Research on Image Retrieval with Multi-features

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Abstract. This paper focuses on the key technology of image feature extraction in the image retrieval of the base ten-content, and systematically discusses the extraction technology of the low-level visual features of the image. The covered content mainly includes the color features, shape features, texture features and color space of the image. The characteristics of distribution are important. In-depth analysis and research on some key technologies in the field of image retrieval in the base ten content, including the description methods of the main low-level features (color, shape, texture, spatial position) of the image, the similarity measure between image features and the image retrieval algorithm Performance evaluation methods, etc.

1. Introduction

With the development of the information age, the carrier with information volume is becoming more and more abundant. It has not been limited to the single way of text, and the image contains more information carrier forms, such as images, videos, audio, etc., and also enters ours [1-3]. Life, you can see a variety of image information, commercial posters, advertisements, flyers, etc., all of which are images. With so many images, we quickly came to our attention. In these image libraries, we wanted to find images we are interested in, such as a needle in a haystack. Since the 1990s, scholars proposed content-based image retrieval. The development of image retrieval can be traced back to the 1960s. Text-based image retrieval is researched. By inputting keywords, the image is manually labeled first, and the retrieval of an image is converted to keyword search. This method is very difficult to meet the needs of users. The limitations are mainly reflected in the following aspects: The first is that the image contains an amount of information that can be described by not a few words, which limits the full expression of the image information; the second image needs to be annotated. And the annotations are not needed. The unified norms are the expressions of subjective will; the third network information is published on the Internet, and people in different regions have different understandings of the same information.

It has been found through research that it is very difficult to find an image in a huge database with the rapid growth of the image library. The text-based manual annotation method is difficult, and it is not suitable for the current development. Aiming at the shortcomings of traditional manual labeling, the research topic of content-based image retrieval has been rapidly researched and applied. This research method has solved the problem of manual labeling, and it is an automated, intelligent and objective search technology. The content-based retrieval is extracted by the feature information of the image itself, and the image required by the user is found in the image library, in the image itself includes the texture, shape, color, etc. of the image, and the idea is to select a related algorithm to extract the image feature [4]. The feature is used as a retrieval index to output the retrieval result, which is an objective and effective retrieval method. At present, the field of image retrieval has penetrated into all aspects of our life, medical images, industrial manufacturing drawings, etc., thus improving the practicality and efficiency of the image retrieval system, and has great significance for practical applications [5].
2. Related technologies for image retrieval

2.1. Principles of Image Retrieval

Image retrieval refers to the retrieval of content and context of media and media objects in a multimedia database, querying and returning media objects that meet user requirements. The related research technique of content-based image retrieval illustrates the principle of image retrieval, mainly by extracting the information of the image itself, comparing these features as an index with the image in the image library, calculating the distance between the two, and sorting according to the distance. We get the most similar image [6-7].

The basic retrieval steps for content-based retrieval are as follows:

1. Image preprocessing
   There are subjective and objective factors in the whole process from image acquisition to storage, which will cause loss of image quality. Image preprocessing restores the original appearance of the image as much as possible, so it is very early for the preprocessed image. Affecting the performance of the algorithm and the results of the search is important [8].

2. Extracting image features
   For image feature extraction, high-level semantic information is expressed by low-level physical features to express images. The accuracy of the algorithm is accurate or not, when extracting image features determines whether the image information. The performance of an algorithm when performing image feature extraction is critical to the outcome. When the traditional method is improved, the shortcomings of the original algorithm are considered, and the improvement is made on the basis to improve the efficiency and performance of the algorithm [9].

3. Similarity calculation
   After extracting the features of the image, we calculate the distance between the retrieved image and the image in the database. The smaller the absolute value of the image distance, the closer they are, when calculating the image distance. According to different image features, different test methods are selected to achieve satisfactory results [10].

4. Result output
   According to the calculation result of the third step, the retrieved images are sorted according to the absolute value of the distance from small to large, and the result is returned to the user, and the threshold and weight in the algorithm are reset according to the feedback result. Finally, to meet the needs of users, in the experiment, you can set the number of returned images [11].

5. Evaluation of results
   The retrieved images are compared with the images that need to be retrieved, whether the required images are retrieved, and the results after the search are comprehensively evaluated, and whether the comparison results have a satisfactory effect. And the recall rate is considered whether the precision is improved, whether the improved algorithm improves the time efficiency compared to the traditional algorithm [12].

Figure 1 is a flow chart of image retrieval.
2.2. Feature similarity measure algorithm

(1) European distance

Euclidean distance is the most common measure of distance. The physical distance that is commonly understood is measured in this way. Many image retrieval systems also use this method. Its definition is as follows:

$$D(A, B) = \sqrt{\sum_{i=1}^{n} (a_i - b_i)^2}$$  \hspace{1cm} (1)

Euclidean distance calculation is simple, the complexity is $O(n)$, and the physical meaning is clear.

(2) Histogram intersect

The histogram intersection method was first proposed by Swain et al. in 1991, which can better suppress the influence of background factors on image retrieval. Its mathematical description is:

$$D(A, B) = 1 - \sum_{i=1}^{n} \min(a_i, b_i)$$  \hspace{1cm} (2)

After normalization, it is:

$$D(A, B) = 1 - \frac{\sum_{i=1}^{n} \min(a_i, b_i)}{\min(\sum_{i=1}^{n} a_i, \sum_{i=1}^{n} b_i)}$$ \hspace{1cm} (3)

(3) Second distance

The second distance is often used in the search algorithm of the base ten color histogram. It considers the similarity between different colors and the correlation between colors, which is more in line with human perception of color. Therefore, the search results tend to be more than the European
And the histogram intersection method is more accurate, but the calculation of the secondary distance is larger. Specifically expressed as:

\[ D(A, B) = (A - B)^T M (A - B) \]  \hspace{1cm} (4)

(4) Cosine distance
The difference in the direction of the cosine distance metric vector is defined as follows:

\[ D(A, B) = 1 - \frac{A^T B}{|A||B|} \] \hspace{1cm} (5)

In addition, the distance between the vectors of feature is measured by correlation coefficients, chi-square distances, and so on.

In the above distance measurement method, there is no optimal distance common to all descriptors. Different descriptors, because of their different extraction methods, each dimension of the feature vector represents different meanings, often need to adopt different distance measurement methods. And this most suitable distance needs to be analyzed by analyzing the construction of feature vectors, and continuously testing various distance measures.

2.3. Algorithm performance evaluation criteria

The algorithm performance evaluation criterion, that is the criterion for distinguishing the advantages and disadvantages of the algorithm, is an important aspect of the image retrieval research which is the base of ten content. At present, the evaluation criteria mainly focus on the accuracy of the retrieval results, and pay less attention to the indicators such as the response time of the system and the occupation of the storage space. Next, we will introduce several evaluation methods for retrieval performance.

(1) Recall rate and precision rate

The recall and precision are commonly used in text retrieval and were later introduced into image retrieval. The recall rate is specified, in a search, the relevant results retrieved account for the proportion of all relevant results in the image library. The precision ratio refers to the proportion of the related results retrieved in a search in the search results. Obviously, in the same number of search results, the more related images, the more images are correctly returned, and the more accurate the search results.

R is used to represent the set of search results, and S is used to represent the set of all the images in the image library related to the query image. The recall and precision can be expressed as:

\[ \text{recall} = \frac{|R \cap S|}{|S|} \] \hspace{1cm} (6)

\[ \text{precision} = \frac{|R \cap S|}{|R|} \] \hspace{1cm} (7)

The higher the recall rate and the precision ratio are, the better the performance of the image retrieval system is. However, these two values are a pair of spears. When the recall rate is high, the search rate tends to be lower, and vice versa. In general, when the image retrieval system finds a suitable balance between the two, it is considered to achieve better retrieval performance.

(2) ANIVIRR

ANMR (Average Normalized Modified Retrieval Rank) is an evaluation method recommended by the MPEG-7 standard. The ANMRR range is from 0 to 1, and the smaller the value, the more accurate the search results.

There is evidence that the ANMRR evaluation results are basically consistent with the subjective evaluation of human retrieval accuracy.

Let NG(q) denote the number of images in the image library similar to the query image q, and Rank(k) denote the position of the k-th image in the image library similar to the query image q in the search result sequence, define the image library and The average position of the image similar to the query image q in the search result sequence is:
\[ VR(q) = \frac{1}{NG(q)} \sum_{k=1}^{NG(q)} \frac{\text{Rank}^*(k)}{NG(q)} \]  

(8)

Among them,

\[ \text{Rank}^*(k) = \begin{cases} \text{Rank}(k), & \text{Rank}(k) \leq K(q) \\ 1.25 \cdot K(q), & \text{Rank}(k) > K(q) \end{cases} \]  

(9)

\[ K(q) = \min \{ 4 \cdot NG(q), 2 \cdot \max \{ NG(q) \forall q \} \} \]  

(10)

The value of AVR(q) varies with the change of NG(d). To eliminate the effect of NG(q) on the value of AVR(q), define Modified Retrieval Rank as:

\[ \text{NMRR}(q) = \frac{\text{MRR}(q)}{1.25 \cdot K(q) - 0.5 \cdot (1 + NG(q))} \]  

(11)

Thus, the value of NMRR(q) is always between 0 and 1, independent of the value of NG(q). In the worst case, the image in the picture library that is similar to the query picture q is later in the search result sequence (after the threshold K(q)), at which time NMRR=1. Naturally, an ANMRR is defined to represent the retrieval performance of the descriptor for all query images. ANMRR is defined as:

\[ \text{ANMRR} = \frac{1}{NQ} \sum_{q=1}^{NQ} \text{NMRR}(q) \]  

(12)

Where NQ represents the total number of query images.

2.4. Experimental environment

In the previous chapter, the image retrieval system GIRS, which is designed and implemented in this paper, is described in detail. It constitutes the basic environment of the next experiment: it provides a common evaluation algorithm interface, and uses ten to quantify the retrieval performance of various descriptors: it provides an easy-to-use user interface, and visually displays the retrieval results corresponding to each descriptor. Hardware environment: Intel i3 processor, 2GB RAM. Operating system: Ubuntu 12.04 on the server side and Windows XP on the client side.

2.5. Evaluation criteria

The generality, convenience and effectiveness of the ANMRR evaluation algorithm in the field of CBIR, the experiments in this paper will be measured by the ANMRR algorithm. The commonality of the ANMRR algorithm is reflected in the fact that the algorithm is an evaluation algorithm recommended by MPEG-7 and is widely used in the CBIR literature. Convenience is reflected in: ANMRR algorithm finally calculates a certain value to judge the pros and cons of the retrieval algorithm. The value is simple and clear, and the evaluation algorithm is easier to use than the precision and recall curve. The effectiveness is reflected in: The research shows that the ANMRR evaluation algorithm calculates the accuracy of the retrieval algorithm, which is consistent with the subjective feelings of the query results corresponding to the retrieval algorithm.

Through the comparison and analysis of the effects of different image feature extraction techniques in image retrieval, the retrieval experiment of image feature fusion is carried out. For Figure 2 and Figure 3, the algorithm results in the existing literature are compared with the algorithm of this paper. The line graph shows the advantages and disadvantages of the algorithm more clearly.
In fact, the accuracy of the above search results can be accurately quantified using the ANMRR algorithm. Figure 4 shows the NMRR values for each descriptor when retrieved on a WANG dataset using a query image. The smaller the NMRR value, the more accurate the search result of the corresponding algorithm. Obviously, the FCEH algorithm proposed in this paper is superior.
Fig. 4 NMRR values for each descriptor when using a query image

For all query images on the WANG dataset (20 photos), on the WANG dataset, the ANMRR values of the descriptors are compared, seen Figure 5.

Next, experiments were performed on various descriptors on the UCID data set. According to the literature, the author has a ground truth file provided with the UCID data set. The query image contains a total of 262 images. Figure 7 shows the ANMRR values corresponding to the descriptors on the UCID data set.
Fig. 6 ANMRR values corresponding to each descriptor on the UCID data set

3. Conclusion

By combining the existing fuzzy color histogram algorithm with the EHD descriptor in the MPEG-7 standard, an image feature description method (CF CEH) for fuzzy color and edge histogram is proposed. At the same time, the spatial position information is obtained by using the block idea. Incorporate into it to improve image retrieval.

Based on Python, a system based on GIRS is built. The system integrates FCEH and various existing image retrieval algorithms, and provides interfaces such as image retrieval and algorithm evaluation. The content of the drop is like the experimental platform of the search algorithm research, but also the stone's prototype is a common image retrieval system like Google similar images, Baidu maps and so on.

The GIRS system was used as an experimental platform for comparative experiments and results analysis. The results show that according to the ANMRR evaluation algorithm, the proposed FCEH algorithm has improved retrieval performance compared with many traditional image retrieval algorithms.

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