Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 50 (2015) 374 – 379

Procedia Computer Science

2nd International Symposium on Big Data and Cloud Computing (ISBCC'15)

Content Based Image Retrieval Using Colour Strings Comparison

Kommineni Jenni[12], Satria Mandala[123*], Mohd Shahrizal Sunar[23]

[1]*Department of Computer Science*
Faculty of Computing
Universiti Teknologi Malaysia, Malaysia

[2]*UTM-IRDA Digital Media Centre*
Media and Games Innovation Centre of Excellence
Universiti Teknologi Malaysia, Malaysia

[3]*IJN-UTM Cardiovascular Engineering Centre*
Universiti Teknologi Malaysia, Malaysia

Abstract

Content Based Image Retrieval (CBIR) is a technique that enables a user to extract an image based on a query, from a database containing a large amount of images. A very fundamental issue in designing a content based image retrieval system is to select the image features that best represent the image contents in a database. In this paper, our proposed method mainly concentrated on database classification and efficient image representation. We present a method for content based image retrieval based on support vector machine classifier. In this method the feature extraction was done based on the colour string coding and string comparison. We succeed in transferring the images retrieval problem to strings comparison. Thus the computational complexity is decreases obviously. The image database used in our experiment contains 1800 colour images from Corel photo galleries. This CBIR approach has significantly increased the accuracy in obtaining results for image retrieval.

Peer-review under responsibility of scientific committee of 2nd International Symposium on Big Data and Cloud Computing (ISBCC'15)

Keywords: Content based image retrieval; Image Databases: colour string coding; strings comparison;

1. Introduction

In the early 1990's Content Based Image Retrieval (CBIR) [4], [5] was proposed to overcome the limitations

Peer-review under responsibility of scientific committee of 2nd International Symposium on Big Data and Cloud Computing (ISBCC'15)
doi:10.1016/j.procs.2015.04.032

of text based image retrieval. Increase in communication bandwidth, information content and the size of the multimedia databases has given rise to the concept of content based image retrieval. Current research works attempt to obtain and use the semantics of image to perform better retrieval. There exist many systems for image retrieval meanwhile. So, CBIR is a challenging task. Some works focused on how to represent an image, which means how to extract the visual features of an image. Some other works focused on how to understand an image, which means how to extract the objects in an image and describe the relationship between objects. All these works emphasize on the accuracy of the retrieval, but pay very little attention on the ability of responding to a huge amount of requests. However the content based image retrieval is very time consuming due to the extraction and matching of high dimensional and complex features.

Content based image retrieval is a process to find images similar in visual content to a given query from an image database. It is usually performed based on a comparison of low level features, such as colour, texture and shape features, extracted from the images themselves. While there is much research effort addressing content based image retrieval issues [1-3], the performance of content based image retrieval methods are still limited, especially in the two aspects of retrieval accuracy and response time.

Early techniques of image retrieval were based on the manual textual annotation of images, a cumbersome and also often a subjective task. Texts alone are not sufficient because of the fact that interpretation of what we see is hard to characterize by them. Hence, contents in an image, colour, shape, and texture, started gaining prominence. The rest of the paper is organized as follows. In section 2, describe the related work .In section 3, describe the proposed methodology. The experimental results are given in section 4, followed by conclusions in section 5.

2. Related work

Initially, image retrievals used the content from an image individually. For example, Huang and Jean [6] used a 2D *C*+-strings and Huang et al. [7] used the colour information for indexing and its applications. Approaches using a combination of contents then started gaining prominence. Combining shape and colour using various strategies such as weighting [8], histogram-based [9], kernel based [10], or invariance-based [11] has been one of the premier combination strategies. Shape and texture using elastic energy based approach to measure image similarity has been presented in [12]. Smith and Chang [13] presented an automated extraction of colour and texture information using binary set representations. Liet al. [14] used a colour histogram along with the texture and spatial information. Image retrieval by segmenting them had been the focus of few research papers such as [15] and [16]. A detailed overview on the various literatures that are available on CBIR can be found in [17] and [18]. A discussion on various similarity measurement techniques can be found in [19]. Despite the extensive research effort, the retrieval techniques used in CBIR systems lag behind the corresponding techniques in today's best text search engines, such as in query [20], Alta Vista, Lycos, etc. At the early stage of CBIR, research primarily focused on exploring various feature representations, hoping to find a "best" representation for each feature. For example, for the texture feature alone, almost a dozen representations have been proposed [21]. This paper mainly concentrated on database classification based on keyword and feature extraction for efficient CBIR. In this method the feature extraction was done based on the colour string coding and string comparison.

3. Proposed Methodology

The proposed methodology consists of mainly 3 steps. These are: database classification using support vector machine, feature extraction and similarity measure. In the fig 1 we can see the proposed content based image retrieval in detail as follows:

1. First, user classifies the database using SVM classifier then we will get different classes, each class have the unique class labels.
2. For given a input query image features are extracted using colour string coding and comparison method. Similarly extract the features for all images in the specified class label in the Database.
3. A similarity measurement is calculated and based on the matching score results are given to the user.

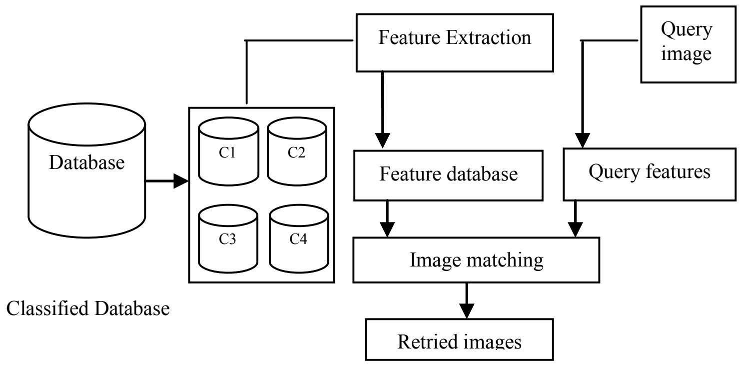

Figure 1: Proposed CBIR system

A. Database classification

In the last few years, the rapid growth of the internet has enormously increased the number of image collections available. In CBIR system, for a given input query image retrieving the relevant images from the huge database. In this procedure, comparing input query image with the each image in database. It takes large amount of time. So, we need to improve the performance of retrieving the relevant images from the huge database, firstly we need to classify the database. So, use the Support Vector Machine (SVM) classifier to classify the huge database.

i. Support Vector Machine

Vapnik proposed Support Vector Machines (SVM) in 1979 (Vapnik, 1995), but they have only recently been gaining popularity in the learning community. The main idea of an SVM is to construct a hyper plane as the decision surface in such a way that the margin of separation between positive and negative examples is maximized. The notion that is central to the construction of the support vector learning algorithm is the inner product kernel between a support vector X_i and a vector X drawn from the input space. The support vectors constitute a small subset of the training data extracted by the support vector learning algorithm. The separation between the hyper plane and closet data point is called the margin of separation, denoted by ρ. The goal of a support vector machine is to find a particular hyper plane for which the margin of separation ρ is maximized. Under this condition, the decision surface is referred to as the optimal hyper plane. The support vectors play a prominent role in the operation of this class of learning machines. In conceptual terms, the support vectors are those data points that lie closest to the decision surface, and therefore the most difficult to classify. They have a direct bearing on the optimum location of the decision surface.

The idea of an SVM is based on the following two mathematical operations:

1. Nonlinear mapping of an input pattern vector on to a higher dimensional feature space that is hidden from both the input and output.
2. Construction of an optimal hyper plane for separating the patterns in the higher dimensional space obtained from operation1.

B. Feature Extraction

Feature extraction is the process of locating an outstanding part, quality and characteristic in a given image. To classify an image, we must first extract some features out of the image. We will use this features inside a classification tool. In this paper, we can use the colour string coding and comparison [23] for efficient CBIR. We extract the features for query image and all images in database.

i. Colour String Coding

First, resize all frames to decrease the effects of variation in size. Because the frames may have different sizes, all frames are normalized to a standard size (i.e. 20 × 20 pixels) in this step. Herein, all frames are resized by the bi cubic interpolation technique [22]. Since RGB colour space is a 3-dimensional vector space, and each pixel, p (i), is defined by an ordered triple of red, green, and blue coordinates, (r (i), g (i), b (i)), which represent the intensities of red, green, and blue colour respectively. We realize that the values of r, g, and b are totally different with the altered illumination conditions. However, the relative values between r (i), g (i), and b (i) are very similar. Therefore, utilize 6 rules to transfer each frame to a colour string as follow:

(1) if a pixel R > G > B, then assigns the pixel as 'R';
(2) if a pixel R > B > G, then assigns the pixel as K(i,j,1)= 'S';
(3) if a pixel G > R > B , then assigns the pixel as K(i,j,2)= 'G';
(4) if a pixel G >= B >= R , then assigns the pixel as K(i,j,2)= 'H';
(5) if a pixel B >= R >= G , then assigns the pixel as K(i,j,3)= 'B';
(6) if a pixel B >= G >= R , then assigns the pixel as K(i,j,3)= 'C';

After the transfer, each frame will become a 2D string array, and then we will convert the 2D string array to a string as below: CCCCCCCCCCCCHCBCCCCC…RRRRRRRRRRRRRRRRRRRR (20×20 = 400 characters) we can perceive the power of discrimination between different frames because 400 characters present 6400 permutations. The 6400 permutations should have enough ability to distinguish most video frames. An example illustrates how to obtain a colour string is shown as Fig. 2.

Fig. 2 (a) Read an original frame; (b) Resize the frame to decrease the effects of variation in size; (c) Transfer the frame to a string array. From the string array, you can see the layout of the tornado, so you can see the contemplating of spatial relation. Since the six rules as above, we can get the impression of the characters "B" and "C" present blue series colours. For example, we can see the blue sky in the frame that is transferred to "B" or "C" as demonstrated as Fig.2.

ii. Colour Strings Comparison

Compare the strings str1 and str2 and return the matching weight. Compare each element of str1 to the same element in str2, where str1 and str2 are equal-size character arrays of strings, then compare each element of str1 to the same element in str3, and so on. When the same location character is the same one, increase 1 to the matching weight, and else increase 0. For example, if two frames of video have all the same characters, then the matching weight should be 400. If the matching weight is 400, then the distance is 0. The more similar frames should have higher matching weight and the lower distance.

C. Similarity measure

After database classification we will get the class labels (each class contains related images). Given input query image contains the caption. Then compare input query image caption with the each class label in the huge database. So that we can easily identify that the query input image belongs to particular class label or not. If the input query image belongs to any one of the class label in the database, now we can select only that matched class images in the database and perform retrieval operations on that selected particular part of the database based on the similarity matching. Using colour string coding and strings comparison method, compare the input query image with the all images in the selected particular database part. Based on matched score retrieve the related images from huge database.

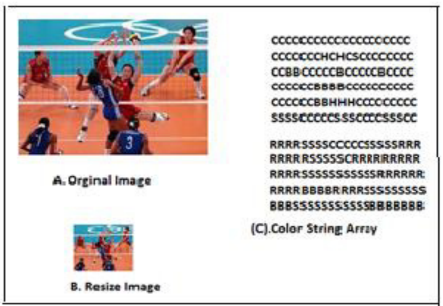

Figure.2: (a) An original frame of video; (b) Resized frame of video; (c) Transfer the frame of video to a colour string array.

4. Experimental Results

The experimental image database consists of 2000 images from various categories like Sports, Flowers, Fruits, Vegetables, Flags, Simulated Images, Tools, and Objects. The images are obtained from various websites on the World Wide Web, Corel Photo Collection compact discs, and Image Bank compact discs. The aim of the retrieval experiments is to measure the retrieval effectiveness between the without database classification and with database classification. The technique is evaluated based on precision and recall. Precision and recall measures have been widely used for evaluating the performance of the CBIR system. This is due to its simple calculations and results obtained from these measures can be easily interpreted. Apart from that, the results obtained from these measures are usually visualized through graph representations, which will make it easier to analyze. A precision rate can be defined as the number of relevant images retrieved by a search divided by the total number of images retrieved by that search. The equation is as follows:

$$\text{Precision} = \frac{\text{RelevantCorrectlyRetrieved}}{\text{AllRetrieved}}$$

$$= A/(A+B)$$

where A is relevant correctly retrieved and B is falsely retrieved.
A recall rate is defined as the number of relevant images retrieved by a search divided by the total number of existing relevant images (which should have been retrieved). The equation is as follows:

$$\text{Recall} = \frac{\text{RelevantCorrectlyRetrieved}}{\text{AllRelevant}}$$

$$=A/(A+C)$$

Where A is relevant correctly retrieved and C is relevant but not retrieved. A total of 20 images from each image category are randomly selected and retrievals are carried out. Overall, a total of 100 query images are selected for the retrieval experiments. The total number of relevant correctly retrieved images and the total number of retrieved images obtained from each of the query performed is recorded. For each query, the recall and precision values will be interpolated. The average precision at each recall level for each image category is then calculated using below equation.

$$\overline{P}(r) = \sum_{i=1}^{N_q} \frac{P_i(r)}{N_q}$$

Where Nq is the number of queries used, and $Pi\ (r)$ is the precision at recall level r for the ith query. With database classification we get the more accurate results than normal content based image retrieval. The results are shown in Table 1. Using this database classification improves the performance of the Content Based Image Retrieval than compared with normal CBIR (without database classification). This technique reduces the unnecessary comparisons and speed up the process.

Image Category	Precision		Precision Difference (%)
	Normal CBIR	With data base classification CBIR	
Flowers	0.612498	0.838040	36.823304
Fruits and Vegetables	0.351525	0.808184	129.907972
Flags	0.518326	0.879447	69.670632
Simulated Images	0.419545	0.871797	107.795826
Tools	0.374463	0.743638	98.587844
Objects	0.469689	0.809720	72.394925
Average			85.863417

TABLE -1: Precision difference between the Normal CBIR and with database classification CBIR

5. Conclusion

In this paper, we presented a new content based image retrieval approach based on the database classification using Support Vector Machine (SVM) and colour string coding feature selection. Overall our contribution, within the ever growing area of image databases is an efficient process to obtain images from huge database. Using database classification we can improve the performance of the content based image retrieval than compared with normal CBIR i.e. without database classification. Finally, this database classification and colour string coding feature selection gives the better results.

References

[1] C. Buckley and G. Salton, "Optimization of relevance feedback weights," in Proc. SIGIR'95.

[2] C. Lee, W. Y. Ma, and H. J. Zhang, "Information Embedding Based on User's Relevance Feedback for Image Retrieval," HP Labs, Tech. Rep.,1998.

[3] Y. Rui and T. S. Huang, "A novel relevance feedback technique in image retrieval," ACM Multimedia, 1999.

[4] Badrinarayan Raghunathan and S.T. Acton,"A content based retrieval engine for remotely sensed imagery", In 4th IEEE Southwest Symposium on Image Analysis and Interpretation, Austin, TX, USA, pages 161-165, April 2000.

[5] Badrinarayan Raghunathan and S.T. Acton,"A content based retrieval engine for circuit board inspection", In Proceedings of the International Conference on Image Processing, Kobe, Japan, pages 104-108, October 1999.

[6] V.N.Gudivada and V.V.Raghavan.: Special issue on content-based image retrieval systems - guest eds. IEEE Computer. 28(9) (1995) .

[7]. M.De Marsicoi, L.Cinque, and S.Levialdi.: Indexing pictorial documents by their content: a survey of current techniques. Image and Vision Computing. 15(2) (1997) 119{141

[8] M.Flickner etal.,: Query by image and video content: the qbic system. IEEE Computer. 28(9) (1995) 23{32

[9] W.Niblack etal.,: The qbic project: Querying images by content using colour, texture and shape. In Storage and Retrieval for Image and Video Databases (SPIE). 1908 173{187

[10] V.E.Ogle and M.Stonebaker.: Chabot: Retrieval from a relational database of images. IEEE Computer. 28(9) (1995) 40{48

[11] J.R.Smith and S.F.Chang.: Visualseek: A fully automated content-based image query system. ACM Multimedia. (1996) 87{98

[12] C.Carson etal.,: Region-based image querying.: In CVPR'97Workshop on Content based Access to Image and Video libraries (CAIVL'97) (1997)

[13] M.J.Swain and D.H.Ballard.: Colour indexing. Intl. Journal of Computer Vision. Vol. 7 No. 1 (1991) 11-32

[14] J.Hafner etal.,: E_cient colour histogram indexing for quadratic form distance functions. PAMI. Vol. 17 No. 7 July. (1995) 729-736

[15] M.Stricker and A.Dimai.: Colour indexing with weak spatial constraints. Proceed ings of SPIE Storage and Retrieval of Still Image and Video Databases IV. Vol. 2670 (1996) 29-40

[16] J.Huang etal.,: Image indexing using colour correlograms. Proceedings of CVPR. (1997) 762-768

[17] H.Zhang etal,.: Image retrieval based on colour features: an evaluation study. Proceedings of SPIE. Vol. 2606 (1995) 212-220

[18] K.C.Ravishankar, B.G.Prasad, S.K.Gupta and K.K.Biswas.: Dominant Colour Region Based Indexing Technique for CBIR. In proceedings of the International Conference on Image Analysis and Processing (ICIAP'99). Venice. Italy. Sept. (1999) 887-892

[19] X.Wan and C.J.Kuo.: A multiresolution colour clustering approach to image indexing and retrieval. Proceedings of ICASSP. (1998)

[20] J. P. Callan, W. B. Croft, and S. M. Harding, "The inquery retrieval system," in Proc. 3rd Int. Conf. Database and Expert Syst. Appl., Sept. 1992.

[21] T. S. Huang and Y. Rui, "Image retrieval: Past, present, and future," in Proc. Int. Symp. Multimedia Inform. Processing, Dec. 1997.

[22] Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Addison-Wesley Publishing Company, 1992.

[23]Chiunhsiun Lin and Ching-Hung Su, "Using Colour Strings Comparison for Video Frames Retrieval", IEEE 2009 International Conference on Information and MultimediaTechnology.