© 2015 IJIRT | Volume 1 Issue 12 | ISSN: 2349-6002

CBIR using low level feature combination

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***Abstract*—In the field of Image Processing, Image Retrieval has become one of the most active research areas in the past few years. In the Image Retrieval three main categories are there, text-based, content-based and semantic-based. In Content based Image Retrieval (CBIR), images are retrieved by their visual content such as color, texture and shapes. CBIR is used to effectively retrieve required images from large collection of images. In this paper the combination of three techniques of content based image retrieval are shown. For Color, Texture and Shape feature there Color moment, Discrete Fourier Transform and Zernike Moment are used respectively. With this three methods Average RGB is also used. It is used for the filtering of Database images according to input image.**

***Index Terms*—CBIR, Feature extraction,**

I. INTRODUCTION

Image retrieval is technique concerned with searching and browsing digital images from database collection. This area of research is very active research since the 1970s [1]. 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]. Fast retrieval of images has not always been easy, especially when you are working with thousands of images. For effectiveness of image retrieval system, it 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.

The purpose of an image database is to store and retrieve an image or image sequences that are relevant to a query. The database provided by James S. Wang is used for this purpose. In the WANG database 1,000 and 10,000 images has been used. In WANG database, the images are divided into 10 classes [2].Each class contain 100 images and 1,000 images has been used respectively. Classification of the images in the database into 10 classes makes the evaluation of the system easy.

In image retrieval research, researchers are moving from keyword based, to content based then towards semantic based image retrieval and the main problem encountered in the content based image retrieval research is the semantic gap between the low-level feature representing and high-level semantics in the images [1].

A. Keyword Based Image Retrieval

In the 1970s, the Keyword Based Image Retrieval system used keyword as descriptors to index an image [1]. In Fig.1General Framework of keyword based image retrieval is show.

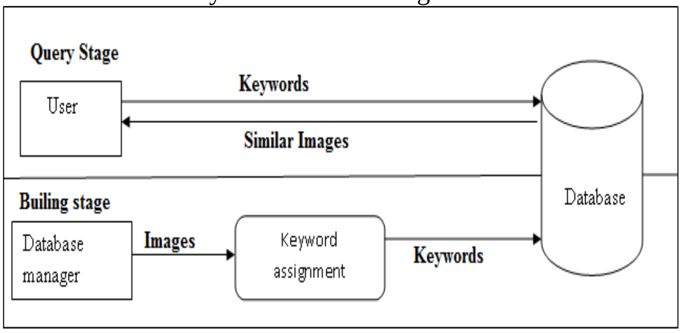

Fig.1 General Framework of Keyword Based Image Retrieval [1].

In this technique when images are stored in the database they are examined manually and assigned keywords that are most appropriate to describe their contents. The Keyword which stored in the database, are stored as the part of the attributes associated to the image. During query stage, the image retrieval system will accept from the user one or many keywords which constitute the search criteria. A keyword matching process is then performed to retrieve images associated with the keywords that match the search criteria.

B. Content Based Image Retrieval

In 1980s, Content-based image retrieval (CBIR) then has been used as an alternative to text based image retrieval [1]. Content Based Image Retrieval (CBIR) is the retrieval of images based on their visual features such as color, texture, and shape. Content-based image retrieval systems have become a reliable tool for many image database applications [2].With the Content Based Image Retrieval there are number's of advantages over image retrieval techniques compared to other simple retrieval approaches such as text based retrieval techniques. CBIR provides a solution for many types of image information management systems such as medical imagery, criminology, and satellite imagery [2]. In Fig.2 General Framework of Content based Image Retrieval is shown.

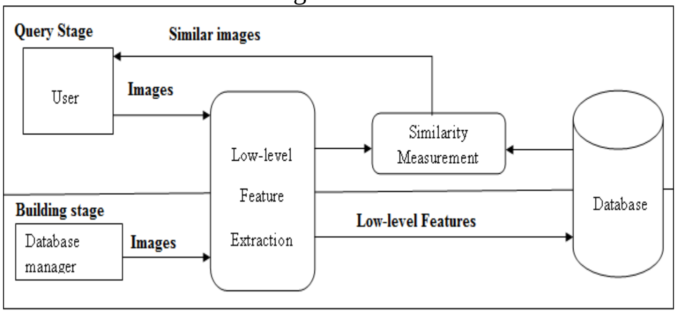

Fig.2General Framework of Content Based Image Retrieval [1]

II. FEATURE EXTRACTION TECHNIQUES

Feature Extraction Techniques may include both text based features and visual features. Within CBIR visual feature are required to extract. In the visual features scope it can be classified as low level and high level features. The selection of the features to represent an image is one of the keys of a CBIR system. Because of perception subjectivity and the complex composition of visual data, there does not exist a single best representation for any given visual feature [4]. Multiple approaches have been introduced for each of these visual features and each of them characterizes the feature from a different perspective [4].Main three low level features are the Color, Texture and Shape.

A. COLOR FEATURE

Color features are the basic characteristics for the content of images. With the color feature human can identifies and distinguish between object and images. Colors are used in image retrieval because they are powerful descriptors and sometimes provide powerful information about images. To extract the color features from the content of an image, we need to select a color space and use its properties in the extraction. In common, colors are defined in three dimensional color spaces. In digital image purposes, RGB color space is the most prevalent choice [2]. The main drawback of the RGB color space is that it is perceptually non-uniform and device dependent system. The HSV color space is an intuitive system, which describes a specific color by its hue, saturation, and brightness values [2]. This color system is very useful in interactive color selection and manipulation [2].

For the description of color feature many methods can be used. They are Color Histogram, Conventional Color Histogram, Invariant Color Histogram, Fuzzy Color Histogram, Geometric Moment, Average RGB, Color Moment, Color Correlogram, and Color Coherence Vector

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I. AVERAGE RGB

The objective of use this feature is to filter out images with larger distance at first stage when multiple feature queries are involved [7]. It uses a small number of data to represent the feature vector and it also uses less computation as compared to others that's why this feature is used. However, the accuracies of query result could be significantly impact if this feature is not combined with other features [7].

II. COLOR MOMENTS

Color moments are used as feature vectors for image retrieval to overcome the quantization drawback of the color histogram. The image is divided horizontally into three equal non-overlapping regions and from each of the three regions, we extract from each color channel the first three moments of the color distribution and store the 27 floating point numbers in the index of the image [7]. The first-order (*mean*), the second (*standard deviation*), and the third-order (*skew-ness*) color moments have been proved to be efficient and effective in representing color distributions of images, If the value of the *i*th color channel at the *j* th image pixel is *pi j* , then the color moments are as follows [2]:

Moment 1: Mean

$$E_i = \frac{1}{N}\sum_{j=1}^{N} p_{ij}$$

Moment 2: Standard Deviation

$$\sigma_i = \sqrt{\left(\frac{1}{N}\sum_{j=1}^{N}\left(p_{ij} - E_i\right)^2\right)}$$

Moment 3: Skew-ness

$$s_i = \sqrt[s]{\left(\frac{1}{N}\sum_{j=1}^{N}\left(p_{ij} - E_i\right)^3\right)}$$

B. TEXTURE FEATURE

There is no formal definition for texture, but it can say that it provides the measure of properties such as smoothness, coarseness, and regularity. In addition, texture can be expressed as repeated patterns of pixels over a spatial domain. If the texture has exposed to some noise, the patterns and their repetition in the texture can be random and unstructured [2]. Because of there is no formal mathematical definition for texture, many different methods are proposed for computing texture but among those methods, no single method works best with all types of texture. Some common methods are used for texture feature extraction such as Discrete Wavelet Transform, Gabor Wavelet Transform, Haar Discrete Wavelet Transforms, Ranklet Transform, Fourier Transform, discrete Fourier transform, Hadamard Transform, Gaussian Pyramid, Laplacian Pyramid, Steerable Pyramid, Gabor Filter.

I. DISCRETE WAVELET TRANSFORM

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 [8]. The decomposition process is illustrated in Fig.3 with the top image undergoing 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*) [8]. The resulting 2-level DWT is shown in Fig. 4.

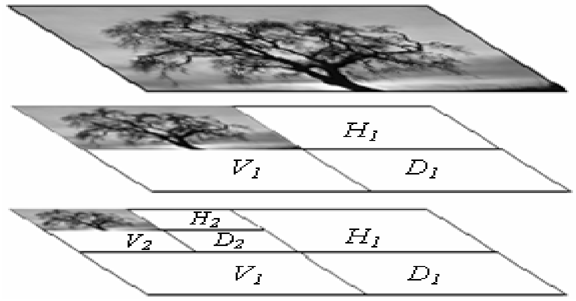

Fig. 3. A two-level wavelet decomposition [8].

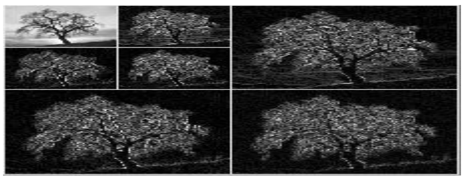

Fig. 4. Resulting sub-bands for a 2-level DWT (original image in Fig. 3.) [8].

II. DISCRETE FOURIER TRANSFORM

In Fourier transform, a signal is decomposed into a number of sinusoids of different frequency. The Fast Fourier Transform (FFT) refers to a class of algorithms for efficiently computing the Discrete Fourier Transform (DFT) [8]. Hence FFT is not an approximation of the DFT, it is the DFT with a reduced number of computations. DFT is most useful in digital signal processing, Convolution and digital filtering. It is shows that DFT can also be conveniently used for Content Based Image Retrieval.

C. SHAPE FEATURE

Another important visual feature is Shape. Shape is the basic features used to describe image content. Shape's representation and description is a difficult task because when a 3-D real world object is projected onto a 2-D image plane, one dimension of object information is lost. As a result, the extracted image is only partially represents the projected object. To make the problem even to difficult, shape is often corrupted with noise, defects, arbitrary distortion and occlusion. As a result, shape properties play an important role in content based image database systems devised by computer vision researchers [14].

The reason for choosing shape feature for describing an object is because of its inherent properties such as identifiability, affine invariance, and reliability and occlusion invariance, thus shape of the object has proved to be a promising feature based on which several image classification and retrieval operations can be performed [14].The shape descriptor are classified into two major kind namely Contour-based shape representation and description techniques and Region-based shape representation and description techniques. In the Counter-based shape techniques use only shape boundary information. In the Region based techniques it takes whole shape under consideration. There are some shape Descriptor methods like Geometric Moments Geometric Moments, Zernike Moments, Fourier Descriptor, Grid Method and Shape Matrix.

I. ZERNIKE MOMENTS

Teague has proposed the use of orthogonal moments to recover the image from moments based on the theory of orthogonal polynomials, and has introduced Zernike moments [14]. Zernike moments are allows independent moment invariants to be develop an arbitrarily high order. The complex Zernike moments are derived from Zernike polynomials [14]:

$$V_{nm}(x,y) = V_{nm}(\rho\cos\theta, \rho\sin\theta) = R_{nm}(\rho)\exp(jm\theta)$$

And

$$R_{nm}(\rho) = \sum_{s=0}^{(n-|m|)/2} (-1)^s \frac{(n-s)!}{s!\left(\frac{(n+|m|)}{2}-s\right)!\left(\frac{(n-|m|)}{2}-s\right)!}\rho^{n-2s}$$

Where n and m are subject to n-$|m|$ = even, $|m|\leq n$. Zernike polynomials are become complete when set of complex valued function added over the unit disk, i.e., $x2 + y2 = 1$.Then the complex Zernike moments of order n with repetition m are defined as [14]:

$$A_{nm} = \frac{n+1}{\pi}\sum_x\sum_y f(x,y)V_{nm}^*(x,y), x^2+y^2 \leq 1$$

Zernike moments are as same as to the Fourier transform, to expand a signal into series of orthogonal basis. The number of Moments truncated from the expansion is called the precision of shape representation. Basis functions of Zernike moments take the unit disk as their domain. Before calculating moments unit disk must be specified. Zernike moments descriptors do not need to know boundary information, making it suitable for more complex shape representation [14]. To overcomes the drawback of geometric moments in which higher order moments are difficult to construct, Zernike moments descriptors are constructed to arbitrary order.

III. PROPOSED METHEDOLOGY

Here in the Content Based Image Retrieval so many methods used for image retrieval. In the previous chapter all methods are describe and with this work related to CBIR is also given. These methods are used for the feature extraction from the images. But they can't get better precision ratio. In the proposed method, the process of image retrieval will carry out with the low level feature extraction. Low level features are Color, Texture and shape and with this features can get better performance.

For performance measurement two factors are here Precision and Recall.

$$P = \frac{\text{Number of relevant image retrieved}}{\text{Total Numaber of images retrieved}}$$

$$R = \frac{\text{Number of relevant image retrieved}}{\text{Total Numaber of relevant images in database}}$$

Euclidean Distance is used to measure the similarity between two images with N-dimensional feature vector. Suppose we have two feature vectors P and Q such that $P = (p_0, p_1, \ldots, p_{N-1})$ and $Q = (q_0, q_1, \ldots, q_{N-1})$. The Euclidean Distance between P and Q will be [2]:

$$D(P,Q) = \sqrt[2]{\sum_{i=0}^{N-1} \left(p_i - q_i\right)^2}$$

A. PROPOSED FOLWGRAGH

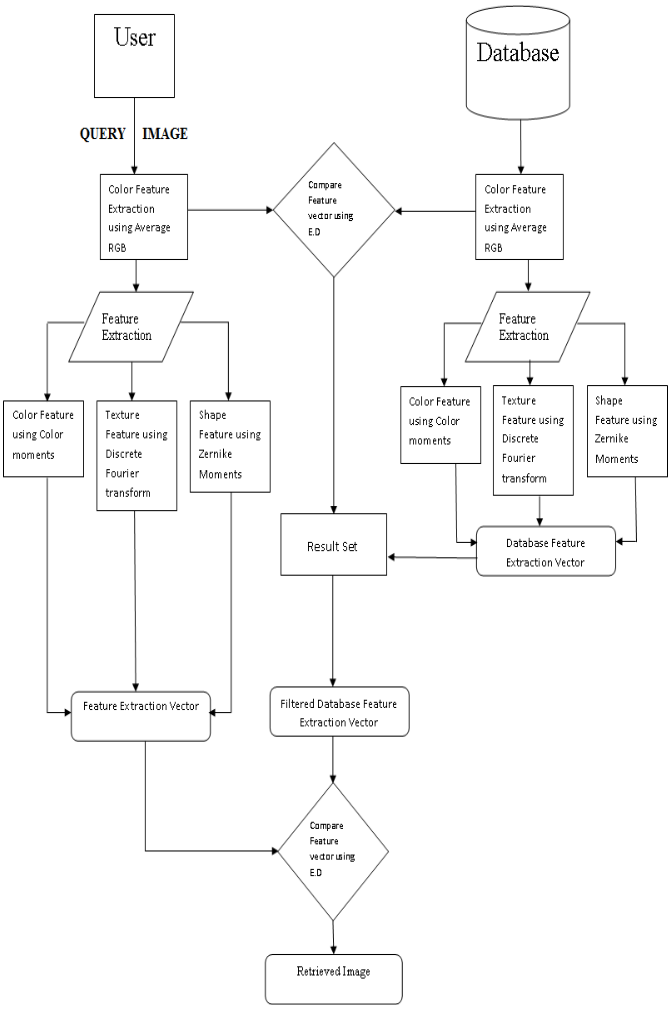

Fig.5 Flowgraph of Proposed method

B. PROPOSED FOLWGRAGH

- PREPROCESSING
  - Extract color feature of database images using average RGB.
  - Extract color, texture and shape features of all database images using Color moments, Discrete Fourier Transform and Zernike Moments and create database feature extraction vector.

Step 2: Extract color feature of query image using average RGB.

Step 3: Compare Average RGB of query image with database Images using Euclidean Distance and create Result set.

Step 4: Create filtered database feature vector from database Feature vector according to Result Set.

Step 5: Extract color, texture and shape features of query Image using Color moments, Discrete Fourier Transform and Zernike Moments and create feature Extraction vector

Step 6: Compare feature vector of query image with filtered Feature vector of database images.

Step 7: Retrieve images by similarity measurement using Euclidean Distance

C. EXPERIMENTAL RESULT

After implementation of proposed method, output is generated based on the precision ratio of the images of different class of database. Following are some snapshots to show results of few classes.

Fig.6 Input Image of flower class.

In Fig.6 it shows the input of the flower class. Based on this given input image the output is generated using Color method, it shows in Fig.7.

Fig.7 Result of class Flower using Color method.

Fig.8: Result of class Flower using Shape method

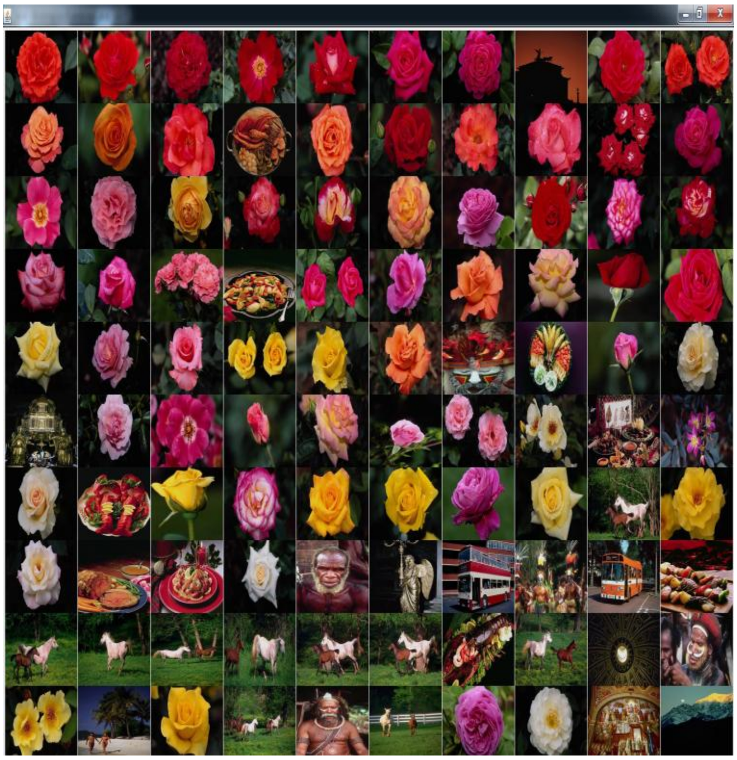

Fig.9 Result of class Flower using combination of three methods.

Fig.10 Result of class Flower using Proposed Method.

D. RESULT ANALYSIS

After doing the implementation of the proposed approach, the comparison of the result is to be analyzed. The result analysis is done by comparing precision of every class of the database. The following are the comparison charts for showing difference between proposed method and existing method.

Wang categories	color moment	Discrete Fourier transform	Zernike moment	Existing Combine method	Proposed method
Africans	0.32	0.28	0.31	0.52	0.55
Beaches	0.29	0.29	0.31	0.38	0.46
Buildings	0.31	0.32	0.32	0.43	0.43
Buses	0.33	0.31	0.37	0.48	0.49
Dinosaurs	0.91	0.87	0.94	0.96	0.97
Elephants	0.44	0.39	0.48	0.63	0.69
Flowers	0.52	0.42	0.49	0.68	0.72
Horses	0.46	0.32	0.45	0.59	0.64
Mountains	0.38	0.28	0.39	0.42	0.47
Foods	0.31	0.28	0.33	0.44	0.47

TABLE.1 COMPARISON TABLE FOR PROPOSED AND EXISTING METHODS

IV. CONCLUSION

In Content based Image Retrieval (CBIR), images are retrieved by their visual content such as color, texture and shapes. CBIR is used to effectively retrieve required images from large collection of images. This report proposes a new CBIR method that uses the combination of color, texture and shape feature of image using Color Moment, Discrete Fourier transform and Zernike Moments respectively and also Average RGB method is used for filtering required images form database.

After the implementation of proposed method with three feature color, texture and shape using color moment, Discrete Fourier transform and Zernike moment results are compare and analysis. Using this comparison it is conclude that proposed method is better than existing.

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