Content-based Image Retrieval based on Integrating Region segmentation and colour histogram

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Abstract: *Ddevelopments in multimedia technology, increasing number of image retrieval functions & capabilities has led to the rapid growth of CBIR techniques. Colour histogram could be compared in terms of speed and efficiency. We have presented a modified approach based on a composite colour image histogram. A major research perspective in CBIR emphasize on matching similar objects based on shape, colour and texture using computer vision techniques in extracting image features. The colour histogram is perhaps the most popular one due to its simplicity. Image retrieval using colour histogram perhaps has both advantages and limitations. This paper presents some recommendations for improvements to CBIR system using unlabelled images. The experimental results presented using Matlab software significantly shows that region based histogram and colour histogram were effective as far as performance is concerned.*

Keywords: *Image analysis, content based image retrieval, retinal imaging, Gray scale and Semantic description.*

1. Introduction

Content-based image retrieval (CBIR) aims at developing techniques that support effective searching and browsing of large image digital libraries on the basis of automatically derived image features [1,5]. The similarities (distances) between the feature vectors of the query images and the images stored in the database are calculated and retrieval is performed by the indexing scheme. Indexing normally improves the retrieval performance and hence it can be used to effective retrieval process. Indexing relevant images as per the query image should retrieve images in the order of similarity of the query image. Unsupervised learning can be applied to those types of problems where in the main issue is to organize the data. So far, a major breakthrough in image retrieval has not been achieved. Furthermore, there is no single universal approach to the content-based retrieval problems, even in a restricted domain application [5]. There are systems that discuss about the objects based on similarity measures. Based on the similarity of each object set in each group (also called a cluster) or they are not similar are put into different clusters. CLUE, cluster-based retrieval of images by unsupervised learning is an example of CBIR technique based on unsupervised learning [2,9,10]. However, content based image retrieval confront many image types, some of them even have not a clear object, so some strategies have to be dealt to reduce such a problem. The main objective is to reduce dependence on accurate image segmentation for a practical image retrieval system [4]. Through the user's feedback high-level semantics could be obtained based on machine learning theory. Such user participation in image retrieval system [3, 6] will be helpful or much effective. Work relating to multipoint query [7], sampling signature [13] or manifold learning [4,7] would be good enough for CBIR systems. In this paper, a colour image retrieval scheme based on a composite colour image histogram and norms of residuals values is described. The paper is organized as follows. Section 1 presented some of the basics on CBIR. Section 2 presents the related work and section 3 presents the proposed work. Section 4 deals with segmentation and visual features, while section 5 discuss on relevance feedback based on residual values. Section 6 illustrates the experimental results and finally section 7 gives the conclusion.

2. The Research Method

Techniques of colour histogram content-based image retrieval could be compared in terms of speed and efficiency, and a modified approach based on a composite colour image histogram processing is introduced. The proposed approach is fast and provides results comparable to those of much slower algorithms [14]. In the above paper a new histogram based image retrieval technique have been proposed which outperforms most previous methods in terms of speed and accuracy. Research of content-based image retrieval, visual signature based on region was attracted more attention. In order to get the signature based on region, the crucial step is image segmentation, and reliable image segmentation is also critical to get the image shape description. Unfortunately, it has been demonstrated that accurate image segmentation is still an open problem [1]. The authors have suggested some strategies for dealing with this problem to reduce dependence on accurate image segmentation for a practical image retrieval system. Due to the semantic gap, there is still many shortcomings for image retrieval system only with the low level visual features. Based on the high dimension bio mimetic information geometry theory, we segment image into main region and margin region for cognition the whole image characteristic. A prototype image retrieval system was made using the colour and texture features of regions. CBIR combining some percentage value of two features namely colour-texture features and colour-shape features would be interesting and taking the union of these two features [4] has gained sufficient interest. The combination of features provides a robust feature set for image retrieval. Evaluation is then measured based on different precision value of the image retrieval on each category of image database. The authors have proposed a content based image retrieval system based on unsupervised learning, where in, we combine all the features values namely shape, colour and texture of an image for assigning a weight on different images (as a target images) in the image database with 60% features stores of each visual features. Content Based Image Retrieval based on unlabelled images and recommendations for improving the CBIR system using unlabelled images improves the retrieval results. The authors have presented a survey in the field of content-based image retrieval, providing an overview of the most important aspects characterizing that kind of images. The image databases are classified into the labelled image as relevant, irrelevant and also unlabelled image [10].

3. Proposed Algorithm

The proposed CBIR framework is given as shown in the Figure 1. The sequence of steps is given below.

Step 1:Input: A Query image "I".
Step 2: Compute image segmentation and then calculate features (colour, texture and edge) values of the image.
Step 3: Convert I to Grayscale
Step 4: Construct Histogram of Image.
Step 5: Similarity comparisons between input images
Step 6: Finally relevant images are retrieved with respect to corresponding query image I.
Step 7: Repeat step 1 to 6 for rest of the query images.
Step 8: End.

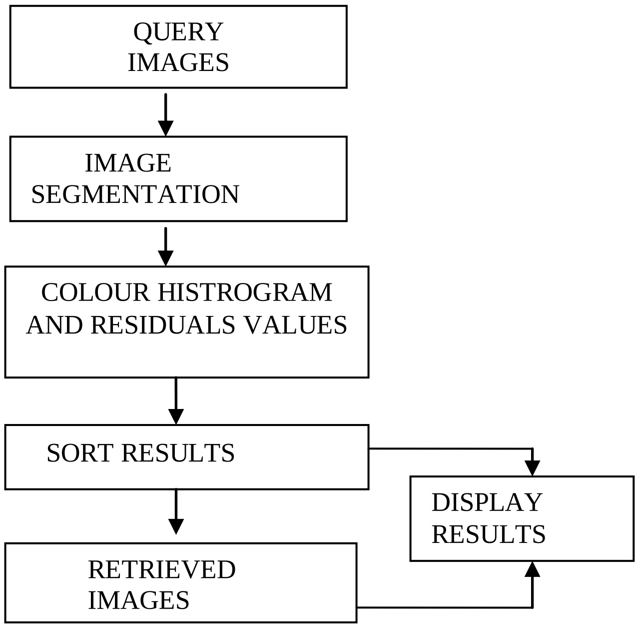

Figure 1.Proposed architecture for CBIR system

The flow diagram for the sequence of steps is presented in Figure 2.

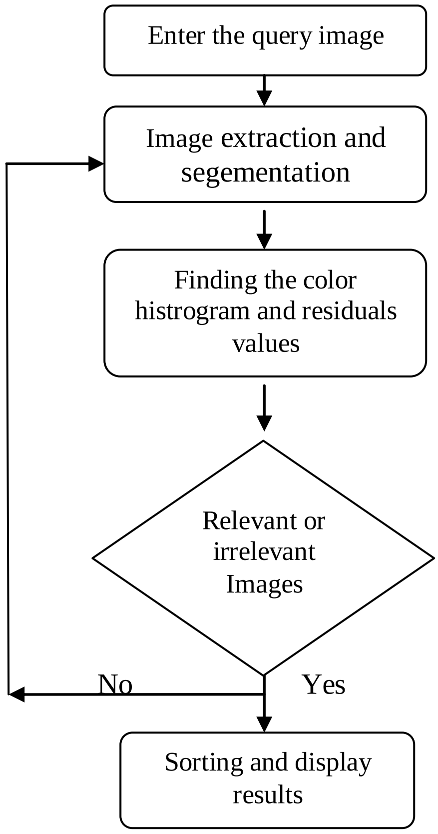

Figure 2.Flow diagram CBIR system

4. Main and marginal segmentation and its region visual features

Image segmentation is the key to visual understanding. Regional signature based on image segmentation is also desirable for object marching in content-based image retrieval. Unfortunately, reliable image segmentation is still an open problem. Some most widely used segmentation approach is k-means clustering method. The advantage of the proposed method is effective computing and satisfaction of real time facts. Apparently the disadvantage is not so refined that affect some features, such as the shape extraction. Based on high dimension bio mimetic information geometry theory, we segment image into main region and margin region. For the objects are often located centre area, it usually represents the main target in image. While margin region provide the environment of the object, it also have certain auxiliary function for image retrieval. We can cognition the whole image characteristic through combining the main region and margin region (see Figure 3). To extract image features, we select the width of margin as 0.1 of image size according to the experiment results. Colour histogram is one commonly used visual features and has a computation simple but efficient characteristics.

Owing some colour spaces (e.g. LUV, HSV) seem to coincide better with human perception than the basic RGB colour space, so we use HSV colour space for histogram-based descriptors. For balance calculation efficiency and retrieval accuracy, we chose the bin's size as (32,16,16). In order to reduce the sensitivity of the center of histogram bin, we slide smooth the colour histogram by average the adjacency histogram value. We chose Gabor filters which are preferred for the local and global texture analysis as image texture features [1]. By using pre-computed filter template to improve computational efficiency, five scales, eight directions of Gabor filter templates were calculated. Only the value of HSV colour space was filtering, mean and variance of resulted filtering image take as the final texture descriptors. Concatenating it with the colour features as the whole region features. Euclidean distance between features as similarity measure. We simply use the average of main and margin distance as decision fusion.

Figure 3. Main region and Marginal region segmentation

5. Relevance feedback based on Norms of Residual values

Relevance feedback (RF) is a query modification technique, originating in Information Retrieval that attempts to capture the user's precise needs through iterative feedback and query refinement. For image similarity are concerned with user's intention, using relevance feedback can improve the performance of image retrieval system [6,15]. According to our experiments we calculate the norms of residuals values of each relevant and irrelevant images and then compare both values. After comparing the residuals values we have found the relevant images having certain range of values and irrelevant images values are not equal with the relevant images values. Table 1 and Table 2 shows the values of relevant and irrelevant residuals values.

Table 1.Norms of residual values of relevant images

IMAGE ID	COEFFICIENT S VALUES	NORM OF (RESIDUALS)	X[11 12]	F(X)
I-1	1.33, 92.71	**689.57**	108	107
I-2	-3.25, 159.19	**477.43**	130	128
I-3	-1.48, 96.25	**453.69**	82.9	82
I-4	2.78, 98.56	**611.56**	122	123
I-5	-0.23, 155.48	**514.16**	153	153
I-6	-2.531, 148.56	**468.35**	124	122
I-7	-0.71, 130.97	**447.73**	123	123
I-8	-3.11, 154.71	**455.87**	125	123
I-9	-1.05, 120.58	**467.64**	112	111
I-10	-0.50, 154.40	**433.12**	150	150

According to relevant images having the values range from 400 to 500 approximately.

Table 2.Norms of residual values for irrelevant images.

IMAGE ID	COEFFICIENTS VALUES	NORM OF (RESIDUALS)	X[11 12]	F(X)
I-1	-2.97, 262.10	**379.3**	236	234
I-2	1.27, 133.07	**331.01**	143	143
I-3	-3.43, 131.34	**218.75**	101	99.3
I-4	5.25, 81.37	**272.1**	128	131
I-5	1.14, 162.23	**328.59**	172	173
I-6	0.27, 158.59	**353.57**	160	160
I-7	-5.72, 131.33	**278.98**	82	78.8
I-8	2.88, 180.89	**355.2**	205	207

According to irrelevant images did not have the ranges of values and not equal, so we consider that these images as irrelevant images.

6. Experimental Results and Analysis

We have made relevance feedback based on this platform. For users convenience, 10 pictures of each category were selected for labelling. The dimension of visual feature of main and margin region is reduced based on linear discriminate analysis respectively. The average distance of them are used for fusion. For comparing retrieval performance after relevance feedback, we use the same query sample as before retrieval results is shown as Figure 4.

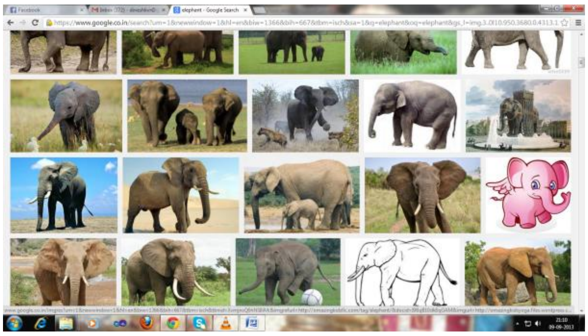

Figure 4 Query image for Elephant

Figure 5 and Figure 6 shows the histogram of relevant and irrelevant images respectively.

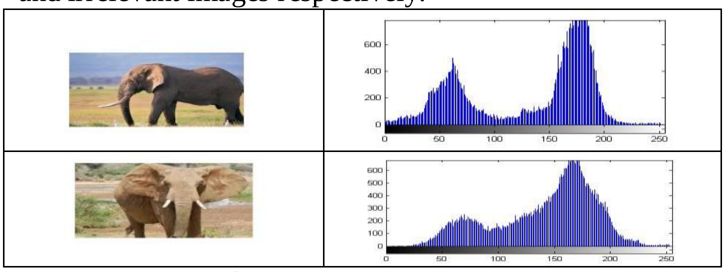

Figure 5. Histogram of Relevant images

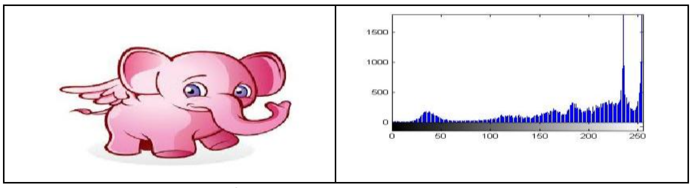

Figure 6. Histogram of Irrelevant images

From the above Figure 5 and Figure 6 we infer the histogram of relevant and irrelevant images. In the RGB histogram method [7], three 256-bin histograms are created representing red, green and blue. These are compared using histogram intersection in each channel and the mean value is computed. The required operations after normalisation are only 768 comparisons. Such normalization using Gaussian filtering, which makes the algorithm very fast. However, two problems arise. First, the method is very sensitive to lighting conditions due to the nature of the RGB colour space. Secondly, perceptually similar colours are interpreted as completely different thus giving non-appealing results. In Figure 1, each bin that holds a non-zero value in one histogram holds a zero value in the other. The intersection of the two histograms holds a result of zero value, although the two histograms are quite similar. The computational time is very short, but the accuracy of the method is not acceptable for most applications. An improved version of this method is the retrieval of a three-dimensional histogram having as axes the values of red, green and blue. This greatly improves the accuracy. However, the number of required comparisons is 224, which means that in this form the algorithm is not of practical use. Reducing the number of bins of the axes improves speed, but lowers accuracy. Using 32 bins per axis (32,768 colours), the algorithm gives moderate results at a reasonable computational burden (32,768 comparisons).

7. Conclusion

In this paper, we proposed a content based image retrieval system based on unsupervised learning, where in, we combine all the features values namely shape, colour texture, norms of residual values for an image for assigning a weight on different images (as a target images) in the image database with 60% features stores of each visual features. We experimented with a standard image database consisting of approximately 100 images to compare the performance of the proposed systems by combining both shape-colour features and colour-texture features. We have taken the union of these two approaches and experimentally, we found that the union of both gives the better performance at different residual values. In our experiments, we used histogram gray scale image as the similarity measure for computing the similarity of images in the database with a query image. Experimentally, we found that the CBIR systems after taking union outperforms at smaller residual at k (almost 100%) in almost all categories of an image database. Experimentally, we also found that the proposed CBIR system gives better results than the CLUE and UFM based CBIR systems.

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