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Content Based Image Retrieval Using Color Histogram and Wavelet Based Color Histogram (WBCH) Algorithms

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Abstract: Content Based Image Retrieval (CBIR), also known as Query By Image Content (QBIC) uses low level features of an image such as color, shape and texture to search images from large image databases based on user's interests for a given input query image. In this paper two algorithms Color Histogram and Wavelet Based Color Histogram (WBCH) have been implemented. Color Histogram algorithm is used for color feature extraction using Color Histogram and WBCH algorithm is used for both color and texture feature extraction using dwt2 wavelet transformation from both query image and images in the image database for retrieving the similar images from the large image database to the user's input query image. The images which are retrieved as result in both algorithms are then compared on the basis of values of the parameters which shows that Wavelet-Based Color Histogram algorithm is better than Color Histogram algorithm in terms of retrieval time as it takes less time in retrieving the images.

Keywords: CBIR, Color Histogram, WBCH

1. INTRODUCTION

Content Based Image Retrieval (CBIR) was first introduced in the early 1980s. It uses low level features of an image such as color, shape and texture to search images from large image databases based on user's interests for a given input query image. CBIR is used in crime prevention, medical profession, architectural and engineering design, publishing and advertising, historical research, commerce, government, fashion, weather forecasting, remote sensing etc. [4]. One of the main task for CBIR is similarity comparison, extracting feature of every image based on its pixel values and devising rules for comparing images. The various components of CBIR are query image, image database, similarity matching and feature extraction [2]. Query image is the image submitted by the user to the retrieval system in search of desired images in the image database of digital images. The various query formations are category browsing, query by concept, query by sketch, query by example. Image database consists of all the images present in the database such as COREL database, Caltech database, Oliva database, Outex database etc. Similarity matching means comparing the values of the pixels of the image. There are various methods for similarity matching like histogram intersection distance, Euclidean distance, relative standard derivation, Bhattacharya distance, Mahalanobis distance etc. Feature extraction means extracting unique and valuable information from the image. Features of an image are also called signature of image. Features are classified into low level features (color, texture), middle level features (shape) and high level features (semantic gap of objects). The various methods for color and texture feature extraction are Color Histogram, Color Correlogram, Color Moments, Gabor Filter, Haar Discrete Wavelet Transform, Tamura Feature and Gray Level Co-occurrence Matrix (GLCM).

2. LITERATURE REVIEW

Manimala Singha et al. [6] presented an approach called Wavelet-Based Color Histogram (WBCH) which uses Color histogram for color feature extraction and Haar discrete wavelet transform for both texture and shape feature extraction efficiently. **K. Haridas et al. [8]** implemented and tested three content based image retrieval methods- RGB color histogram, Tamura texture and Gabor feature on the basis of three parameters- precision value, recall value and accuracy rate which shows that Gabor texture feature gives better performance than other two methods. **Swati Thakur et al. [3]** discussed and analysed the techniques of content based image retrieval and proposed a new method Line Edge Singular Value Pattern (LESVP) in detail. **S. Chidambaranathan [5]** introduced image mining techniques using color, texture and shape image content descriptors and relevance feedback technique for improving the system performance. **Nitin Jain et al. [4]** briefly described two color and texture based extraction algorithms- Color histogram and Gabor filter. **Saurav Seth et al. [2]** introduced a simple content based image retrieval system and it's few techniques- conventional system, relevance feedback system and a fuzzy logic system. **Ms. Pragati Ashok Deole et al. [1]** introduced three techniques color correlogram, color moment, HSV histogram for color feature extraction with KNN classification. **Dr. K. Velmurugan [10]** introduced Scale-Invariant Feature Transform (SIFT) algorithm for color based and shape based image retrieval in content based image retrieval system. **Ammar Huneiti et al. [9]** introduced a CBIR method using the Discrete Wavelet Transform (DWT) and the Self Organizing Map (SOM) artificial neural networks for extracting both color and texture feature vectors. **Shanmugapriya, N. et al. [11]** presented a

new CBIR system using Gaussian Mixture Models (GMM) to retrieve texture based images, auto color correlogram to retrieve color based images and then combining GMM and auto color correlogram algorithms to retrieve color and texture-based images. **Keyuri M. Zinzuvadia et al. [7]** described and compared various color based, texture based and shape based feature extraction techniques using classification and relevance feedback. **Zainab Ibrahim Abood et al. [12]** presented content based image retrieval using hybrid technique which is better for image retrieval with 100% higher match performance for each type of similarity measure.

3. PROPOSED COLOR HISTOGRAM and WBCH

The system framework is as follows:

Step 1: The user submits a query image to the system for getting the similar images to the input query image from the image database which consists of all the images belonging to different categories.

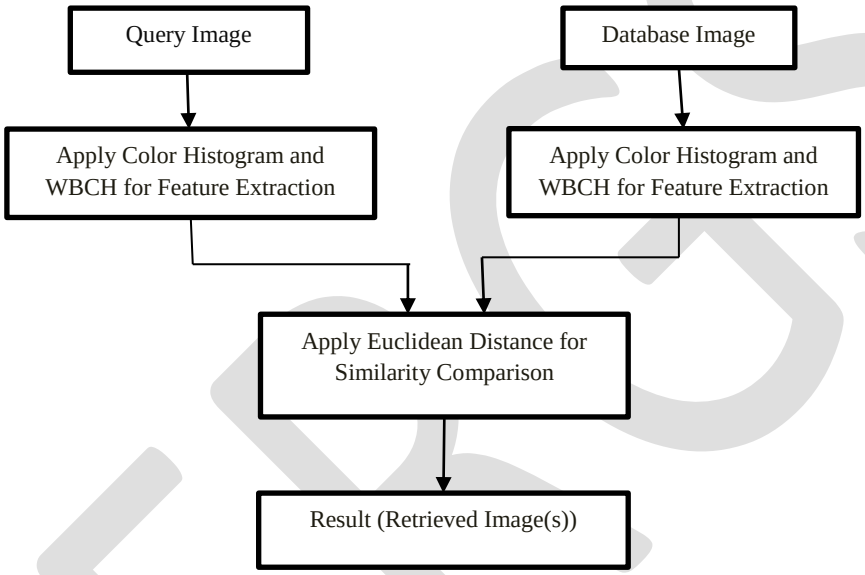

Fig. 1. System Framework

Step 2: Color Histogram and WBCH algorithms are applied to both query image and images in the image database for extracting color and texture features. Color Histogram algorithm extracts only color feature using color histogram whereas WBCH algorithm extracts both color and texture features using dwt2 wavelet transformation.

Step 3: In the last for similarity comparison between the images, Euclidean distance is applied in order to retrieve similar images with the user's input query image as result from the image database.

4. RESULT AND DISCUSSION

The image database being used here is formed by making six classes "Human Faces (50)", "Horses and Elephants (100)", "Airplanes and Motorbikes (100)", "Mountains and Buildings (100)", "Lamps and Grand_pianos (100)" and "Hedgehog and Crocodile (100)" from Caltech Image Database where each class is a combination of two categories except Human Faces class. Each category consists of 50 images. Figure 2. represents the main working window consisting of two columns Color Histogram and WBCH which can be compared by the values of seven parameters and the six similar images to the input query image being obtained as result in both cases.

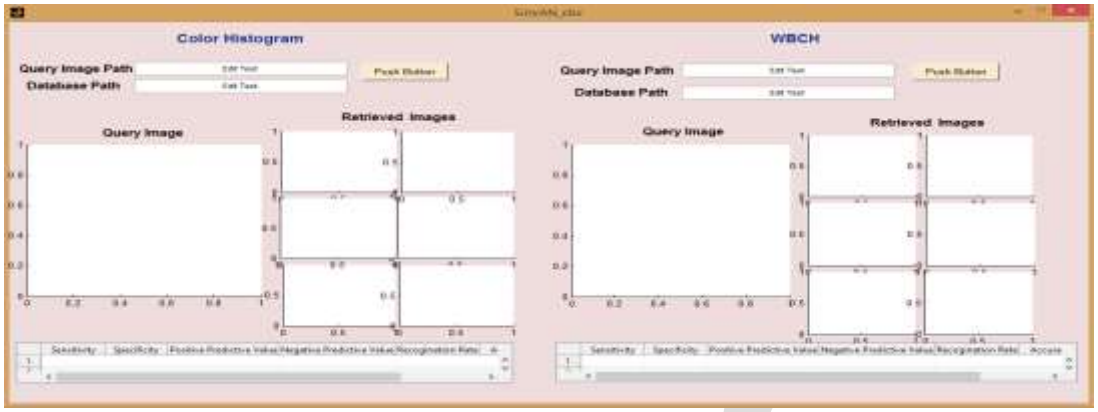

Figure 2. Main Working Window

The user will input a query image and then provide the image database path for getting the similar images to the input query image. Only the results for two classes "Horses and Elephants" and "Lamps and Grand_pianos" are shown here and the results for other classes can also be obtained in the same way. The following figures Figure 3, Figure 4, Figure 5 and Figure 6 show the Retrieved Images for category Horse from "Horses and Elephants" class and category Lamp from "Lamps and Grand_pianos" class along with graphs on the basis of the values obtained for seven parameters Sensitivity, Specificity, Positive Predictive Value (PPV), Negative Predictive Value(NPV), Recogination Rate (RR), Accuracy and Execution Time .

Figure 3. Retrieved Images for Horse category

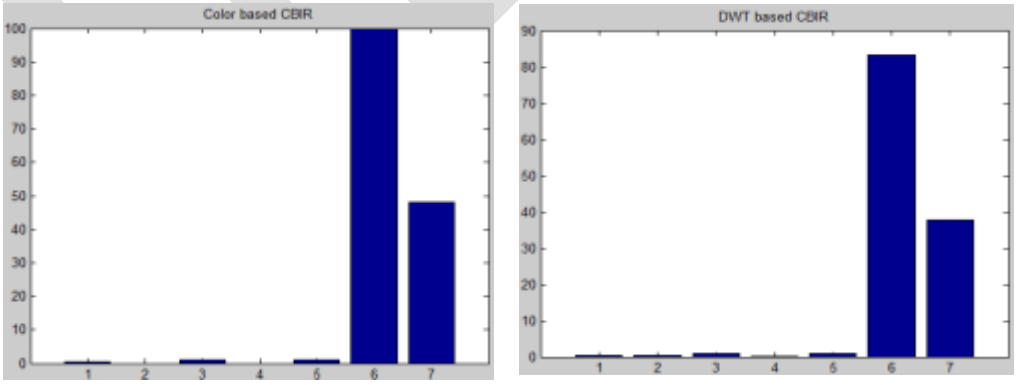

Figure 4. Graphs obtained for Horse category

Figure 5. Retrieved Images for Lamp category

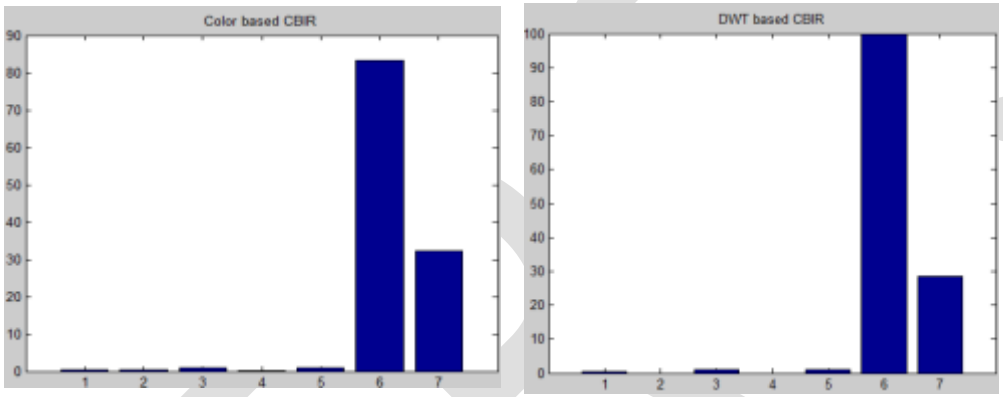

Figure 6. Graphs obtained for Lamp category

The performance of content based image retrieval is measured by seven parameters sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), recogination rate, accuracy and execution time. Sensitivity tells how likely the test is come back positive in someone who has the characteristic. It is calculated as TP/(TP+FN). Specificity tells how likely the test is come back negative in someone who does not have the characteristic. It is calculated as TN/(TN+FP). PPV is defined as the ratio of the number of the relevant images retrieved to the total number of images retrieved. NPV is defined as the ratio of the number of relevant images retrieved to the total number of the relevant images in the database. Recogination rate is calculated as TP/(TP+FP). Accuracy is calculated as AC=RR*100. Execution time is the total time taken in retrieving the similar images from the image database related to the user's input query image. The values of these parameters for each class for Color Histogram and Wavelet Based Color Histogram (WBCH) algorithms are shown in the table below:

Table 1. Values of Sensitivity, Specificity, PPV, NPV, Recogination Rate, Accuracy and Execution Time for Color Histogram and Wavelet-Based Color Histogram (WBCH) algorithms

		COLOR HISTOGRAM							WAVELET-BASED COLOR HISTOGRAM						
S.No.	Classes	Sensitivity	Specificity	PPV	NPV	Recogination Rate	Accuracy	Time	Sensitivity	Specificity	PPV	NPV	Recogination Rate	Accuracy	Time
1	Human Faces	0.5	NaN	1	0	1	100	40.8125	0.5	NaN	1	0	1	100	30.8438
2	Horses and Elephants	0.5	NaN	1	0	1	100	41.75	0.5	0.5	0.8333	0.1667	0.8333	83.3333	35
3	Airplanes and Motorbikes	0.5	0.5	0.6667	0.3333	0.6667	66.6667	24.8438	0.5	0.5	0.8333	0.1667	0.8333	83.3333	23.2656
4	Mountains and Buildings	0.5	NaN	1	0	1	100	43.2031	0.5	NaN	1	0	1	100	34.5625
5	Lamps and Grand_pianos	0.5	0.5	0.8333	0.1667	0.8333	83.3333	31.3594	0.5	NaN	1	0	1	100	28.5625
6	Hedgehog and Crocodile	0.5	0.5	0.8333	0.1667	0.8333	83.3333	27.8594	0.5	0.5	0.6667	0.3333	0.6667	66.6667	25.0625

5. CONCLUSION AND FUTURE SCOPE

Content based image retrieval (CBIR) is a challenging problem due to large size of the image database, difficulty in recognizing images, computational load to manage large data files and overall retrieval time. Number of approaches were used; they were trying to make more efficient content based image retrieval. This research work has implemented the proposed techniques for content based image retrieval which are Color Histogram and Wavelet-Based Color Histogram Image Retrieval approaches with some changes in while considering some parameters like sensitivity, specificity, positive predictive value (PPV), negative predictive value(NPV), recogination rate, accuracy and execution time. The values so obtained for these parameters show that both algorithms are best from their point of view as one retrieves images on the basis of color feature only and the other on the basis of both color and texture features but Wavelet-Based Color Histogram algorithm is better than Color Histogram algorithm in terms of retrieval time as it takes less time in retrieving the images. The future work to be conducted under the current research work could include taking more features of an image for more accurate retrieval of images with the combination of other different techniques like relevance feedback for content based image retrieval.

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