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Content Based Image Retrieval Using Support Vector Machine

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Abstract: A significant issue in multimedia systems is image retrieval. It is identified as the procedure for looking through and obtaining pictures from a dataset. One important and difficult area of study in digital image processing is content-based image retrieval (CBIR). Retrieving pertinent data from a vast picture database after a query image with better system output is a fundamental requirement of the CBIR system. Regretfully, not all techniques can be applied to achieve high retrieval accuracy. Thus, the purpose of this research is to use Support Vector Machine (SVM) to classify query picture data with image database data in order to get similar images. Based on the classification, the accuracy of the image retrieval will be verified.

Keywords: SVM,CBIR, Image Retrieval, Accuracy.

I. INTRODUCTION

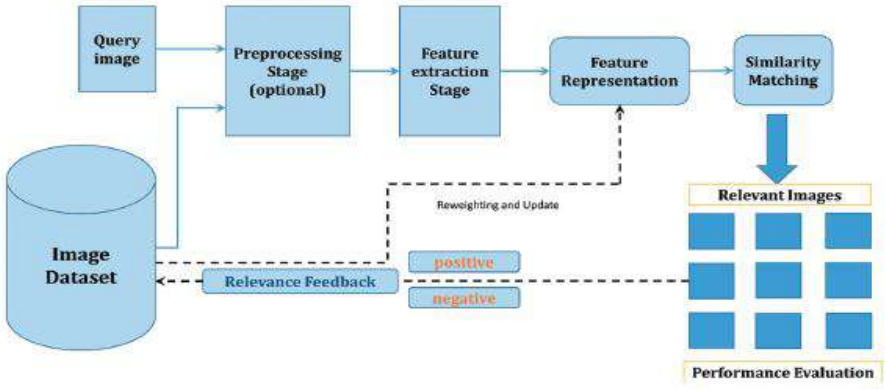
A vast quantity of picture databases has been produced by industrial, medical, and educational, social and other amenities of daily living. A robust picture search engine is necessary for each of these image libraries. There are two typical ways to search. The first approach is keyword-based. Utilized for image annotation; this technique is referred to as text-based image retrieval (Y. Liu et al., 2007). This approach has numerous drawbacks: Large datasets cannot be manually annotated;2) annotations must be made by the end user, subjecting the method to human perception; and3) the annotations are limited to a single language. The second approach, known as "content-based image retrieval" (CBIR), is strongly advised in order to get beyond the drawbacks of text-based image retrieval techniques (Raghu Nathan & Acton, 1999). Feature extraction is the first process in CBIR that aims to convert human perception into a numerical description that can be manipulated by machines. The extracted features have a significant impact on the retrieved images' correctness (Piras & Giacinto, Citation 2017). But the criteria for this choice are those of the user. According to D. Zhang et al. (2012), CBIR performance can be enhanced by feeding extracted characteristics into supervised or unsupervised machine learning algorithms. Recent advances in image retrieval research have focused on using deep learning to increase accuracy at the expense of longer processing times (Markowska- Kaczmar & Kwaśnicka, Citation 2018). The high-dimensional characteristics that are typically produced when attempting to translate are another issue that negatively impacts CBIR performance (i.e., memory utilization, scalability, speed, accuracy).

As seen in Figure 1 the overall CBIR architecture has some required stages and other optional stages. The user submits the query image as the initial step in the CBIR process. Every operation applied to the query image will be applied, in the same order, to every image in the database (Kokare et al., Citation 2002). These procedures are generally carried out on the query image at the time of user submission and are referred to as online procedures. Alternatively, the same procedures may be used on dataset images before the query is submitted and are referred to as offline procedures. The architecture of the framework may incorporate an optional pre-processing step that entails resizing, segmentation, denoising, rescaling, and other operations. The most crucial stage, feature extraction, comes after this optional one and involves translating a visual concept into a numerical form. Local descriptors or low-level features, such as color, shape, texture, and spatial information, are examples of extracted features. Normalization or categorization is an additional optional preprocessing step that comes after feature extraction. Finding the most relevant photos in the dataset requires comparing the extracted features from the query image to every other image in the dataset.

This is the last step in the process. By selecting pertinent and irrelevant returning photos, relevance feedback is an additional stage that can be used to improve the results through user interaction.

II. CBIR FRAMEWORK

Figure 1. General framework of the CBIR system



Numerous methods have been put forth to provide relevance feedback in order to improve CBIR performance (Ciocca&Schettini, Citation 1999; Dacheng).

III. COLOR FEATURE

Color is first and most straightforward visual feature for indexing and retrieval of images. They are usually robust in noise, resolution, and orientation and resizing. Because of their little semantic meaning and its compact representation, color feature tend to be more domain independent compared to other features. The image retrieval process can be divided in two steps:

- Indexing for each image in database a set or a vector of features summarizing. Its content properties is computed and stored in metadata database.
- Retrieval given a query image, its features are extracted and compared to others in database. Database images are then ordered following a similarity criterion.

In color indexing, given a query image, goal is to retrieve all images whose color compositions are similar to color composition of query image. Typically, color content is characterized by color histograms, which are compared using histogram distance measure. A color histogram can be constructed in 3D color space. This proposed method for extending use of image histograms to characterize local and global color properties of images. This method is based on two types of color representations:

• Color Descriptor to represent global color features of images.
• Color Descriptor Matrix to represent spatial color features of images.

The color descriptor is defined to be: Color Descriptor ={ {ci, pi}, i=1…M}…….(1)

Where M is total number of color clusters in image, ci is an Arabic number corresponding to color, pi is its percentage, and ∑pi=1. Note that M can vary from image to image. First, most dominant color in image is added and then less dominant color follows. As each pair {ci, pi} is added, color descriptor becomes more expressive representation of color distribution of an image. Currently, there are ten colors in the definition of color code book, color code is changed as image. Try to combine image quantization and perceptual color model to represent spatial color information in images and define 2-D vector Color Descriptor Matrix.

Color Descriptor Matrix = {Ci,j,i=0...N,j=0...N}……...(2)

In order to create this structure whole image is divided into NxN (where N=4, 8, 16, 32) equal parts. This matrix stores dominant colors for image blocks. Original images were NxN quantized and were represented as NxN blocks (or sub images). Original images are 16X16 quantized and represented as 16X16 color blocks (as Fig. 2).

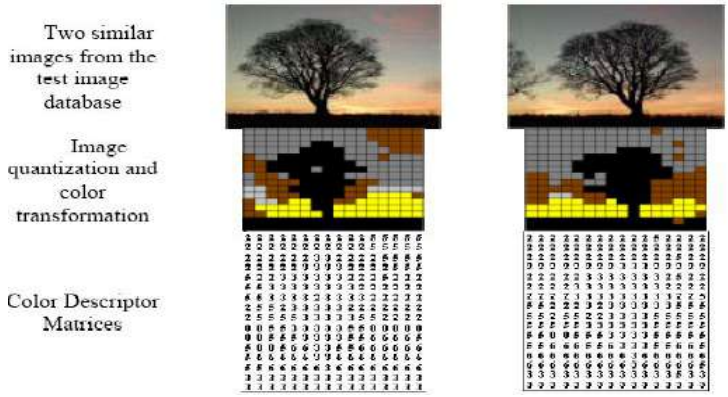


Fig. 2: The process of color descriptor matrix

Quantized image [2] is divided into 5x5 matrix and 16 bin histogram is calculated for each sub image and most dominant color is new replacement of small block and hence 125x83 images are reduced to 25x16.

IV. SUPPORT VECTOR MACHINE

Support Vector Machines (SVM) is an approximate implementation of structural risk minimization (SRM) principle. It creates a classifier with minimized Vapnik-Chervonenkis (VC) dimension. SVM minimizes an upper bound on generalization error rate. Error rate is bounded by sum of the training vectors. Consider problem of separating set of training vectors belonging to two classes, e.g., image retrieval problem, +1 denotes positive example, -1 denotes negative example.

$$\{xi, yi\}Ni=1,\ yi =+1/-1 \quad \text{.....(3)}$$

Where $\vec{x}$ is an input pattern, e.g., feature vector in image retrieval, for ith example and yi is label. If two classes are linearly separable, hyper plane that does separation is:

$$wT\vec{x} + b = 0 \quad \text{.....(4)}$$

Where $\vec{x}$ an input vector, w is a weight vector, and b is a bias. The goal of a support vector machine is to find parameter wo and bo for a optimal hyper plane to maximize the distance between the hyper plane and the closest data point:

$$woT\vec{x} + bo \geq 0 \text{ for } yi = +1 \quad \text{.....(5)}$$

$$woT\vec{x} + bo \leq 0 \text{ for } yi = -1 \quad \text{.....(6)}$$

For a given wo, and bo, distance of a point $\vec{x}$ from optimal hyper plane defined in equation (5) and (6) is d(wo, bo, $\vec{x}$) $=|woT\vec{x} + bo| \ / \ ||wo|| \quad \text{.....(7)}$

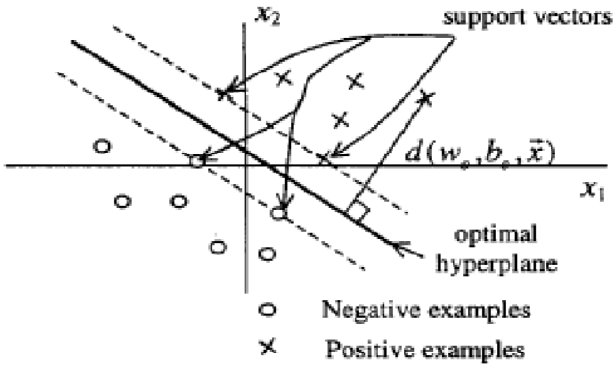


Fig. 3: Illustration of the idea of an optimal hyper plane for linearly separable patterns and definition of distance

A linear separable example in 2D is illustrated in Figure 3. If two classes are non-linearly separable, input vectors should be nonlinearly mapped to a high dimensional feature space by an inner-product kernel function. This hyper plane is optimal in sense of being a maximal margin classifier with respect to training data. Distance from hyper plane determined by support vectors can be used to measure how much an example belonging to one class is different from other class. This motivates us to use SVM for automatically generating preference weights for relevant images.

V. EXPERIMENTAL RESULTS

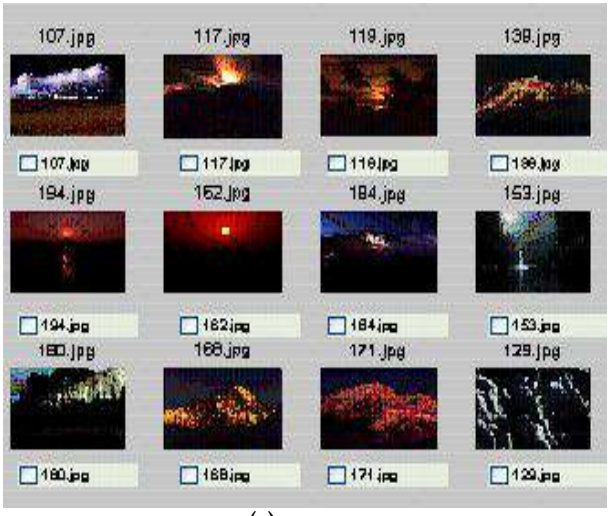
Using of MATLAB 2007b and Postgre SQL 8.3, experimental results are as shown below: First Query is given by example image which is selected from list box or allocated path, i.e. user select cloudy image as Fig. 4. Based on this example image, total 36 images using color feature are retrieved. Here, user has given 10 positive feedbacks for relevant images. Based on these relevance feedback images (SVM is used), total relevant images are 21 as user perception from 31 images. Total cloudy images are 30 in a 100 images database. Color based image retrieval's relevant images efficiency is (10/30) 33.33% (see Fig. 5(a)(b)(c)) and relevant images based on SVM is (21/30) 70% (see Fig 6(a)(b)(c)).

Fig. 4. Query by example

Different users select same 107.jpg example image and results are as TABLE I and Fig. 7. Efficiency of relevant images using SVM is also better than content based relevant images in 1000 images database (119.jpg, 441.jpg, 464.jpg, 762.jpg examples of TABLE II). Survey of 25 users, average relevant images efficiency using SVM is 78.6% which is better than content based relevant image using color feature (51.13%) as TABLE II.

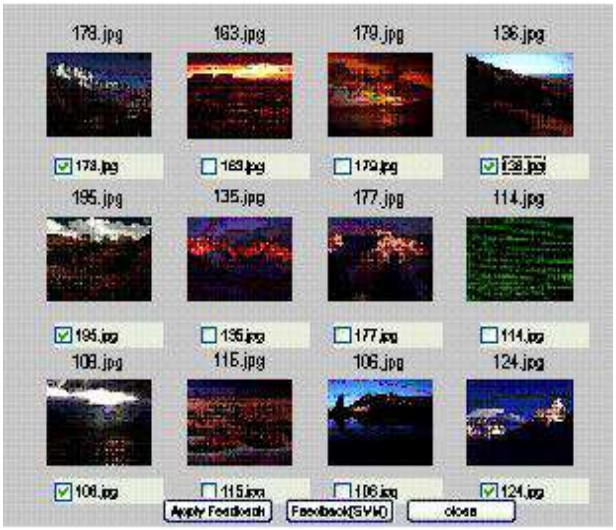
VI. CONCLUSION

The experiments were conducted with color database images. Images retrieved based on color feature. But the semantic gap in user perception and obtained output is quite usable.

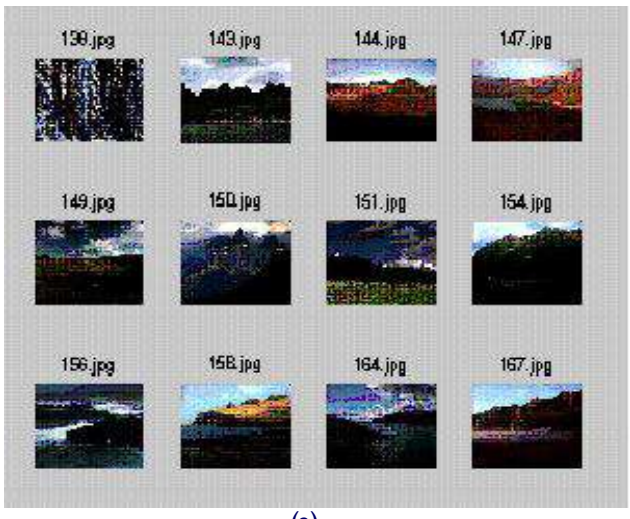


(a)

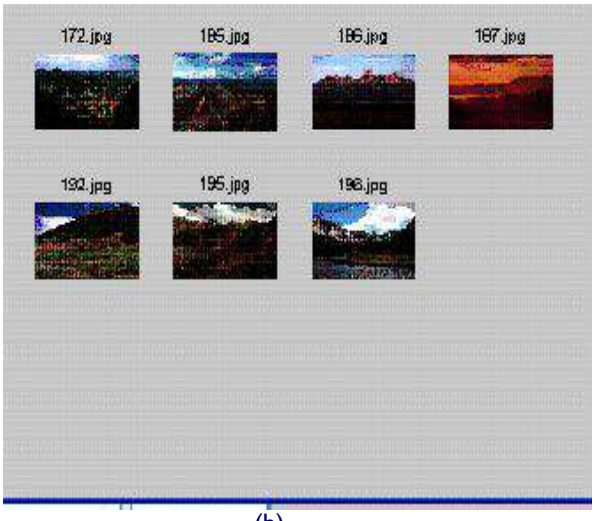
(b)



(c) Fig. 5 (a), (b) (c) Images are retrieved based on color feature



(a)



(b)

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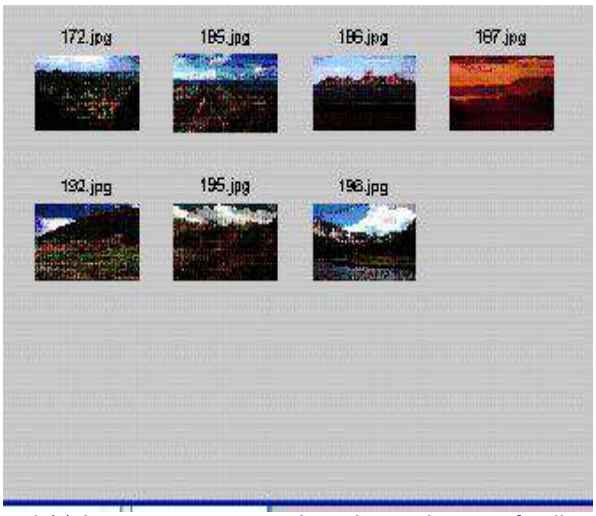

Fig. 6.(a),(b) and (c) Images are retrieve based on relevance feedback using SVM

TABLE I Different user select same 107.jpg example image

User	Example Image	Feature based image retrieve	Relevance Feedback Images using SVM	Total relevant images as example images
User 1	107.jpg	10 (33.33%)	21 (70.0%)	30
User 2	107.jpg	6 (50%)	9 (75%)	12
User 3	107.jpg	21 (52.5%)	35 (87.5%)	40
User 4	107.jpg	19 (73.07%)	22(86.41%)	26
User5	107.jpg	3 (42.85%)	5 (71.42%)	7
User 6	107.jpg	9 (60%)	12 (80%)	15
User 7	107.jpg	3 (30%)	7 (70%)	10
User 8	107.jpg	6 (30%)	15 (75%)	20
User 9	107.jpg	9 (30%)	25 (83.33%)	30
User 10	107.jpg	11 (36.67%)	25 (83.33%)	30
User 11	107.jpg	10 (33.33%)	27 (90%)	30

Table II - average Efficiency of relevant images (%) based on color feature and RF (SVM)

User	Example Image	Feature based image retrieve	Relevance Feedback Images using SVM	Total relevant images as example images
User1	107.jpg	10(33.33%)	21(70.0%)	30
User2	100.jpg	9(47.36%)	15(78.94%)	19
User3	441.jpg	7(20.58%)	22(64.7%)	34
User4	119.jpg	5(38.46%)	12(92.30%)	13
User5	464.jpg	10(50%)	15(75%)	20
User6	762.jpg	7(41.17%)	14(82.35%)	17
User7	Brick_1.jpg	11(84.6%)	12(92.3%)	13
User8	Water_6.jpg	5(41.66%)	11(91.66%)	12
User9	100.jpg	17(37.7%)	23(51.11%)	45
User10	100.jpg	7(70%)	8(80%)	10
User11	100.jpg	12(80%)	13(86.66%)	15
User12	100.jpg	5(62.5%)	6(75%)	8
User13	100.jpg	7(31.8%)	19(86.36%)	22
User14	107.jpg	6(50%)	9(75%)	12
User15	107.jpg	21(52.5%)	35(87.5%)	40
User16	107.jpg	15(57.69%)	22(86.41%)	26
User17	107.jpg	3(42.85%)	5(71.42%)	7
User18	107.jpg	9(60%)	12(80%)	15
User19	107.jpg	3(30%)	7(70%)	10
User20	107.jpg	6(30%)	15(75%)	20
User21	107.jpg	9(30%)	25(83.33%)	30
User22	100.jpg	9(47.36%)	13(68.42%)	19
User23	107.jpg	11(36.67%)	25(83.33%)	30
User24	107.jpg	10(33.33%)	27(90%)	30
User25	100.jpg	5(30%)	11(73.33%)	15
Average		51.23%	78.60%	

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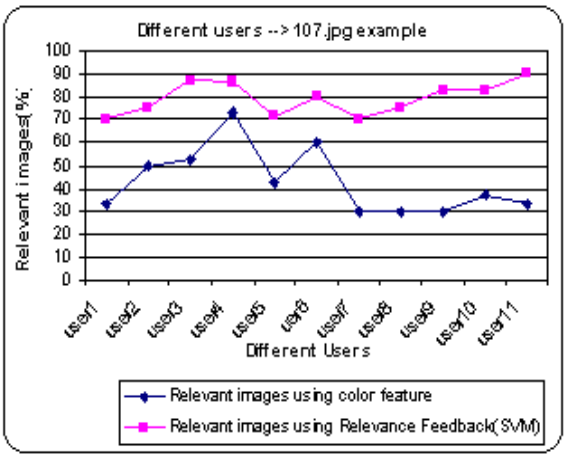

Fig. 7. Graph for different user → same example image

Using of relevance feedback with SVM, results are more efficient as user perception. SVM classification can be even better if the feature vector used in more relevant to images.

REFERENCES

[1]. D. F. Long, D. H. Zhang, and P. D. D. Feng, "Fundametal of content based image retrieval," research microsoft, 2003.
[2]. S. Jain and S.N.Pradhan, "Enhancement of color image retrieval capabilitites: function of color with texture (optimized)," NUCONE 2007,Nirma University, December 2007.
[3]. Valova and B. Rachev, "Image databases an approach for image segmentation and color reduction analysis and synthesis," International Conference on Computer Systems and Technologies - CompSysTech2003,.
[4]. I. Valova and B. Rache, "Retrieval by color features in image databases," International Conference on Computer Systems and Technologies - CompSysTech2002.
[5]. I. Valova, B. Rachev, and M. Vassilakopoulos, "Optimization of the algorithm for image retrieval by color features," International Conference on Computer Systems and Technologies – Comp SysTech, 2006.
[6]. Valova and B. Rachev, "Image databases- an approach for image segmentation and color reduction analysis and synthesis," International Conference on Computer Systems and Technologies - CompSysTech2003.
[7]. Q. Tian, H. Pengyu, and H. Thomas, "Update relevant image weights for content-based image retrieval using support vector machines," 2000 IEEE International Conference on volume 2, 2002.
[8]. O. Takashi. and M. Hiroshi and Y. Seiji, "Relevance feedback document retrieval using support vector machines," 2004 IEEE International Joint Conference on Volume 4, pp. 1359– 1364, July 2004.
[9]. C.H. Hoi and M. Lyu, "Group-based relevance feedback with support vector machine ensembles," ICPR 2004, 17th International Conference on Volume 3, page no. 874 – 877, August 2004.
[10]. C. H. Hoi, C.H. Chan, K. Huang, M. Lyu, and I.King, "Biased support vector machine for relevance feedback in image retrieval," 2004 IEEE International Joint Conference on Volume 4, pp. 3189 – 3194, July 2004.

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