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An Efficient Approach for Relevance Feedback in CBIR using Navigation Patterns

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Abstract: *Content Based Image Retrieval (CBIR) is a traditional and developing trend in Digital Image Processing. Relevance feedback (RF) is a technique used in collecting relevant information from the user. Content-based Image Retrieval (CBIR) using Relevance Feedback systems generates image based on image features and store in database and compare input query image feature with the features stored in database. To get good results, relevance feedback techniques were incorporated into CBIR so we can achieve better performance by taking users feedback. CBIR is used combine low level features and high level semantics according to need of the user. In this work, we are using two type of methods like SVM (support vector machine) and NPRF (navigation-pattern based relevance feedback). SVM classifier is used to differentiate between relevant and irrelevant images by using low level features like color, shape, texture features. By applying SVM we may reduce the size of query search in the data base and we may apply NPRF algorithm. The NPRF uses the discovered navigation pattern and three query refinement concepts viz Query Point Movement (QPM), Query Reweighting (QR), and Query Expansion (QEX), to provide a better search towards user. SVM based navigation pattern provide good quality of image retrieval in less number of feedback.*

Keywords: CBIR, *Relevance Feedback, SVM and NPRF, Navigation pattern, QPM, QR, QEX, color, shape and texture features*.

1. Introduction

A picture is worth of thousand words and every image gives subjectative meaning. Image Processing is form of signal processing in which input should be image and output is a set of images or its characteristics. An image retrieval system is a very efficient system which allows us to browse, search and retrieve images. Earlier image retrieval system were relay on textual based approach and it involves manual entering of keywords like files names, integer value, category and this approach is time consuming and expensive. To overcome these problems of image retrieval, Content based image retrieval is used. There is a gap between the semantic understandings of users query image and low-level descriptions of image content in the content-based image retrieval, therefore there is a strong need for developing an efficient technique for huge amount of digital information in image retrieval. If user wants to search for many rose images then he can submit an existing rose image as query so the system will extract image features for this query. Further it will compare these features with that of other images in a database and relevant results will be displayed to the user.

Content based image retrieval is one kind of application in the computer system which is used for retrieving image. CBIR is process of retrieving the image based on its content and word content means shape, color and texture and any other features of an image. Content based image retrieval (CBIR) is the process of retrieving the required query image based on the contents of the image from huge databases. There are three fundamental basics of content based image retrieval such as visual feature extraction, retrieval system design and multidimensional indexing. Some of the examples for the current CBIR are QBIC which is Query by Image Content and Visual seeks which is a web tool for searching images and videos. Many times we cannot get the required image in first attempt if image contains complex feature, so to get good image retrieval quality relevance feedback (RF) is used in CBIR.

Relevance feedback is technique for image retrieving system, which gives the relevant information to the user. There are number of RF techniques used for CBIR but existing techniques have problems like redundant browsing and exploration convergence. In redundant browsing previous RF methods concentrates on how to satisfy user within one query process. Especially for complex images users should go up to long search to obtain desired image and in practical it is not possible for large database. Another problem is exploration convergence. Consider if two users query with the same image whose concept consists of "rose" and "sunset". In this example, both concepts of two users are similar like "rose" and "sunset" respectively. By seeing a set of feedback for query 1 and query 2, it produces two different paths that will lead to aimed image, so this concept is called as visual diversity. Because both concept contains "rose", "sunset" and "sunset and rose". It is difficult for traditional CBIR to target the specific location in feature at query session.

2. Related Work

In [1], 2013 sujata T Bhairnally et al. For retrieving medical images they have used textual-based approach and which includes entering of metadata such as captioning, keywords, or descriptions to the images so that retrieval can be performed over the annotation words. In retrieving biomedical image, existing approach uses Manual image annotation and manual indexing and it requires interaction of user to define class or subclass. By using this method they can achieve the result but this methods is time consuming and expensive. Content based image retrieval methods can be used to solve such problem.

In [2], 2012 Le hoang Thai et al. proposed Artificial Neural Network (ANN) and Support Vector Machine (SVM) for image classification. Firstly, we separate the image into many sub-images based on the features of images. Each sub-image is classified into the responsive class by an ANN. Finally, SVM has been compiled all the classify result of ANN. Disadvantage of this technique is training time of ANN_SVM in the large dataset and we must redesign the model when number of classes are increases in ANN.

In [3], 2010 Yu Sun and Bir Bhanu recommended relevance feedback in content based image retrieval and the online feature selection methods. The variation from relevance feedback was used as a semantic measure to lead the feature selection. By using feedback information, the feature selection is used to reduce the gap between low-level visual features and high-level semantic information, to give high retrieval quality.

In [4], 2007Ryszard S. Chora´s introduced a technique for the recognition of the troubles existing in CBIR and Biometrics systems giving information about image content and feature extraction. They have discussed methods for mapping image content into low-level features. They have used different color, texture and shape features for image retrieval in CBIR systems.

In [5], 2002 Xiaofie He and Wei-Ying Ma et al. presented Short-Term Learning (STL) and Long-Term Learning (LTL) relevance feedback approaches. In STL approach, it mainly uses the feedback only from the current session using the features of images. The feature set should include the features that can give the similarities between positive images. In STL approaches, it has limitations like size of the training set is smaller than the width of feature space. In long term learning approach, in this state of the retrieval system has to be reset after every session. Long-term learning approaches are designed to use the information of earlier sessions to improve the retrieval results of future sessions. This approach requires more memory and unsuitable for applications that frequently add and remove images.

In [6, 7], 1971and 2003 E.Ide and M.L kherfi et al. introduced relevance feedback in the text retrieval approaches, to look up retrieval effectiveness. It is the process of mechanically adjusting an existing query using information given by the user about the significance of earlier retrieved documents. In the context of CBIR, relevance feedback is used to overcome some difficulties. In existing example-based query approach, it is very difficult to identify user needs this is because user can not convert query image in to combination of required image or the retrieval system may not succeed in translating the user's needs into image features and similarity actions. Because of these reason iterative queries refinement technique is essential.

In [8], 2000 Muller, H. and Marchand-Maillet et al. the researchers have well thought-out RF as a classification problem in which images provided by the user are used to train a classifier, which is then used to classify the database images that are relevant to the input image and those that are not.

3. Proposed methodology

The proposed system combines SVM based navigation pattern relevance feedback (NPRF) technique and NPRF is used for accurate image retrieval in CBIR. Figure 1 shows the working flow of proposed system, user queries the system by giving an input image and features of query images are extracted using color moment, HSV histogram, wavelet transformation etc. By using SVM, we are classifying features of input images with database images. After comparing resultant images are displayed to the user and user need to give feedback for related images. By analyzing user browsing behavior, certain relevant results are displayed to the user and if user is satisfied with retrieval result system will be terminated else it goes for NPRF search; relevant images are retrieved and shown to the user.

Image retrieval consists of two phase: 1.Query processing phase and 2.Image search phase.

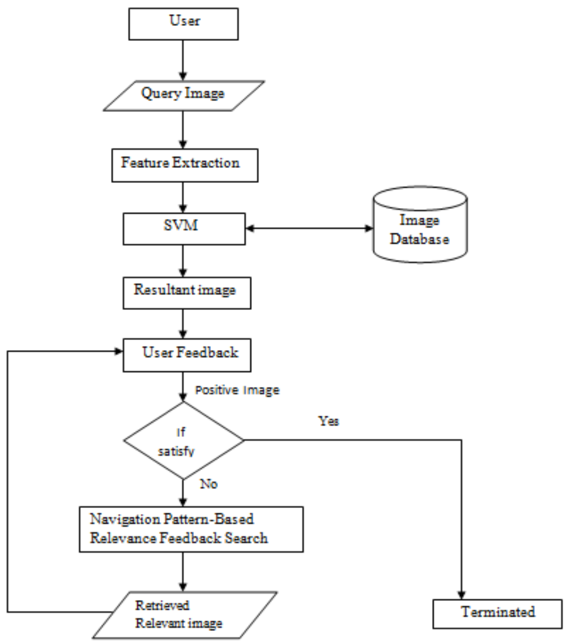

Fig.1 Proposed system

3.1 Feature Extraction

Feature extraction is most important step in retrieving images and it is process of mapping pixels in feature space. By using features of image we can search, browse and retrieve images from database and measures similarity between stored images. If given dataset is larger, feature extraction is used for reducing amount of description of that database. Color, texture and shape are low-level features of images and these features can be extracted by using following approaches.

- Color Moment
- Color Auto Correlogram
- HSV Histogram
- Gabor Wavelet

- Wavelet Transformation

3.1.1 Color Moment

Color feature is most popular feature of image and uses basic RGB model to extract color moments, where RGB stands for red, Green and blue. Color moment can define both shape and color of images, it can be computed over per channel like for e.g. 9 moments are computed for RGB model.

$$\sum i = \sum_{j=1}^{N} \frac{1}{N} P_{ij} \quad \text{................ (1)}$$

$$\sigma_i = \sqrt{\frac{1}{N}\sum_{j=1}^{N}(P_{ij-\sum i})^2} \quad \text{....... (2)}$$

Color moments is computed in the same way as computing moments of probability distribution and color moment can interpreted as average color in image, it can be calculated by using mean formula equation 1 and standard deviation equation 2 which is discussed in chapter 2 gives distribution of colors in images.

3.1.2 Color Auto correlogram

The color correlogram was projected to differentiate not only the color distributions of pixels, but also the spatial relationship of pairs of colors. In three-dimensional histogram, the first and the second dimension are the colors of any pixel pair and the third dimension is represents spatial distance. A color correlogram is a table indexed by color pairs, where the k-th entry for (i, j) specifies the probability of finding a pixel of color j at a distance k from a pixel of color i in the image. Let I represent the entire set of image pixels and Ic (i) represent the set of pixels whose colors are c (i). Then, the color correlogram is defined as:

$$\Upsilon_{i,j}^{(k)} = p_1 \in I_{c(i)}^{Pr}, p_2 \in I^{\left(p_2 \in I_{c(j)} \middle| |p_1 - p_2|\right)} \quad \text{........ (3)}$$

Where i, j ϵ {1, 2… N}, k ϵ {1, 2… d}, and | p1 – p2 | is the distance between pixels p_1 and p_2. If we consider all the possible combinations of color pairs the size of the color correlogram will be very large (O (N^2d)), therefore a simplified version of the feature called the color auto correlogram is often used instead. The color auto correlogram only captures the spatial correlation between identical colors and thus reduces the dimension to O (Nd).

3.1.3 HSV Histogram

Histogram is graph like structure which gives information about frequency of object that fall under certain interval or ranges. It represents number of times a particular gray level occurs in image and for color image it describes number of time particular color occurred in the image. HSV stands for Hue, saturation and value, where hue is feature which extract pure color from the image (e.g. orange, yellow etc) and saturation gives maximum space which is filled by white color. Value indicates brightness of an image and V=0 when axis is black or else it gives value 1 for representing white color.

The original 24-bit RGB images used in this study are of size M*N*3 where M and N are the height and width of image respectively and 3 indicates the three 8-bit RGB components of the original images, viz. Red (R), Green (G), and Blue (B). From the original image, RGB components are separated and the HSI components are derived. The mean, variance and range for all these 3 components (H, S and I) are calculated and a total of 9 HSI features (first order) are stored in HSI database.

Algorithm 3.1: HSV Feature Extraction

Input: Original 24-bit RGB image

Output: 9 HSV features

Start:

Step 1: Separate the RGB components from original 24-bit input color image.

Step 2: Obtain the HSV Components from RGB Components using the following equations.

$$H = \begin{cases} \theta & if \quad B \le G \\ 360 - \theta & if \quad B > G \end{cases} \quad \text{..........................(3.1)}$$

With

$$\theta = cos^{-1}\left\{ \frac{\frac{1}{2}\left[(R-G)+(R-B)\right]}{\left[(R-G)^2 + (R-B)(G-B)\right]^{1/2}} \right\}$$

$$S = 1 - \frac{3}{(R+G+B)}\left[min(R,G,B)\right] \quad \text{............. (3.2)}$$

$$I = \frac{1}{3}(R+G+B) \quad \text{..(3.3)}$$

Step 3: Find the mean, variance, and range for each RGB and HSI components.

Stop.

3.1.4 Gabor wavelet

Wavelet is like oscillation with amplitude that begins with zero then increases and end with zero when it decreases. It is a function which works on gray-scale image and calculates mean-squared energy and means amplitude of image using formula for signal processing. It is closely related to Fourier transform and Gabor filters, features of gray-scale image can be calculated by using following Gabor wavelet formula:

$$f(x) = e^{-(x-x_0)^2/a^2} \; e^{-ik_0(x-x_0)} \quad \text{......... (3.4)}$$

It has some properties x_0 increases when value of function is suppressed, a controls rate of exponential drop-off and k_0 gives rate of modulation.

3.1.5 Wavelet transformation

DWT is a mathematical function in which an image hierarchically decomposes. it is also called as multilevel decomposition. This wavelet transform decompose an image into four sub bands (LL, HL, LH and HH). Where L is low pass filter and H is high pass filter. LL is a low frequency part that represents approximate details of an image. HL, LH and HH are high frequency parts, where HL gives horizontal details, LH gives vertical details and HH gives diagonal details of an image. These all sub bands having same bandwidth and creating a multi resolution viewpoint. Because of this advantage the watermark can be embed in any part of the frequency bands.

3.2 SVM Classifier

As we discussed about SVM by comparing features of input images to the features of database image, it will display number of images from the database that are relevant to input image. Features of database images are stored in the form of integer value. Here we are training data by using mean and standard deviation formula. We are using svmtrain and svmclassify function for classifying input images to database images, both function consist of name-value pair arguments. We are using 'boxconstraint', ‘kernel functions’ and ‘rbf’ these pair of arguments and functions of these arguments are given below:

1. ***Boxconstraint:*** Value of the box constraint C for the soft margin and C can be a scalar, or a vector of the same length as the training data. when C is a scalar, it is rescaled by P/(2*P1) for the data points of group one and by P/(2*P2) for the data points of group two, where P1 is the number of elements in group one, P2 is the number of elements in group two and P = P1 + P2.

2. ***kernel_function:*** It is used for mapping training data into kernel space by svmtrain function and this function is defined by using dot product.

3. ***rbf:*** It stands for Gaussian Radial Basis Function kernel and gives a default scaling factor, sigma, of 1.

3.3 NPRF Algorithm

Here we are discussing step-by-step working of NPRF module.

Algorithm 3.2: Navigation pattern based relevance feedback.

Input: A set of positive images P[i] and a set of negative images N[i] selected by user.
Output: A set of similar images R[i] is returned.
Step 1: Generate query points and extract features $\sum_{t=1}^{n} F_i$ of positive images.
Step 2: All the Negative images are stored in image set N[i].
Step 3: Set flag=0;
for each input image belonging to P[i] do
find out the images with the shortest distance to input image $D_i = \min\sum_{i=1}^{n}(T_i - Q_i)$;
end for
if threshold exceed satisfactory rate then
for each negative image belonging to N[i] do
find out the images with the least distance to negative images.
end for
end if
if flag=1 then
Find the set of visual relevant images within the retrieved image set
end if
for i=1 to n do
Determine the relevant image set R[i] from the database
end for
Discard the negative images N[i] from retrieved images.
return the retrieved image set R[i] of top n similar images.

Query reweighting: If the i^{th} feature f_i exists in positive examples repeatedly, the system assigns the higher degree to f_i
Query Expansion: This approach solves problem of exploration convergence, helps in discovering similar patterns for image. It first finds images which is nearest to positive example or query image and finds negative image, at each iteration there exist both positive and negative example. So by using positive example search can be extended up to every iteration and gives desired result by discarding negative image set.

4. Result and discussion

In this section, we test the performance our proposed approach for the CBIR system. We evaluate the system with respect two performance parameters Precision and Recall. In the experiments, 10 images are randomly selected as queries from each of the 10 semantic classes in the database, for each query the precision and recall of retrieved images is obtained and evaluate the retrieval quality for successive iterations starting with these queries. All the measurements are averaged over 100 queries, to give the final precision/recall. For each experiment, one image is selected at random from each category and top K=20 images are retrieved and the results are displayed. Then, the relevant images are marked from the retrieved images. An image is considered as relevant (irrelevant), if it belongs to the same (different) category as (than) the initial query image.

Table 1 Average retrieval Accuracy and Recall using SVM for different Semantic categories

Category	SVM based NPRF	
	Precision%	Recall%
Africans	70.00	14.0

Beach	65.02	13.0
Buildings	75.05	15.1
Buses	60.00	12.0
Dinosaurs	95.00	18.0
Elephants	70.50	14.3
Roses	65.27	13.2
Horses	40.71	8.8
Mountains	55.16	11.1
Dishes	35.50	7.2

From the table1 it can also be noticed that SVM based navigation pattern gives good results for the image that have distinct objects with color contrast from the background (e.g. Dinosaurs) and this is because these images give good results in the feature extraction process.

The results illustrating the performance improvement of the proposed approach are depicted in Figure4.1 and 4.2 for the query image belonging to the Buildings semantic category. Figure 4.1 displays the result of the first pass, which is purely based on the similarity matching of visual features, using SVM. The first 20 images closest to the query image are displayed, among the 20 images, 15 images belong to the desired category and remaining images are irrelevant. Figure4.2 shows the retrieval results after applying navigation pattern based relevance feedback iteration, in which all the top 15 images displayed belong to the same semantic category as the query image.

Fig 4.1 Top #20 Retrieval results for query image using SVM

Fig 4.2 Shows top 15 images relevant to query image by Using NPRF

If the user is satisfied with his selection then the system will terminate the execution by giving proper result, otherwise it allows the user to select an image which is relevant to the query image. The below figure 4.3 shows that the menu window.

Fig 4.3 Menu window

5. Conclusion

From the simulation results, we can conclude that the Content based image retrieval (CBIR) is a challenging method of capturing relevant images from a large storage space. Although this area has been explored for decades, no technique has achieved the accuracy of human visual perception in distinguishing images. Whatever the size and content of the image database is, a human being can easily recognize images of same category. In this work, we proposed a framework for CBIR that performs an efficient and quick retrieval using svm based navigation pattern. We used color moment, color correlogram, and HSV histogram approaches for extracting low-level features of image, which gives good results. Support vector machine (SVM) helps for classifying different category of images based on its feature and display relevant images. On one hand, the navigation patterns derived from the users' long-term browsing behaviors are used as a good support for minimizing the number of user feedbacks. This method helps to reduce number of feedback. Traditional problems like redundant browsing and visual diversity are solved. This technique will help user to get desired image within less number of feedback and proposed system performs well to classify different category of images.

References

[1] Sujata T Bhairnallykar, “Content based Medical Image Retrieval with SVM Classification and Relevance Feedback” 2013 International Journal of Applied Information Systems (IJAIS) – ISSN : 2249-0868 pp.25-29.

[2]Le Hoang Thai,Computer Science Department, University of Science, Ho Chi Minh City, Vietnam, “Image Classification using Support Vector Machine and Artificial Neural Network”, MECS I.J. Information Technology and Computer Science, 2012, pp. 32-38.

[3] Yu Sun, Bir Bhanu “Image Retrieval With Feature Selection and Relevance Feedback” Proceedings of IEEE 17th International Conference on Image Processing September 26-29, 2010, Hong Kong.

[4] Ryszard S. Chora´s, “Image Feature Extraction Techniques an.d Their Applications for CBIR and Biometrics Systems”, International Journal of Biology and Biomedical Engineering Issue 1, Vol. 1, 2007.

[5] Xiaofie He, Wei-Ying Ma, Oliver King, Mingjing Li, Hongjiang Zhang, “ Learning and Inferring a Semantic Space from User’s Relevance Feedback for Image Retrieval”, Multimedia ’02, December 1-6, 2002, Juan-les-pins, France.

[6] E. Ide, “New experiments in relevance feedback,” in The Smart System- Experiments in Automatic Document Processing. Englewood Cliffs, NJ: Prentice-Hall, pp. 337–354, 1971.

[7] M. L. Kherfi, D. Ziou, and A. Bernardi, “Combining positive and negative examples in relevance feedback for content-based image retrieval,” J. Vis. Commun. Image Represent, vol. 14, no. 4, pp. 428–457, 2003.

[8] Muller, H.; Muller, W.; Marchand-Maillet, S.; Pun, T.; Squire, D.M., "Strategies for positive and negative relevance feedback in image retrieval," Pattern Recognition, 2000. Proceedings. 15th International Conference on, vol.1, no., pp.1043, 1046 vol.1, 2000

[9]http://en.wikipedia.org/wiki/Contentbased_image_retrieval

[10] Y. Rui, T.S.Huang, and S. Mehrotra, "Content-based image retrieval with relevance feedback in MARS," Proceedings of International Conference on Image Processing, Vol.2, pp. 815 -818, 1997.

[11] Meilhac, C., Nastar, C., "Relevance feedback and category search in image databases," Multimedia Computing and Systems, 1999. IEEE International Conference on, vol.1, no., pp.512, 517 vol.1, Jul 1999

[12] Wei Bian and Dacheng Tao, “Biased Discriminant Euclidean Embedding for Content-Based Image Retrieval” IEEE Trans.on Image Processing, Vol. 19, No. 2, pp.545-554, Feb 2010.

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