© May 2016 | IJIRT | Volume 2 Issue 12 | ISSN: 2349-6002

Content Based Image Retrieval using Dynamic weighted features combination

Brinda N. Joshi[1], Narendrasinh Limbad[2]
[1]*P.G. Student, Department of Computer Engineering,*
[2]*Asst. Prof., Department of Computer Engineering,*
L. J. Institute of Engineering and Technology, Ahmedabad, Gujarat, India

***Abstract*- Content-based image retrieval (CBIR) is an image retrieval technique used to retrieve images efficiently by using low level features (like texture, shape, color) of those images. It is an efficient retrieval mechanism to retrieve images from the multimedia database. The combination of these low level features give better results than individual feature. In the previous years, the amount of low level features to be retrieved were decided based on manual assumption or heuristic experiments. In this paper, we have focused on features extraction process dynamically and improving the precision value. The weightage of image features (color and Shape) are calculated dynamically and then their combination is used to retrieve more relevant images. Euclidean distance method is used for feature matching. An efficiency of image retrieval is measured by precision value of it.**

***Index Terms*— Content based image retrieval, Feature matching, CBIR, weighted features, dynamic feature extraction**

I. INTRODUCTION

Image Retrieval is the process of browsing, searching and retrieving images from a large database of digital images. Nowadays, a huge number of images are generated and transmitted in digital format over the Internet and there are varieties of tools to access the digital images. There are various application domains where image retrieval is essential like Medical diagnosis, Satellite system, Biometrics, Industry inspection, Geographical information, Web searching, historical analysis, etc. However, when searching for image from the web, the retrieved results may not meet the user's expectations. Because of, the images searching is based on associated metadata such as keyword, text, etc. This kind of approach of searching is known as Text Based Image Retrieval (TBIR) which suffers from manual annotation and inaccuracy arising due to human perception[3][4].

Another approach is Content Based Image Retrieval (CBIR) in which image retrieval is based on some image features like colors, textures or shapes which are also known as low-level visual features of the image. [1-4]

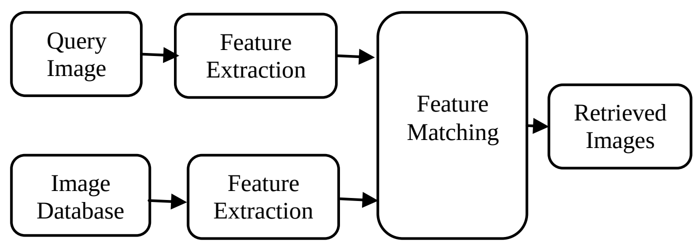

Figure 1: Block diagram of basic CBIR System [1]

Content Based Image Retrieval, also known as query *by image content* or *content based visual information retrieval.* Figure 1 shows block diagram of CBIR System. It involves two main phases: Feature extraction and Feature matching (Similarity measurement)[4]. The first phase involves extracting image features which are represented by feature vector. Second phase involves matching of these features by comparing it with the features of query image. If the distance between query image and database image is small enough, the corresponding image in the database is to be considered as a matched image to the query. The matched images are then ranked accordingly to a similarity index. Finally, the retrieved images are specified according to the highest similarity [2]. There are various techniques for measuring similarity like Euclidean distance method, Manhattan distance [7] metric, Canberra distance method, City block [5], etc.

In this paper, color moment and Fourier Descriptor methods are used for color and shape feature extraction respectively. For feature matching, Euclidean distance method is used.

The rest of this paper is organized as follows. Section-II gives background about CBIR system. Section-III describes proposed system, Section-IV shows Experimental result and Section-V covers conclusion and future work.

II. BACKGROUND

In the first generation, TBIR technique was used where text annotations were used to retrieve the images. However manual annotation is not always preferable. To overcome the difficulties encountered by TBIR system, CBIR was proposed.

CBIR focuses on image retrieval using low-level contents/ features of the image like color, shape, texture, etc. Main three features- color, shape and texture – are used in CBIR. Researchers have started retrieving process using single feature extraction method only. That means, either color or texture or shape feature was used by CBIR. For color feature extraction, various methods like color histogram, color moment, color coherence vector, color correlogram, average RGB, etc. are used.[3] For texture features, two kind of methods were there- statistical based and transform based. GLCM (Grey Level Co-occurrence matrix) [2], Fourier Transform, Ranklet transform [1], Discrete Wavelet Transform (DWT) [7], etc. are examples of it. Shape base image retrieval can be possible through either contour based or region base. Both of them further classified into Global and structural methods. Chain code, signatures, Fourier descriptors etc. are boundary/ contour based methods and region descriptors like, grid-based, moments-based etc.[3] By using only single feature for retrieving more relevant images is not sufficient.

To improve relevancy of retrieved images, combination of image features were used rather than single feature.[1] That means combination of color – texture, color - shape or shape-texture as well as combination of all of three features are used. As a result more relevant images can be retrieved and hence efficiency increases.

After that, researchers focus on reducing semantic gaps in CBIR. This is because though the system retrieves relevant images as much as possible, it may have possibilities that don't match to human perception. That means there is a little gap between what the System gives as a result and what user actually wants. This is called semantic gap which can be overcome by involving end users in decision making process. Fuzzy rule sets[6], Genetic algorithms etc. are used to reduce semantic gap. Still CBIR in image processing is an open research area to researchers for acquiring more improvisation.

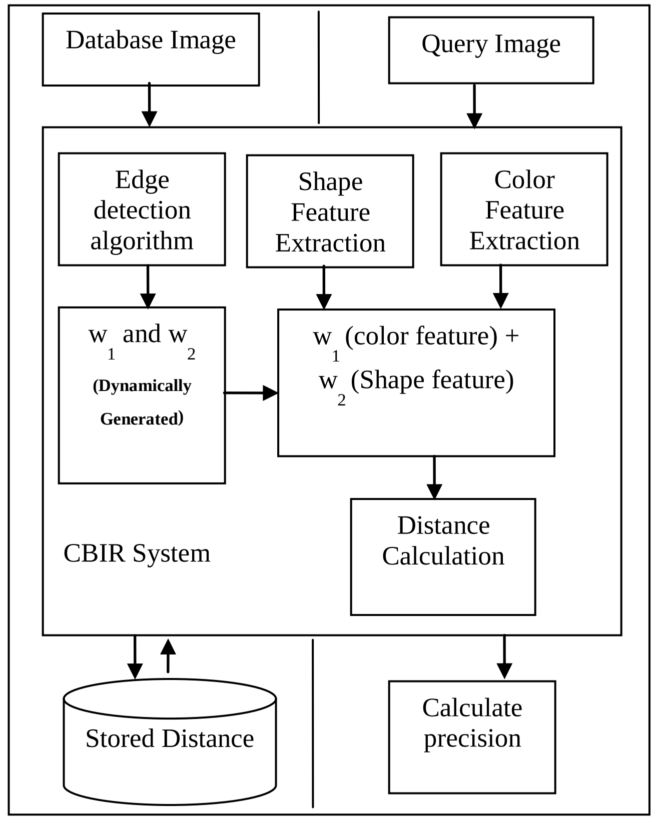

Figure: 2 Proposed System Architecture

III. PROPOSED SYSTEM

From the literature survey it can be observed that while combining the different features of an image, the proportion of that features have not been mentioned clearly. They have provided either manually or on the basis of experiments i.e. using heuristic approach. But this kind of approach is never advisable in real system. We cannot predict in advance that how much amount of content is required to fetch the desired relevant images. So rather than statically, calculate the weight of feature dynamically i.e. at the time of a query fired.

In this paper, we have proposed CBIR system that combines the dynamically weighted features- color and shape by using color moment and Fourier descriptor method respectively. For calculating weight of a feature canny edge detection algorithm is used. To measure the similarity, Euclidean distance method is used. For performance evaluation we have focused on precision parameter. The proposed System architecture is shown in Figure 2.

A. *Color Moment*

To extract the color features from the image, first HSV color space is selected which describes a specific color by its hue, saturation and brightness value.

Color moments have been proved to be efficient and effective in representing color distributions of images. Three moments are calculated in this method: first-order (Mean), second-order (Variance) and third-order (Skewness). Suppose value of the i^{th} color channel at the j^{th} image pixel is p_{ij}, then the color moments are[1]:

Moment 1: Mean

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

Moment 2: Standard Deviation

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

Moment 3: Skewness

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

Calculating the 3 color moment for each image (H, S, V) the color feature vector will be a nine dimension vector.

B. *Fourier Descriptor*

A contour based / boundary based shape representation method which is invariant against translation, scale, rotation, and their starting point. It provides well representation and well normalization. It overcomes the weak discrimination, noise sensitivity in the shape signature representations. FD derived from different shape signatures. Here, shape signature is any 1-D function representing 2-D areas or boundaries- central distance, complex coordinates, curvature function, and cumulative angles.[9]

Shape signature- Centroid distance function

$$d(t) = \left[(x_t - X_c)^2 + (y_t - Y_C)^2\right]^{1/2} \quad (4)$$

Where,

$$X_C = \frac{1}{C}\sum_{t=1}^{C} x(t) \quad (5)$$

$$Y_C = \frac{1}{C}\sum_{t=1}^{C} y(t) \quad (6)$$

$(x(t), y(t))$ is the location of t^{th} pixel of boundary.

Fourier coefficients

$$b_n = \sum_{t=1}^{C} d(t)\exp\left(\frac{-2j\pi nt}{C}\right), n = 0,1,\ldots N-1 \quad (7)$$

Here, coefficients are known as Fourier descriptors which represent discrete contour shape in Fourier domain. Global shape features are captured by the first few low frequency terms and higher frequency terms capture finer features of the shape.

C. *Canny Edge detection*

By using canny edge operator, edge histograms of images are generated, which are given as shape feature for further processing in retrieval system. The following shows the canny edge detection algorithm steps. The algorithm runs in 5 separate steps [11].

- **Smoothing.** Blurring of the image to remove noise.
- **Finding gradients.** The edges should be marked where the gradients of the image have large magnitudes.
- **Non-maximum suppression.** Only local maxima should be marked as edges.
- **Double thresholding.** Potential edges are determined by thresholding.
- **Edge tracking by hysteresis.** Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge

D. Similarity measurement

To compare the similarity between the images in database and the query image, distance between feature vectors of both is calculated. Euclidean distance [5] method is used for feature matching process.

For similarity between two images having N dimensional feature vector,

Let two feature vectors X and Y such that $X=(x_0, x_1, \ldots, x_{N-1})$ and $Y = (y_0, y_1, \ldots, y_{N-1})$

$$D(X,Y) = \sqrt[2]{\sum_{i=0}^{N-1}(x_i - y_i)^2} \quad (8)$$

In fused features,

$$S = w_1 D_c(X,Y) + w_2 D_s(X,Y) \quad (9)$$

Where,

S= Similarity, D_c = color distance, D_s = Shape distance, w_1 = color weight, w_2 = shape weight

E. Database

A standard database for testing is the WANG database. It is a subset of 1,000 images of the Corel stock photo database, manually selected and which form 10 classes of 100 images each. The 10 classes are African people and villages, beaches, buildings, buses, dinosaurs, elephants, flowers, horses, mountains and

glaciers, and food [1].

Figure 3: Example Images from WANG Database

F. Proposed Algorithm

Aim: Make CBIR system to get relevant image from database

Input: An RGB image, WANG image dataset

Output: n similar images to the input image

Algorithm

Step 1: Start

Step 2: User inputs a query image (Query by example). Convert RGB color space of images into HSV.

Step 3: Apply Color Feature extraction, Shape Feature extraction and Edge detection method on image.

Step 4: Find weights w1 and w_2

Step 5: Calculate w_1 (Color feature) + w_2 (Shape feature)

Step 6: Do step 2 to step 5 for all database images

Step 7: Compare query image to each database image by finding the distance between them

Step 8: Store distance in database in ascending order

Step 9: Calculate Precision and Recall based on output.

Step 10: End

G. Performance evaluation

To evaluate a CBIR system, the most commonly used performance measures Precision parameter is used.

Precision= (Number of relevant retrieve images) / (Number of retrieved images) [1]

IV. RESULT ANALYSIS

Experiment results are shown in the precision table includes precision values for images from each classes of WANG database. First the precision values of individual methods – color moment and Fourier Descriptor are shown. Then analyse the combination of this methods by evaluating it through precision values. In combined method weight of both features are calculated statically. In the last column the precision values are calculated using proposed method i.e. used weight of features which are generated dynamically and then combined them.

Category	Color	Shape	Combined (Statically)	Proposed (Dynamically)
Flower	0.72	0.61	0.81	0.89
African	0.49	0.42	0.53	0.64
Building	0.42	0.49	0.57	0.69
Dinosaur	0.99	0.97	1.00	1.00
Buses	0.41	0.49	0.54	0.59
Elephant	0.59	0.65	0.73	0.82
Horse	0.47	0.41	0.58	0.64
Beach	0.56	0.50	0.69	0.73
Mountain	0.34	0.46	0.57	0.65
Foods	0.39	0.31	0.48	0.57

Table 1: Precision Table

Figure 5: Results of Color Moment

From the result analysis it can be observed that precision values are increased by applying proposed method. Comparative graph is shown below which gives clear difference between existing method using static weight of features and proposed method. Result of each different methods are shown in Figure 5, 6 , 7, 8.

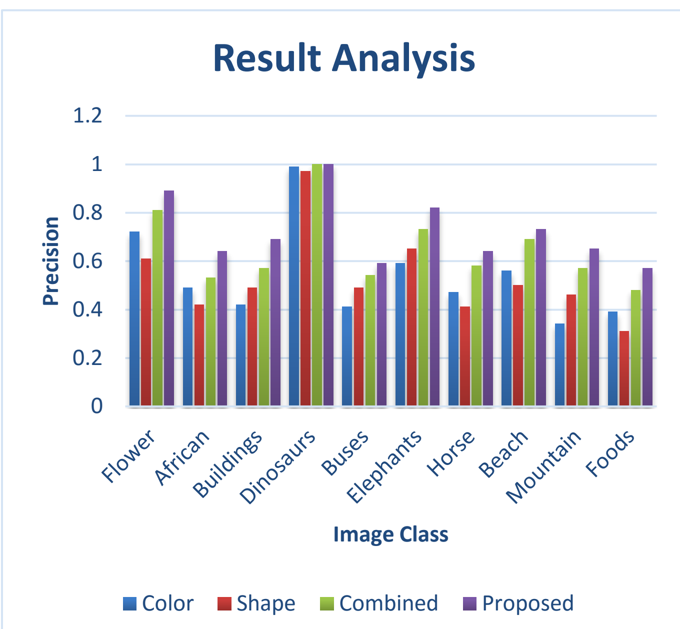

Figure 4: Experiment results graph

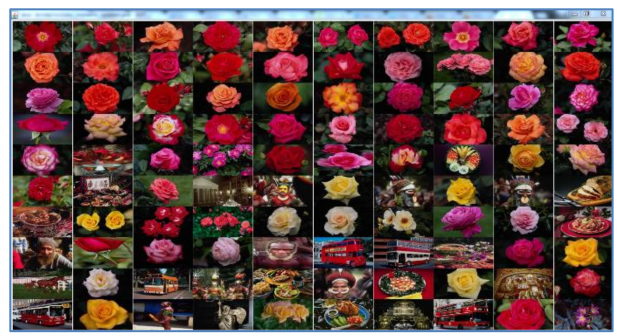

Figure 6: Results of Fourier Descriptor

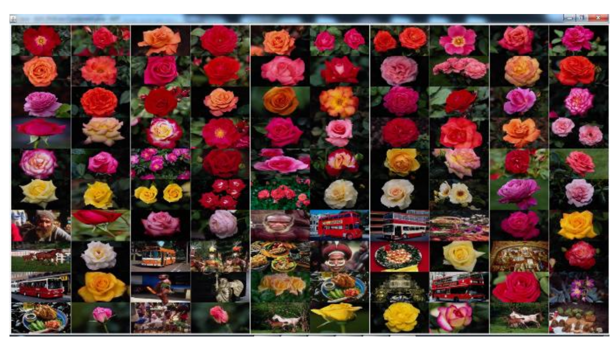

Figure 7: Results of Combined method with static weight

Figure 8: Results of Proposed method

V. CONCLUSION AND FUTURE WORK

In CBIR low level descriptors for feature extraction such as color, texture, and shape are very useful for extracting detail information from the image. The several researches are going on for image retrieval by using these image features. In early stage, only single feature was used for image retrieval but because of their limitation, combination of image features are carried out. To make user interacting system, fuzzy rule sets were used in retrieving process to choose the images according to their requirements. Still the researchers keep finding more effective method to make more accurate and efficient image retrieval. At the time of fusion of features, their weight or proportion is mentioned statically or based on some experiments. Rather than following static measurement, dynamically calculation of weight of features is more preferable. In this paper we have proposed a CBIR system which calculates the weight of color and shape feature dynamically and accordingly they combines for retrieving more relevant images. For evaluating similarity, various similarity measures are used which compares the query image with database images by calculating the distance between extracted features of images. Images having less distance are considered as more relevant images. We have used Euclidean distance method for it. After evaluating our proposed system by using precision parameter, we can obtain more relevant images and increases efficiency of the system.

For more enhancement purpose, we can use more image features like texture to have more relevant images as a result.

REFERENCES

[1] Ahmed J. Afifi, Wesam M. Ashour, “Content Based Image Retrieval Using Invariant Color and Texture Features”, Digital Image Computing Techniques and Applications (DICTA), IEEE International Conference, page-1-6, 3-5 Dec, 2012.

[2] Aman Chadha, Sushmit Malik, 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.

[3] Ms. A. Bhagyalakshmi, Dr. V. Vijyachamuneeswari, “A Survey on Content Based Image Retrieval Usding Various Operators”, IEEE International Conferrence on Computer Communication and System, Chennai, Page-018-023, 20-21 Feb, 2014.

[4] Komal Juneja, Akhilesh Verma, Savita Goel, Swati Goel,”A Survey on Recent Image Idexing and Retrieval Techniques for Low-level Feature Extraction in CBIR System”, IEEE International Conferrence on Computational Intelligence & Communication Technology, Page- 67-72, 13-14 Feb, 2015.

[5] Meenakshi Madugunki, Dr. D.S.Bormane, Sonali Bhadoria, Dr. C. G. Dethe, “Comparison of Different CBIR Techniques”, Electronics Computer Technology (ICECT) IEEE, 3rd International Conference, page 372-375, Volume 4, 8-10 April, 2011.

[6] Nikita Raina, Neeshu, Roshi, Rashmi Chauhan, Dr. R H Goudar,” A fused features approach on Content-Based Image Retrieval based on Fuzzy rule-set” , Advances in Computing, Communications and Informatics (ICACCI), IEEE International conference, Page 2436-2442, 24-27 Sept, 2014.

[7] Sushant Shrikant Hiwale, Dhanraj Dhotre, Dr. G.R.Bamnote,” Quick Interactive Image Search in Huge Databases Using Content-Based Image Retrieval”, Innovations in Information, Embedded and Communication Systems (ICIIECS),IEEE International Conference, Page 1-5, 19-20 March, 2015 .

[8] Ms. Apurva N. Ganar, Prof. C. S. Gode, Prof. Sachin M. Jambhulkar,” Enhancement of image retrieval by using color, texture and shape

features", IEEE International Conference on Electronic Systems, Signal Processing and Computing Technologies, Page 251-255, 9-11 Jan, 2014.

[9] M Mary Helta Daisy, Dr.S. TamilSelvi, Js. GinuMol," Combined texture and Shape Features for Content Based Image Retrieval",IEEE International Conference on Circuits, Power and Computing Technologies [ICCPCT-2013], Page 912-916, 20-21 March, 2013.

[10] You Fu-cheng, Zhang Cong," The Technique of Color and Shape-based Multifeature Combination of TradeMark Image Retrieval", Multimedia Technology (ICMT), IEEE International Conference, Page 1-5, 29-31 Oct, 2010.

[11] Savita Gandhani , Rakesh Bhujade, Amit Sinhal," An improved and efficient implementation of CBIR system based on combined features", Computational Intelligence and Information Technology,. CIIT, IEEE Third International Conference, Page 353-359, 18-19 Oct, 2013.

[12] Ashutosh Gupta, M. Gangadharappa," Image Retrieval Based on Color, Shape and Texture", Computing for Sustainable Global Development (INDIACom), IEEE 2nd International Conference, Page 2097-2104,11-13 March, 2015.

[13] Jia Song, Zunwen He," Content Based Image Retrieval by IPP algorithm", Computational Intelligence and Virtual Environments for Measurement Systems and Applications (CIVEMSA), IEEE International Conference,Page 1-4, 12-14 June, 2015.