CONTENT BASED IMAGE RETRIEVAL

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***Abstract*:-This experiment of image retrieval system is retrieve similar image using two types of content feature, color and texture. For color retrieval HSV color space and color histogram is used and for texture retrieval haar wavelet transform is used. Firstly, color space is quantified in equal interval, then histogram is used as one dimensional feature vector that represent color feature. Now for texture, first level Haar wavelet decomposition gives four different band, using mean and standard deviation of each band we construct one dimensional texture feature vector. The image retrieval experiment shows that feature are sensitive for different type of image. This experiment is also reveal that using one of the method similar images could be retrieved but method of multi feature retrieval provide more accurate result.**

Keywords:- Image Retrieval, Color Histogram, Color Spaces, Quantization, Similarity Matching, Haar Wavelet, Precision and Recall.

I. INTRODUCTION

Content-based image retrieval (CBIR), also known as Query By Image Content (QBIC) and Content-Based Visual Information Retrieval (CBVIR). It is the problem of searching for digital images in large databases. The term 'content' in this context might refer to colors, shapes, textures, or any other information that can be derived from the image itself. Features are derived directly from the images and they are extracted and analyzed by means of computer processing [3].With the advent of internet, there has been an explosion in the amount of visual data available to us. On internet we use numbers of image search engines rely purely on metadata and that produces a lot of garbage in the results [5]. Keywords, tags, and/or descriptions associated with the image are called metadata. Thus a system that can filter images based on their content would provide better indexing and return more accurate results [5]. Most content-based image retrievals (CBIR) use color as image features. But, image retrieval using color features often gives disappointing results because in many cases, images with similar colors do not have similar content [1]. Color methods incorporating spatial information have been proposed to solve this problem, however, these methods often result in very high dimensions of features which drastically slow down the retrieval speed [1]. Therefor in this paper we use two low level features color and texture for image retrieval.

This paper proposed a method of content based image retrieval using two features color and texture. Color features are extracted using Histogram in HSV color space and texture features are extracted using Haar Wavelet transform. Here during the retrieval process, given a query image, images in the database are firstly compare and retrieve using texture features. Then in the second process, this images are compare and retrieve according to their texture features.

The rest of the paper is organized as follows: In section 2, a brief review of the related work is presented. The section 3 describes the color feature extraction. The section 4, presents the texture feature extraction and the section 5, presents the similarity matching. The proposed method is given in section 6 and section 7 describes the performance evaluation of the proposed method. Finally the experimental work and the conclusions are presented in section 8 and section 9 respectively.

II. RELATED WORK

Dengsheng Zhang [1] proposed a method combining both color and texture features of image is proposed to improve the retrieval performance. Given a query, images in the database are firstly ranked using color features. Then the top ranked images are re-ranked according to their texture features. They use the perceptually weighted histogram or PWH for color feature extraction and Gabor filters for texture feature extraction. Dr.N.Krishnan, M.Sheerin Banu, C.Callins Christiyana [2] proposes the method to retrieve images based on dominant colors in the foreground image. They use image segmentation to differentiate foreground and background objects. Mrs.Y. M. Latha, Dr.B.C.Jinaga, V.S.K.Reddy [3], they use Haar and D4 wavelet to decompose color images into multilevel scale and wavelet coefficients, with which they perform image feature extraction and similarity match by means of F-norm theory. Ji-quan ma [4] proposed a method of multiple query of color and texture, they use HSV color space for color and Daubechies wavelet transform for texture feature extraction. Yong-Hwan Lee, Sang-Burm Rhee, Bonam Kim [5] proposed a method of CBIR using color Correlogram for for color and Gabor filter for texture feature extraction. Manimala Singha, K.Hemachandranm[6] presents the content based image retrieval, using features like texture and color, called WBCHIR (Wavelet Based Color Histogram Image Retrieval).The texture and color features are extracted through wavelet transformation and color histogram and the combination of these features is robust to scaling and translation of objects in an image.

III. COLOR FEATURE

Color is linked to the chromatic part of an image. Color is usually represented by color histogram, color correlogram, color coherence vector and color moment, Digital image is represented by one of the color spaces like HSV, HIS, CIE, RGB, CMY, etc.

3.1. Color feature extraction

Here we use HSV color space and color histogram method for color feature extraction because HSV color space gives the best color histogram feature, among the different color spaces [6]. Hue is used to distinguish colors. Saturation is the percentage of white light added to a pure color. Value refers to the perceived light intensity.

A color histogram provides allotment of colors which is achieved by calculate how many numbers of pixels fit into every color. First we convert RGB color space to HSV color space. It is essential to quantify HSV space component to reduce computation and improve efficiency [4]. Accordance with the human eyes to distinguish, we can divide color into eight parts. Saturation and intensity is divided into three parts [4]. But for increase accuracy we divide each portion in ten parts. So we get quantified image of 10x10x10, Now form two dimensional feature vector G, we used following equation[4].

$$G = Q_S*Q_V*H + Q_S*S + Q_V*V \quad (1)$$

Where Q_S and Q_V are constant. Here we set Q_S =6 and Q_V = 3, then

$$G = 18*H + 6*S + 3*V \quad (2)$$

Here, value range of H, S and V is between 0 and 10, so maximum G =270, Now we construct histogram, thus we get 270 bins of histogram from this quantified image.

Figure 1:- Query Image.

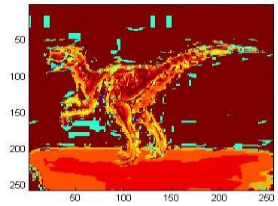

Figure 2:-Quantified image.

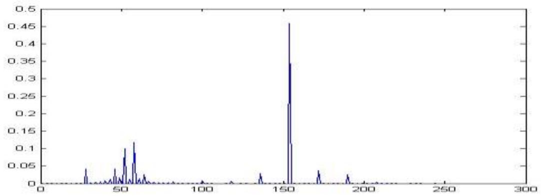

Figure 3:-Histogram of Quantified image.

IV. TEXTURE FEATURE

Dissimilarity in brightness with high frequencies in the image spectrum, textures are characterized. While making a distinction between areas of the images with same color, these features are very useful. The common known texture descriptors are Wavelet Transform, Gabor-filter, co-occurrence matrices and Tamura features.

Wavelet Transform decomposes an image into orthogonal components, because of its better localization and computationally inexpensive properties to extract color feature we use HSV color space and color histogram method.to extract texture feature we use Haar wavelet transform. Firstly we retrieved images using texture features then we use color feature to accurate our result.

4.1. Texture feature extraction

Wavelet analysis has been widely used in the image processing because of the unique characteristics and advantages of signal analysis. The powerful time-frequency analysis ability of the wavelet makes the image characteristics can be well described and provides a feasible way for high-accuracy retrieval system [4]. Haar wavelets are the fastest to compute and also have been found to perform well in practice [6]. So here we use Haar wavelet to extract texture feature.

The technical disadvantage of the Haar wavelet is that it is not continuous, and therefore not differentiable. This property can, however, be an advantage for the analysis of signals with sudden transitions. The wavelet transform computation of a two-dimensional image is also a multi-resolution approach, which applies recursive filtering and sub-sampling. The Haar wavelet's mother wavelet function (t) can be described as:

$$\psi(t) = \begin{cases} 1, \ 0 < t < \frac{1}{2} \\ -1, \ \frac{1}{2} \leq t < 1 \\ 0. \quad otherwise \end{cases} \qquad (3)$$

and its scaling function ϕ(t) can be described as:

$$\phi(t) = \begin{cases} -1, \ 0 \leq t < t \\ x, \ \ otherwise \end{cases} \qquad (4)$$

At each level (scale), the image is decomposed into four frequency sub-bands, LL, LH, HL, and HH where L denotes low frequency and H denotes high frequency as shown in Figure 4.

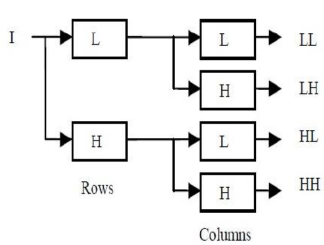

Figure 4 :- Discrete Wavelet sub-band Decomposition

Figure 5:- Query Image

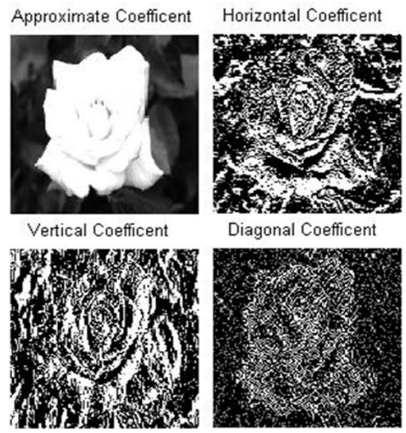

Figure 6:- four band of wavelet Decomposition.

Here Figure 5 shows a Query image and Figure 6 shows different coefficient after Haar wavelet decomposition. After a one-level wavelet transform, the wavelet coefficients is $c_{i,j}$ at the point (i, j), then the mean and standard deviation of any band are calculated as:

$$\mu = \frac{1}{MN} \sum_{i=i}^{M} \sum_{j=1}^{N} c \qquad (3)$$

$$D = \sqrt{\frac{1}{MN} \sum_{i=i}^{M} \sum_{j=1}^{N} (c - \mu)^2} \qquad (4)$$

Texture feature extraction algorithm based on wavelet transform is that using formula (3) and (4) calculate the mean and standard deviation of the each band of the image and form one-dimensional texture feature.

V. FEATURE SIMILARITY MATCHING

The Similarity matching is the process of approximating a solution, based on the computation of a similarity function between a pair of images, and the result is a set of approximate values [6]. We have used the Euclidian Distance function method.

The Euclidean distance between two feature vector A and B is the length of the line segment connecting them in Cartesian coordinates, if A = (A1, A2... An) and B = (B1, B2,..., Bn) are two points in Euclidean n-space, then the distance from A to B, or from B to A is given by:

$$d(A,B) = \sqrt{\sum_{i=1}^{n}(Ai - Bi)^2} \quad (5)$$

Where i=1,2,..n, A is feature vector of query image and B is feature vector of dataset image. We use this equation for both type of feature vector color feature vector and texture feature vector.

VI. PROPOSED METHOD

In this study we are proposing an algorithms for image retrieval based on the color histogram in HSV color space for color retrieval and Haar Wavelet for texture retrieval. The block diagrams of the proposed methods are shown in Figure 7.

6.1. PROPOSED ALGORITHM

Step1. Convert RGB color space image to grayscale image.

Step2. Decompose query image using Haar Wavelet transformation at 1st level to get approximate coefficient and vertical, horizontal and diagonal detail coefficients.

Step3. Calculate mean and standard deviation of each coefficient and form one dimensional feature vector.

Step4. Calculate the similarity using distance function between feature vector of query image and an image present in the dataset.

Step5. Retrieve the image if similar else repeat step1 to step4 for next image in dataset

Step6. Convert Query RGB color space image into HSV color space.

Step7. Quantified image by assigning 10 level each to hue, saturation and value to give a quantized HSV space.

Step8. Now calculate the feature vector using following equation.

G=18*H+6*S+3*V

Step9. Compute the Histogram for two dimensional feature vector G.

Step10. Calculate the similarity using distance function between feature vector of query image and the retrieve image.

Step11. Repeat the step1 to step10 for all the images in dataset.

Step12. Retrieve and show similar images.

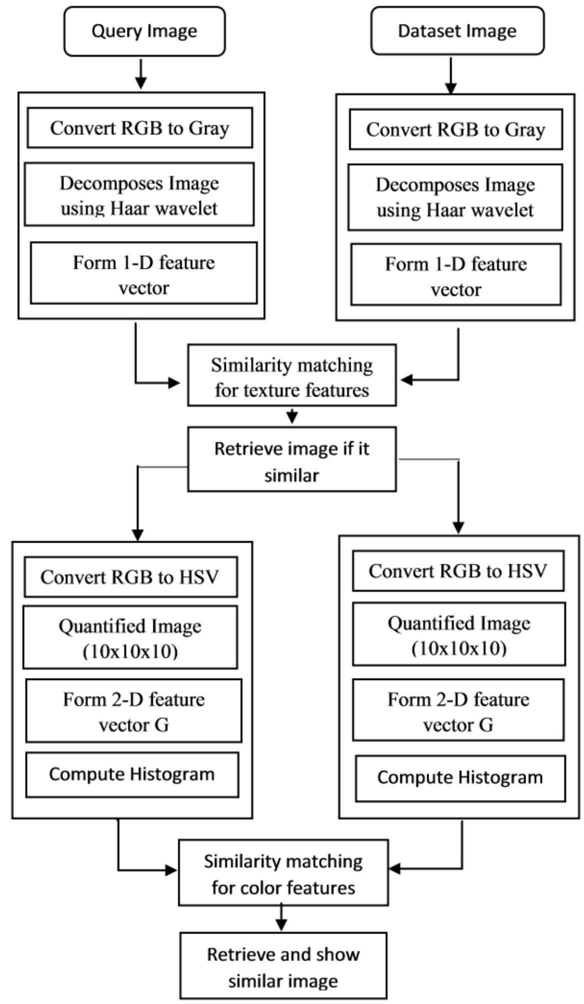

Figure 7:- Block diagram of proposed algorithm.

VII. PERFORMANCE EVALUATION

The performance of retrieval of the system can be measured in terms of its recall and precision [1]-[6]. Recall measures the ability of the system to retrieve all the models that are relevant, while precision measures the ability of the system to retrieve only the models that are relevant. It has been reported that the histogram gives the best performance through recall and precision value. They are defined as:

$$Precision = \frac{Number\ of\ relevant\ images\ retrieved}{Total\ number\ of\ images\ retrived} \quad (6)$$

$$Recall = \frac{Number\ of\ relevant\ images\ retrieved}{Total\ number\ of\ relevant\ images} \quad (7)$$

The total number of items retrieved is the number of images that are returned by the search engine. The average precision for the images that belongs to the n^{th} category (A_n) has been computed by [6]

$$p'' = \sum_{j=An} \frac{p(ij)}{|An|} \quad (8)$$

Where n=1, 2……5.

Finally, the average precision is given by:

$$p' = \sum_{n=1}^{5} \frac{P''n}{5} \quad (9)$$

VIII. RESULT AND ANALYSIS

Here I have 500 image database from which we select our query image and retrieve similar images. Sample images are shown in figure 8. Figure 9-12 show some images from snapshots of retrieval result.

Figure 8:- Sample images from dataset

Figure 9:- Retrieval result for buses.

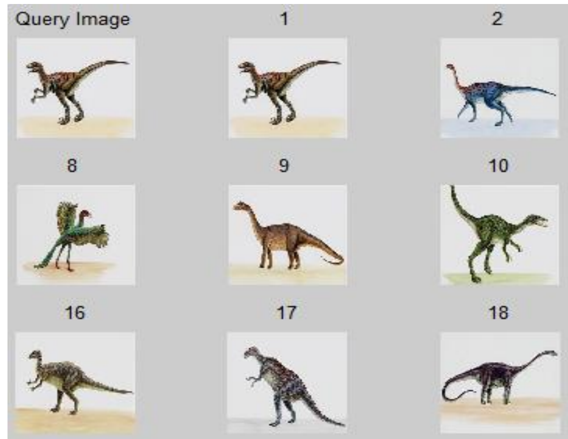

Figure 10:- Retrieval result for dinosaurs.

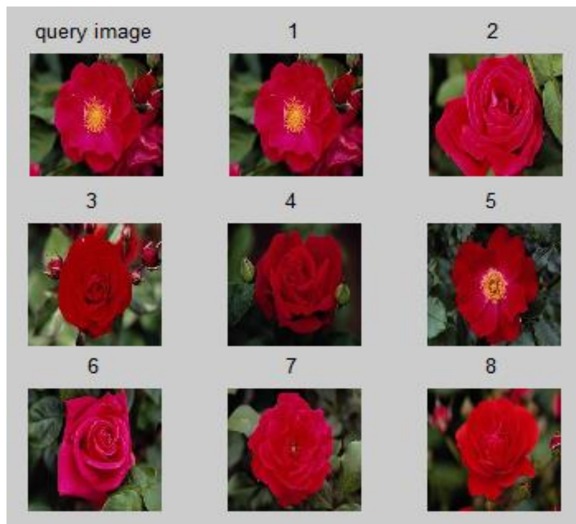

Figure 11:- Retrieval result for flowers.

Figure 12:- Retrieval result for horses.

Figure 13:- Retrieval result for mountain.

Here we used three approaches for image retrieval
1) Texture Based Approach.
2) Color Based Approach.
3) (Texture + Color) Based Approach.

Image Type	**Texture Based Approach**	**Color Based Approach**	**Texture + Color Based Approach**
	Precision	Precision	Precision
Buses	0.60	0.73	0.82
Dinosaurs	0.99	0.99	0.99
Flowers	0.76	0.78	0.93
Horses	0.49	0.77	0.91
Mountains	0.40	0.46	0.72
Average	0.65	0.74	0.87

Table1:- Precision table for three different approaches

Result from table shows that (texture + color) approach is better than texture and color approach in terms of average precision.

Image Type	**CH** [6]	**WBCH[6]**	**Proposed Algorithm**
	Precision	**Precision**	**Precision**
Buses	0.93	0.92	0.82
Dinosaurs	0.95	0.97	0.99
Flowers	0.66	0.76	0.93
Horses	0.89	0.87	0.91
Mountains	0.47	0.49	0.72
Average	0.78	0.80	0.87

Table 2:- Precision table for three different Algorithm

Result from table shows that proposed Algorithm is better than CH(Color Histogram) algorithm and WBCH(Wavelet Based Color Histogram) algorithm in terms of average precision.

IX. CONCLUSION

Proposed system has demonstrated a retrieval method on an image dataset containing five hundred general-purpose color images. From this experiment we can conclude that feature are sensitive for different type of images. The experimental result shows that the proposed method performance is better than the other retrieval methods in terms of average precision.

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