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CONTENT BASED IMAGE RETRIVAL USING COMBINATION HISTOGRAM AND MOMENT METHODS

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ABSTRACT

In this work, we introduce content based image retrieval CBIR. One of the essential features is colour in an image processing and CBIR so we use the colour histogram and colour moment features in order to compare a inquiry image with the image in the database. The two ways, colour histogram and colour moment have achieved state-of-art results when we applied them to WANG database images. For testing purposes, We have used 100 images (10 images from each class).The mean retrieval of precision of histogram was 74.4 % and the average of colour moment was 72.4% when test every algorithm alone and the result be more efficient when combine them which be 75.1 % by using constant weight and the precision increase to 81.9% when make the weight of combination variable by the user. (Restate with marks)

Keywords: *Image Processing, CBIR, Colour Histogram, Feature Extraction, Color Moment.*

1. INTRODUCTION

Images are considered a vital category of data, particularly with the growth of computers usability and the industry of greater storage and communication capacities. The revolution in digital photography produced a massive amount of images which are saved as digital data. As a result, there is an increased need for efficient ways to save and retrieve these still images. Hence, the content-based image retrieval field has turned into a topic of interest for many researchers who are majoring in image processing and computer vision. With the increase of today's communication network it's becoming more difficult to find a desired image within a huge collection of images. CBIR provides the means to efficiently retrieve digital image with certain subject by combining two or more image processing techniques. CBIR field has launched 30 years ago and it's getting more attention and growth every day. There are a large number of commercial products and prototypes being introduced by many research groups and scientists who's working in this area. However, there still a need for more efficient solutions to reach the optimal goal [1]. The basic CBIR system is illustrated in Figure 1.

2. RELATED WORK

Zhenhua Zhang et al. in 2009, depended on colour histogram as one of the most frequently

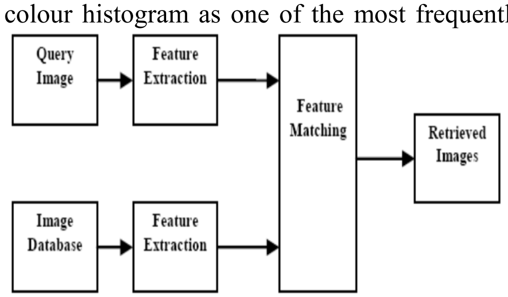

Figure 1, Basic scheme for CBIR

Used features in the domain of CBIR. They proposed a high-resolution, non-uniform quantized colour histogram along with the improving representation of such histogram. Using the technique they provided, much redundant information were eliminated related to high resolution images that are irrelevant to the image content. They prove that the new method is robust to rotation and translation, and is more excellent in based on originality, significance, quality and clarity [2].

In their paper in 2012, Naresh Babu and Dr.K Ashok Babu proposed a CBIR system that divides the retrieving part into three parts, namely Colour feature: Shape Feature and Texture Feature. The reason behind this was using one information feature to retrieve images may lead to inaccuracy compared to using more than one feature. They proposed a module which gets the single shape-feature then, increases to the complex shape feature. The results of their experiment got more accurate compared to single feature use, also they eliminated the issue of rotation-transition [3].

Seung-Sun Yoo1 et al. in 2006 proposed an Adaptive Colour Histogram (ACH) that works be dividing the process into three parts. The first part calculates the histogram bins while the second one measures the start point of the histogram. The third part works by measuring the intersection between the query image and database images. Compared to other histogram-based methods, their method seems to be simpler and more accurate. It doesn't have special requirement or extra restriction for images. Their work was tested on a group of hundreds of images and the simulation results showed the highly accurate candidate images in comparison to other retrieval methods [5].

Saikrishna et al. in 2012 proposed a RGB image recovery technique that works on the primitives of RGB moments. Their work starts by dividing the image into four parts, and then calculating the RGB moments for all parts and clustered into four categories. The average moments of each class are deemed as a primitive of the image, therefore all primitives are utilized as features and each category average is unified into one category average. By using Sum-of-Absolute Differences (SAD) method the distance between the inquiry image averages with the stored images is figured at the extraction phase. They prove that their method works better in comparison to other moment-based methods using the new measurements [7].

T. Gokaramaiah et al. (2013) produced a novel signature indexing for CBIR which improves the performance of image retrieval process. Using complex CBIR method can cost much time if the database was too large. To help reduce the computational requirement of the retrieval process, images are being indexed by its Colour, Medial Axis, Area, Eccentricity, and Euler number. These types of indexes are bias. They worked to overcome this issue by calculating the static parameter such as mean based on the signature histogram. According to these means, the images are being indexed. This process reduces the search space during retrieval so that the performance is increased [8].

3. PROBLEM STATEMENT

The problem was summarized as entering a query image into a software application that was designed to use CBIR techniques in extracting features, and matching them. This can be achieved by retrieving stored images are most similar to the inquiry image.

In CBIR system, getting more accuracy means acquiring more basic features of a inquiry image and comparing them to those features of images that are saved in the database. Such image features maybe colour, texture and shape. Dealing with this much of data can cost much space and time unless an efficient technique is used to reduce the computational requirements. The comparison process is performed using colour , texture and shape distance metrics. In the end, these metrics are checked in a sequence order in order to retrieve database's images that are similar to the query. Using comparison algorithms that are used by well-known CBIR systems, the similarity between features was calculated and stored in an array. In this paper, the Canberra distance measure is utilized for similarity expression. For each specific feature there was a specific algorithm for extraction and another one for matching [9].

4. COLOUR SPACE

We can define the colour space as a model for representing colour s in terms of intensity values. Normally, a one-to-four dimensional space is defined by a colour space. A colour channel or a colour component is one of the dimensions. A dimensional colour space (i.e. each pixel has one dimension) represents the gray scale space.

4.1. The RGB colour model

The most common model of representing the colour is the RGB model. This model uses the three primitive colour s, red, green and blue, in an additive way to produce new colour s. Since this model is the basis of most computer displays nowadays, it has an advantage of being simple to extract. Generally, in any colour ed image, each pixel will content red, green and blue values starting from 0 ending 255 which give a total of 16777216 different colour s from which we can get.

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In this paper we used the RGB colour model to calculate the histogram.

4.2. HSV Colour Space

In general, an optimum colour space can be defined for image recuperation. Nevertheless, for the content-based query by colour, there are many colour spaces such as lab, Luv, and HSV that can be used.

We prefer using the HSV (Hue, Saturation, and Value) colour model because it is easy to convert the RGB (Red, Green, and Blue) colour space with consideration of all the available image formats are characterized.

When dealing with colour, the HSV colour space is widely used. It is been established and built in a way that offers intuitive illustration of colour s and easy to predict how humans detect and deal with colour.

The process of transforming RGB to HSV is nonlinear and reversible. The control spectral elements (the colour in its unadulterated form), an as in red, blue, or yellow is represented by the hue (H).

The saturation is affected by changing the white values where adding more white to the unadulterated colour reduces the colour saturation and less the white value is more the colour saturation will be. This matches to the saturation (S) vector. The value (V) links to the brightness of colour .

There is no relation between the hue (colour) and the light and camera direction: thus, it is appropriate for objection recognition explained in Figure 2.

The hue is characterized by the space around the central vertical axis and represented by the angle given between the 0 and 360 degrees. The radius represents the distance from the center of the cylinder axis to its outline corresponds to “saturation while the distance along the vertical axis matches the “value ", “lightness” or “brightness” [10].

The HSV can be taken out of from the RGB illustration according to the following equations [6].

In This paper, the HSV colour model is used to extract the colour moment.

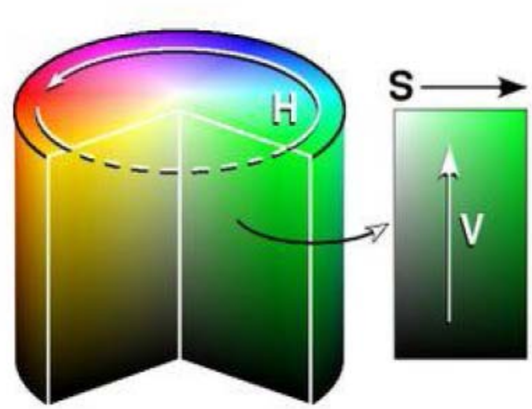


Figure 2, The HSV colour space

The HSV values can be extracted from their RGB representation according to the following equations
[6].

$$H=\cos^{-1}\frac{\frac{1}{2}[(R\_G)+(R\_B)]}{\sqrt{(R\_G)^2+(R_B)(G\_B)}} \quad (1)$$

$$S=1-\frac{3[min(R,G,B)]}{R+G+B} \quad (2)$$

$$V=(\frac{R+G+B}{3}) \quad (3)$$

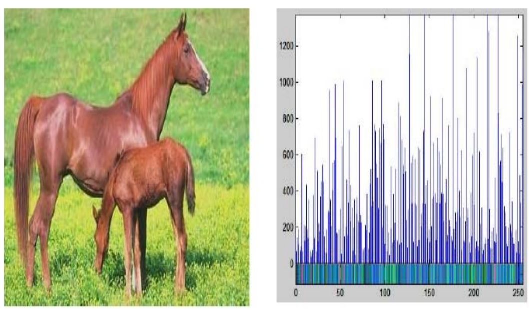
The HSV colour model is used to calculate the colour moment in this paper.

4.3. Colour histogram

The colour histogram can be constructed by counting the frequency of pixels for each colour. In the following studies, the evolution of the extraction algorithms has a similar progression

(1) Selection of a colour space
(2) Quantization of the colour space
(3) Computation of histograms.

The histogram of an image usually refers to a diagram of the pixel intensity values in an image processing field. Such histogram represents a graph that shows the number of pixels in an image at each different level of intensity found in that image. For an image with 8-bit grayscale colour s, there will be 256 different possible intensities, and hence the histogram will graphically shows 256 numbers with the distribution of colour pixels amongst those grayscale values. Histograms can also be constructed for colour ed images either by taking each colour individually (red, green and blue), or producing a 3-D histogram to all channels, with the three axes representing the red, blue and green channels, while the brightness at each point will represent the pixel count. The exact outcome of this operation depends on the implementation phase, it may simply be an image of the required histogram in a suitable format, or it can be represented as a data file with some sort of the histogram statistics. The figure below (Figure 3) ,shows the original image and its histogram image.



a) Sample Image. b) Corresponding Color Histogram.

Figure 3, Example of image histogram and its original Image

4.4. COLOUR MOMENT

Many CBIR systems have successfully utilized colour moments to achieve their goals. That moment based colour distribution properties can be strongly matched like colour histograms which will be discussed in this paper. By using their three equations, colour moments are used to extract colour features of an image .The first order (mean), the second order (variance) and the third order (skewers). Colour moments have proven its efficiency in representing colour distribution of images .The first three moments are defined as:[6].

$$E_{r,i} = \frac{1}{N}\sum_{j=1}^{N} Iij \tag{4}$$

$$\sigma_{r,i} = \left(\frac{1}{N}\sum_{j=1}^{N}\left(I_{ij-E_{r,i}}\right)^2\right)^{\frac{1}{2}} \tag{5}$$

$$S_{r,i} = \left(\frac{1}{N}\sum_{j=1}^{N}\left(I_{ij-E_{r,i}}\right)^3\right)^{\frac{1}{3}} \tag{6}$$

Where Iij represents the value of the image pixel I at the i-th colour component, and N is the number of pixels in the image. Colour moments are considered a very compact representation when compared to other colour features since it uses only 9 numbers (three moments for each of the three colour components) to represent the colour content of each image. It may also lower the discrimination power due to this compactness [6].

5. THE PROPOSED TECHNIQUE

The proposed method retrieves the images from the database that are the most similar ones to the query image. CBIR is an application of computer imaging to the image retrieval problems, that is, the problem of searching for digital images in large databases. Content-based refers to searching for the contents of the images themselves, rather than depending on human-input metadata like captions or keywords. In CBIR, each image will have its features stored in the database and then compared to the features of the query image [1]. The proposed technique in this paper is implemented using colour histogram and colour moment algorithms alone and with combination of each other. Histogram features are recorded by calculating the density of each of the three colour s in the image (red, green, blue). These values are lately stored to be then used for retrieval. When a query is initiated, the histogram algorithm is applied to the query image and then the features extracted are compared to those of the database images. After the comparison process, the values of differences between the query and database images are sorted in ascending order and the ten most similar images are then retrieved. The other implemented method in the proposed system is the colour moment. This feature is extracted by first dividing the image horizontally into three equal parts as in Figure 4. Before calculating the moment features, the colour system is converted from RGB to HSV. Then moment features are calculated and stored for further retrieval. The retrieval process is done as in the histogram algorithm and the merge between these two algorithms is done via the equation (7) in two cases. The first case uses a constant weight while in the second case the weight is variable. Figure 5 shows the proposed method.

Figure 4, dived the image in three regions in colour moment

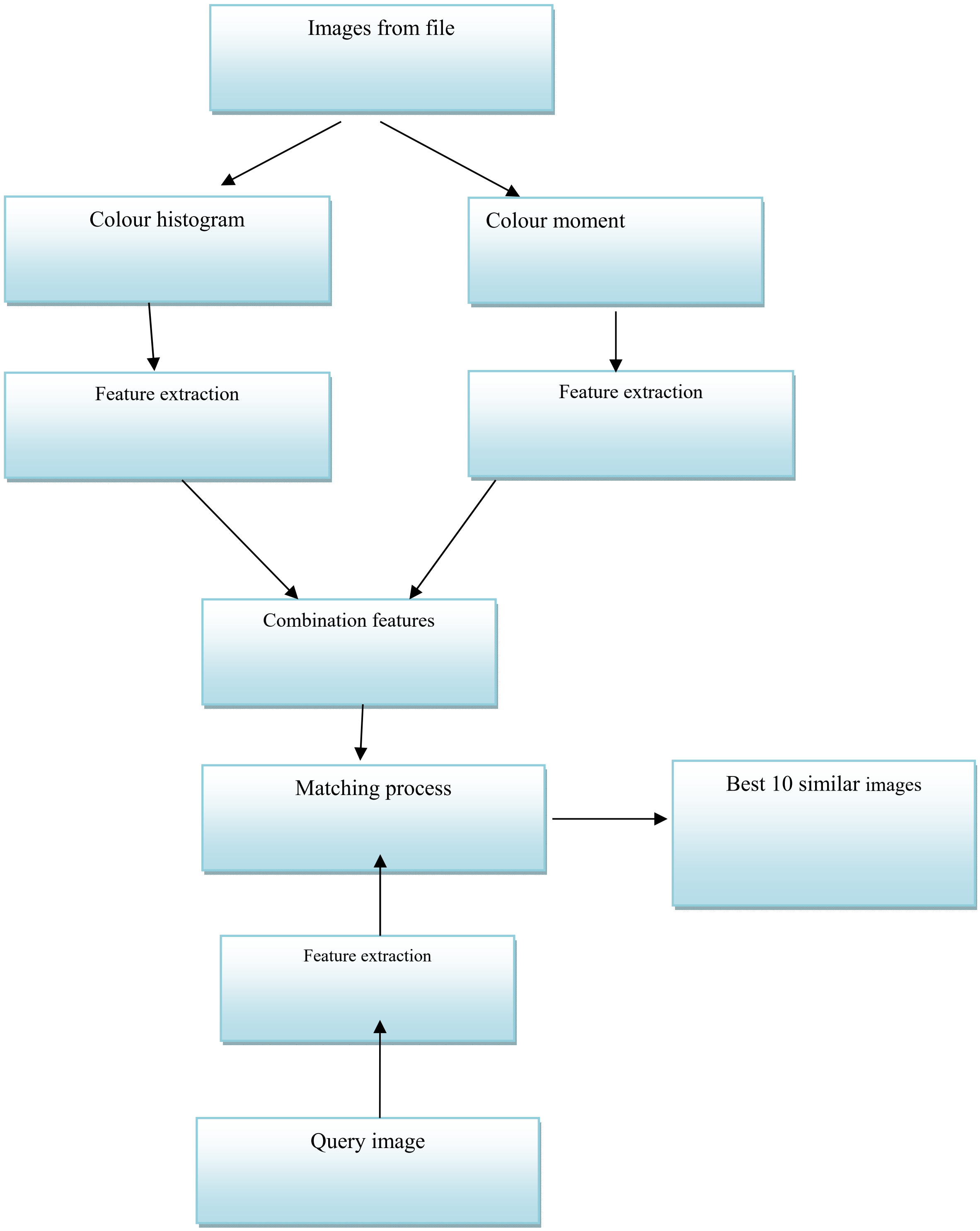


Figure 5, Graph of proposed structure

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5.1 Image Database

The Visual Studio 2010 is used to implement the proposed method and a general-purpose WANG database is used for testing holding 1000 core digital images in the format of JPEG with size (384x256 or 256x384).The database is built of 10 categories where each one contains a set of 100 images. In the implemented experiment, 100 images were randomly chosen where 10 images from each class and the images are resized to 256 x 384.

In this database, if the two images are from the same category, they considered a match. Particularly, a retrieved image is considered a match if and only if it is in the same class as the inquiry image. Figure 6 presents a sample of Wang database images [10].

Figure 6, sample of images for Wang database

6. COMBINATION METHOD

The inquiry and target image are similar in how they are calculated using two kinds of colour features which include Moment, and Histogram features. Two kinds of properties of images show different sides of property. So, during similarity measuring, adequate weights are given to combine the features. The distance (difference) between the inquiry image and the image in the database is computed as in eq7:

$$d = w1 * d1 + w2 * d2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots . (7)$$

Where w1 represents the weight of the first colour features and w2 represents the weight of the second colour features while d1 and d2 represent the distances which are calculated using colour moments and Histogram equations. Experiments have shown that we put w1 and w2 in a way that are variable by the user, better recovery performances are achieved. The weight factor differs from one colour feature distance to the other because our database has of variety of images.

The distance‘d’ stated above is calculated between the inquiry image and every single image in the database and then sorted in ascending order. The image corresponding to the first value in the array of distances‘d’ represents the most comparative image in comparison with the inquiry image. The initial 10 most comparable images are then shown according to this distance array.

7. RESULT AND ANALYSIS

In Any CBIR system, the result can be measured based on accuracy and recall. Accuracy measures can be given as the system’s ability to regain the only models that are related to the subject, while "Recall" measure is given as the ability to regain all related models at which illustrated as number of relevant images retrieved.

In this work, 10 images in the database form each class were tested to regain 10 comparable images for each class.

$$\text{Precision} = \frac{Number\ of relevent\ image\ retrived}{Total\ number\ of\ images\ retrived} = \frac{A}{A+B}$$

$$\text{Recall} = \frac{Number\ of\ relvent\ image\ retrived}{Total\ number\ of\ rlevent\ image\ in\ database} = \frac{A}{A+C}$$

Where:

- The number of related images that are retrieved is given by *A* character.
- The number of related items is given by *B* character.
- The number of related items that were not retrieved in database is given by C character.

The Accuracy and Recall was extracted for each method individually in table (1) and added in the table (2) in two cases. The first case is where the weight of combination made constant in value 0.2 while the second case is where the weight of combination was variable. The range of weights can be between 0 and 1 so when the weight 0 is given to any algorithm it is same not using the algorithm because there is no value for the algorithm in combination.

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Table1, The Result of Moment and Histogram

Class	Average precision %	
	CM	HIS
African	0.92	0.90
Beach	0.46	0.54
Building	0.61	0.72
Buses	0.85	0.61
Dinosaurs	0.97	1
Elephants	0.67	0.80
Flowers	0.65	0.82
Horses	0.85	0.84
Mountains	0.54	0.40
Food	0.72	0.81
Average	72.4	74.4

Table (1) presents the results of each single algorithm which refers that the moment. The highest accuracy is given tailed by the histogram in retrieving the correct images.

The moments functioned better since it splits the image into three parts and takes the data of each part as features. The separation method stops the colour spreading of an image from affecting the regained because every single part will be featured with the related part.

In addition, the moment features were better because the RGB is converted to HSV where the HSV colour space holds the majority of the image data in the H channel, thus, the comparison is applied on the H channel instead of three. Adding that the dividing the images into three parts improve the quality of retrieved images due to the parts will have variant set features. This decreases the fake distribution of colour in the image. Figure (7) presents a plot of the result in table (1).

The results in table 2 are formed by merging both algorithms which presents that this process gave higher quality and recall than table 1. Moreover, having the weight variable made the retrieval better since it makes the program suitable for every image in different category. Figure (8) presents a plot a plot of the results in table (2).

Table 2, the result of combination

Class	Average precision %	
	CM+HIS constant	CM+HIS variable
African	0.9	9.2
Beach	5.1	0.6
Building	7.4	8.1
Buses	6.2	8.7
Dinosaurs	1	1
Elephants	8.1	8.3
Flowers	8.2	8.8
Horses	8.4	8.8
Mountains	4.2	5.7
Food	8.1	8.3
Average	75.1	81.9

8. CONCLUSION

This paper proposes a CBIR system based on the histogram technique and the moment algorithm. The proposed system implements each algorithm alone and in a combination.

The results showed that best results achieved when we made the weights variable because each category in the database has its own colour distribution, and when controlled by weight, the query gives more power to the system. The retrieval percentage of the combination is raised from 75.1% to 81.9%. Dividing the image into blocks or parts in Moment technique gave better quality in retrieving the required images since the implemented algorithms work on colour features of the image.

The advantage of the system is credited to the use of three colour s values. The two applied methods (histogram and moment) can be used in the CBIR and also CBIR can use just colour features to retrieve images from the database. The following conclusions can be taken looking at the results of our proposed method:

The colour histogram is one of the best techniques for CBIR systems but not in all classes as we faced some bad results in beach and mountain classes. This can be explained by the fact that the colour of the sky is close to the colour of sea.

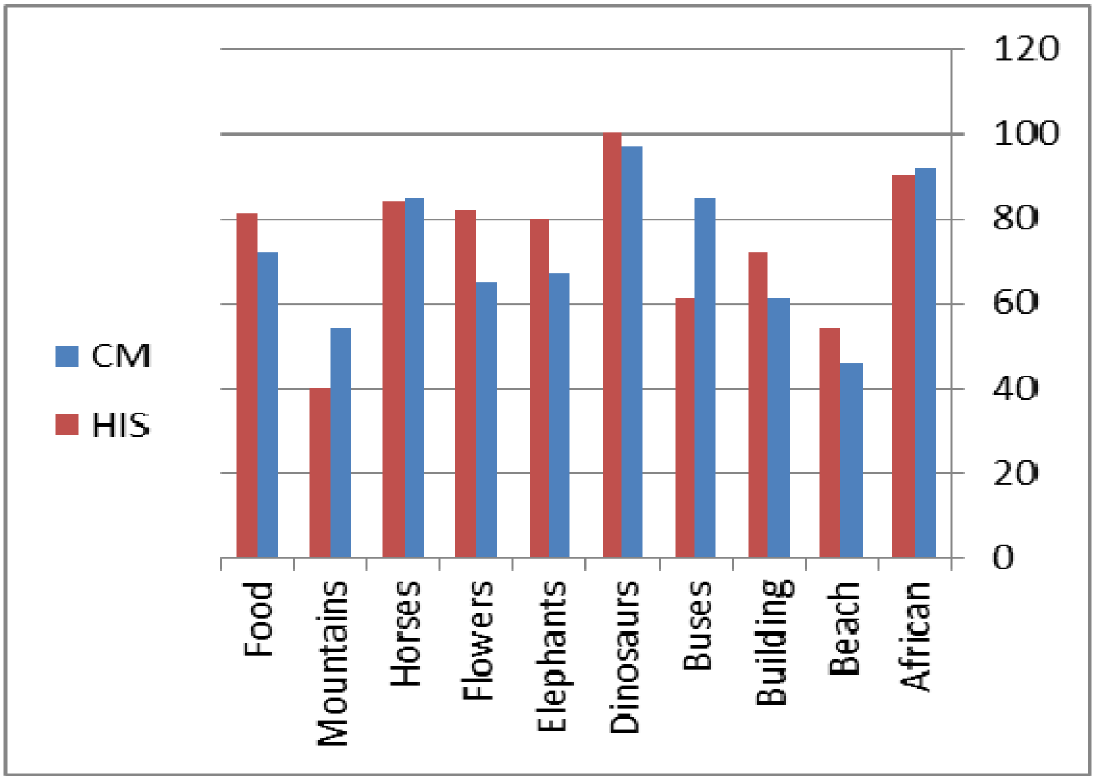

Figure 7, the plot of diffrence between combination of histogram and moment

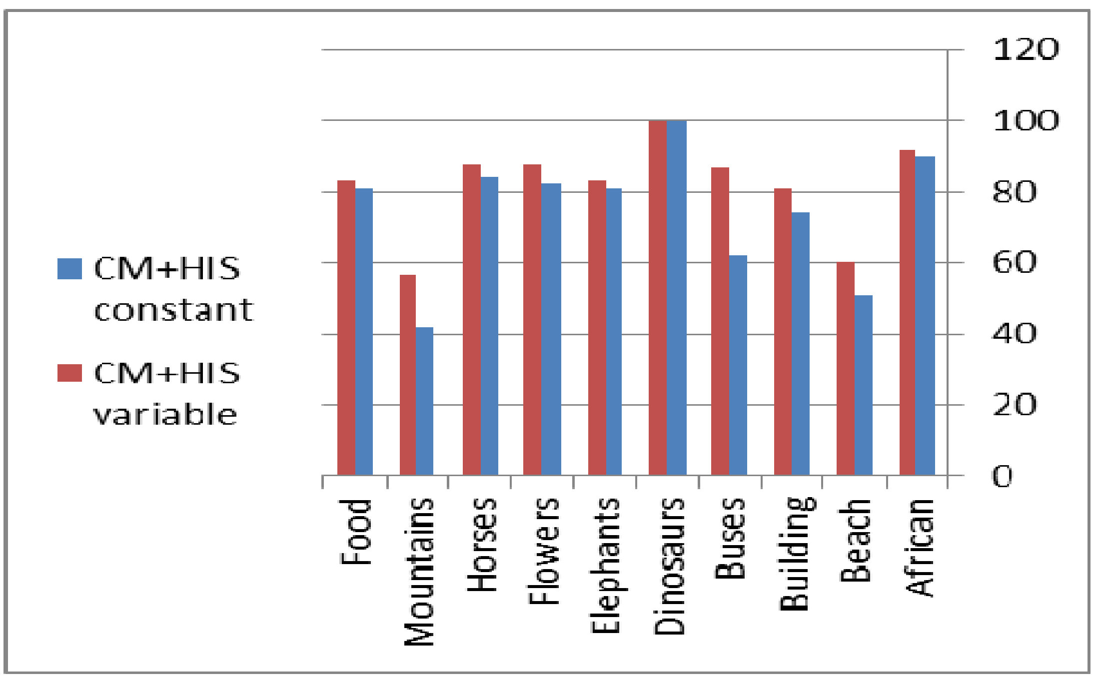

Figure 8, the plot of diffrence between result of histogram and moment

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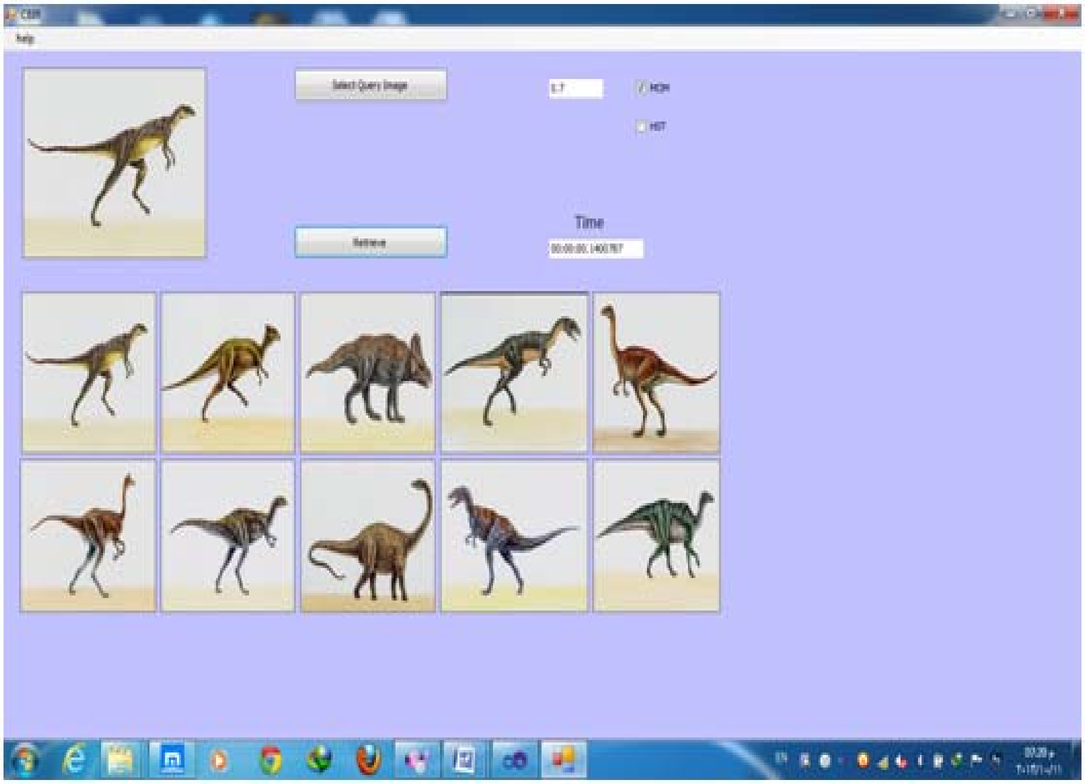

Figure 9, samples of the user interface of test the program

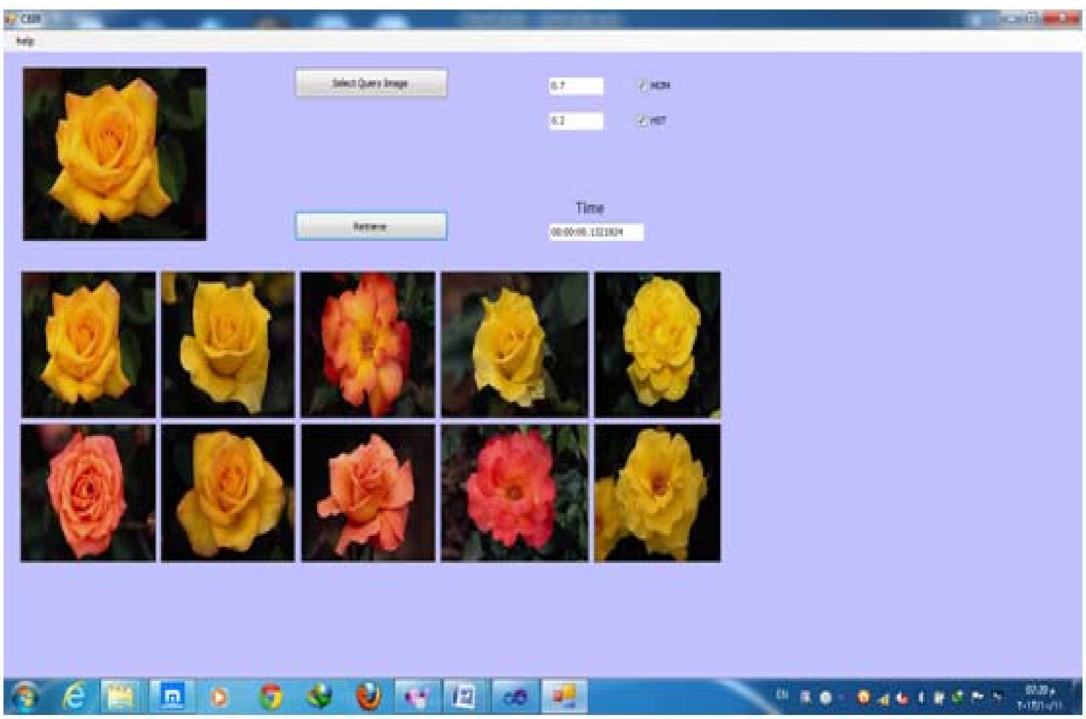

Figure 9, samples B of the user interface of test the program

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Figure 11, sample of the user interface of test the program

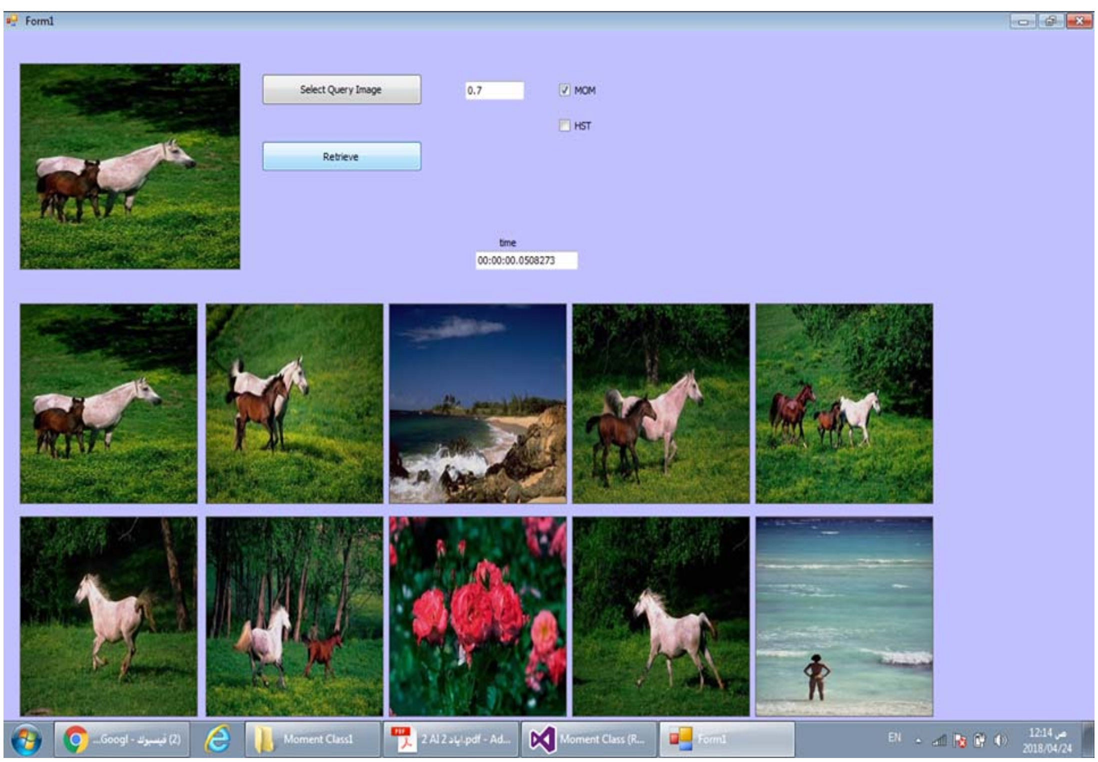

Figure 12, sample of the user interface of test the program

Colour moment gives better results, but it is not the optimal choice. It depends on the clarity of all image contents.

To get even better results, we can combine more than two algorithms and use colour and texture features to get a more robust feature that can be lately saved and compared to database images for retrieval.

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