance between of them is such as (6) below:

$$D(F_1,\ F_2)=\sum_{i=1}^{N_1}\sum_{j=1}^{N_1}a_{1i,1j}p_{1i}p_{1j}+\sum_{i=1}^{N_2}\sum_{j=1}^{N_2}a_{2i,2j}p_{2i}p_{2j}-2\sum_{i=1}^{N_1}\sum_{j=1}^{N_2}a_{1i,2j}p_{1i}p_{2j} \tag{6}$$

Here, the a_{ij} is the similarity of two colors. The variable d_{ij} is the Euclidean distance between two colors. The parameter $d_{\max}$ is the maximum distance. The formula is such as below:

$$a_{ij}=1-\frac{d_{ij}}{d_{\max}} \tag{7}$$

Finally, the image is retrieved from the library according to the size of the similar distance, and is displayed on the computer.

COLOR LAYOUT

The image retrieval based on color layout is also an algorithm of the standard. First of all, the image is transformed from the RGB space to the YC_bC_r space. The second, the whole image is divided into 64 parts evenly. The average value of the three components Y,C_bC_r is calculated for each block. The value of Y,C_bC_r is transformed respectively by DCT method, and the two-dimensional DCT transform can be done through the two transformation of one-dimension. The scanning and quantization are done after DCT transformation. The low-frequency component is retained, and the color layout descriptor is constituted by them.

The similar distance is calculated as below.

$$d(c_1,c_2)=\sqrt{\sum_i\omega_{yi}(Y_{1i}-Y_{2i})^2+\sum_i\omega_{bi}(b_{1i}-b_{2i})^2+\sum_i\omega_{ri}(r_{1i}-r_{2i})^2} \tag{8}$$

Here, $c_1=\{Y_1,\ r_1,b_1\},c_2=\{Y_2,\ r_2,b_2\}$. It is the DCT coefficient. The parameter $(\omega_{yi},\omega_{bi},\omega_{ri})$ is the weight of each coefficient. The main information of image is contained in the low frequency, and the detail is contained in the high frequency. So the larger weight is distribution to the low frequency coefficient, and the smaller weight is given to the high frequency coefficient[6-7].

The image is displayed on the computer according to the size of the similar distance.

HYBRID ALGORITHM

The hybrid algorithm based on primary color and color layout in this paper can retrieve the most images. First at all, the image is divided into 16 blocks evenly, and a primary color is extracted in each block. These primary colors are arrayed in order according to the different directions. There are four directions of $0^0, 45^0, 90^0\ 135^0$ respectively. The subtraction is performed in these primary colors according to different direction. The primary color characteristics based on the layout is as follows:

$$F_{-0} = \sum_{i=1}^{4}\sum_{j=1}^{4}\sqrt{(h_{ij} - h_{i,j+1})^2 + (s_{ij} - s_{i,j+1})^2 + (v_{ij} - v_{i,j+1})^2} \tag{9}$$

$$F_{-45} = \sum_{i=1}^{4}\sum_{j=1}^{4}\sqrt{(h_{ij} - h_{i+1,j+1})^2 + (s_{ij} - s_{i+1,j+1})^2 + (v_{ij} - v_{+1i,j+1})^2} \tag{10}$$

$$F_{-90} = \sum_{i=1}^{4}\sum_{j=1}^{4}\sqrt{(h_{ij} - h_{+1i,j})^2 + (s_{ij} - s_{i+1,j})^2 + (v_{ij} - v_{i+1,j})^2} \tag{11}$$

$$F_{-135} = \sum_{i=1}^{4}\sum_{j=1}^{4}\sqrt{(h_{ij} - h_{i+1,j-1})^2 + (s_{ij} - s_{i+1,j-1})^2 + (v_{ij} - v_{i+1,j-1})^2} \tag{12}$$

Here, F_{-0}, F_{-45}, F_{-90} and F_{-135} are represented the layout characteristics in the different direction respectively.

The similar distance is calculated as below:

$$d(F, F') = \sqrt{(F_{-0} - F_{-0}')^2 + (F_{-45} - F_{-45}')^2 + (F_{-90} - F_{-90}')^2 + (F_{-135} - F_{-135}')^2} \tag{13}$$

Here, the F, F' is the primary color of two image.

Finally, the image is displayed on the computer according to the size of the similar distance.

SIMULATION RESULTS

Image is retrieved from different library according to the hybrid algorithm. The process is done in MATALB simulation environment. The recall ratio and the precision ratio are the important indicators in image retrieval. There are flowers, animals, buildings, sea and so on in the library. The different methods are used to retrieve image as follows. Image retrieval based on primary color is such as Fig1 below, and the retrieval result based on color layout is such as Fig2. The hybrid method of primary color and color layout is as shown in Fig3.

Fig1 primary color

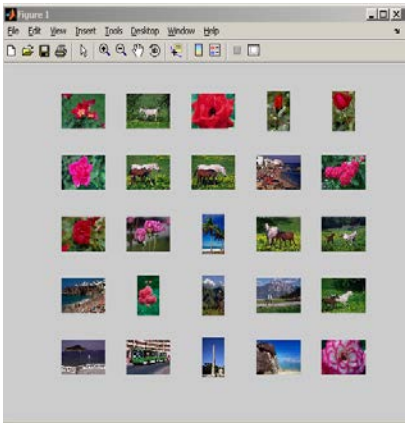

Fig2 color layout

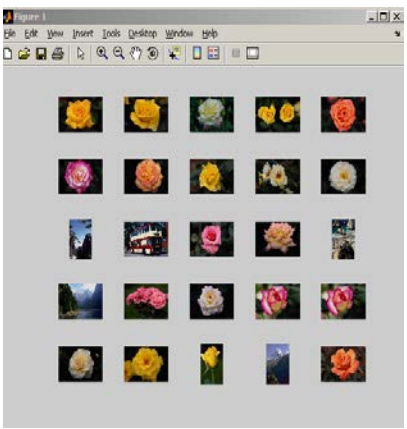

Fig3 hybrid method

The retrieval results show that the flowers are detected in Fig3 more than in fig1 and fig2. So the retrieval effect is the most best according to the hybrid algorithm.

CONCLUSION

The image retrieval based on content has become the key technology in multimedia field. The feature extraction is the base of image retrieval. The primary color and color layout is both the basic feature in the standard. The hybrid method based on primary color layout feature is proposed in this paper in order to overcome the shortcoming of single feature. Simulation results show that the algorithm can obtain a very good retrieval effect.

The method can be further improved, such as introducing other color and texture features to describe image. In addition, the primary color and the color layout descriptor can be extracted directly from the DCT domain. It can be reduced the feature extraction time.

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