Retrieval of images on the Basis of Contents: a Review

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***Abstract* - With the rapid advancement and development of the Internet, the availability of various devices for capturing the images such as image scanners, the digital image collection's size is rising quickly. A well-organized image browsing, searching and retrieval tools are essential for users from different domains, including crime prevention, remote sensing, publishing, architecture, medicine etc. Therefore, several general purpose image retrieval systems have been exploited. In CBIR, images are accessed, searched and indexed by their visual contents. Content based image retrieval consists of two parts: feature extraction/indexing and retrieval part. The techniques which are used to extract features of an image are called feature extraction techniques. The choice of features plays a significant role in image retrieval. Some of the features used in CBIR are color, texture and shape. Combination of these features provides better performance than single feature. Here we have reviewed some of the work carried out in this field.**

***Keywords* - Content Based Image Retrieval, Annotation Based Image Retrieval, color, texture, shape.**

I. INTRODUCTION

Content-based image retrieval (CBIR) [1] has become an outstanding analysis topic as a result of the proliferation of video and image knowledge in digital type. Majority of data that is shared and accessed over the internet are in the form of multimedia contents. The multimedia database such as images and videos are more approachable because of visual contents. So the rapid advancement and access of various images over various social sites and blogging sites increase the image database size. With the increment in size of image database, there is a need of effective and reliable searching and retrieval policy for the images.

Retrieval of images is done by various users to extract their meaningful images from huge digital image libraries. For maintenance and retrieval of the various images from the huge image libraries, image retrieval is done[1][3][11].Therefore, fast and improved retrieval of pictures from a giant database is vital downside that must be self-addressed. High retrieval potency and fewer machine quality area units are the required characteristics of CBIR systems [2].

To retrieve the meaningful images from a large image database we have two approaches [9]. One is text-annotated based approach and another one is based on visual contents of the image i.e. content based approach. Traditionally we extract or retrieve our images from the database based on the text-annotation and that retrieval method is called Annotation based image retrieval (ABIR). In this image is defined in the form of well-defined keywords, tags and other descriptors [9]. So it is manual based image retrieval because every image has some meta-data associated with it for the retrieval process.

Some of the limitations of text based approach are:
1. Image retrieval which is relying on the keyword is not suitable since there is no permanent group of words that depict the image contents.
2. Keyword annotation is very subjective [2][9]. So it requires very much time for annotation.

We can use an alternative technique which is based on image's visual contents to avoid the text annotation for the retrieval of images. Thus technique is based on contents hence called Content Based Image Retrieval (CBIR) [8]. In this scheme, images would be accessed and indexed by its contents like color, shape, texture and face etc. and the required images are retrieved from large image libraries. There are two types of features in an image. The low level features of CBIR contain color, shape and texture. The high level features of CBIR describe the concept of human brain. Mostly in CBIR we use low level features as these are very efficient for use.

CBIR is one of the applications of computer vision in which retrieval rely on the visual contents of the image data. The straight forward image to image searching mechanism is not considered in CBIR because these types of mechanisms are not practically feasible to consider in real time applications as the image data is larger in size. So in CBIR, suitable feature extraction techniques are required to form the image data so that relevant images can be retrieved based on those extracted image features. A number of CBIR techniques were developed based on considering the significant feature like color, texture, shape and faces etc.

In CBIR we compare the query image with the database image based on these contents i.e. color, texture, shape and others. Retrieval is based on contents so that is why earliest CBIR is also called Query by Image contents. We compare the two images

and calculate the image distance with the database image based on these various visual contents. For example, if the distance between the database image and query image is 0 it means both images are exactly similar. A value slightly greater than 0 means both query and database image have many similarities. In this way all the images after searching are sorted according to the image distance and the user will choose their appropriate image. We can compute this image distance by any of the content of Image. **Here are three main image measure models which are used in CBIR mostly.**

a) **Color**
We can compute the image distance between both the images (query image and database image) based on color feature of an image. Color is the low level feature which is famous for CBIR. Mostly color feature is represented in the form of color histogram. There are various other methods also for color like color moment, color coherent vector etc. Yet color histogram is easy to compute so it's mostly used. Color histogram is prepared by the values of colors in various pixels of an image. It is easy and fast method to extract the image from a large image library based on color because color features can be easily extracted and computationally fast also hence effective and efficient to use. Because search can be completed without regard to the direction, orientation and size, thus color feature is mostly used for the CBIR.

b) **Texture**
Texture is a low level feature which tells us the spatial distribution of various patterns in an image. Texture of an image tells how much regularities, smoothness, coarseness in an object. Texels or textons are used to representation the textures in an image. There can be numbers of textures in an image so these texels are further grouped into the sets. Hence these sets define how many textures are there in an image and also spatial distribution of that set of texels in image. We have many methods to classify the texture in an image like wavelet transform, co-occurrence matrix etc.

c) Shape
Shape is another important and effective feature for the retrieval of image. it is widely used for the retrieval of binary image. Shape features define the shape of various regions in an image. Shape of a particular region in an image can be defined by two methods based on external and internal characteristics. External methods used the external characteristics like boundary of a region in an image. It is easy to calculate. Internal methods use the internal characteristics of image for shape representation and description. To determining the shapes, we have to detect the edges and apply some segmentation. Shape features descriptors are of two kinds. One is structural descriptors and another one is global descriptors. Fourier transform and wavelet descriptor are famous for the shape features in CBIR.

Hence these are the features which are used for image retrieval now days. We can combine these features for getting the good performance of image retrieval systems. For example: As color does not gives us the spatial distribution of the object so we can extract texture and color features both from image, hence our CBIR system gives us a good performance for the retrieval. Many researchers are looking for the better result so they combine these features as shown in many papers because combination of these features has been shown more efficient performance in image retrieval systems [3].

CBIR SYSTEMS: -
In CBIR, we use the visual features of an image to access the image from a large library. CBIR systems can retrieve the images from the multimedia database by performing two steps [11].

- Feature extraction and indexing of various images into a new database.
- Searching and matching for the desired image

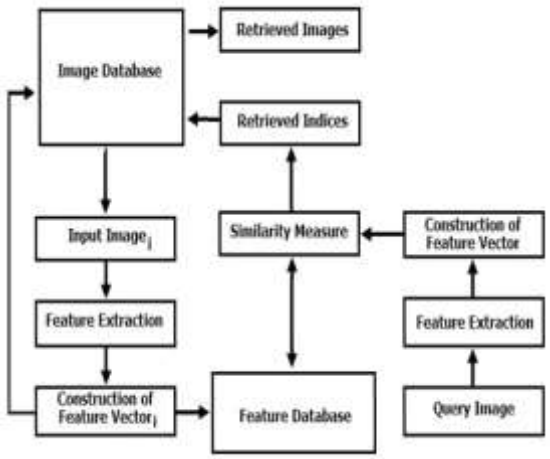

Figure 1: *CBIR Systems* [11]

Features are automatically extracted from an image when it is stored in image database. These extracted features (based on color, shape or textures etc.) are stored in a new database called feature database. These extracted features are also called image signature and they are smaller in size than the image data. So it is the compressed form of an image. As actual image pixel values need more space so it is better to compress the image for the efficient use of database size and extract the features from the image.

When any user query for the image, same feature extraction algorithm is applied to the query image also. Then matching is done, we compare the extracted features of both the images and calculate the image distance between both the images. Those images which have minimum distance are chosen from the database.

Application of CBIR: CBIR is used in many areas because of the limitations of text based image retrieval [8]. Here are some of areas where CBIR is used now a day:

- Medical diagnosis
- Crime prevention
- Online shopping and in retail catalogues
- Art collection and in Engineering Designs
- Geographical information and other Sensing Devices

II. Literature Survey

Hiremath, P. S., and Jagadeesh Pujari et al. [1] in this paper CBIR method has been presented which uses color, shape and texture information to attain high efficiency. In this work firstly images is divided into non-overlapping tiles and extract the color and texture features. After the matching scheme the shape features are extracted. By combining the three features, this work has showed the better performance than the others methods.

Yue, Jun, Zhenbo Li et al. [4] proposed a novel technique based on CBIR to extract texture feature and color features of an image. Initially, a feature vector was formed by extracting the co-occurrence matrix which is relying on color and texture feature. After feature vector was formed, characteristics of various histograms such as local and global color histogram and texture features has been analyzed and compared for content based retrieval image. Depending on the steps, proposed method has been developed by constructing weights of feature vectors. The performance result demonstrated that the fused features retrieval provides better retrieval results.

Singha, Manimala et al. [5] in this paper, Content Based Image Retrieval has been presented by combining the color and texture features. This proposed approach is termed as Wavelet-Based Color Histogram Image Retrieval (WBCHIR). In terms of accuracy, the results shows that proposed method have performed better as compared to other retrieval methods.

Table 1: ***A Brief overview of this literature survey***

Author's Name	Feature used	Dataset/ Database	Performance parameter/metrics	Result (An average value)
P. S. Hiremath and Jagadeesh Pujari (2007) [1]	color, texture and shape	Wang's dataset comprising of 1000 Corel images with ground truth(100 images in each of various 10 categories)	Average Precision	0.59 for all the 10 categories but highest precision for Dinosaur(0.96)
Jun Yue, Zhenbo Li , Lu Liu, Zetian Fu (2011)[4]	Color and texture fused features (Linear weighted mode combining with similar distances of color and texture features) [4]	SQL server 2005 served as the system database (various images of cars)	Weights of color and texture features	0.5 and 0.5 weights for color and texture respectively is better than 0.6 and 0.4
Manimala Singha and K.Hemachandran (2012) [5]	texture and color (Wavelet Based Color Histogram) [5]	Wang image database having 1000 images of the Corel stock photo	1.Precision and recall 2. Time	1) 0.762 (average precision) 2) 5-6 min for whole indexing of database 1 min (for 10 query retrievals)

M. Singha K. Hemachandran A. Paul(2012) [6]	Color and texture (the colour histogram and using the lifting scheme with Haar wavelet Transformation)[6]	Wang image database having 1000 images of the Corel stock photo database	1.Precision and recall 2. Time (For LWBCH (A,H)(Haar))	1) 0.661 (Total average precision 2) 56.503 sec (Total average time)
Subrahmanyam Murala · R. P. Maheshwari · R. Balasubramanian (2012) [7]	Texture and color (directional edge information based on local extrema in 0◦, 45◦, 90◦, and 135◦ directions in an image))[7]	1. Corel-1K 2. Corel-5K (5000 images) 3. Corel-10K 4. Brodatz database(DB2)	Precision and recall Precision and recall Precision and recall Average Retrieval Rate	Corel-1K (P-(74.8%, R- 49.16%) Corel-5K (P-(48.8%, R- 21.1%) Corel-10K (P-(40.0%, R- 15.7%) 82.68%
Sandeep Singh, Er.Rachna Rajput(2015)[9]	Color (color Auto Correlogram) with the SVM, Neural Network and KNN Classification methods)[9]	Images of 10 categories (Beach, Monuments,Buses, Dinosaurs, Elephants, Flowers, Horses, Mountains, Food)	1. Precision	Shows an image as a result of better precision (which shows 88.5% precision as an average)
Dileshwar Patel, Amit Yerpude (2015) [10]	Color and shape (color edge detection and histogram of an image with haar wavelet transform)[10]	Wang's database contains total number of 500 images having 10 classes	1.Precision 2.Recall Average precision for retrieval of 40 images for 5 classes Recall for the images of 5 classes	97% 78% (Max. result for horse) 88.9% 70.8 % (average) recall
Naushad Varish, Arup Kumar Pal(2015)[11]	Color (Statistical features of color histogram) [11]	Corel image Database (1000 images of 10 various categories)	Precision and Recall	84.0
Bingfei Nan, Ye Xu, Zhichun Mu, Long Chen(2015) [12]	Texture and color (local texture-based color histogram) [12]	Corel-1000 database and corel-5000	Precision and Recall	0.7061 Precision increased from 4 to 20%
B.Jyothi, Y.MadhaveeLatha, P.G.Krishna Mohan	Shape and texture (texture features using second order	various classes of medical images characterized by certain	Recall rate Error rate	63.32 36.18

(2015) [13]	statistical Values) [13]	objects such as liver, body outline, spine for CT or MRI images of the skull, abdomen, ventricles for images of the head etc.		
Jayamala K.Patil, Rajkumar (2016) [14]	texture feature (Local Gray Gabor Pattern) [14]	Agricultural Database of Three major soybean leaf diseases named Alfalfa Mosaic Virus, Septoria Brown Spot and Pod Mottle(Total 270 images)	Precision and Recall	58% (Max. Precision obtained compared to other methods in that paper)
Xiangyuan Zhao, Brian Nutter(2016) [15]	shape and texture (multiple input multiple task deep autoencoder(MIMT-DAE) utilizing wavelet transformation) [15]	MNIST a database of handwritten digits.	Precision and Recall	60.32% 30.00%

K. Hemachandran, et al. [6] in this paper, image retrieval technique has been presented. This proposed method is based on the combination of color histogram with the Haar wavelet transformation and lifting scheme which is basically called as lifting wavelet-based color histogram. The color features has translation and rotation invariant. In order to increase the accuracy of the system, the wavelet transformation is used to extract the texture features. And to reduce the processing time, the lifting scheme has been used which showed higher performance for CBIR systems.

Murala, Subrahmanyam, et al. [7] presented a novel techniques using directional local extrema patterns meant for content-based image retrieval application. The proposed method can able to extract the directional edge information in 0◦, 45◦, 90◦, and 135◦ in an image. The result is compared with existing approaches such as local edge patterns for segmentation, local edge patterns for image retrieval, center-symmetric local binary pattern, block-based LBP. The performance indicates that there will be improvement in proposed method in comparison with existing methods on databases.

Singh, Sandeep et al. [9] in this paper content based image retrieval system has been presented based on the image recovery system. This novel approach provides precise results among other developed system. Image recovery system is used to estimate the image similarity of every image only in terms of visual features. And then it will return the image with similarity, the feature weight based on the neural network is used to evaluate the efficient feature extraction. In this study, feed forward algorithm has been applied for neural network.

Patel, dileshwer et al. [10] proposed an approach for image retrieval from very large image database. In last decades, various research works has been developed and much technique has been proposed but most of the approaches deals with the accuracy problem. In this paper, novel technique has been presented which uses histogram and color edge of an image with wavelet transform. The proposed algorithm is calculated with two parameters i.e. is precision and images of Wang database.

Varish, Naushad, and Arup Kumar Pal et al. [11] CBIR method has been presented in this work based on statistical features that uses the color histogram for the image retrieval in this paper statistical values (standard deviation, skewness and kurtosis) are calculated from the three probabilistic color histograms. Then these values are used for the feature extraction. This is the novel technique which shows the good performance for the retrieval of images.

Nan B., Xu Y., Mu Z., and Chen L. et al. [12] presented a novel representation method for the image features called local texture-based color histogram (LTCH), for CBIR. LTCH is the visual feature descriptor which combines the various features i.e. color, local texture and spatial layout for any image but without any model training and image segmentation. This feature representation method is defined as a micro-structure image with a near-uniform texture which can describe the color distribution under a mask. This paper shows the comparison of LTCH with the other four descriptors color difference histogram (CDH), microstructure descriptor (MSD), multi-texton histogram (MTH) and structure elements' descriptor (SED). This method shows the better result than the other descriptors.

B.Jyothi,Y. MadhaveeLatha and P.G.Krishna Mohan et al. [13] presented a novel approach for the image retrieval which extracts the texture features based on region. These texture features of various images using the second order statistical values for

the retrieval of medical images. In this paper they compared this technique with the other three methods i.e. Gray-level co-occurrence matrix(GLCM), histogram and block GLCM and shows the better performance.

Jayamala K.Patil and Rajkumar et al. [14] presented the paper which compares the three texture features method for the image retrieval. In this paper they developed a new texture feature which is called Local Gray Gabor Pattern (LGGP). This CBIR technique has developed for the various diseased leaves of soybean images. As a result this is a novel technique for the image retrieval as compared to other two methods (Gabor filter and local binary pattern(LBP)).

Xiangyuan Zhao and Brian Nutter et al. [15] in this paper, a novel algorithm is presented for CBIR system which is based on wavelet transformation and multiple input and multiple task deep autoencoder (MIMT-DAE). The various wavelet coefficients from an images is calculated and then these coeficients became the input for the MIMT-DAE and as an output this approach shows the better result compared to SIST-DAE (single input single task deep autoencoder).

III. Conclusion

This review work has focused on various CBIR methods. There are three main features by which we can retrieve our images from the database i.e. color, shape and texture. From a technical viewpoint, we have put forward the variety of the proposed solutions for image description and similarity calculation techniques. These are considered as the two important components of a CBIR system. Future work will look for the fast and accurate retrieval of the images based on the contents.

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