Journal of Theoretical and Applied Information Technology
31st October 2012. Vol. 44 No.2

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

STUDY ALGORITHM FOR IMAGE CONTENT RETRIEVAL BASED ON SHAPE AND TEXTURE FEATURES

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ABSTRACT

A content-based image retrieval algorithm is proposed after researching feature extraction of image texture, shape feature extraction and relevance feedback algorithm. Fourier transform is used in the feature extraction of the texture. Boundary moments to detect the image boundaries is used in the feature extraction of the shape, similarity measuring function is used in image similarity match. And the introduction of relevance feedback algorithm in order to allow users to interact with the query system for image retrieval system to increase the adaptability features.

Keywords: *CBIR; Image Features; Similarity Measuring Function; Relevance Feedback*

1. INTRODUCTION

Content-based image retrieval (CBIR) itself contains different levels of structure and semantic information retrieval. Studied at this stage is how to use color, texture, shape and spatial location of low-level visual features and combination of features to be retrieved. From content-based image retrieval technology and image processing, image recognition, database and other related fields of knowledge. Its research results can contribute to the development of other areas, such as feature representation, feature extraction, similarity measurement problems are digital image processing basic questions. However, content-based image retrieval system described in the image features, feature extraction and similarity measurement technology has yet to be mature; there is still much research space.

2. DESIGN CONTENT-BASED IMAGE RETRIEVAL ALGORITHMS

2.1. The Image Preprocessing

The purpose of image pre-processing is to facilitate the calculation of image feature extraction and similarity measure in order to improve the efficiency of image retrieval. The preprocessing original image set a series of processing to produce an image process to describe the characteristics of libraries, including: scale unification, format conversion, grayscale processing.

2.2. Image Feature Extraction

Feature extraction is a library to generate the core responsible for extracting image characteristics of visual features including color, shape, texture, spatial location relations, image feature extraction should be accurate and fast extracted features can be an effective characterization of the image or the distinction between image capabilities.

Color feature is one of the basic characteristics of the image, color feature is the most widely used visual features in the image retrieval, color feature extraction is also relatively easy to achieve, by calculating the number of pixels of each color in the establishment of the color histogram. Color histogram reflects the statistical characteristics of the image color distribution are a common means of image color. A histogram is a function of the number of pixels in each gray level image is displayed.

On the basis of Fourier transform extracts the wedge ring features as the texture feature vector.

Two-dimensional Fourier transform of the image:

$$F(u,v)=\frac{1}{N}\sum_{x=0}^{x=N-1}\sum_{y=0}^{y=N-1}f(x,y)\exp[-j2\pi(ux+vy)/N]$$

$$u,v=0,1,\ldots,N-1$$

According to the separation characteristics of two-dimensional Fourier transform:

$$F(u,v)=\frac{1}{N}\sum_{x=0}^{x=N-1}\exp[\frac{-j2\pi ux}{N}]\sum_{y=0}^{y=N-1}f(x,y)\exp[\frac{-j2\pi vy}{N}]$$

According to the above forms of separation, the use of one-dimensional Fourier transform by two to two-dimensional Fourier transform spectrum

$$|F(u,v)|=[R^2(u,v)+I^2(u,v)]^{\frac{1}{2}}$$

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The spectrum is an important feature of the image, and reflects the image gray level distribution, if the image is in the target shape or arrangement of showing some kind of directional, then the higher value of the spectrum shows the directional distribution orthogonal to the direction of image target. Based on Fourier transform, extract the wedge ring features as the feature vectors.

A) Circular sampling

Ring sample is given texture roughness and periodicity.

$$P(u,v) = |F(u,v)|^2 \quad u,v = 0,1,\ldots N-1$$

(u,v) Cartesian coordinate system converted to (r,φ) in polar coordinates to obtain $P(r_i,\varphi_i)$.

Fixed r φ sum, we get:

$$P_1(r) = \sum_{i=1}^{n} P(r,\varphi_i),$$

$$r = r_1, r_2, \ldots, r_n$$

$P_1(r)$ is the ring characteristics. For the r, φ summing line forms a ring. Said $P_1(r)$ reveal different frequency components of the energy distribution of the information in the coarse texture of the case, if r is small, a large $P_1(r)$, the r is large, $P_1(r)$ smaller scale; and in the case of texture smaller r changes $P_1(r)$, the impact is not great.

2) wedge-shaped sample

Wedge-shaped sample is given the direction information

$$P_2(\varphi) = \sum_{i=1}^{n} P(r_i,\varphi), \quad \varphi = \varphi_1, \varphi_2, \ldots, \varphi_n,$$

That $P_2(\varphi)$ is a wedge-shaped feature. Different φ is the summation of r line of the wedge-shaped.

Analysis of the histogram of the $P_2(\varphi)$, when there are a lot of the line, the edge of a texture image along the θ direction, in the frequency domain along the $\theta + \frac{\pi}{2}$ and θ at right angles to the direction of energy concentrated. If the texture does not show the direction, the power spectrum is not showing directionality.

By a description of the boundary feature to get the image of the shape parameter, the boundary of the image generally refers to around the image gray-scale intensity contrast changes in the set of pixels. Boundary moments detects the image boundaries, set for the regional center of gravity $(\bar{x}, \bar{y})$, the boundary points of the set of points on the $\{x(i), y(i) | i = 1,2,\ldots N\}$ center of gravity to the boundary of Euclidean distance:

$z(i) = [(x(i)-\bar{x})^2 + (y(i)-\bar{y})^2]^{1/2}, i = 1,2,\ldots,N$ Mom ent is a widely used model characteristics, the pth moment is defined as: $m_p = \frac{1}{N}\sum_{i=1}^{N}[z(i)]^p$

p-order central moments is defined as : $M_p = \frac{1}{N}\sum_{i=1}^{N}[z(i)-m_1]^p$

The corresponding normalized moments defined as

$$\overline{m_p} = \frac{m_p}{(M_2)^{\frac{p}{2}}} = \frac{\frac{1}{N}\sum_{i=1}^{N}[z(i)]^p}{[\frac{1}{N}\sum_{i=1}^{N}[z(i)-m_1]^2]^{\frac{p}{2}}}$$

$$\overline{M_p} = \frac{M_p}{(M_2)^{\frac{p}{2}}} = \frac{\frac{1}{N}\sum_{i=1}^{N}[z(i)-m_1]^p}{[\frac{1}{N}\sum_{i=1}^{N}[z(i)-m_1]^2]^{\frac{p}{2}}}$$

Higher order moments are very sensitive to noise, thus reducing the affordability of the results of classification noise. Therefore, in practical applications often use the following lower order moments.

$$F_1 = \frac{(M_2)^{\frac{1}{2}}}{m_1} = \frac{[\frac{1}{N}\sum_{i-1}^{N}[z(i)-m_1]^2]^{\frac{1}{2}}}{\frac{1}{N}\sum_{i=1}^{N}z(i)}$$

$$F_2 = \frac{M_3}{(M_2)^{\frac{3}{2}}} = \frac{\frac{1}{N}\sum_{i=1}^{N}[z(i)-m_1]^3}{[\frac{1}{N}\sum_{i=1}^{N}[z(i)-m_1]^2]^{\frac{3}{2}}}$$

$$F_3 = \frac{M_4}{(M_2)^2} = \frac{\frac{1}{N}\sum_{i=1}^{N}[z(i)-m_1]^4}{[\frac{1}{N}\sum_{i=1}^{N}[z(i)-m_1]^2]^2}$$

The edge of the shape of the different types of F_2 and F_3 is no obvious changeing in the same type of object, F_2 is the performance of very different, so F_2 is not a good shape description, in

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

order to overcome these shortcomings, Liang, Sheng, redefines the F_2 and F_3

$$F_1^{'} = F_1$$

$$F_2^{'} = \frac{(M_3)^{\frac{1}{3}}}{m_1} = \frac{[\frac{1}{N}\sum_{i-1}^{N}[z(i)-m_1]^3]^{\frac{1}{3}}}{\frac{1}{N}\sum_{i=1}^{N}z(i)}$$

$$F_3^{'} = \frac{(M_4)^{\frac{1}{4}}}{m_1} = \frac{[\frac{1}{N}\sum_{i-1}^{N}[z(i)-m_1]^4]^{\frac{1}{4}}}{\frac{1}{N}\sum_{i=1}^{N}z(i)}$$

Using Euclidean distance as a similarity measure between the image feature vector, similarity matching.

(1), the query image for the Q-, assigned weight W_{ij} to the various features of the f_i on, each characteristic f_i , according to the right weight W_{ij} further to the requirements of the queries allocated to the various features of the expression vector r_{ij} , in r_{ij} of each component of rights re- W_{ijk}

(2), using the similarity algorithm m_{ij} , calculate the query image Q and database image feature representation of the similarity of r_{ij} : $S(r_{ij}) = m_{ij}(r_{ij,}W_{ijk})$

(3), the similarity of the query image Q and database image in the image feature f_i through merging the expression of each feature on the similarity

$$S(f_i) = \sum_j W_{ij} S(r_{ij})$$

(4) Integrated similarity of Q and database image from the query image is obtained by merging the various $S(f_i)$:

$$S = \sum_i W_i S(f_i)$$

(5) To calculate the database image and query image Q, the total similarity, according to the size of the arrangement of S, returns the most similar N images to the user.

(6) The user query requirements and subjective opinions, each image feedback to the system.

(7) The system based on user feedback adjusts the weights to make the adjustment after weight with the query image Q is closer to the needs of users.

(8) And return to step (1), re-start a new search.

Since computer vision on the color characteristics of similarity is defined and people of color perception exists a certain gap and high-level semantic concepts with low-level features of the gap between the image content-based retrieval results are not always ideal, in order to embed the user model to the image retrieval system in recent years the introduction of content-based image retrieval relevance feedback mechanism.

Relevance feedback to learn from the interaction of the user and query system, and capture the user's query intention to fix the system query strategy get the results as consistent as possible with the actual needs of users.

Be roughly divided into parameter adjustment method based on relevance feedback in content retrieval, clustering analysis method, the probability of learning methods and neural network methods.

Discussed the parameter adjustment method and the user evaluation of image from the most similar to least similar sort, take sort of the first m objects, they correspond to the characteristics of r_{ij}, take the average of the m r_{ij} as a new the characteristics of the query object, adjust the corresponding weight value $W_{ij} = 3 * W_{ij}$ That the characteristics are the fancy features of the user to give a higher weight.

3. EXPERIMENTAL RESULTS

With Delphi eigen decomposition of the above algorithm, feature extraction, similar figures to measure and relevance feedback algorithm. The search returned 20 images from the 150 images. The image database contains flowers, trees, butterflies and cats.

Query object contains a cat to return to the experiment results shown in Figure 1:

The user interface from the image retrieval selects "and" no "feedback" on the results of the image, the system will be automatically adjusted according to the user choice of the retrieval characteristics of said weight values, in order to conduct a second search.

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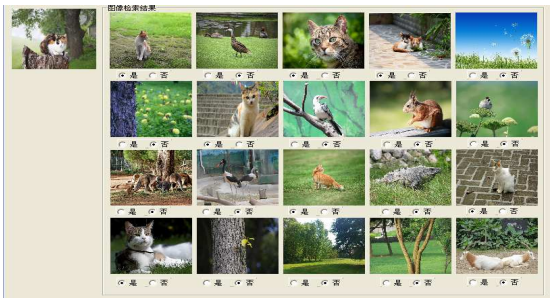

Figure 1 Search Results For The First Time

The image of the second search returned 20 images containing cats to 12, greatly improve the retrieval efficiency.

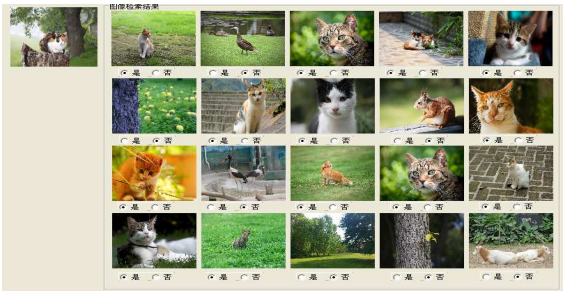

Figure 2 Search Results For The Second T Time

Usually the color histogram indexing algorithm based on color features (Swain, & Ballard, 1991) [4], the cumulative histogram (the Striker & Orengo, 1995) [5] to represent the color characteristics of the image. Color histogram of the biggest drawback is that the overall probability of the application of the color distribution, completely lost the image color space information, later research has made many improvements. Pass polymerization color vector CCV (color coherence vector) method [6]; Stricker and Orengo cumulate color histogram and color moments [5]. The above method retains the probability of color in the image information, but lost a lot of color space information at the same time, different images may have the same color feature representation: Many argue that the indexing methods of the local color features. Hsu et al. Part of them trying to combine the image color information and image color space information on the color histogram retrieval [8]. Smith and Chang color automatic segmentation method [9], the formation of a binary set of color index. In image matching to compare the distance of the image color set and color areas of spatial information. The human eye is generally more sensitive to the main colors, therefore it was suggested that the main colors-based retrieval method [10, 11]. Color by color quantization error, which makes the originally very similar color to be quantified to a different range, resulting in leakage chooses the image matching. Normal distribution fitting method to obtain an extension of the specified color value to extend the main colors, and can compensate for errors caused by quantization.

Different color characteristics of the index of the similarity matching algorithm based on the color index the content and the different algorithms, including histogram intersection method, Manhattan distance, absolute distance (L1), the second distance (L2), and the Euclidean distance 12].

Texture refers to the image pixel gray set or some kind of regularity of color changes can be considered as arising from certain changes in the form of grayscale (color) in the space pattern. The general texture image gray distribution has some kind of cyclical, with certain statistical properties, but usually the high-frequency components in the image spectrum are closely linked. Image texture features six areas: roughness (coarseness), contrast (contrast), the direction degrees (directionality), lines like degree (line-likeness), regularity (regularity) and rough (rough-ness) [13], of which the most important features is the roughness of texture, contrast and orientating degrees.

Texture analysis methods can be basically divided into four categories for the statistical method, the structural method, the model and the space / frequency domain joint analysis method [14], and statistical results of the analysis as an index of the image. The method is based on statistical information for statistical distribution of color intensity in the image space, including the co-occurrence matrix method (Haralick & Shanmugam, 1973), Laws texture energy method [15,16]; structure-based approach to focus on the analysis of texture on the interrelationship between and regularly arranged; assumptions texture model-based approach by some type of distribution, such as Markov Random Field Model, the fractal model; joint analysis based on the space / frequency domain including Gabor transform and wavelet transform method .

Study pure mathematics in the 1970s, Haralick et al. Grayscale image texture space dependencies and texture characteristics of co-occurrence matrix notation [17]. Tamura et al. From the psychological point view of visual texture representation and texture nature have expressed an intuitive visual significance to the corresponding human visual perception [13], 1980s, the random field model for texture classification and identification. FSCohen Gaussian Markov random field model (GMRF), the

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

identification of nine kinds of natural texture of 99-100% corrects [18]. DKPanjwani and G-Healy, further GMRF model for color texture image segmentation and have achieved good results [19]. In the 1990s, the wavelet transform theory is applied to the texture representation. People after the wavelet transform coefficient as the index of the image, such as Smith and Chang, extracted from the wavelet sub-band statistical characteristics as the texture of the image, and achieved very good retrieval results [20-21]. The shape is a distinctive feature of the image, the shape is generally considered to be the area surrounded by a closed contour curves involves the description of the shape of the contours of the boundary description and the description of the region surrounded by this border. The results described in the Approximation are the boundary in the image area.

Shape features to retrieve matching methods are based on the accurate extraction of the shape in the image region under the premise of pattern recognition to automatically extract the shape of the region is still immature, need to develop a more accurate method.

For multi-feature retrieval in terms of weight, in addition to the choice of feature selection and combinations thereof, a reasonable set of all features is another important factor to affect the search results.

Retrieval method based on color, texture, shape, or multi-feature retrieval method, belonging to image low-level visual content. Image retrieval technique based on the color characteristics of the image from the computer's point of view as a discrete pixel between the pixel is isolated and can only say that the image presented by the overall consistency of color, cannot distinguish between the image internal characteristics; retrieval based on texture features is considered on the basis of color, adjacent like the relationship between the image measure of regularity, roughness, direction and degree of linear features; shape-based retrieval is image segmentation into a closed area, shielding the background of the image, such as details of the elements, and more approaching the image of the cognitive.

Image is in fact the people of the world cognition indirectly, an image full of rich semantic information, not just the color, texture, shape, in addition, the image is full of a physical object, the object in space on the existence of a relationship, one or a series of images can represent a specific scene and action, and even some of the images contain a wealth of authors emotional and moral.

Image retrieval, there is always a rough idea, the concept of the object described in the image scene events and the emotions expressed high-level semantics of images, including image content, so in recent years a high-level semantic content-based image retrieval technology research, has become the key to solving the gap between the image of simple visual features and user semantics.

The relationship between characteristics of the space between objects and objects in the image to image retrieval has been important research direction of the image database retrieval the Tanimoto primitive method to represent the image entities, and the primitive image object index. Subsequently Chang adoption of the, and propose to use the two-dimensional string of symbols (2D-String) method to retrieve the image spatial relationships, this method is simple and their symbols for parts of the image reconstruction from the 2D-String map, many people adopt and improve: Jungert based on the minimum bounding box of the image object to represent the spatial relationships between objects , respectively, in overlapping relationship between the x-axis and y-axis projection interval; Lee and Hsu et al. 2DC-String method; point set topological relations between the the Nabil comprehensive 2D-String methods and the objects in the two-dimensional plane, the 2D-PIR retrieval method.

4. CONCLUSIONS

Explicit content-based image retrieval is particularly important with the increase of the image database, extract what image characteristics, how to extract features for efficient and accurate retrieval of the core issue of content-based image retrieval. The Fourier transform extracts texture features, the boundary moments detect the image boundaries, then the introduction of relevance feedback algorithm, the prototype system, the basic realization of a high-speed, efficient image retrieval in future research will try to choose a different relevance feedback retrieval algorithm further improve the retrieval efficiency of the system.

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