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Content Based Image Retrieval using Color Edge Detection and Haar Wavelet Transform

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Abstract - ***With the advancement of Internet and Multimedia social networking technologies, the evolutionary usage of such multimedia contents like images ,video, audio etc are increased. The efficient management and retrieval of such data are required. Therefore to carry out management & retrieval we a technique. This paper present a novel technique for efficient retrieval of images from a large image database called Content Based Image Retrieval(CBIR) system. Since from last two decades several key techniques have been proposed, But most of them suffers from efficient retrieval accuracy whenever performance was measured with respect to time. This paper introduces a method that uses color edge and histogram of an image with haar wavelet transform for efficient retrieval of similar images from a image database along with query image. The proposed algorithm is evaluated with two parameters precision and recall on the images of Wang database***

Key Words: *Color, Canny edge detector, Haar, RGB, YCbCr, Connected Components, Region, Co-relation.*

1. INTRODUCTION

With the tremendous growth of the Internet and the cheaper availability of the image capturing devices such as digital scanner ,digital cameras and smart phone , the size of the digital image collection increased at a high rate. It is important to develop efficient management of those images that are required for future references. There are [1,5] several fields in a real life scenario like crime prevention, fashion designing, medical imaginary system, civil engineering and architectural designing etc. To fulfill [17] the purpose of image retrieval, we have two well adopted techniques namely text based image retrieval system and content based image retrieval system. Since the text based image retrieval [8] system uses image tag i.e. image patch name as a search keyword for retrieval of images from the database, There are two deficiencies are found [6]. First one is that a considerable level of human labor is required for manual annotation of each and every image on the database that leads your system costlier. Second is that the human perception for each and every image is different. which directly influenced the efficiency of the whole system. To overcome these deficiencies the content based image retrieval (CBIR) system are developed in the early 1980's. CBIR uses the internal properties of an image . The internal properties refers to the low level image contents such as color, shape and texture of an image. These three features of an image is robust, Since these are always present with a image in normal situation. Since the last decades, Content Based image Retrieval is the hot research area in academics. In paper [2,Color feature is extracted by using color moments of an HSV image and texture feature is extracted from ranklet transformation in a gray image. Another method [3] of getting texture feature by using color co-occurrence matrix. A method that uses both [4] color co-occurrence for texture and color histogram for color feature extraction process. An effective method [9] that employed multi-wavelet transform and color correlogram in RGB color space. Haar wavelet transformation[20] is used to reduce the size of the feature vector.

In the proposed algorithm, the feature database is prepared by using color edge detection method and wavelet transformation. For extraction of color feature RGB and YCbCr color space is used . RGB is the combination of three colors components Red , Green and Blue to form an image. Whereas YCbCr is the combination of luminance Y and Chrominance Cb and Cr color components, Y contains the gray scale information and Cb,Cr contains color information. That's why in the proposed algorithm will convert RGB image into YCbCr. Because [23] the hospitalized reports says that the human eye is less sensitive to color variation as compare to intensity value. Which means a human eye can easily distinguished brightness value in a image but they suffers from the color identification. For extracting the edge from RGB color space, We need to separate each color components and apply canny edge detector. Canny edge detector [23] is the optimal and feasible edge detection technique. Since canny edge detector can detect changes in the intensity value in noisy image. In the proposed method, first of all the feature vector is computed for query or input image, After that the preparation for

feature [25] vector on image database will be done. In this proposed work, Wang image database is used for dataset purpose. At last the similarity check will be done between query image feature database and the feature image database. The search [26] is generally based on the similarity measurement rather than exact matching of feature vector. For similarity measurement [21] Euclidean distance formula has been used. The lower the difference [8,19,23] will be considered as a most similar image to the query image and there will be a performance evaluation technique to check the proposed system will work efficiently or not by using precision and recall.

The rest of the paper is organized in various sections. Section 2 describe the proposed feature extraction methodology. Experimental work is discussed in Section 3. Last but not the least Section 4 describes the conclusion followed by several references

2. PROPOSED METHODOLOGY

The generalized content based image retrieval system shown in the figure 1. The CBIR system extracts the features of image database and the feature of query image and stored them into the separate feature database. Next stage is to compare the similar or most similar feature database value of the image database and the relevant query image. Similarity between the query image and the image database image's has been find out by distance measurement formulas such as Euclidean, city block, Manhattan distances. Therefore we can say that , CBIR system performance their activity in two different stages namely Feature extraction process and feature matching process.

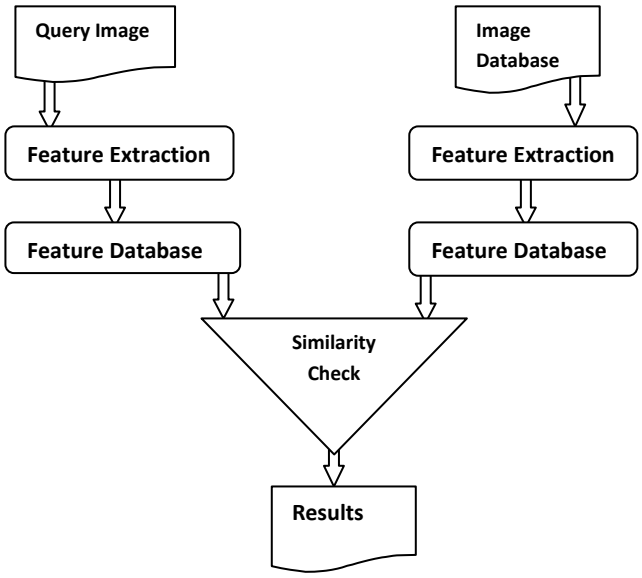

Fig.1 Generalized CBIR System

2.1 FEATURE EXTRACTION PROCESS

The feature extraction process starts with obtaining the low level feature descriptor [21,13,11] such as color, shape and texture. In the proposed feature extraction process, first of all input image let us consider them as a RGB image is converted into the YCbCr color space representation. In YCbCr of input image is separated to two different component Y and Cb,Cr. Where Y contains luminance channel and Cb & Cr having chrominance channel. Since Y having only intensity value, We can apply canny edge detector to this channel to detect the intensity changes (edge) on an image. The extracted edge matrix is then recombined with unaltered Cb and Cr matrices to make them as a RGB image. The resultant RGB image contains both edge and color information. Some sample RGB image and their respective edges are shown in figure 2.

(a) Original RGB Image (b)Y Component Edge

Fig.2 Edge of Y component after converting RGB to YCbCr color space.

Once the edge is found from Y channel by applying canny edge detector , Now divide RGB color space into three separate channel namely R, G, B. Next step is to get edges from all channels with the help of canny edge detector technique. We have now four edges from Y,R,G and B Channels. Perform feature extraction process to these edges such as number of connected edges, Regions and Co-relation feature matrix. We can merge these features to a single solid feature and named them as a feature database1.

In this proposed scheme, Histogram can also be used as a features by taking the input from R, G and B channel. Once the histogram have been extracted , We have facility to reduce the feature vector by applying wavelet transformation . In this scheme , We are using haar wavelet transformation to reduce the size of feature vector into a manageable extents. The proposed algorithms are shown in fig no.3.

Main steps of this proposed algorithms are as follows : -

Step 1 : Load directory of image database or select a query image from database.

Step 2 : Transform an input RGB image having size M×N into YCbCr color space image.

Step 3 : Separate Y,Cb and Cr channel .

Step 4 : Combine these Y Cb Cr channels into a RGB color image space.

Step 5 : Separate RGB color space into Red(R), Green(G) and Blue(B) matrix.

Step 6 : Apply Canny edge detector onto Y, R, G and B channel Separately. Obtain E_Y, E_R, E_G and E_B edges to the respective channels. Also find out respective histogram for each RGB channel separately to obtain HR, HG and HB.

Step 7 : Perform 1st level Haar wavelet transform on each histogram channels.

Step 8 : Extract Features such as Number of connected components, Regions and Co-relation matrix from the edges of E_Y, E_R, E_G and E_B , Now combine the extracted features into feature 1 vector . Also we have the features that are obtained by applying haar wavelet transform of FR , FG and FB into feature 2 vector.

Step 9 : Now Combine the feature vector 1 and Feature vector 2 into a single feature vector (F) database.

The overall feature extraction process is shown in fig.3.

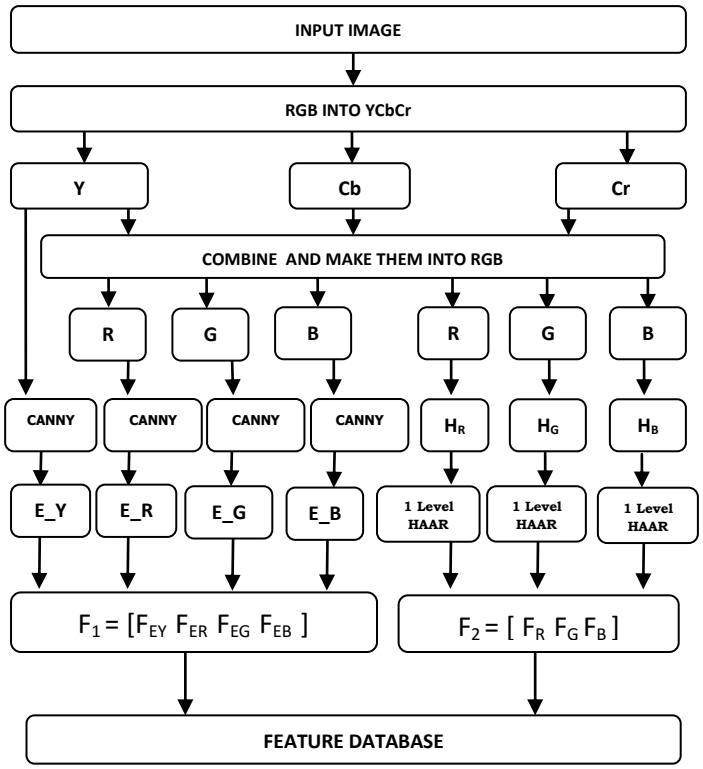

Fig. 3 Proposed CBIR feature extraction process

2.2 FEATURE MATCHING PROCESS

Finally feature matching process will be used to calculate the similarity between the features of query image and image database. The method used to perform the similarity between feature vector of query image [31] and the feature vector of each and every image of an image database by using distance measurement process. In this proposed methodology Euclidean distance measurement technique have been used. The Euclidean matrix [35] is the distance between two points in an Euclidean geometry. Let two points be p at a co-ordinate (x, y) and q at a co-ordinate (a, b), the Euclidean distance between these two points is given by the following eq. no.(1).

$$dist((x, y), (a, b)) = \sqrt{(x-a)2 + (x-b)2} \quad .....(1)$$

3. EXPERIMENTAL ANALYSIS AND RESULTS

In this section, We presents the analysis based on the experiments and compare the performance of the system as compare to other systems that are proposed earlier. For experimental purpose , Wang image database is used. The exploited Wang's database contains total number of 500 images having 10 classes . Each class contains 50 images of the same type. Out of which 500 images we are randomly choose some test images for testing purposes. In the proposed scheme , A user who want to test this system needs to select the query image first and extract the features of the query image. Next step is to compare the similarity between the query image feature with the feature vector of the image database. In this paper we are chosen randomly total 5 images for experimental purpose as a testing images. These testing images are shown in fig. 4.

Fig. 4 Test images

We are taken some of the test images as a query image and the results of the proposed system is shown below . In Fig. 5 we are taken 435.jpg as query image of class 'Dinosaur' from Wang's database and first 20 images has been retrieved. Whereas in Fig. 6 we are taken 705.jpg as query image of class 'Horse' from Wang's database and first 20 images has been retrieved.

Fig. 5 Retrieval results for query image 435.jpg (Dinosaur)

Fig. 6 Retrieval results for query image 705.jpg (Horse)

The content based image retrieval system is evaluated with the performance measurement terms namely Precision and Recall. These two formulas are described below in eq. no. (2) and (3) respectively.

$$\text{Precision} = \frac{\text{No. of relevant images retrieved}}{\text{Total no. of images retrieved}} \quad ....(2)$$

$$\text{Recall} = \frac{\text{No. of relevant images retrieved}}{\text{Total no. of relevant images}} \quad ....(3)$$

It is important to discuss here, That the efficiency of the system is measured with the higher precision and recall values. Therefore the Precision and Recall rate should be higher for better system. The experimental results are shown in the form of the tables and also presented in the form of the graph. Table 1 shows the performance in terms of Precision and Recall parameter. Also the precision and Recall rate for the test image are presented in fig. no. 7 and 8 respectively.

Table 1: Comparison between Precision and Recall

Image class and name	Precision (%)				Recall (%)
	$N_R = 10$	$N_R = 20$	$N_R = 30$	$N_R = 40$	
Dinosaur (435.jpg)	100	100	100	95	75
Elephant (501.jpg)	100	100	95	95	75
Horse (705.jpg)	100	100	100	97	78
Bus (300.jpg)	100	90	86.66	82.5	66
Rose (613.jpg)	100	85	83.33	75	60

Where , N_R= Number of images retrieved

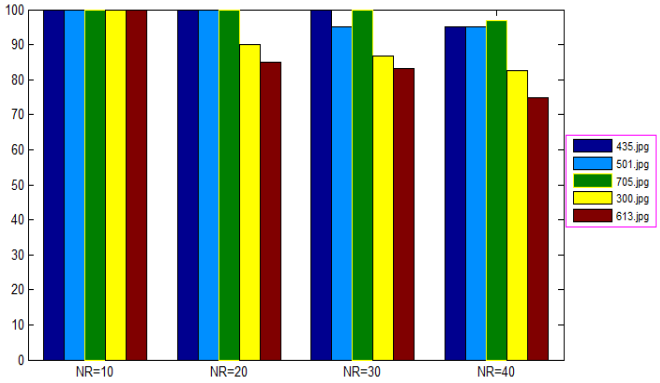

Fig. 7 Precision value for test images

The Precision value for the test images are shown graphically in fig. no. 7. The figure clearly indicates that the performance or efficiency of the system will be much better as compare to the earlier proposed system that employed this type of techniques for image retrieval.

Whereas in case of fig.no.8 , That shows the performance in terms of Recall. The Precision and Recall values must be higher for efficient image retrieval system

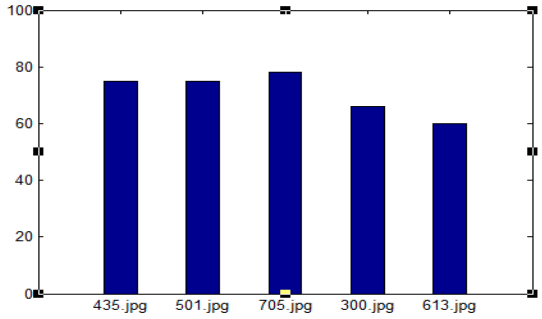

Fig. 8 Recall value for test images

The outcome of the proposed system are analyzed with different system which also uses some other techniques for image retrieval . In paper [1] the technique used for image retrieval is that color edge detection and discrete wavelet transform was used , As compare to that system , The proposed system will effectively reduce the time required to retrieve the images as well as the retrieval accuracy will effectively increased.

4. CONCLUSIONS

In this paper, A new technique for content based image retrieval is presented that combines both the color and shape features. The proposed scheme uses color edge detection technique and haar wavelet transformation based feature extraction process. The proposed algorithm extract edges from luminance part of the color RGB image by converting the target RGB image into YCbCr color

spaces. Also we can get edges from R, G and B channels and find the number of connected edges, regions of the particular edges and co-relation matrix from that color edges , Which will help to get the feature vector of color descriptor. Also we have another feature to extract called shape feature, This feature is obtained by extracting the R, G and B color channels and apply histogram and reduces the number of the feature vector length by using haar wavelet transform.

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