A Review of Different Content Based Image Retrieval Techniques

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Abstract: The extraction of features and its demonstration from the large database is the major issue in content based image retrieval (CBIR). The image retrieval is interesting and fastest developing methodology in all fields. It is effective and well-organized approach for retrieving the image. In CBIR system the images are stored in the form of low level visual information due to this the direct correlation with high level semantic is absent. To bridge the gap between high-level and low-level semantics several methodologies has developed. For the retrieval of image, firstly extracts the features of stored images then all extracted features will goes for the training. After the completion of preprocess, it'll compare with the query image. In this paper the study of different approaches are discussed.

Keywords*:* - CBIR, Extraction, Semantic gap, DWT, SVM, Relevance Feedback, EHD, Color model.

INTRODUCTION

With the development in the computer technologies and the advent of the internet, there has been bang in the amount and the difficulty of digital data being produced, stored, conveyed, analyzed, and accessed. The lots of this information are multimedia in behavior, comprising digital images, audio, video, graphics, and text information. In order to construct use of this enormous amount of data, proficient and valuable techniques to retrieve multimedia information based on its content need to be developed. In all the features of multimedia, image is the prime factor.

Image retrieval techniques are splitted into two categories text and content-based categories. The text-based algorithm comprises some special words like keywords. Keywords and annotations should be dispenses to each image, when the images are stored in a database. The annotation operation is time consuming and tedious. In addition, it is subjective. Furthermore, the annotations are sometimes incomplete and it is possible that some image features may not be mentioned in annotations [1]. In a CBIR system, images are automatically indexed by their visual contents through extracted low-level features, such as shape, texture, color, size and so on [1, 2]. However, extracting all visual features of an image is a difficult task and there is a problem namely semantic gap in the semantic gap, presenting high-level visual concepts using low-level visual concept is very hard. In order to alleviate these limitations, some researchers use both techniques together using different features. This combination improves the performance compared to each technique separately [3, 4].

In this paper, there are two steps for answering a query to retrieve an image. First, some keywords are used to retrieve similar images and after that some special visual features such as color and texture are extracted. In other words, in the second step, CBIR is applied. Color moments for color feature and co-occurrence matrix for extraction of texture features have been computed. This paper is organized as follows. The next session focuses on the related works in the field. In section 3, content-based image retrieval systems have been explained. In section 4, about different CBIR techniques are explained and in last section the paper is concluded.

CONTENT BASED IMAGE RETIEVAL

A typical CBIR system automatically extract visual attributes (color, shape, texture and spatial information) of each image in the database based on its pixel values and stores them in to a different database within the system called feature database [5,6]. The feature data for each of the visual attributes of each image is very much smaller in size compared to the image data. The feature database contains an abstraction of the images in the image database; each image is represented by a compact representation of its contents like color, texture, shape and spatial information in the form of a fixed length real-valued multi-component feature vectors or signature. The users usually prepare query image and present to the system. The system usually extract the visual attributes of the query image in the same mode as it does for each database image and then identifies images in the database whose feature vectors match those of the query image, and sorts the finest analogous objects according to their similarity value. During operation the system processes less compact feature vectors rather than the large size image data thus giving CBIR is contemptible, speedy and proficient advantageous over text-based retrieval. CBIR system can be used in one of two ways. First, precise image matching, that is matching two images, one an example image and another image in image database. Second is estimated image matching which is finding very intimately match images to a query image [7].

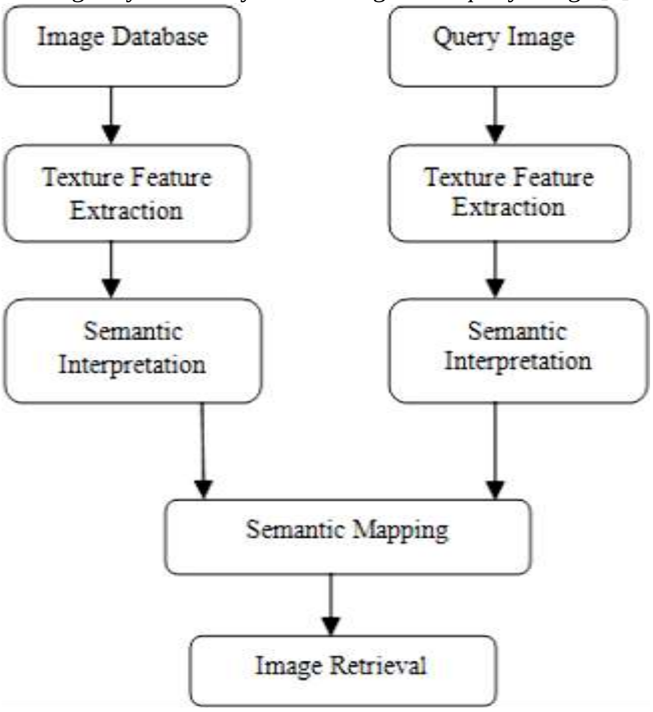


FIG. 1. BLOCK DIAGRAM OF SEMANTIC IMAGE RETRIEVAL

BASICALLY CBIR USED TWO APPROACHES FOR RETRIEVING THE IMAGES FROM THE IMAGE DATA BASE.

- **Two approaches**

TEXT-BASED APPROACH (INDEX IMAGES USING KEYWORDS)
CONTENT-BASED APPROACH (INDEX IMAGES USING IMAGES)

Text-Based Approach:

Text based method used the keywords descriptions as a input and get the desired output in the form of similar types of images .Examples:- (Google, Lycos, etc.) [14].

Content-Based Approach:

Content based approach using image as an input query and it generate the output of similar types of images [14].

RELATED WORK

There are various method has been proposed to extract the features of images from very large database. In this paper various algorithms are discussed to retrieve the image:

a) Jisha. K. P, Thusnavis Bella Mary. I, Dr. A. Vasuki [8]: proposed the semantic based image retrieval system using Gray Level Co-occurrence Matrix (GLCM) for texture attribute extraction. On the basis of texture features, semantic explanation is given to the extracted textures. The images are regained according to user contentment and thereby lessen the semantic gap between low level features and high level features.

b) Swati Agarwal, A. K. Verma, Preetvanti Singh [9]:

The proposed algorithm is enlightened for image retrieval based on shape and texture features not only on the basis of color information. Firstly the input image is decomposed into wavelet coefficients these wavelet coefficients give generally horizontal, vertical and diagonal features in the image. Subsequent to wavelet transform (WT) and Edge Histogram Descriptor (EHD) is then used on preferred wavelet coefficients to gather the information of foremost edge orientations. The grouping of DWT and EHD methods increases the performance of image retrieval system for shape and texture based retrieve. The performance of diverse wavelets is also compared to find the appropriateness of meticulous wavelet function for image retrieval. The proposed algorithm is skilled and examined for large image database. The results of retrieval are conveyed in terms of exactitude and recall and compared with different other proposed schemes to show the supremacy of our scheme.

c) Xiang-Yang Wang, Hong-Ying Yang, Dong-Ming Li [10]: proposed a new content-based image retrieval technique using color and texture information, which achieves higher retrieval effectiveness..Initially, the image is altered from RGB space to adversary chromaticity space and the individuality of the color contents of an image is incarcerated by using Zernike chromaticity distribution moments from the chromaticity space. In next, the texture attributes are extracted using a rotation-invariant and scale-invariant image descriptor in contour-let domain, which presents the proficient and flexible estimation of early processing in the human visual system. Lastly, the amalgamation of the color and texture information provides a vigorous feature set for color image retrieval. The experimental results reveal that the proposed color image retrieval is more accurate and efficient in retrieving the user-interested images.

d) S. Manoharan, S. Sathappan [11]: They Implemented the high level filtering wherever they are using the Anisotropic Morphological Filters, hierarchical Kaman filter and particle filter proceeding with feature extraction method based on color and gray level feature and subsequent to this the results were normalized.

e) Heng Chen and Zhicheng Zhao [12]: authors described relevance feedback method for image retrieval. Relevance feedback (RF) is an efficient method for content-based image retrieval (CBIR), and it is also a realistic step to shorten the semantic gap between low-level visual feature and high-level perception. SVM-based RF algorithm is proposed to advances the performance of image retrieval. In classifier training, a model expanding method is adopted to stability the proportion of positive samples and negative samples. After that a fusion method for multiple classifiers based on adaptive weighting is proposed to vote the final query results. SVM-based RF scheme is proposed to improve performance of image retrieval. In classifier training, a sample intensifying scheme is accepted to balance the proportion of positive and negative samples and then fusion scheme for multiple classifiers based on adaptive weighting is anticipated to vote the final query results.

f) Monika Daga, Kamlesh Lakhwani [13]:

Proposed a new CBIR classification was being developed using the negative selection algorithm (NSA) of ais. Matrix laboratory functionalities are being used to extend a fresh CBIR system which has reduced complexity and an effectiveness of retrieval is increasing in percentage depending upon the image type.

g) S. Nandagopalan, Dr. B. S. Adiga, and N. Deepak [15]: They proposed a novel technique for generalized image retrieval based on semantic contents is offered. The grouping of three feature extraction methods specifically color, texture, and edge histogram descriptor. There is a prerequisite to include new features in future for better retrieval efficiency. Any combination of these techniques, which is more suitable for the application, can be used for retrieval. This is presented through User Interface (UI) in the form of relevance feedback. The image properties analyzed in this work are by using computer vision and image processing algorithms. Anticipated for color the histogram of images are calculated, for texture co-occurrence matrix based entropy, energy etc are calculated and for edge density it is Edge Histogram Descriptor (EHD) that is found. To retrieval of images, a new idea is developed based on greedy approach to lessen the computational complexity.

h) G. Pass [16]: They proposed a novel method to describe spatial features in a more precise way. Moreover, this model is invariant to scaling, rotation and shifting. In the proposed method segmentations are objects of the images and all images are segmented into several pieces and ROI (Region of Interest) technique is applied to extract the ROI region to enhance the user interaction.

i) Yamamoto [17] proposed a content-based image retrieval system which takes account of the spatial information of colours by using multiple histograms. The proposed system roughly captures spatial information of colors by dividing an image into two rectangular sub-images recursively. The proposed method divides an image into dominant two regions using a straight line vertically or horizontally, even when the image has three or more color regions and the shape of each region is not rectangular. In each sub-image, the division process continues recursively until each region has a homogeneous color distribution or the size of each region becomes smaller than a given threshold value. As a result, a binary tree which roughly represents the color distribution of the image is derived. The tree structure facilitates the evaluation of similarity among images.

DIFFERENT IMAGE RETRIEVAL TECHNIQUES

There are various techniques have been proposed to retrieve the image effectively and efficiently from the large set of image data in which some of the methods are described below:

Relevance Feedback:

Every user's need will be different and time varying. A typical scenario for relevance feedback in content-based image retrieval is as follows [19]:

Step 1: Machine provides early retrieval results

Step 2: User provides opinion on the currently exhibited images based on the degree whether they are relevant or irrelevant to her/his request

Step 3: Machine learns the judgment of the user and again search for the images according to user query. Go to step 2

Gaussian Mixture Models:

Gaussian mixture models are one of the density models which includes a number of component Gaussian functions. These functions are combined with different weights to form a multi-modal density. Gaussian mixture models are a semi-parametric which can be used instead of non-parametric histograms (which can also be used to approximate densities). It has high flexibility and precision in modeling the underlying distribution of sub-band coefficients. Consider N texture classes labeled by n ∈N ≅{1,….N} related to different entities. In order to classify a pixel, neighborhood of that pixel must be considered. Then S´S sub-images blocks features can be computed assign classes to these blocks [20]. The set of blocks is represented by B. The neighborhood of a block b is called patch P(b). It should be defined as the group of blocks in a larger T.´T sub-image with b at its centre. Db is designated as the data associated to that block and Vb ∈ N be the classification of b. The classification can be done based on the following rule Equation (1):

v = argmax ÕPr(Db | vb = n) (1)

Thus, all the blocks in P(b) which has class n maximizes the probability of the data in P(b). It reduces computation time to classify the texture. The data Db linked with each block is denoted by the vector of features $\overline{x}$. For each and every texture class, a probability distribution that represents the feature statistics of a block of that class must be selected. Thus the probability that obtained $\bar{x}$ will be a convex combination of M Gaussian densities Equation (2):

$$P(\bar{x}|\{p_i ,\bar{\mu} \Sigma_i \}) = \sum_{i=1}^{M} p_i \, b(\bar{x}, \bar{\mu_i} \Sigma_i) \qquad (2)$$

where, $b\left(\bar{x}, \overline{\mu_i \Sigma_i}\right)$ is Gaussian of mean $\overline{\mu_i}$ and

Covariance Σ the parameters for a given class are thus

$\{p_i, \bar{\mu_i} \Sigma_i \ |i \in M\}$.

A GMM is the natural model which can be if a texture class contains a number of distinct subclasses. Thus by using Gaussian mixture model to retrieve the texture properties of the image gives desired accuracy.

Semantic template:

This technique is not so widely used. Semantic templates are generated to support high-level image retrieval. Semantic template is usually defined as the "representative" feature of concept calculated from a collection of sample images [8].

Wavelet Transform:

Wavelet transforms are based on diminutive waves, called wavelets, of varying frequency & limited duration. Discrete wavelet transform renovate the image in four different parts higher frequency part (HH), high low frequency part (HL), Low high frequency part(LH), lower part (LL) vertical parts is 1-level image decompositions then compute moments of all frequency part than store and use it as feature to obtain the images. Texture entropy and contrast, clumsiness are the mostly used properties. Statistical features of grey levels were one of the efficient methods to classify texture. The Grey Level Co-occurrence Matrix (GLCM) is used to extract second order statistics from an image. GLCMs have been used very profitably for texture calculations. From Grey Level Co-occurrence Matrix all the features are deliberated and stored into the database. The use of Grey Level Co-occurrence Matrix provides good result but it is in spatial domain so it is more error pron. CCH (Contrast Context Histogram) to find out the feature of the query image and other images stored in the database. CCH is in spatial domain and it presents global distribution. The MPEG Descriptors has been used like Edge Histogram Descriptor for texture. The Edge histogram differentiates edges according to their direction [20].

Gabor filter:

They are widely used for texture analysis because its similar characteristics with human perception. A two-dimensional Gabor function g(x ,y) consists of a sinusoidal plane wave of some frequency and orientation (carrier), modulated by a two dimensional translated Gaussian envelope. Gabor Filter have one mother filter using that other filter banks are generated and their features are calculated and stored in database. Structure of different types of Edges [20]

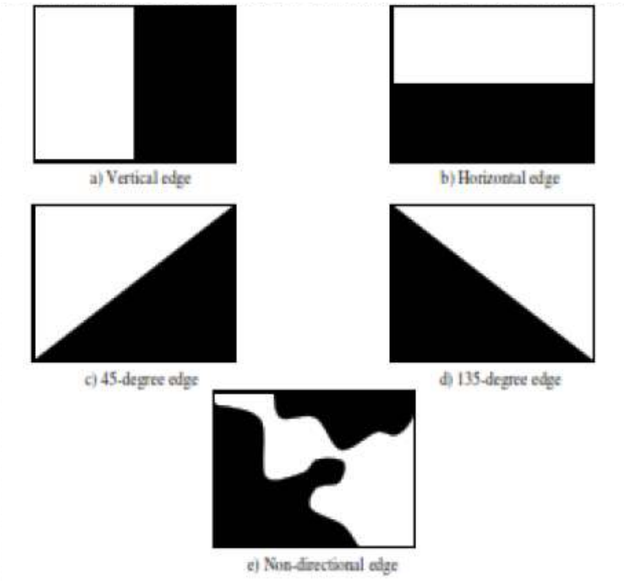


Fig. 2. Different types of edges

Support Vector Machine

Support vector machine is a supervised learning technique that analyzes data and identify pattern used for classification. It takes a set of input, read it and for each input desired output form [21] such type of process is known as classification, when if output is continuous than regression performed. For constructing maximum separating hyper-planes SVM maps input vector to a higher dimension feature space. Feature space refers to an input space which is reserved for measuring similarity with the help of kernel function. It is high dimension space where linear separation becomes very easier than input space [22]. In this, raw data is transformed into a fixed length sample vectors. Here are two terms which are used in feature space i.e. called feature values and feature vectors. The features of image is called feature values and these feature values presented the machine in a vectors is known as feature vectors. Kernel function used in the kernel method performing some operation such as classification, clustering upon different categories of data like text document, progression, vectors, group of points, image and graphs etc. it maps the input data into a higher dimension feature space because in this data could be easily separated or better structured [23]. There are some points in the feature space which are separated by some distance is called support vectors. It is the point between origin and that point and demonstrates the location of the separator. The detachment from the decision surface to the closet data point concludes the margin the classifier.

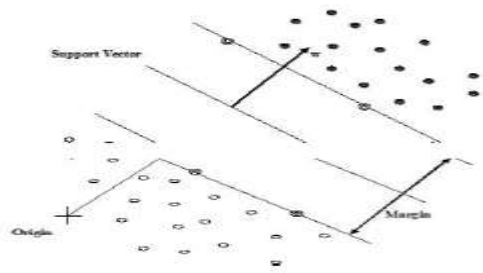


Fig. 3. Linear separating hyper-planes for two class separation

Color Histogram:

It is a standard demonstration of color characteristic in CBIR systems. It is very efficient in description of both local and global features of colors. This computes the chromatic information and invariant of image along the view axes for translation and rotation, when the large scale image data base computes histogram, its efficiency is not satisfactory and to overcome this conflict joint histogram technique is introduced. Color histograms are a fundamental technique for retrieving images and extensively used in CBIR system. The color space has segmentation, for every segment the pixels of the color within its bandwidth are counted, which demonstrates the relative frequencies of the counted colors. We use the RGB color space for the histograms. Only minor differences have been observed with other color spaces for the histogram. Color Histogram H(m) is a distant probability function of the image color. This probability function is used for the determination of joint probability function for the intensities of the three color channels. Further informally, the color histogram is defined as.

ha,b,c=N.prob(a,b,c)

where a, b, c represent the three color channel (RGB)

H (m) = [h1, h2…hn]

Hk=nk/N, k=1, 2….n;

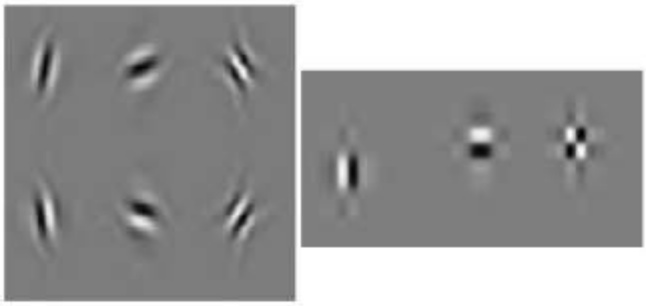
where N is the no. of pixel image M and nk is the no. of pixel with the image value k.

2D Dual-Tree Discrete Wavelet Transform:

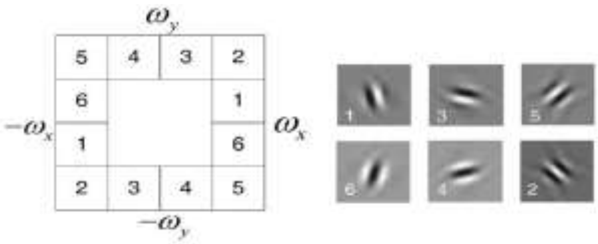
D-DWT is developed to overcome two main drawbacks of DWT: shift variance and poor directional selectivity [24]. With carefully designed filter banks, DDWT mainly has following advantages: approximate shift invariance, directional selectivity, restricted redundancy, and analogous computation efficiency as DWT either the real part or the imaginary part of DDWT [24] yields perfect reconstruction and thus can be employed as a stand-alone transform. We use magnitude of sub-bands to determine feature vector. The execution of DDWT is very simple. An input image is decomposed by two partitions of filter banks, $(H_0^a, H_1^a)$and $\left(H_0^b, H_1^b\right)$ disjointedly, filtering the image horizontally and then vertically just as predictable 2D- DWT does. Then eight sub bands are acquired:

$LL_a, HL_a, LH_a, HH_a, LL_b, HL_b, LH_b$ and HH_b

Each high-pass sub-band from one filter bank is combined with the corresponding sub-band from the other filter bank by uncomplicated linear operations: averaging or differencing. The size of every sub-band is the equal as that of 2D DWT at the same level. But there are six high pass sub-bands instead of three high-pass sub-bands at each level. There are two low-pass sub-bands, LLb and LLa are recursively decomposed up to a preferred level within each branch. The basic functions of 2D DDWT and 2D DWT are shown in Fig. 4.a and Fig. 4.b correspondingly. Each DDWT basis function is oriented at a definite direction, including ±75º, ± 15º, and ±45º. Conversely, the basis function of HH sub-band of 2D DWT mixes directions of ±45º together.



(a) (b)



(c)

Fig. 4. 2-D Discrete Wavelet Transform sub-bands

CONCLUSION AND FUTURE WORK

The study in content-based image retrieval (CBIR) in the past has been emphasis on image processing, low-level feature extraction, etc. Extensive experiments on CBIR systems demonstrate that low-level image features cannot always describe high-level semantic concepts in the users' mind. It is believed that CBIR systems should provide maximum support in bridging the 'semantic gap' between low-level visual features and the richness of human semantics. In this paper literature of different content retrieval method is discussed like SVM based retrieval, SVM with relevance feedback method, DWT based method etc in which some of the methods are efficient to shorten the semantic gap between the image while some are less so in future work need to develop such technique which much efficiently and effectively reduces the semantic gap and increases the information gain.

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