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# Content Based Image Retrieval using First Order Derivates and Wavelet Moments

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***Abstract* - Content Based Image Retrieval uses the visual content of a picture such as color, shape, texture and indexes the image. In this paper a method is proposed for content based image retrieval. The proposed method based on a combination of statistical feature of color histogram of RGB image and wavelet moments. In this method histogram divides in some number of bins and for every bin we compute the statistical value and these values are combined with the wavelet moments to maintain a feature vector. Finally we get top image by comparing the query image with the database image on the basis of feature vector by using Euclidean distance measure.**

***Key Words: CBIR, Wavelet Moments, Statistical Feature, Precision, Recall.***

## 1. INTRODUCTION

Now a day's World Wide Web or internet becomes very popular for data transfer and storing of multimedia data like audio, image, video, graphics and animation, is also a part of system. Therefore fast retrieval of data from a database is an important problem that needs to be solved and for this retrieval Content based image retrieval system is developed. Here content is shows the actual visual content of image such as color, texture, shape etc these are also called feature of the image , In the basis of these features image is retrieved and indexed. From historical perspective, one shall notice that the earlier image retrieval systems are rather text-based search since the images are required to be annotated and indexed accordingly. However, with the substantial increase of the size of images as well as the size of image database, the task of user-based annotation becomes very cumbersome, and, at some extent, subjective and, thereby, incomplete as the text often fails to convey the rich structure of the images. This motivates the research into what is referred to as content-based image retrieval (CBIR). In CBIR a user has query image and he/she interested in similar image who match with query image. It aims is retrieve relevant based on the semantic and visual content of image.

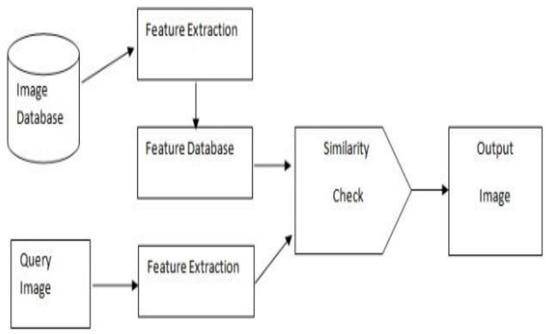


Figure 1. A CBIR system

A number of research done in the area of CBIR based on shape [1-2], color [3] and texture [4]. First histogram method is proposed by Swain et al.[5] was based on histogram intersection between the query image and database image. Another method is proposed by F.malik et al. [6] where color image first converted in grayscale and then proceeds by laplacian filter. Liuying et al. [7] gave a new approach to previous histogram based approach they use the color coherence vector for extracting color distribution of image and spatial information of the pixel in the image .another efficient work done by Zhihua xu.et al. [8] they proposed multi resolution histogram which adds some extra feature like encoding of spatial information directly. Naushad et al. [9] proposed an effective method for image retrieving using the statistical feature of color histogram. Recently wavelet based method is used to extract feature in which Haar and Daubechies are the most used in CBIR [10-11]. In this paper we demonstrated the result of the first order derivates or statistical feature of color histogram and wavelet moments in retrieving image and which give the best performance in terms of image retrieval.

The rest of the paper is organized as follows: sections 2 describe feature extraction process. Section 3 describes the similarity measurement of the image retrieval and section 4 analyzes the experimental result of the proposed method in term of precision and finally section 5 concludes the paper.

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## 2. FEATURE EXTRACTION PROCESS

CBIR systems extract the feature of each image in the database and stores in a different database which called as feature database. The feature extraction processes extracts the feature to a distinguishable extent and maintain a database of feature vector [12], to extracting these features from the image various techniques has been used. In our proposed method we use first order derivates and wavelet moments to extracting features.

### *2.1. First order derivates*

To extract the feature by using first order derivates are as follows:

Step 1. First we compute the probability histogram for each color component (RGB), by given formula.

$$p(f_i) = \frac{Number\ of\ Pixel\ in\ f_i}{Total\ number\ of\ pixel} \quad (1)$$

Where $p(f_i)$ represents the frequency or probability of i-th intensity value of pixel range of i is [0, l-1] where l has different intensity level.

Step 2. Divide the probability histogram into non-uniform bins and for every bin calculate the first order moments using probability histogram , in this we use mean, skewness, kurtosis etc as follows :

$$mean = \sum_{i=1}^{l} f_i\ P(f_i) \quad (2)$$

$$stddev = \sqrt{\sum_{i=1}^{l} (f_i - mean)^2 P(f_i)} \quad (3)$$

$$kurtosis = \frac{1}{(stdev)^4} \sum_{i=1}^{l} (f_i - mean)^4 P(f_i) \quad (4)$$

$$Skew = \frac{1}{(stdev)^3} \sum_{i=1}^{l} (f_i - mean)^3 P(f_i) \quad (5)$$

Step 3. Maintain the feature vectors using these moments for every color component which is obtained by step 2.

$$fv_A = \{Mean, skewness, stand.deviation, kurtosis\} \quad (6)$$

### *2.2. Wavelet moments*

Wavelet moments are part of the Discrete Wavelet Transform. Discrete wavelet transform is a mathematical tool which is use for the decomposing and analyzing an image. Wavelet transform provides both spatial and frequency description of an image. It analyzes the signal at different frequencies by giving different resolution; this feature is called multi-resolution analysis of wavelet transformation. DWT divides the signal into low frequency and high frequency. The high frequency contains information about the edge component while low frequency part contains coarse information of signal. DWT decompose the signal in 4 sub bands: LL, LH, HL, and HH. LL sub-band represents the coarse-scale DWT coefficients while the HL, LH and HH sub-bands represents the fine-scale DWT coefficient.

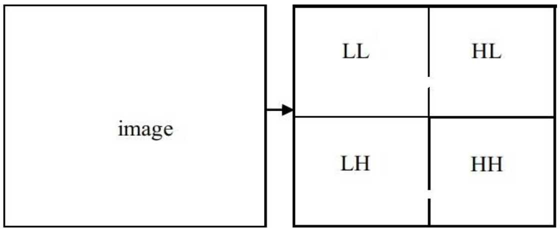

Figure 2. Discrete wavelet decomposition

In the proposed model we use the Single-level discrete 2-D wavelet transformation for extracting feature and maintaining a feature table by calculating standard deviation and mean of the resultant wavelet moments. The algorithm is as follows:

Step 1. Read the image and convert it to in grayscale image.
Step 2. Resize the image in 256*256.
Step 3. Calculate Single-level discrete 2-D wavelet coefficient by own function of Matlab.
Step 4. Construct a feature $fv_B$ vector after calculating mean and standard deviation of the resultant coefficient.
Step 5. Combine the $fv_A$ with wavelet moments as follows;

$$fv = \{fv_A, fv_B\} \quad (7)$$

## 3. SIMILARITY MEASUREMENTS

To measure the similarity between the query image and database image the difference is calculated between the query feature vector and database feature vector by using the any distance metric like cityblock, Euclidean, minkowski etc but, for the efficiency and effectiveness we use the Euclidean distance for similarity measurement. It measured the distance in two vectors by calculating the square root of the sum of the squared absolute differences [6]. If the query feature vector is $Q_i$ and database feature vector is $D_i$ then Euclidean distance between $Q_i$ and $D_i$ is calculated by:

$$\Delta d = \sqrt{\sum_{i=1}^{n} (Q_i - D_i)^2} \quad (8)$$

Where n=number of features, i=1, 2,..., n. If the both image are same then $\Delta d = 0$ and the small value of $\Delta d$ shows the image are most relevant of the query image.

## 4. RESULTS AND DISCUSSION

To do a systematical test on this algorithm, we use Corel database of image provided by Wang et al. [13]. Images on the database are general purposed pictures including snap shots and landscapes from natural scenes such as tribes, elephants, horse, flowers and dinosaurs etc. Besides, each category contains 100 pictures in JPEG format and in the sizes of 384×256 and 256×384.

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Figure 3. Sample of Wang Image Database

The performance of System is measured in term of precision which is evaluated as:

$$Precision = \frac{No.of\ Relevant\ Image\ Retrieved}{Total\ No.of\ Image\ Retrieved} \quad (9)$$

In general higher value of precision indicates the better performance of the image retrieval system or we can say as precision increases better result is obtained and if precision is decreased bad result is obtained. To test the system more accurately we select five pictures of each category in the database and take the average value of the precision. Because there are 10 categories, we take the experiment 50 times. After retrieving image we have considered first 10 relevant images those having minimum Euclidean
distance and calculate precision value for each query. The test results using the proposed algorithms are shown in table 1 and Figure 4 shows the precision rate for the proposed algorithm.

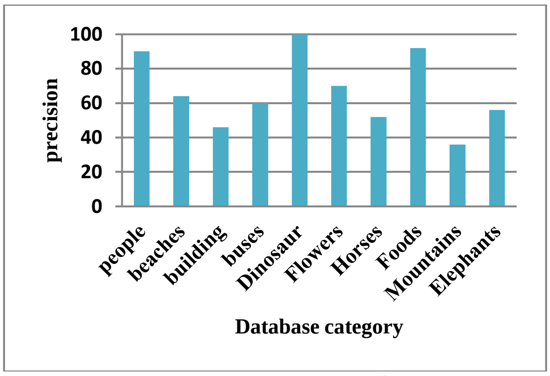


Figure 4. Average precision for each category.

## 5. CONCLUSIONS

In this work a new approach is presented for retrieving image from the database. Two different domains are combined to take the advantage of both domains, first order computed directly from an image histogram and have low computation cost and using wavelet it cover the multi resolution analysis from the query picture. The presented method gives good precision value for Peoples, Dinosaurs and Horses.

Table 1.Result obtained from the proposed method.

| Category | Query 1 | Query 2 | Query 3 | Query 4 | Query 5 | Average |
|---|---|---|---|---|---|---|
| Peoples | 90% Image No.=0 | 100% 25 | 80% 47 | 100% 62 | 80% 87 | 90% |
| Beaches | 80% 101 | 90% 102 | 30% 109 | 80% 113 | 40% 166 | 64% |
| Buildings | 50% 209 | 30% 210 | 50% 215 | 20% 251% | 80% 288 | 46% |
| Buses | 90% 301 | 60% 321 | 80% 340 | 10% 359 | 60% 397 | 60% |
| Dinosaurs | 100% 404 | 100% 422 | 100% 431 | 100% 452 | 100% 492 | 100% |
| Elephants | 70% 503 | 100% 521 | 90% 560 | 50% 575 | 40% 596 | 70% |
| Flowers | 60% 605 | 60% 637 | 60% 661 | 70% 677 | 10% 685 | 52% |
| Horses | 60% 708 | 100% 718 | 100% 734 | 100% 766 | 100% 789 | 92% |
| Mountains | 20% 817 | 50% 832 | 80% 842 | 20% 865 | 10% 883 | 36% |
| Food | 20% 910 | 100% 933 | 20% 952 | 100% 980 | 40% 998 | 56% |
| | | | | | | Average 66.6% |


Figure 5. Simulation Results.

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