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Content-Based Image Retrieval Techniques: A Review

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***Abstract*— Present-day, medicinal and healthcare industry needs a direct attention in the care of human organs and disease objects. They are extensively used for the analysis, treatment, and spotting of the disease. The retrieval of the appropriate images from the database is very difficult if the volume of the image database has increased. By means of this, Content-Based Image Retrieval (CBIR) acquired animmense deliberation to excerpt the pertinent information from the large image archive. It contains two activities, extracting the features and measuring the similarity. Based on these, many CBIR systems are proposed. This paper provides the exhaustive study of the recent CBIR which is used to design a mechanism for image retrieval to get better retrieval results with lesser computational complexity.**

Keywords — CBIR, Feature Extraction, GLCM, Shape, Texture, Wavelet Transform.

I. INTRODUCTION

The Digital Image contains significant data used in a variety of areas like journalism, private life, medicine,crime prevention, education,defense and etc. Bases on its usage, the content contribution of the digital image to be expanded highly as well. A large database which is used to store the digital images and competent retrieval system must be provided in their area to handle and manage these enormous data. Though, the digital information is used in all application. Because of the importance of the analysis and diagnosis of medical image for spotting the diseases, medical application plays a vital role in retrieval system.It is an important task to retrieve images from a database, and hence there are many challenging research work exists in computer vision area [2]. Then, how to improve the retrieval efficiency while retrieving the images from a large database? To answer this, basically Image Retrieval System is carried out by matching the query image with the database image in two ways. First, metadata of an image such as name, keywords etc. are used for the matching process. But, for effective retrieval, this information is not enough and also they need a significant amount of human effort to organize the images and labeled according to semantic contents. The content-based image retrieval system is used to reduce this human exertion,.The images are matched by using various types of image contents such as color, texture, and shape etc in this method. One of the basic and important feature of an image which can be considered is color. Because, when we look at an image, our brain first notices the color composition. The Texture excerpts the spatial information from the spatial distribution of an image using color intensity. This may be useful for distinguishing semantically different images that have similar color information. For detecting the objects, and recognizing the objects shape information may be used . Shape features are very helpful For retrieval of images in satellite imagery, medical image databases etc. [5] shape features may help to retrieve the information.

A CBIR mainly performs two major functions: (i) feature extraction and (ii) similarity measurement. In feature extraction, the image content is described by a set of features which are extracted from an image and stored as a feature vector. In similarity measurement, features are excerpted from an input image and then compared with the database image by using the similarity measurement techniques.

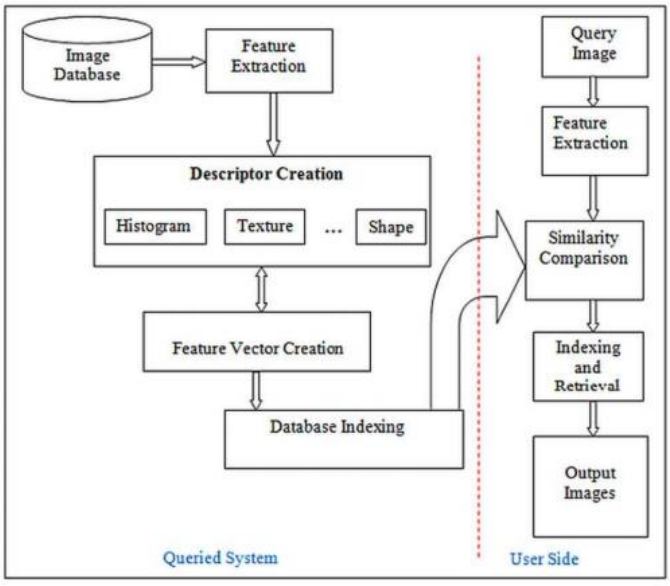

Fig. 1. Basic Block diagram of CBIR

Based on the similarity measurement value, the retrieved images are ranked; the most similar images are finally displayed to the user. This two-tier approach reduces retrieval time and increases the accuracy

In CBIR, the selection of feature, which is used to describe the image content take place an important role and a challenging task. Meanwhile, deciding the size of the feature vector also act as the key to the successful retrieval system. [1].

This paper is formed in various sections; section II provides the Literature survey on existing research work. Analysis of various CBIR System and summary is given in section III and also the conclusion and motivation of the future research work are given in section IV.

II. LITERATURE SURVEY

A study on recent CBIR system using color, shape and texture features are given below.

A.K.Naveena et. al., presented a CBIR system which combines feature such as texture, color, and shapes to give accurate results and reduce image retrieval time. In this image retrieval system, the images are collectively stored in a database, from that; one image is selected for excerpting color, texture and shape features and stored as a feature vector. The same procedure is repeated for all images on the database. Finally feature vector database is created. For extracting the color feature, the Color moment is used. For this, the image is transformed into L*a*b* color space and then partitioned into 5×5 grid.Finally, the three color moments are extracted for the accurate result. Pyramid structured and tree-structured wavelet transform is used to extract the texture feature. In this,Daubchies Wavelet is applied on gray scale image then mean and standard deviations are calculated at each level of decomposition. Edge histogram is used as the shape feature. The edge of the image is extracted using the Canny edge detection algorithm. Finally,feature vector for the query image is created by combining all three color, texture and shape feature.Now, query image's feature vector is compared with the feature vector database. Then the query image is classified into any one of the class using SVM classifier. Then, the similarity between the query image and the images in the database is computed using Euclidean distance in that class where the input image is classified and finally, the top 20 images are retrieved[1].

Sawet Somungpomg et. al.,proposed a CBIR which gives a solution to the spatial changing problem by combining the Edge Direction Histogram (EDH) and Color Correlograms.This system gives priority to spatial information of an image such as, pairs of color changes with distance for the same image; same images are zooming in various sizes, etc.Color correlograms give the spatial color correlation information. Sometimes the same image may be repeated with different color that is identified by using EDH. In this system, the first process is feature extraction process; the input image is fed into the feature extraction module. There, correlograms and EDH features are extracted and are combined using vector concatenation process. The second process is start by measuring the similarity between query image features and template features, which saved in the database using Euclidean Distance. This is known as matching process. Lastly,in keeping with the similarity scores, the top most relevant images are retrieved and shown on the screen as the result. The combination of texture and spatial correlation of pairs of color feature provides more robustness to the high changing image and EDH will fulfill the image semantic in term of texture and geometry [2].

Dhanraj J. Dhotre et. al.,proposed a system which increases the retrieval speed and takes less time for retrieval the images. To provide accurate results, the Color features and Texture features were combined and in order excerpt the color and texture feature from an image the Color Histogram and Haar Wavelet Transformation were used . In this paper, the computation of the Haar Wavelet Transforms of a two-dimensional signal involves 4 levels of recursive filtering and subsampling which reduce the computational cost. For Color Histogram, Average RGB model is used. First, the color image is converted into RGB values and stored in a matrix form. All R, G, B components in an image are reduced and separated into 3 different arrays. Then calculate the total number of red pixel, the green pixel and blue pixel and later the average of each pixel is calculated individually. After extracting both color and texture feature comparison made with the database images. At third level of decompositions of haar wavelet transform, the image search similar images for the query image from the database [3].

Anusha Yalavarthi et. al.,proposed enhanced Gabor Wavelet Transforms technique which produce the result with high recognition rate as well as less computational time. This system consists two phases. First one is training phase; there the images are converted into grey scale image. GWT is used, to decompose all the images into 5 different levels of scaling and 8 different levels of dilation that will create a Gabor filter bank.From that, features are extracted using the up and down sampling process. Apply the same procedure for all training images and the extracted features are stored in a database.Second one is testing phase, the test image is gone through the above mentioned steps and features are extracted and compared with the training image database by applying different distance methods and finally display the top matching images with high recognition rate and computational time [4].

Fahim Mohiuddin et. al.,combined Local Binary Pattern (LBP) and Color Coherence Vector (CCV) for extracting texture information and color information respectively which display most similar images. Basically the images are stored in the database as a RGB image.Initially, these RGB images in the database are converted into HSV image and apply Color Coherence Histogram technique is used to extract the color information. Again, the same RGB image in the database converted into grey image and texture features are extracted using Local Binary Pattern Histogram. Now Feature database created for the all database image by combining these two features. After that, the input image features are extracted and is tested with the feature vector database using distance function. Based on the distance value, the resultant images are sorted and display the similarity images. [5].

Shiraaz Saad et. al.,proposed an efficient two-level classification technique. In order to extract the features from the training image SIFT is used. Also a number of features are selected from the training images for the formation of bags.Bag of words is used to create the dictionary. Now, the training image database is ready. Query image features are extracted

using SIFT, from these feature bags of words are created. In first level classifications, using the bags of words of query image, the appropriate related kind of the query image is to be found from the database and in second level,within these related kinds,the same bags of words are used to find the most similar image. The efficiency depends on the type image descriptors selected and the size of training set [6].

Mohd. Aquib Ansari et. al.,proposed an enhanced system .The human visual framework first focus on the color information of an image and gives more robust information from it. In this work, to extract color information of an image HSV color histogram is used, and then to extract complex texture pattern,the discrete wavelet transform is applied on each component (H, S and V) of HSV image and finally the geometry and special information of edges are extracted by applying the global as well as local edge histogram descriptor. To find out how much the user image is similar with respect to the image in the database the similarity metric such as Euclidean distance was used. With the mixture of the color, texture and shape based techniques the precision was alo increased[7].

Navdeep Kaur et. al.,proposed a HMMD (Hue Min Max Difference) along with color mean features and color standard deviation feature which is used to reduce the size of feature vectors, storage space and gives high performance than, RGB-color mean feature. First, the Hue value is calculated from an image and Max and Min value among R, G, and B are calculated. Then apply the HMMD method for extracting the features and stored in feature vector database. Finally, naïve Bayes classifier identify the similarity between the query image and database image and display the result. But in some cases, there will be irrelevant images with the result of query image in some cases these irrelevant images are totally different from query image on basis of color and shape and also the computation time for the whole process is on a bit higher side. Therefore, the future work will be focused on reducing the processing time for the feature extraction so that the complete process is fast enough for real time application [8].

R.Durga Prasad et. al.,verified the dominance of image retrieval with multi feature than single feature. In this system, multiple features are extracted from the query image.(i) Tonal distribution derived from the Histogram of individual image. (ii) Texture feature are extracted using GLCM (Gray Level Co-occurrence Matrix) based on the four statistical parameters contrast, correlation, energy and homogeneity. (iii) Color feature extracted using Color Dominant which can be represented as a connected homogeneous color pixels. These three features can be used to the retrieve the similar images from the image database. Then similarity matching is done by Euclidean Distance and K-Means Clustering algorithms and display the similar image [9].

Simranjit Kaur et. al., combined and compared Color Histogram and Wavelet Based Color Histogram (WBCH) to produce a good results with less retrieval time. First, similar image from the database are retrieved based on the query image, then apply the Color Histogram which is used to extract the color feature and WBCH which is used to extract the color and texture feature for both query image and database image. Finally, apply Euclidean Distance for similarity comparison and display the results [10].

III. Analysis of different CBIR techniques and Summary

Presently due to large size of the image database Content based image retrieval (CBIR) is a challenging issue. Also there exists difficulty in recognizing images, manage large data files and the total retrieval time. This paper, focus on some recently developed CBIR which are used in many different applications to give accurate results in image retrieval. Each application has different types of images and each image has different features.So selection of feature of an image for a particular application is more important and also measurement of similarity between the images. Table 1 gives some of the feature extraction techniques and similarity measurement methods. Image content can be described by color, texture, and shape features which is one of the most widely used low level visual features. From this survey, it has been summarized that,

- Color Moment, Color Correlograms, Color Histogram, Color Coherence Vector, HSV histogram, HMMD, and Color Descriptor etc., techniques are used to extract color features.
- Haar Wavelet Transform, Gabor Wavelet Transform, Discrete wavelet transforms, and GLCM etc., are used for extracting texture features.
- Canny Edge Detection, Edge Detection Histogram, and edge histogram descriptor etc., are used to extract shape features.
- Similarity measurement is carried on by Euclidean distance, Chi-square Distance, Wavelet Depose, Naïve Bayes, and K-Means Clustering methods.

TABLE I. SOME RELATED WORK IN CBIR

Paper	Features	Feature Extraction Techniques	Similarity Measure	Result
[1]	Color, Texture and Shape	Color Moment, Wavelet and Canny Edge Detection	Euclidean Distance	98%
[2]	Color and Shape	Color Correlograms and Edge Detection Histogram	Euclidean Distance	93%
[3]	Texture and Color	Haar Wavelet Transform and Color Histogram	Wavelet Decompose	81.13%
[4]	Texture	Gabor Wavelet Transform	Euclidean Distance, Chi-square Distance	79.5%
[5]	Color and Texture	Color Coherence Vector, Local Binary Pattern	Euclidean Distance	67.13%
[6]	Color, Texture and Shape	HSV histogram, discrete wavelet transforms and edge histogram descriptor	Euclidean distance	95%
[7]	Color Mean	HMMD	Naïve Bayes	76%
[8]	Color and Texture	Histogram, GLCM and Color Dominant	Euclidean Distance and K-Means Clustering	82%
[9]	Color and Texture	Color Histogram and WBCH	Euclidean Distance	83%
[10]	Color and Texture	Color Descriptor and GLCM	Euclidean Distance	75%

In CBIR, the images are categorized into a semantically meaningful classes based on low level feature. To improve the CBIR performance during the matching process the images are filtering out from irrelevant class. From the above survey we observed that,

- Better image semantic will obtain by Spatial Correlation and Image Geometry instead of using the traditional histogram. So the efficiency will increase by combining the Color Correlograms and Edge Direction Histogram.

- Different levels of scaling and dilation of an image is carried out by decomposing for that Gabor Wavelet Transform is used. GWT is not only applicable for spatial frequency domain but also applicable for spatial relevant of the given input image.
- Orthogonal Wavelet features requires less space and also very fast for computation of transform and inverse wavelet transform. So computational time is less which increase retrieval speed.

Single feature descriptor may never reveal accurate results. When we combine more than one feature we get accurate results with less retrieval time. If we combine texture feature with color or shape feature we may get the results above 80% only. If we combine color, texture and shape features together we may get the results above 90% of accuracy. Figure.2 shows the accuracy level of the CBIR specified in Table 1.

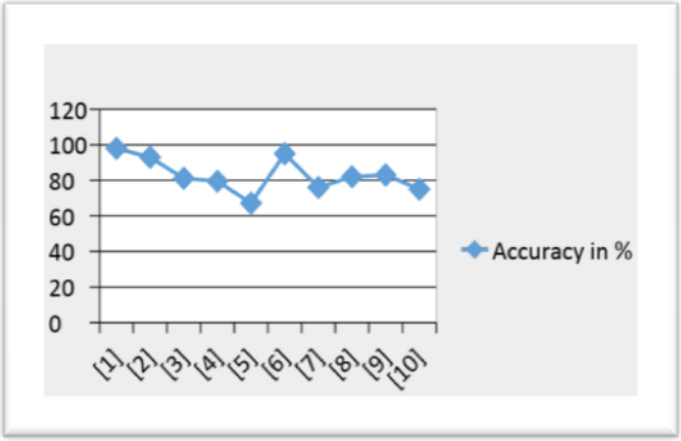

Fig. 2. Accuracy levels of different proposed methods

IV. Conclusion and Future Work

Content Based Image Retrieval is a challenging task for catching pertinent image from a large database. This paper highlights the recently proposed CBIR systems to find which one provides the accurate result with efficiently.From the above survey we found that,

- There are some disadvantages in color based feature extraction techniques. For, medical image color based extraction method could not provide accurate information.
- Spatial information and color similarity have provided irrelevant information and also it takes the huge computing time for process the image information.
- Edge Histogram for Shape and Wavelet for Texture feature are collectively used for feature extraction which gives more accurate results. To find the similarity between the input and database image the metric Euclidean distance is used.

Medical images play a pivotal role in the care of human organs and disease inquiry. They are used widely for effective diagnosis, treatment and monitoring of the disease. So our future work will focus on CBIR in medical applications. Particularly, the brain is an important organ that is responsible for operating and supervising the body's functions. It has the capability to enable the conscious communication with our body and governing the organs to do automatic operation. In that, the life threatening disease in brain is tumor. The extra cells growing in the brain which forms a mass of tissue is termed as brain tumor. Detection of tumor from MRI (Magnetic Resonance Image) images is a challenging issue. For this reason, this research work focus on early detection of Brain Tumor to save life.

References

[1] Naveena A k and N.K. Narayanan, " Image Retrieval using Combination of Color, Texture and Shape Descriptor " International Conference on next generation intelligent systems, IEEE , April 2016.

[2] Sawet Somunugpog and Kanokwan Khiewwan, " Content Based Image Retrieval using a Combination of Color Correlograms and Edge Direction Histogram " International Conference on Computer Science and Software Engineering, IEEE, Jan 2016.

[3] Dhanraj R.Dhotre and Dr. G.R. Bamnote, "Multilevel Haar Wavelet Transform and Histogram usage in Content based Image Retrieval System "International Conference on vision, Image and signal Processing, IEEE, pp. 82 – 87, Apr 2017.

[4] Anusha Yalavarthi, K. Veeraswamy and K. Anitha Sheela, "Content Based Image Retrieval Using Enhanced Gabor Wavelet Transform"International Conference on Computer, Communications and Electronics, IEEE, pp. 339 – 343, July 2017.

[5] Fahim Mohiuddin, Ishmam Hossian and Md. Wasi UI Kabir, "A Noble Color-Texture Hybrid Method for Content Based Image Retrieval "International Conference of Computer and Information' Technology, IEEE Trans, Dec 2017.

[6] Shiraaz Saad, Harendra Kumar and Tribhuwan Kumar Tewari, "Efficient Content Based Image Retrieval using SVM and Color Histogram "International Conference on Contemporary Computing (IC3), IEEE, Aug 2017.

[7] Mohd.Aquib Ansari and Manish Dixit, "An Enhanced CBIR using HSV Quantization, Discrete Wavelet Transform and Edge Histogram Descriptor" International Conference on Computing, Communication and Automation, IEEE, pp. 1136 – 1141, July 2017.

[8] Navdeep kaur and Rajbhupinder Kaur, "Content Based Image Retrieval Using Color Mean with Feature Classification Using Naïve Bayes", International Journal of Advanced Research in Computer Science, Vol 7, No.6,PP.1 – 5, Nov 2016.

[9] R.Durga Prasad, B.V.K. Sai Kumar, K. Sai Ram and B. Veera Manoj el, "Content Based Image Retrieval using Dominant Color and Texture Features", international Journal for Modern Trends in Science and Technology", vol 2, issue:4, pp. 36 – 41, Apr 2016.

[10] Simranjit Kaur and Ms. Navpreet Kaur, "Content Based Image Retrieval using Color Histogram and Wavelet Based Color Histogram Algorithms", International Journal of Engineering Research and General Science, Vol 4, Issue 3, pp. 530 – 535, may-june 2016.