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Investigation of Feature Extraction Methods for Image Retrieval Application

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Abstract: Content-based image retrieval is a technique used for retrieval of desired images via their colour, texture, and shape features. Features play a major role in an image. The major challenge in image retrieval lies in extracting the optimal features from an image. Feature extraction is a process of selecting optimal low level feature subsets. It transforms the input image into a set of features that describes the image with sufficient accuracy. In this paper, three specialized features i.e. colour moments, Region properties and Grey Level Co-Occurrence Matrix (GLCM) are extracted. This Image retrieval system using the hybrid features are tested using Corel image datasets consisting of 1000 images from 10 semantic categories. The efficiency of the system is evaluated in terms of precision, recall and error rate. From the experimental results, we can conclude that these hybrid features have improved the precision of the retrieval system when compared with other state-of-the-art methods.

***Keywords*:** Content-based image retrieval· Feature extraction· Colour moments· GLCM· Region Properties

I. INTRODUCTION

The advancement of digital technology has remarkably increased the digital images which are used in countless of applications, such as medicine,agriculture,journalism, ilitary, crime investigation, and so on. There is a need for efficiently retrieving the image from the digital image database. As different methods and techniques use images for many purposes, it is important to retrieve the exact image for good performance metrics.

The CBIR also known as query image content (QBIC) utilizes low level features in order to represent the index of the image. Progressive changes are continually made by the research community for obtaining effective results.

Generally, low-level and high-level visual features exist. In this paper, we are working on basic low-level features.

We propose an efficient and effective CBIR system by using low level features. To identify color information of an image, colour moments in HSI colour space is used and for texture, we use GLCM features, and for shape features we use geometric properties.

Color is widely used low level feature in CBIR. To identify colour feature there are color histogram [3], color moments [2] , Gabor filter[6], and color autocorrelation[1] under a certain color space. In this paper we are using a color moment which measures the characteristic color distribution in an image and uniquely describes a probability distribution. The main use of colour feature is for color indexing purpose which compares the similarity of two images based on color. This process is achieved by comparing the given query image to a database of Corel images in order to find and retrieve similarity images.

Texture feature is another low level feature used to indicate quality of the image in addition to colour features as they are not sufficient to identify the image because different images may have similar histogram. Texture features give us more details about specific region to an image. There are many texture analysis method such as GLCM/GLSD[6],Gabor Wavelet[1-2],Wavelet moment[3],Quantized Histogram[4],Local Binary Pattern[7],Binarized Statistical Image Features(BSIF)[2].Among these we are using Grey-Level Co-occurrence Matrix(GLCM) represents the statistical method for the spatial relationship of pixels also known as the grey-level spatial dependence matrix.

For describing shape features we have Wavelet transforms[1],Canny edge extraction[7],Hue moment shape feature[6], Sobel operator[5].Here we are using region based properties for representing shapes which specifies the objects body within the closed boundary.

The rest of the paper is organised as follows: division IIdefines the methodology of the work, division IIIdefines the results and the last division gives theconclusion and future work.

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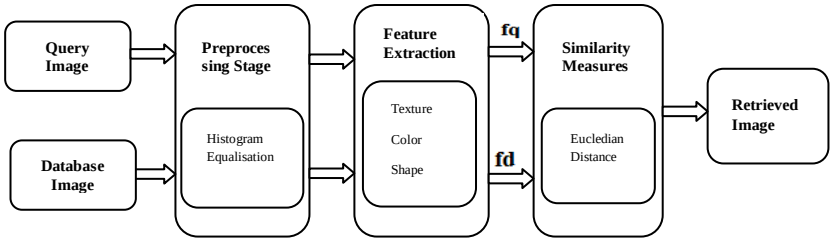
II. METHODOLOGY

To improve the efficiency of the retrieved image, the procedureas displayed in figure 1 is followed.



fq- Query feature vector fd- Database feature vector
Figure 1: Basic Flow of Image Retrieval system

A. Input database: The input database contains images from Corel database (1K). From this database 10 images are taken as query images and 990 images are taken as database images.

*B. Pre-processing:*It is the initial stage in Image retrieval system. It enhances some image features or quashes undesired distortion for further processing. Histogram equalization adjusts image intensities to enhance contrast which is achieved by persuasively spreading out the most intermittently intensity values.

*C. Feature extraction:*Feature extraction makes the image proficient for scrutiny and categorizing. In feature extraction certain features of interest in an image is further processed. We have considered the common lineaments like shape, texture and colour.

*Texture feature extraction:*According to the prospect specification to retrieve an meticulous image many types of texture feature extraction methods are used.In our work we are going for GLCM which is a analytical method.

Shape feature extraction:

Generally shape is described as the outer edge of the image.For any object shape is a basic feature to portray its content. For efficient shape feature extraction Region Properties are used.They are

1) Area:
2) Eccentricity
3) Euler number
4) Convex area
5) Perimeter
7) Orientation

Colour feature extraction:

Colour feature is widely used visual feature. Colour moments technique is experimented to extract colourfeatures. Two steps are used for this purpose:

(1)In first step, input RGB image is separated into R, G and B component images.

(2) Second step involves computation of mean (which describes the centre of probability distribution of the signal) and standard deviation of each of the component. Colour moments generates 6-D feature vector.

III.EXPERIMENTAL RESULTS

A. Similarity Measurements

Similarity measurement is another important issue in CBIR in which the input query image is compared with other database images for the similarity by using *Euclidean distance.*

$$D_E = \sqrt{\sum_{i=1}^{n}(|I_i - D_i|)^2}$$

B. Performance Metrics

The retrieval performance of the present method is measured efficiently in terms of Precision(P) and Recall(R).We can define them as follows

$$P = \frac{Nr}{I}$$

$$R = \frac{Nr}{Nt}$$

Where*I*is the number of images retrieved that is similar to the query image, $N_r$is the count of relevant images from retrieved images, and$N_i$is the total countof relevant images available in the database. If the precision is closer to 1 it indicates the system is more effective.

IV. RESULTS

The proposed method tests the hybrid features (colour, texture, and shape features). This database is implemented in Matlab2013b. For the query image, top 10 matches are retrieved. P@10 is calculated.

To validate the results comparison graph is drawn in Figure 6. The proposed method is compared with the method in [31]. The average precision obtained here is 78%. Comparison is

done for all categories in the dataset. For all the categories the implemented method achieved higher average precision than the approach used in Method [31].

Figure 2: Input Query Image

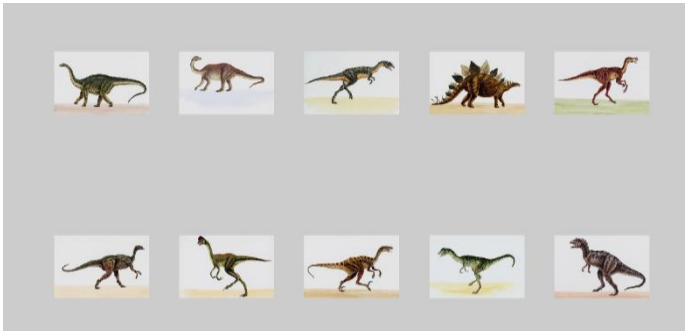


Figure 3: Experimental Results For Dinosaur

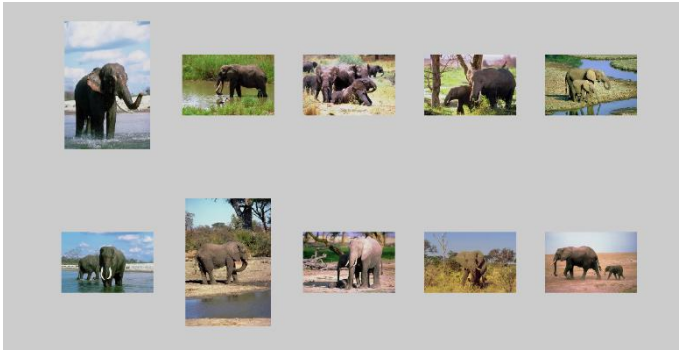


Figure 4: Experimental Results For Elephant

Table 1
Average Precision and Recall

Category	*Precision (I=10)*	*Recall (I=10)*
Bus	1	0.1
Elephant	1	0.1
Horses	0.9	0.09
African	0.8	0.08
Mountains	0.5	0.05
Beaches	0.6	0.06
Food	0.5	0.05
Dinosaur	1	0.1
Buildings	0.7	0.07
Roses	0.8	0.08

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Average	**0.78**	**0.078**

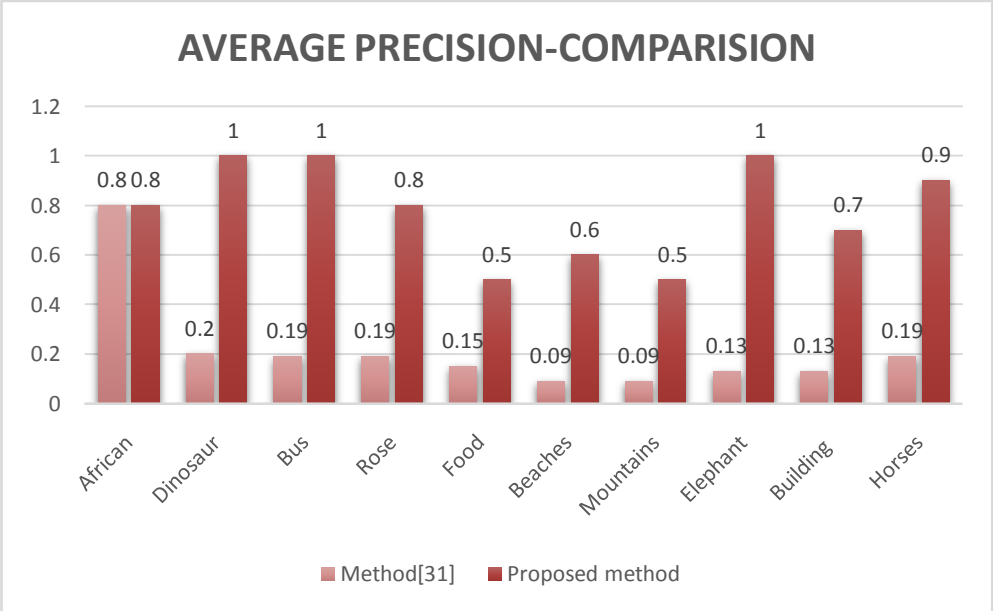

Figure 6: Comparison of Proposed approach with Method from [31]

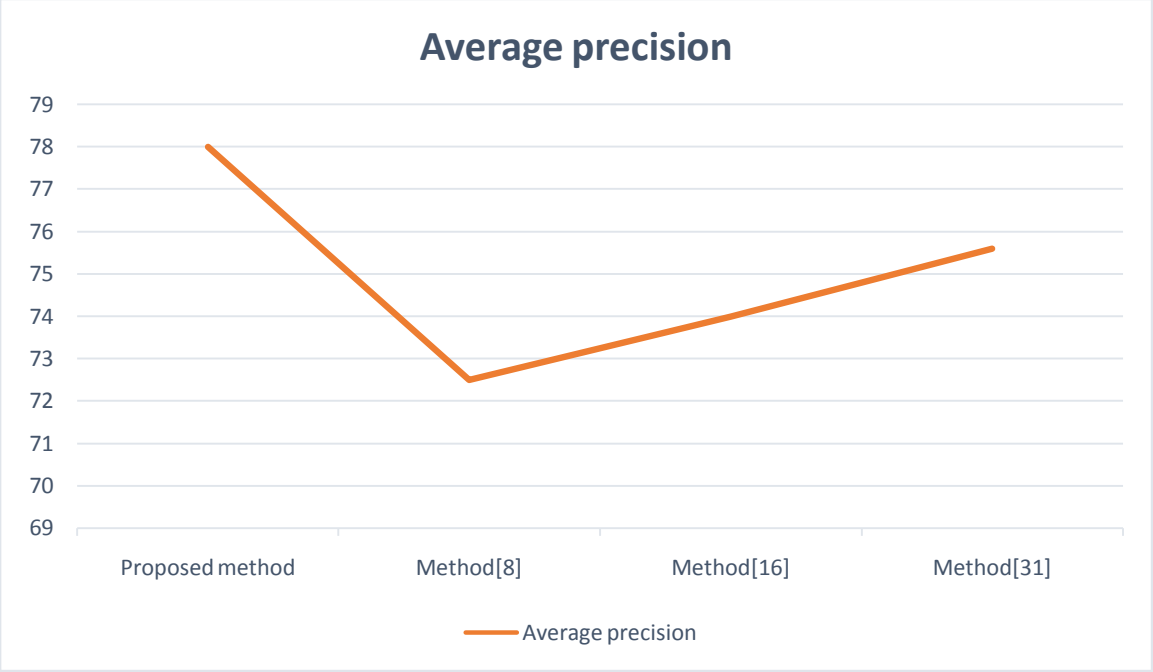

Figure 7: Comparison of proposed method with other methods.

V.CONCLUSION AND FUTURE WORK

This paper adopted GLCM, region properties and color moments features for integrating the relations between textures, shape and color. The proposed technique performance is tested on coral database. For similarity measurement Euclidean distance is a used. The experimental result indicates that the suggested model gained a percentage of 78% in terms of precision when related with other models.For future work the performance of the implemented system can be combined with other special features.

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