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CONTENT BASED IMAGE RETRIEVAL USING INTEGRATION OF COLOR AND TEXTURE FEATURES

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***Abstract*— CBIR is a process of retrieve and display relevant images from large collection of image database on the basis of their visual content. CBIR is used for retrieval of images depending upon visual contents of images known as features. This paper focuses on color and texture based techniques for achieving efficient and effective retrieval of images Color feature extraction is done by color histogram and color moment. Texture feature extraction is acquired by wavelet and gabor transform. For classification of extracted features we have used support vector machine. Euclidian distances are calculated of every features for similarity measures.**

***Keywords*— Content Based Image Retrieval (CBIR), Color histogram, Color moment, Gabor transform, Wavelet transform, Support vector machine.**

I. INTRODUCTION

CBIR or Content Based Image Retrieval term content refers to color, texture, shape and spatial layout or any other information of images. ’Content-Based’ means that search will analyse the actual contents of images. ’Image-Retrieval’ means searching, browsing and retrieval of images from a large database of digital images. Automatic indexing and retrieval of images are used in CBIR which is depending upon content of images known as features.

This paper is organised as follows: In section II CBIR proposed model is discussed. In section III similarity of features are measured is discussed. Section IV presents system evaluation. In section V experimental results are presented. Finally conclusion is presented in section VI.

II. PROPOSED CBIR SYSTEM FEATURE

The proposed CBIR model is shown in figure. The images are stored in database called image database. Images are any one of formats .jpeg, .png, .bmp, .tif.

In this proposed system, we use color histogram, color moment methods for color feature extraction. For texture feature extraction Gabor transform and wavelet transform are used.

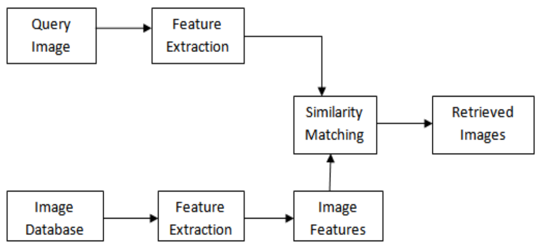

Figure 1: Block diagram of CBIR

A. Color Histogram

Color histogram is a representation of the distribution of colors in an image. A color histogram represents the number of pixels that have colors in each of a fixed list of color ranges that span the image's color space, the set of all possible colors, for digital images. The color histogram can be built for any kind of color space, the histogram is more often used for three dimensional spaces like RGB or HSV. The intensity histogram may be used for monochromatic images. Each pixel is represented by an arbitrary number of measurements, for multi-spectral images. The color histogram is *N* dimensional, with N number of measurements taken. Each measurement has its own wavelength range of the light spectrum, some of which may be outside the visible spectrum. Color histogram is the most commonly used color feature in CBIR [3][1]. Characterizing the global distribution of colors in an image color histogram has been found to be very effective, and for image characterization it can be used as an important feature. The color space is quantized into a finite number of discrete levels to define color histograms. Each of these levels becomes a bin in the histogram. By counting the number of pixels in each of these discrete levels then color histogram is computed. Many different approaches are use to quantize a color space to determine the number of such discrete levels [3][2].

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B. Color Moment

Color moment is a representation of the color feature. This is used to characterize a color image [1]. By the three low-order moments most of the color distribution information is captured. The mean color captures by first-order moment (μ), the standard deviation captures by the second-order moment (σ), and the skewness of color captures by the third-order moment (θ). For each of the three color planes these three low-order moments (μ_c,σ_c,θ_c) are extracted, using the following mathematical formulation.

$$\mu_c = \frac{1}{MN} \sum_{i=1}^{M} \sum_{j=1}^{N} p_{ij}^{c} \qquad [1]$$

$$\sigma_c = [\frac{1}{MN} \sum_{i=1}^{M} \sum_{j=1}^{N} (p_{ij}^{c} - \mu_c)^2]^{\frac{1}{2}} \qquad [2]$$

$$\theta_c = [\frac{1}{MN} \sum_{i=1}^{M} \sum_{j=1}^{N} (p_{ij}^{c} - \mu_c)^3]^{\frac{1}{3}} \qquad [3]$$

Where,
p_{ij}^{c} = value of the c_{th} color component of the color pixel in the i_{th} row and j_{th} column of the image.

As a result, to characterize the color image we need to extract only nine parameters (three moments for each of the three color planes). T to calculate color similarity calculate color similarity [2] Euclidean distance between the color moments of two images has been found to be effective.

C. Gabor filters

Gabor filters consists of a group of wavelets each of which capturing energy at a specific resolution and orientation. Therefore, To capture the local energy of the entire signal or image gabor filters are able. Especially for texture features [4] , the Gabor filter has been widely used to extract image features. Gabor filters provide optimal Heisenberg joint resolution in spatial frequency and visual space that discovered by Daugman. For this reason, Gabor filters have been successfully employed in many applications including texture segmentation, fractal dimension measurement, image coding, document analysis, retina identification, target detection, edge detection, line characterization, image representation etc.

D. Wavelet Transform

Wavelet transform is a multi-resolution approach. In many aspects of image processing wavelet transform have been used. A wide range of wavelet-based tools and ideas have been proposed and studied for image compression, noise removal from images, image retrieval and image reconstruction. To retrieve images for texture features [5] the multi resolution wavelet transform has been employed. The wavelet features do not achieve high level of retrieval accuracy. Therefore, to achieve higher level of retrieval accuracy using wavelet transform various methods have been developed. To increase effectiveness in CBIR [6] wavelet features computed from discrete wavelet coefficients are assigned weights.

E. Support Vector Machines

Support Vector Machines have shown their capacities in pattern recognition. Find the best hyper-plane separating relevant and irrelevant vectors maximizing the size of the margin (between both classes) is the main aim of SVM classification method. Relevant and irrelevant vectors are linearly separable [7] assumes in initial method. The whole image database separated into two classes by SVM. The two classes are including the unlabelled images with two types they are relevant and irrelevant unlabelled images. The relevant labelled image is related to the relevant unlabelled images in the image database. In similar way the irrelevant labelled image is related to the irrelevant unlabelled images in the database. SVM is also classifying the unlabelled images in accuracy manner.

III. ALGORITHM

1. Collection of Image Database
   - We consider a database containing 100 images with any one of the formats .bmp, .jpg or .tiff.
   - First of all images will be converted into HSV model form RGB model.
2. Feature Extraction
   - Feature Extraction is carried out by using colors and textures. For color feature extraction, color histograms and color moment are used. For texture feature extraction, Gabor Transform and Wavelet Transform are used.
   - The images are registered with their corresponding features such as color, texture.
   - These extracted features will be forwarded to Feature Vector Module.
3. Similarity Measures

To find the similarities between query image and the images in the database distance between two images is used. The proposed method used the Euclidean distance between the two feature vectors of the images. The distance can be calculated by the following formula:

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$$d(P,Q) = \sqrt{\sum_{i=1}^{N}(p_i - q_i)^2} \quad [1]$$

Where,

$P = (p_1, p_2 \ldots p_n)$
$Q = (q_1, q_2 \ldots q_n)$
P,Q are two points in n dimensional space.

4. Comparison of results
When the user passes a query image, the composite feature vector of both query image and the image which is stored in database will go through Similarity Comparison according to color and texture features.
5. Finally similar images will be retrieved.

IV. EVALUATION OF SYSTEM

An important aspect in content-based image retrieval is evaluation of retrieval performance. From generic information retrieval systems many performance measures are adapted. Precision and recall are the most common evaluation measures used in information retrieval, and are defined as follows[8] [9]:

Where,

$$Precision = \frac{No\ of\ relevance\ \ image\ \ retrieved}{Total\ \ no\ of\ images\ \ retrieved\ \ on\ the\ screen}$$

$$Recall = \frac{\text{No of relevance Images Retrieved}}{\text{Total no of relevant images in the database}}$$

V. EXPERIMENTAL RESULTS

This section is used to explain result analysis. To get desired result, Intel Core i5-3230M CPU @ 2.60 GHz with 4GB RAM ,1TB hard Disk ,10 MBPS Ethernet Card, MatLab7.14. Window-7 Operating System, Microsoft Office 2007 Pack are used. *Wang Database* [10] is used for experiment which contains a set of 1000 images. The database consists of 100 images of every class. It is a commonly used database for image retrieval experiments. But the method of the experiment proves to work well with any database having any number of image and any format of images.

Table 1: Wang image database classes

ID	Category Name
1.	Africa people and villages
2.	Beach
3.	Buildings
4.	Buses
5.	Dinosaurs
6.	Elephants
7.	Flowers
8.	Horse
9.	Mountains and glaciers
10.	Food

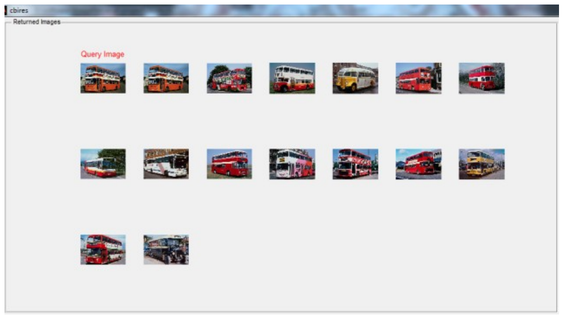

Figure 2: Snapshot of result for query image image1

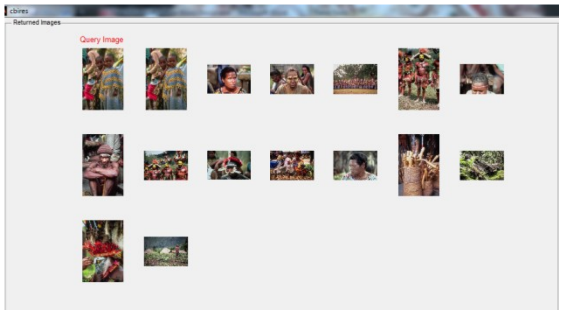

Figure 3: Snapshot of result for query image image2

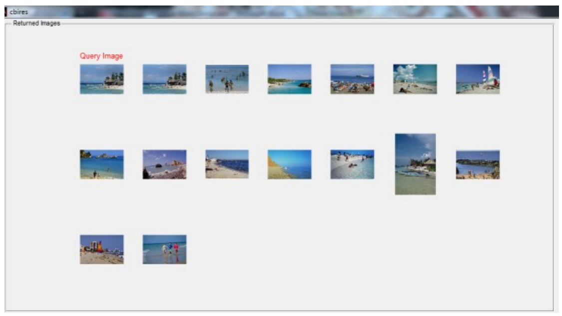

Figure 4: Snapshot of result for query image image3

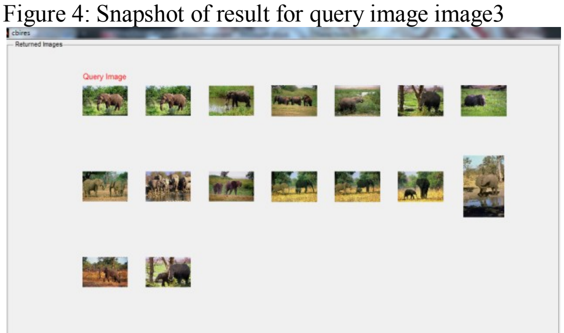

Figure 5: Snapshot of result for query image image4

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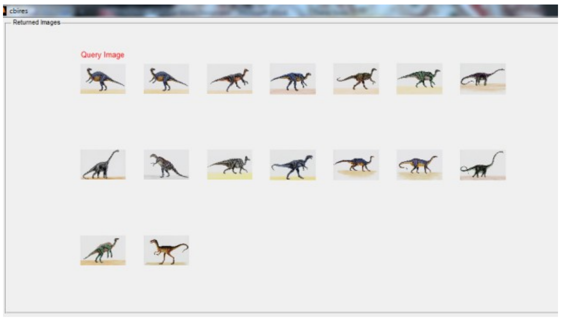

Figure 6: Snapshot of result for query image image5

Table 2: Accuracy of images retrieved

Image	Accuracy
Image1	78%
Image2	80%
Image3	81%
Image4	77%
Image5	82%

VI. CONCLUSION

In this paper, proposed a Content Based Image Retrieval System by combining the Color Histogram, Color Moment, Gabor Filter, and Wavelet Transform features. The results are quite good for most of the query images and it is possible to further improve by fine tuning the threshold and adding relevance feedback. In this paper four different approaches of color texture methods were investigated in HSV color space . Histogram search characterizes an image by its color distribution, representation is that information about color and texture is included. In this paper the Euclidian distances are calculated between the two pixels the matching images is made. Wavelet transform and Gabor filter are utilized to obtain better efficiency in image retrieval.

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