

The Research of Techniques in Content-based Image Retrieval

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Abstract. Image feature extraction is the realization of content-based image retrieval based on the first step, but also is the most critical step. Image feature extraction is suitable or not directly affect the performance of image retrieval system, this paper describes the features of the image, and construct a feature-based similarity metric matrix. By using these matrix combinations, a kernel based image similarity measurement matrix is constructed, which lays the foundation for the clustering processing of similarity matrix.

Keywords: image retrieval; feature extraction; Similarity matrix.

1. Introduction

With the development of network technology and digital video image processing technology, a variety of large-scale image database have emerged, the Internet has entered the era of an image and video and other multimedia information for the main content. The content of the image retrieval is achieved directly through the analysis of image content retrieval based on the process accords with the human cognitive process, can better meet the user search demand. The content of the image retrieval technology is widely used in many areas based on, for example in the daily shopping, you can directly use the mobile phone to shoot pictures of the merchandise to the commodity information retrieval in the field of medical image, through the technology of searching similar cases.

2. Strategy of Image Retrieval

Content based image retrieval must first extract the features that can represent the content of the image, and the appropriateness of the image feature extraction is directly related to the final image retrieval results, and figure 1 shows the content based image retrieval process.

In image retrieval, we can usually use three kinds of extraction methods of image feature extraction of image feature extraction based on region based feature extraction based on the characteristics of the object.

The image feature extraction feature extraction strategy based on the entire image, such as color feature of [1], this method does not need to image segmentation, the calculation speed is fast, the disadvantage is not reflected in image information. [2] feature extraction strategy each segmented region based image segmentation to extract regional features based on this class. The method can obtain the image object information, regional segmentation cannot drawback is the accurate expression of the characteristics of the object, the computational complexity is large. The object feature extraction strategy [3] to identify the target in the image based on the extraction of the semantic content of the image, this method can realize the semantic retrieval, improve The accuracy of retrieval is that the extraction of object semantic content is still immature.

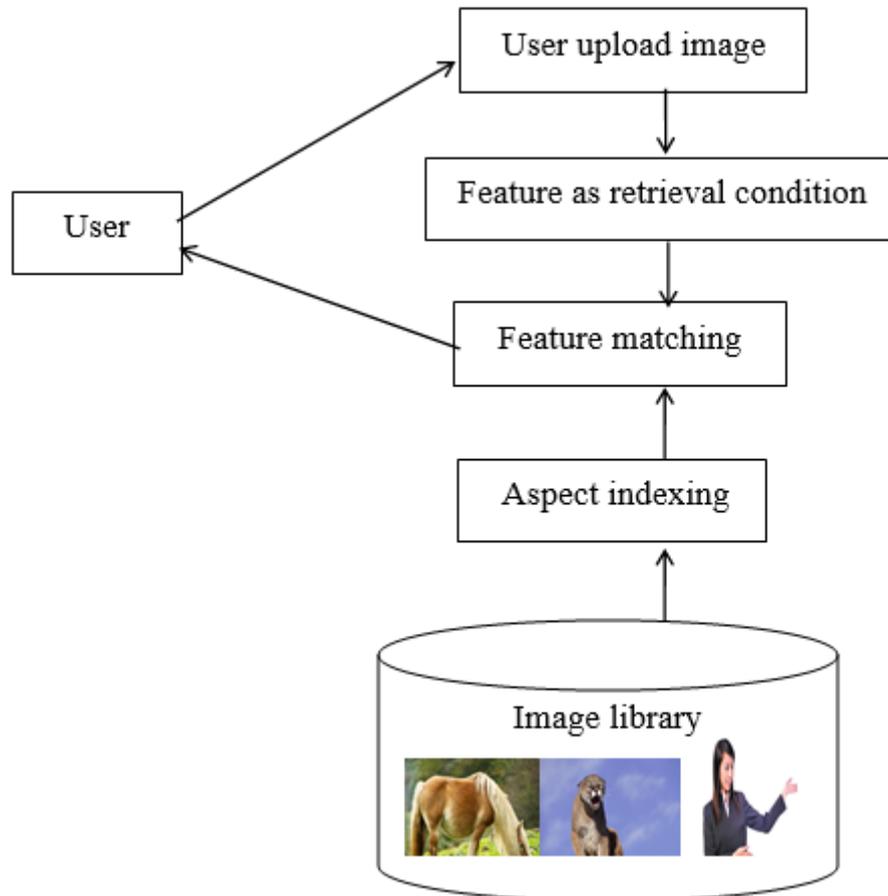


Figure 1. content-based image retrieval

3. Image Feature Extraction

In the process of image retrieval, image database of each image has its own feature, when a user query input image, feature extraction of user input image system, and the characteristics of image features and image database for comparison, to find the most similar image feedback to the user. Feature extraction is content-based image retrieval the key step is based on the image after this step by the image data into a feature. For the retrieval of image features are the following:

3.1 Color Feature

Color is the most basic description of image content and visual features are the most effective and widely used in image retrieval. The color feature is the most commonly used, it can reflect the image of the scene information, but also for the image rotation, zoom and has better robustness. The image feature is the most commonly used color histogram the use of a variety of color features, the frequency statistical characteristics in the image. The image fuzzy color histogram retrieval method has been widely concerned based on color histogram is more efficient compared with the traditional.[4][5]

3.2 Textural Feature

Texture analysis is an important research content belongs to image analysis processing, gray distribution of texture features by analyzing the commonly used to describe the neighborhood pixels in the image. The images often contain rich texture, so the texture feature is one of the important features of image retrieval. The texture features are commonly used Gabor texture features and [6] wavelet texture features. The texture analysis and feature extraction based on the structure of the complex texture can be regarded as by the simple texture unit in a certain rule arrangement, so the texture features can by nature and spatial relationship between the unit texture units to represent.

3.3 Form Feature

Image shape feature description relies on image segmentation and image segmentation, the result is not satisfactory, and time consuming in larger applications limited real-time, commonly used shape feature description of length and width, rectangular, circular, invariant moments and contour descriptor Fu Liye [7]. When the object is segmented from in the image, the shape of a variety of features and dimensions in combination, can be used to distinguish different objects according to shape feature retrieval in recent years. Based on more research is to consider how to effectively shape similarity between computers.

3.4 Key Point Feature

The key points are those points in the image gray level changes, such as corner, dot. Key features can be applied to image matching, object description and recognition in many aspects, such as moving object tracking. An image contains many key points, key points of common features are: significant point wavelet feature, Harris feature point, the key point is the most widely used features of SIFT [8].

4. Performance Analysis of Feature Classification

In order to test four kinds of image features to distinguish ability, the Caltech256 based image database to test four kinds of characteristics of their performance in clustering analysis. Using K clustering algorithm. In the experiment, three tests were used 1200 images, 2400 images and 3600 images. The experimental results are given in Table 1 error rate.

Table 1. performance analysis of four feature images

Image Number \ Feature	1200	2400	3600
Color feature	22.79%	23.37%	24.38%
Textural feature	21.98%	22.04%	22.83%
Form feature	21.36%	21.94%	22.69%
Key point feature	20.15%	21.30%	22.46%

From the table, when the number of images increases, four characteristics of the image error rate will increase, the key features of the classification error rate is relatively low. Four kinds of features have different advantages in terms of classification, there is emphasis on the scene distinction, there is emphasis on texture segmentation, so if you can put four features in combination, will further improve the expression ability of image feature.

5. The Similarity Matrix Structure of Image

In the extraction of image features can measure the similarity between images with these features, the similarity matrix structure of image, the similarity calculation is a certain distance between images. The four characteristics of the description of the content of the image information from different angles, so how to measure the similarity between the two characteristics of the hypothesis becomes very important. A set of X , the set is a metric space, if it is a metric space $\forall p, q \in X, \exists d(p, q) \in R$, meet the following three conditions can be called distance as similarity measure:

$$p \neq q, d(p, q) > 0, d(p, q) = 0 \quad (1)$$

$$d(p, q) = d(q, p) \tag{2}$$

$$\forall r \in X, d(p, q) \leq d(q, r) + d(r, q) \tag{3}$$

In the image feature extraction, image features are arranged into a vector, the content of the image is a feature vector to express the similarity between the images with the distance between the feature vector description. The commonly used method has Euclidean distance method, Mahalanobis distance method, kernel function method and other methods, the kernel function of distance: $K(x, y) = \varphi(x) \cdot \varphi(y)$. In this paper, using the similarity measure of Gauss kernel function of two images and measure the similarity matrix constructed image.

A function satisfying the Mercer conditions can be used as a kernel function is a symmetric function $K(x, x')$ satisfied

$$\iint K(x, x') \varphi(x) \varphi(x') dx dx' > 0. \tag{4}$$

$$K = \sum_{i=1}^4 a_i K_i, \tag{5}$$

K is similarity matrix,

K_i is the weight factor, parameter $\sum_{i=1}^4 a_i$ The value is 1, the value can also be adjusted according to the situation. The steps of constructing the similarity matrix are shown in figure 2:

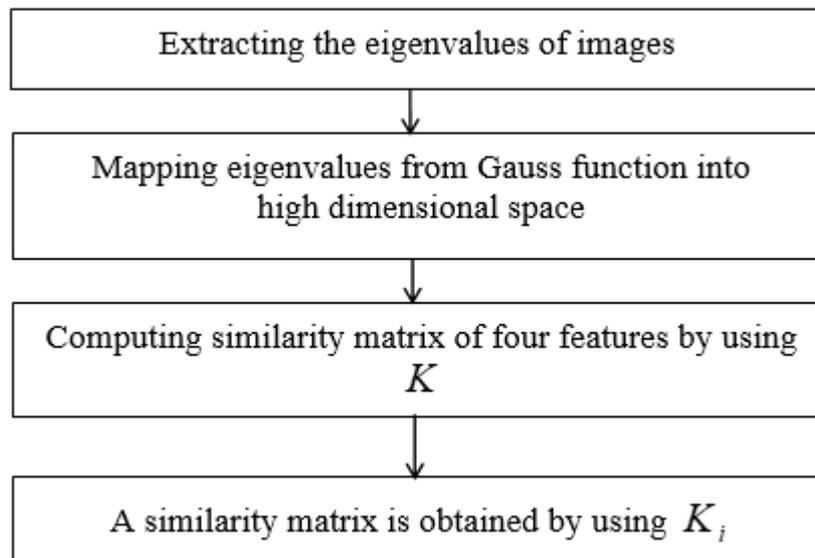


Figure 2. construction steps of similarity matrix

6. Conclusion

In image retrieval, feature extraction is the key step. This paper chooses the strategy of extracting image features based on color histogram feature extraction, both the expression of global image content, and extracts the characteristic expression of local image content. Content extraction, construction of similarity matrix using the Gauss kernel function method, and the similarity matrix into a combination of diversified expression image similarity measure matrix, similarity between images for characterization.

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