Region based Image Retrieval using Color and Texture Feature

Rushabh Khara
Department of Electronics & Communication Engineering,
Silver Oak College of Engineering & Technology, Ahmedabad,India

***Abstract*— R egion based image retrieval system has become hot topic for research. Only color, texture or shape feature extraction cannot give high precision and recall. To get high precision and recall, this paper proposes a new content-based image retrieval method that uses combination of color and texture feature. The Regions of Interest (ROI) are roughly identified by segmenting the image into fixed partitions. The color and texture features of the ROIs are computed. The color moment will be calculated to extract the color feature, where the image will be converted from RGB to HSV color space. The Discrete Wavelet Transform is performed to extract the texture feature. A combined colour and texture feature vector is computed for each ROI and Euclidean distance measure is used for computing the distance between the features of the query and target image. Preliminary experimental results show that the proposed method provides better retrieving result than some of the existing methods.**

***Index Terms*— Region Based Image Retrieval, Color Moment, Discrete Wavelet Transform.**

I. INTRODUCTION

Image retrieval is the field of study concerned with searching and browsing digital images from database collection. Due to more and more images have been generated in digital form around the world, image retrieval attracts interest among researchers in the fields of image processing, multimedia, digital libraries, remote sensing, astronomy, database applications and other related area[1]. There are several advantages of image retrieval techniques compared to other simple retrieval approaches such as text -based retrieval techniques Effective and fast retrieval of digital images has not always been easy, especially when the collections grow into thousands. An effective image retrieval system needs to operate on the collection of images to retrieve the relevant images based on the query image which conforms as closely as possible to human perception.

Image retrieval based on content is extremely useful in lots of applications such as geographical information architectural and engineering design, historical research, fashion and graphic design, medical diagnosis and remo te sensing systems, etc. [3]. In the commerce department, before trademark is finally approved for use, there is need to find out if such or similar ones ever existed. In hospitals, some ailments require the medical practitioner to search and review similar X-rays or scanned images of a patient before proffering a solution [4].

Spatial feature is proved useful and effective in grating with other low level features such as colour and texture to further increase the confidence in image understanding. CBIR systems extract features (color, texture, and shape) from images in the database. Each image is represented by a compact representation of its contents (color, texture, shape, and spatial information) in the form of a fixed length real-valued multicomponent feature vectors or signature [4]. This is called offline feature extraction [5]. The main advantage of using CBIR system is that the system uses image features instead of using the image itself. So, CBIR is cheap, fast, and efficient over image search methods.

A key component of the CBIR system is feature extraction. A feature is a characteristic that can capture a certain visual property of the image. One of the key issues with an y kind of image processing is the need to extract useful information from the raw data before any kind of reasoning about the image's contents is possible [3]. Early studies on CBIR used a single visual content such s color, texture, or shape to describe the image. The drawback of this method is that using one feature is not enough to describe the image. The image contains various visual characteristics. In this paper, we propose to extract color, texture and shape features from the image.

The rest of the paper is organized as the following. Section 2 presents the color and the texture features to represent the image. Section 3 introduces the proposed system for CBIR. System implementation and experimental results are given in Section 4. Section 5 summarizes our proposed system and some proposed future work.

II. RELATED WORK

All CBIR systems view the query image and the target images as a collection of features [4]. These features characterize the content of the image. The advantages of using image features instead of the original image pixels appear in image representat ion and comparison for retrieving. When we use the image features for matching, we almost do compression for the image and use the most important content of the image. This also bridges the gaps between the semantic meaning of the image and the pixel representation [6]. Each feature of image is explained here.

Color Feature

One of the most important features visually recognized by humans in images is color. Humans tend to distinguish images based mostly on color features. Because of this, color features are the most widely used in CBIR systems and the most studied in literature. Color is a powerful descriptor that simplifies object identification, and is one of the most frequently used visual features for content-based image retrieval. To extract the color features from the content of an image, a proper color space and an effective color descriptor have to be determined.

The purpose of a color space is to facilitate the specification of colors. Each color in the color space is a single point represented in a coordinate system. Several color spaces, such as RGB, HSV, CIE L*a*b, and CIE L*u*v, have been developed for different purposes. Although there is no agreement on which color space is the best for CBIR, an appropriate color system is required to ensure perceptual uniformity. Therefore, the RGB color space, a widely used system for representing color images, is not suitable for CBIR because it is a perceptually non-uniform and device-dependent system. The most frequently used technique is to convert color representations from the RGB color space to the HSV. The HSV color space is an intuitive system, which describes a specific color by its hue, saturation, and brightness values. This color system is very useful in interactive color selection and manipulation [7]. After selecting a color space, an effective color descriptor should be developed in order to represent the color of the global or regional areas. Several color descriptors have been developed from various representation schemes, such as color histograms [10], color moments [12], color edge, color texture, and color correlation [11]. In this paper, we will use color moment method will be combined with Average RGB. Average RGB feature is used to filter out images with larger distance at first stage when multiple feature queries are involved. Another reason of choosing this feature is the fact that it uses a small number of data to represent the feature vector and it also uses less computation as compared to others. Color moment has the lowest feature vector dimension and lower computational complexity. In color moment we have to find three parameters, the first-order (mean), the second (standard deviation), and the third -order (skewness) color moments have been proved to be efficient and effective in representing color distributions of images.

Texture Feature

In the field of computer vision and image processing, there is no clear-cut definition of texture. This is because available texture definitions are based on texture analysis methods and the features extracted from the image. However, texture can be thought of as repeated patterns of pixels over a spatial domain, of which the addition of noise to t he patterns and their repetition frequencies results in textures that can appear to be random and unstructured. Texture properties are the visual patterns in an image that have properties of homogeneity that do not result from the presence of only a single color or intensity. The different texture properties as perceived by the human eye are, for example, regularity, directionality, smoothness, and coarseness.

Image textures have useful applications in image processing and computer vision. They include: recognition of image regions using texture properties, known as texture classification, recognition of texture boundaries using texture properties, known as texture segmentation, texture synthesis, and generation of texture images from known texture models. Since there is no accepted mathematical definition for texture, many different methods for computing texture features have been proposed over the years. Unfortunately, there is still no single method that works best with all types of textures. The commonly used methods for texture feature description are statistical, model-based, and transform-based methods [4].

Before we extract the texture feature from the image, we perform a preprocessing step For analyze images in a multi-scale framework the two dimensional discrete wavelet transform (DWT) is an effective tool. It is also an effective tool to capture localized image details in both space and frequency domains. Through the Mallat’s tree algorithm the DWT is efficiently implemented. On original image DWT applies iterative linear filtering and critical down-sampling that yielding three high-frequency directional sub-bands at each scale level, in addition to one low-frequency sub-band usually known as image approximation. Directional sub-bands are sparse sub-images exhibiting image details according to horizontal, vertical and diagonal orientations. In this method image will undergo a first level decomposition to generate 3 detail sub-bands (*H1*, *V1*, and *D1*), and one image approximation (*A1*). At the second level of decomposition, the approximation image (*A1*) undergoes the same process to produce a second scale level of image details (*V2*, *H2* and *D2*) and a new image approximation (*A2*).

III. PROPOSED ALGORITHM

The proposed algorithm of the CBIR system is divided into two main steps. The first step is to extract the color feature and the texture feature from the image. The second step is to measure the similarity between the images using the extracted feature vectors. Figure describes the steps of the proposed method.

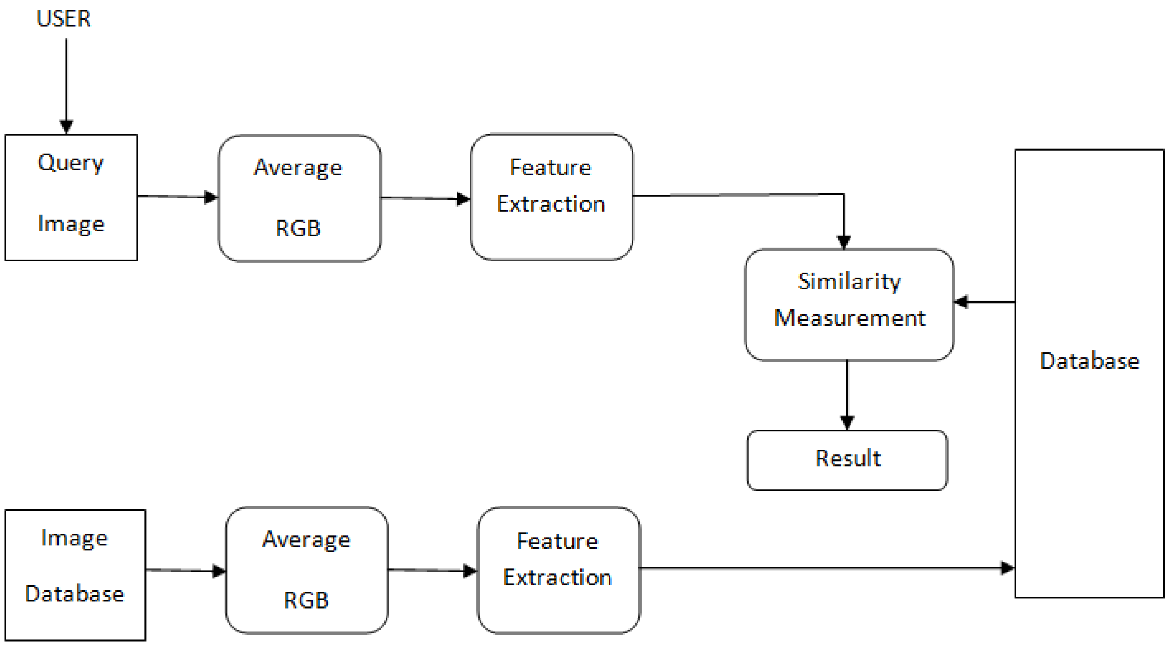

Fig 1 Diagram of proposed method

IV. SIMILARITY MEASUREMENT

One fundamental step in CBIR system is the similarity measures. Similarity between two images is to find the distance between them. The distance between two images can be calculated by using feature vectors that are extracted from the database images. Therefore, the retrieval result is not a single image, but many images will be retrieved. Different simi larity measures have been proposed based on the empirical estimates of the distribution of features, so the kind of features extracted from the im age and the arrangement of these features in a vector will determine the kind of similarity measures to be use d. Different similarity measures will affect the retrieval performance of image retrieval significantly. [4]

One of the most popular similarity measurements is Euclidean Distance. Euclidean Distance is used to measure the similarity between two images with N-dimensional feature vector.

V. EXPERIMENTS AND RESULTS

We choose the database provided by James S. Wang for testing our proposed method. WANG [25] database is an image database where the images are manually selected from the Corel database. In WANG database, the images are divided into 10 classes. Each class contains 100 images. It is widely used for testing CBIR systems. Classification of the images in the data base into 10 classes makes the evaluation of the system easy. Our proposed system is implemented using Matlab image processing. For evaluation, we use all the images in the database. Each image in the database went through the proposed method to extract the color feature and the texture feature. This step is made off line for the 1000 images in the database. The database now is ready for testing and evaluating our CBIR proposed system.[4]

Purpose: The algorithm is to retrieve images similar to the input image.
Input: An RGB image,
Number of retrieved images n.

Output: n images similar to the input image.

Method:

Part I: Apply Average RGB:

Step 1: Apply average RGB method on image stored in database.

Step 2: Calculate average RGB value for all images of database.

Part II: Extract Color Feature:

Step 1: Convert the input image from RGB color space to HSV color space.

Step 2: Calculate the color moments for each image layer (H, S, and V).

Step 3: Construct the color feature vector.

Part III: Extract Texture Feature:

Step 1: Apply the Discrete Wavelet Transform on the image. The output images will be in different orientation (vertical, horizontal, and diagonal)

Step 2: Calculate the texture moments for each Discrete Wavelet image.

Step 3: Construct the texture feature vector.

Step 4: Store all the parameters of the image in database for all images of WANG database.

Part IV: Retrieve the images:

Step 1: Apply average RGB to the query image.

Step 2: Retrieve the first n similar images to the input image by calculate the distance between the input image and the images in the database using color feature only.

Step 3: Calculate the precision and recall.

Step 4: Retrieve the first n similar images to the input image by calculating the distance between the input image and the images in the database using texture feature only.

Step 5: Calculate the precision and recall.

Step 6: Retrieve the first n similar images to the input image by calculate the distance between the input image and the images in the database using color and texture features.

Step 7: Calculate the precision and recall.

To evaluate a CBIR system, we have to choose some performance metrics. The problem is that neither a standard image database nor a unique performance measure is available [4]. In CBIR, the most commonly used performance measures are Precision and Recall.

We are going to consider precision and recall both. Precision is defined as the ratio of the number of retrieved relevant images to the total number of retrieved images [13]. We denote to the precision by P. Recall is defined as the ratio of the number of retrieved relevant images to the total number of relevant images in the database [13]. We denote to the recall by R [4].

In CBIR, if the precision score is 1.0, this means that every image retrieved by a search is relevant, but we do not know if the search retrieves all the images relevant to the query. If the recall score is 1.0, this means that all relevant images are retrieved by the search, be we do not know the number of irrelevant images were also retrieved [4].

We perform some experiments to check the retrieval effectiveness of the proposed method. Some experiments on this system is already done before. They have selected some images randomly from each category to test the system. The testing process is divided into 3 phases. In the first phase, that method was using the randomly selected images to retrieve similar images from the database using the color feature only. The precision and recall are calculated for each experiment and for each category. In the second phase, that method will retrieve similar images from the database using the texture feature only. Also, the precision and recall are calculated for each experiment. In the third phase, the proposed method will retrieve images similar to the input image according to the color feature and the texture feature. Table I shows the experimental results for each category by calculating the precision and recall for each experiment.

Table 1
Precision of each category

Wang Categories	Average RGB	Color Moments	Combined	Proposed Algorithm
Africans	0.31	0.43	0.51	0.61
Beaches	0.33	0.32	0.39	0.42
Buildings	0.39	0.31	0.43	0.45
Buses	0.34	0.34	0.38	0.43
Dinosaurs	0.87	0.91	0.94	0.96
Elephants	0.43	0.57	0.61	0.64
Flowers	0.51	0.49	0.57	0.67
Horses	0.42	0.53	0.63	0.68
Mountains	0.38	0.41	0.47	0.51
Foods	0.33	0.39	0.43	0.56

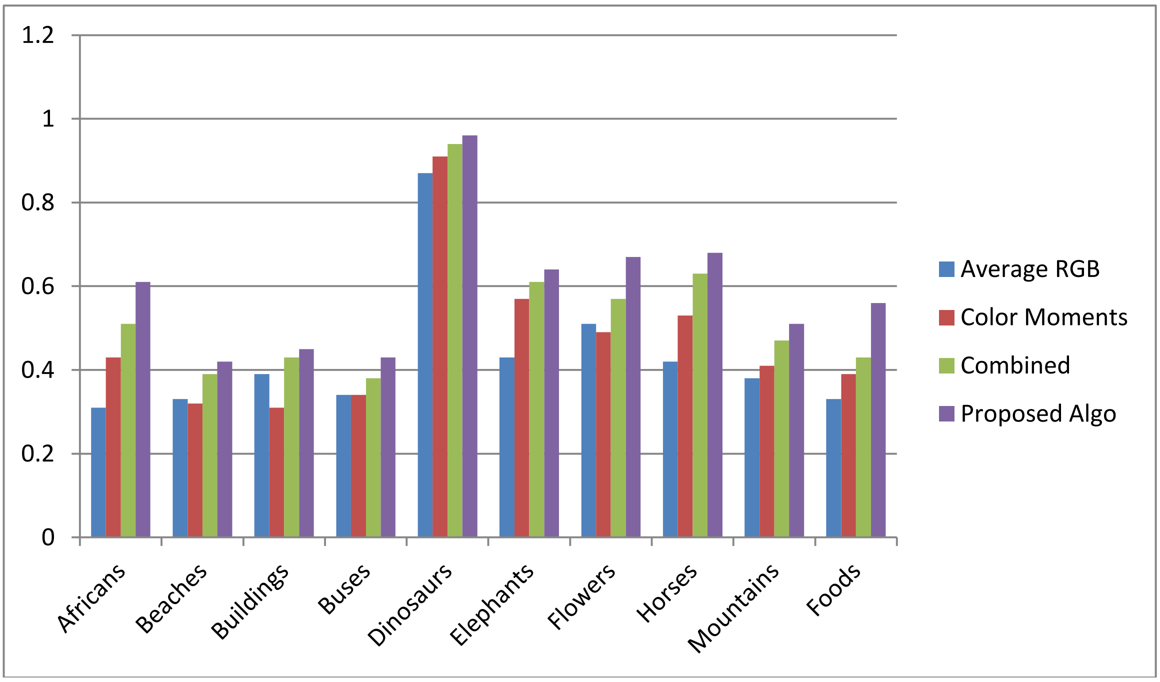

Fig 2 Graph of precision VS categories.

It is clear from Table I that proposed method works very well when we use combination of color and texture feature to retrieve images similar to the input image. Also, using the combination of color and texture features to represent the image and retrieve images similar to it has more accuracy compared with only color feature or only texture feature. Fig.2shows a graph to visualize which method has more accurate results.

VI. CONCLUSION

CBIR has been a very active research area since 1995. Because of the complexity of image data, many challenges are issued. This paper proposes a new CBIR method that uses the combination of HSV color moment feature, Discrete Wavelet texture feature. WANG image database is used to evaluate the proposed method because it is widely used for system evaluation. Experimental results for ten class images showed that the proposed method will have better precision and recall ratio than those based on color and texture features respectively.Because the method uses multi-features, which make use of each feature's unique advantages, in addition the dimensions of features vector are low.

In the future, I propose a method that combines spatial features with the color, texture and shape feature to represent the image. This will give good results.

REFERENCES

[1] Hui Hui Wang, Dzulkifli Mohamad and N.A. Ismail ―Approaches, Challenges and Future Direction of Image Retrieval ‖ journal of computing, volume 2, issue 6, june 2010, issn 2151-9617,pp. 193- 199.

[2] Ahmed J. Afifi and Wesam M. Ashour ―Content-Based Image Retrieval Using Invariant Color and Texture Features‖ 978-1-4673- 2181-5/12/$31.00 ©2012 IEEE.

[3] Amandeep Khokher, Rajneesh Talwar, ―Content-based Image Retrieval:Feature Extraction Techniques and Applications‖ International Conference on Recent Advances and Future Trends in Information Technology (iRAFIT2012),pp.9-14.

[4] Pushpa B. PATIL, Manesh B. KOKARE, B.L.D.E.A's, College of Engineering and Technology, Bijapur-586103, India. S.G.G.S. Institute of Engineering and Technology, Nanded-431606, India. "Relevance Feedback in Content Based Image Retrieval: A Review", Journal of Applied Computer Science & Mathematics, no. 10 (5) /2011, Suceava.

[5] Aman Chadha,,Sushmit Mallik and Ravdeep Johar ―Comparative Study and Optimization of Feature- Extraction Techniques for Content based Image Retrieval‖. International Journal of Computer Applications (0975 – 8887), Volume 52– No.20, August 2012

[6] P.S.Suhasini , Dr. K.Sri Rama Krishna, Dr. I. V. Murali Krishna ―Cbir Using Color Histogram Processing ‖ Journal of Theoretical and Applied Information Technology, Vol6. No1. pp 116 – 122.

[7] Nadia Baaziz, Omar Abahmane and Rokia Missaoui, ―Texture Feature Extraction In The Spatial-Frequency Domain For Content-Based Image Retrieval,

[8] Mangimala Singha and K.Hemachandran, ―Content Based Image Retrieval using Color and Texture,‖ Signal & Image Processing : An International Journal (SIPIJ) Vol.3, No.1, February 2012, pp.39-57

[9] Ahmed J. Afifi andWesam M. Ashour, ―Image Retrieval Based on Content Using Color Feature,‖ International Scholarly Research Network, ISRN Computer Graphics, Volume 2012, Article ID 248285, 11 pages.

[10] Swapna Borde and Udhav Bhosle, PhD. ―Feature Vectors based CBIR in Spatial and Transform Domain,‖ International Journal of Computer Applications (0975 – 8887), Volume 60-No.19, December 2012, pp. 34-45.

[11] Vibha Bhandari1, Sandeep B.Patil ,‖Comparison of CBIR Techniques using DCT and FFT for Feature Vector Generation, ‖ International Journal of Emerging Trends & Technology in Computer Science (IJETTCS), Volume 1, Issue 4, November – December 2012, pp. 90-96.