Method of Image Retrieval Based on Annular Isometric Division and Color Histogram

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***Abstract*—Based on color histogram, a new search method is presented in this paper. Firstly, quantify the image in HSV space and split it into annular isometric region. Calculate the third-order moment as feature vectors and realize image retrieval by the similarity comparing between the images. Experimental results show that this improved approach is better than the simple use of color histogram in an accurate survey.**

Keywords-image retrieval; colour histogram; annular division; similarity

I. INTRODUCTION

With the rapid development of the imaging technology and the storage technology, image database came into being. How retrieve useful information from the large-scale images warehouse became a new research direction in the field of information retrieval at home and abroad. To overcome the text-based image retrieval methods can not use the rich visual features (color, texture, shape, etc.) of the images, content-based image retrieval (CBIR) become a hot spot of research. Color is not only the most significantly and intuitive visual features of the image, but also the most widely used lower layer features in image retrieval. In general make use of color histogram **Error! Reference source not found.** to retrieval images, it describes the demographic characteristics of the color, and has a translation, scale, rotation invariance. The image retrieval methods based on the color histogram is to choose the right color space and then quantify the color space **Error! Reference source not found.**. In general, the image's color is quantified to the less dimensions, and statistics to obtain color histogram. Retrieve images by matching the color histogram. Therefore, color histogram of the image recorded the overall situation of color information, which does not take into account the spatial distribution of color. Two identical or very similar images according to the color histogram may be corresponding to two entirely different images, therefore prone to erroneous retrieval results. Based on the above issues, this paper presents that it can use annular isometric division and color histogram to extract the spatial distribution of color and make use of color centre moment to describe the color image spatial distribution. The method made full use of visual perception and spatial distribution of the image and can get a better search results.

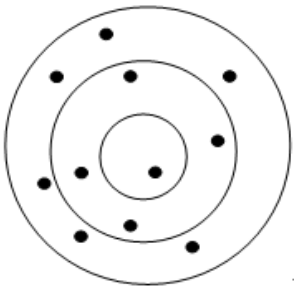
II. METHOD OF IMAGE RETRIEVAL BASED ON ANNULAR ISOMETRIC DIVISION AND COLOR HISTOGRAM

A. Annular Isometric Division

A image for m line and n column, regard the center of the image as the centre of a circle, use formula (1) to calculate and get its central O (x, y). Use the formula (2) to calculate and get the half of its diagonal R, and can set a positive integer N, it is divided into N dengfen. We can get a circle regard central O as the centre of the circle and regard $\frac{R}{N}$ j (1≤j≤N) as the radius for the Circle. From outside to inside, get N rings , image is divided into N parts.

$$x=\lfloor m/2 \rfloor;\quad y=\lfloor n/2 \rfloor \qquad (1)$$

$$R=\sqrt{(1-x)^2+(n-y)^2} \qquad (2)$$



B. The Choice of Color Space

The so-called color model is a visible light subset of the three-dimensional color space. It contains all colors of a color domain. Common color model as follows: RGB、CMY/CMYK, HIS, NTSC, $YcbCr$, HSV. HSV color model is more suited to the application of image retrieval. It includes hue that show color spectrum, saturation that show color richness and value that show color brightness. Currently the RGB color model is often used in the color image for information expression, value of RGB is converted into value of HSV.

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C. Color Quantization

In general, image contains many types of colors. With color histogram's dimension increases, retrieval accuracy can be improved, but calculation is increased largely and the time of retrieval is extended. Therefore, quantify the color space firstly and then calculated histogram can reduce calculation and improve the efficiency of search. In HSV three components, H's impact to people's vision is greatest. This paper will quantify hue into sixteen levels, quantify saturation into three levels, and quantify value into two levels. So image color space is quantified into ninety-six levels in total. Specific methods are as follows:

$$H=\begin{cases}0 & h\in(0,0.0625]\\ 1 & h\in(0.0625,0.125]\\ 2 & h\in(0.125,0.1875]\\ 3 & h\in(0.1875,0.25]\\ 4 & h\in(0.25,0.3125]\\ 5 & h\in(0.3125,0.375]\\ 6 & h\in(0.375,0.4375]\\ 7 & h\in(0.4375,0.5]\\ 8 & h\in(0.5,0.5625]\\ 9 & h\in(0.5625,0.625]\\ 10 & h\in(0.625,0.6875]\\ 11 & h\in(0.6875,0.75]\\ 12 & h\in(0.75,0.8125]\\ 13 & h\in(0.8125,0.875]\\ 14 & h\in(0.875,0.9375]\\ 15 & h\in(0.9375,1]\end{cases}$$

$$S=\begin{cases}0 & s\in(0,\frac{1}{3}]\\ 1 & s\in(\frac{1}{3},\frac{2}{3}]\\ 2 & s\in(\frac{2}{3},1]\end{cases}$$

$$V=\begin{cases}0 & v\in(0,0.5]\\ 1 & v\in(0.5,1]\end{cases}$$

D. The Formation of Color Histogram

According to the results of quantization, the color of each pixel of the image is quantified into one of 96 colors, and statistics the number of the pixels of each color to get the probability of each color. 96 kinds of colors for the Abscissa, the probability of color to the size of longitudinal coordinates, get the color histogram of the image.

E. Generate Eigenvector of Image Retrieval

After annular isometric division, calculate goals of all kinds of colors that land every annular region respectively. Color apace distribution histogram of color I is $K_i=(K_{i1},K_{i2},\cdots K_{iN})$, normalization of the histogram of color i at the j-annular regional division is $K_{ij}=|k_{ij}|/|k_i|$. In order to further reduce the number of peacekeeping match, moment of the centre has translational invariance, third-order center moment of color can be selected as a feature vector, similarity matching.

$$\begin{cases}L_{i1}=\frac{1}{N}\sum_{i=1}^{N}k_{ij}\\ L_{i2}=\left[\frac{1}{N}\sum_{i=1}^{N}(k_{ij}-L_{i1})^2\right]^{\frac{1}{2}}\\ L_{i3}=\left[\frac{1}{N}\sum_{i=1}^{N}(k_{ij}-L_{i1})^3\right]^{\frac{1}{3}}\end{cases}\quad(3)$$

So image feature vectors can be expressed as $L_{11},L_{12},L_{13}\cdots L_{i1},L_{i2},L_{i3}\cdots L_{n1},L_{n2},L_{n3})$.

F. Similarity Matching

Suppose two images' (P and Q) eigenvector are L^P and L^Q respectively, we make use of the absolute distance that formula (4) shows to calculate the similarity of the two images. This value of the similarity is regard as similar evaluation criteria of the two images.

$$D(P,Q)=\sum_{i=1}^{n}\left[\left|L_{i1}^{P}-L_{i1}^{Q}\right|+\left|L_{i2}^{P}-L_{i2}^{Q}\right|+\left|L_{i3}^{P}-L_{i3}^{Q}\right|\right]\quad(4)$$

III. Algorithm and Comparison of the Retrieval Efficiency

A. Image Retrieval Algorithms Based on Improved Color Histogram

- The color image is converted to the HSV color space, H, S, V component corresponding quantitative and the color values of each pixel of the image is assigned again by quantitative result.
- Regarding central as the centre of the circle, the image is divided. Account each color's third-order centre moment of the image as eigenvector.
- According to the formula (4) similarity matching, image retrieval.

B. Search Performance Comparison

To test and evaluate the performance of the algorithm, the test image library has a total of 1000 images. It includes landscapes, figures, animals, flowers, architecture and so on. Usually make use of rate of accurate survey and rate of recall survey to evaluate detection performance of the system. The rate of recall survey shows the rate of the target image retrieval in the queue of the search results and database of the entire target image, the rate of accurate survey shows the rate of the target image retrieval in the queue of the search results and all images.

Figure 1. Sample image 618.jpg

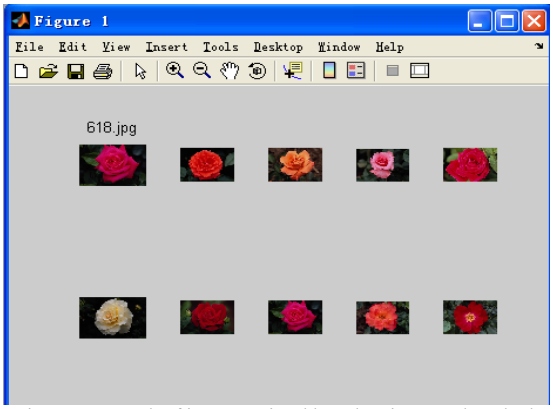

Figure 2. Result of image retrieval based on improved method

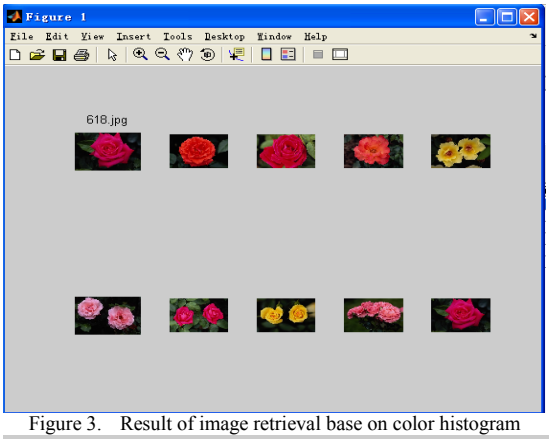

Figure 3. Result of image retrieval base on color histogram

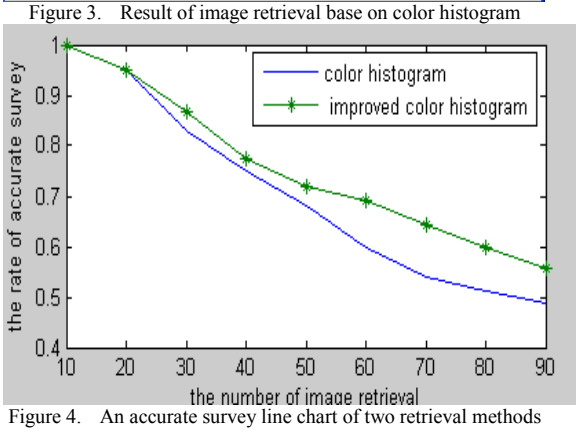

Figure 4. An accurate survey line chart of two retrieval methods

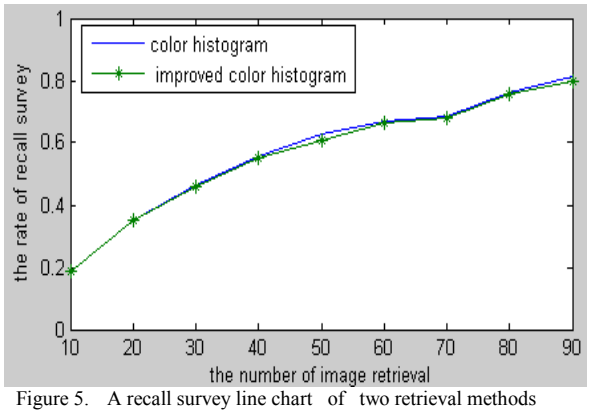

Figure 5. A recall survey line chart of two retrieval methods

From the above icon, we can see the improved search algorithm in the precision was superior to color histogram retrieval methods

IV. CONCLUSION

Improved color histogram not only reflects the color of the statistical properties, but also reflects the attributes of its location, so the search results are more accurate.

Color is an important visual feature, and is more and more attention. However, the single color characteristics expression is lack, the next step can be combined edge information or texture features and other image information to retrieval. This is the direction of future research in this paper.

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