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# Texture Based Image retrieval using Human interactive Genetic Algorithm

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**Abstract**— Content-based image retrieval has been keenly calculated in numerous fields. This provides more active management and retrieval of images than the keyword-based method. So the content based image retrieval has become one of the liveliest researches in the past few years. As earlier, we were using the text-based approach where it initiate very boring and hard task for solving the purpose of image retrieval. But the CBIR is the method where there are several methodologies are available and the task of image retrieval becomes well easier. In this, there are specific effective methods for CBIR are discussed and the relative study is made. However most of the proposed methods emphasize on finding the best representation for diverse image features. Here, the user-oriented mechanism for CBIR method based on an interactivegenetic algorithm (IGA) is proposed. Color attributes likethe mean value, the standard deviation, and the image bitmap of a color image are used as the features for retrieval. In addition, the entropy based on the gray level co-occurrence matrix and the edge histograms of an image are too considered as the texture features.

**Key words** - content-based image retrieval (CBIR), human–machine interaction, interactive genetic algorithm (IGA), color attributes, low-level descriptors.

## I. INTRODUCTION

As the technology improves, the use of internet and new progressive digital image sensor technologies increases and a very large database of image are being created by scientific, industrial, medical and educational presentations. We often need to professionally store and retrieve image data to perform allotted tasks and to make a result. Therefore, developing proper tools for the retrieval image from large image gathering is challenging. Two different types of approaches, i.e., text- and content based, are usually adopted in image retrieval. In the text-based system, the images are manually annotated by text descriptors and then used by a database management system to perform image retrieval. However, there are two limitations of using keywords to achieve image retrieval: the vast amount of labour required in manual image annotation and the task of describing image content is highly subjective. That is, the perspective of textual descriptions given by an annotator could be different from the perspective of a user. In other words, there are inconsistencies between user textual queries and image annotations or descriptions. To alleviate the inconsistency problem, the image retrieval is carried out according to the image contents. Such strategy is the so-called content-based image retrieval (CBIR).

The primary goal of the CBIR system is to assemble meaningful descriptions of physical attributes from images to simplify efficient and effective retrieval [1], [2]. CBIR has become an active and fast-advancing research area in image retrieval in the last decade. By and large, research events in CBIR have progressed in four major directions: global image properties based, region-level features based, relevance feedback, and semantic based. Initially, developedalgorithms exploit the low-level features of the image such as color, texture, and shape of an object to help retrieve images. They are easy to implement and perform well for images that are either simple or contain few semantic contents. However,the semantics of an image are difficult to be revealed by the visualfeatures, and these algorithms have many limitations whendealing with broad content image database. Therefore, in orderto improve the retrieval accuracy of CBIR systems, regionbasedimage retrievalmethods via image segmentation were introduced. These methods attempt to overcome the drawbacks of global features by representing images at object level, whichis intended to be close to the perception of human visual system.However, the performance of these methods mainly relies onthe results of segmentation.

A wide variety of CBIR algorithms has been planned, but most of them focus on the likeness computation phase to efficiently find a specific image or a group of images that are similar to the given enquiry. In order to achieve an improved approximation of the user's information need for the followingsearch in the image database, involving user's interaction isnecessary for a CBIR system. In this paper, we propose auser-oriented CBIR system that uses the interactive geneticalgorithm (GA) (IGA) [5] to infer which images in the databases would be of most interest to the user. Three visual features, color, texture, and edge, of an image are utilized in ourapproach. IGA provides an interactive mechanism to better capture user's intention.It is a technique which uses visual contents of an image such as color, shape & texture to search images from large databases. There are many areas where this technique works effectively.

## II. RELATED WORK

The authors in [2] considered the RGB color space and adopted the color distributions, as well as the image bitmap, as the visual features for image retrieval. This approach was quite efficient and opened the door for other researchers in this field of image retrieval. In [14], the YUV color space is used, and discrete wavelet transform is applied to extract four types of features i.e., approximations, horizontal details, vertical details, and diagonal details at each wavelet level. It produces some different results than previous one on the same database. This approach was not too good because its experimental result shows low precision values than the previous one. In [15]. Author proposed a content-based image retrieval method based on an interactive genetic algorithm (IGA). The mean value and the standard deviation of a color image are used as color features. In addition, author also considered the entropy based on the gray level co-occurrence matrix as the texture feature. Further, to bridge the gap betweenthe retrieving results and the users‟ expectation, the IGA is employed such that the users can adjust the weight for each image according to their expectations. In this paper author used two types of feature.

**i) *The Color Feature***

Each image in the database can be represented using three primaries of a color space. The most common color space is RGB. Thus, each pixel of a color image is represented by a vector Color Image Retrieval Based on Interactive Genetic Algorithm.

$$P_i=\begin{bmatrix}Ri\\Gi\\Bi\end{bmatrix}\ldots\ldots\ldots\ldots(1)$$

Where $Pi$ is the $i$th pixel of the image, $1 \leq i \leq M$. $Ri$, $Gi$, and $Bi$ are the components of primary colors red, green, blue, respectively. The $M$ is the size of the image, and the components of $Pi$ depict the color information. The mean value ($\mu$) and the standard deviation ($\sigma$) of the color image are determined as follows:

$$\mu=\frac{1}{M}\sum_{i=1}^{M} Pi\ldots\ldots\ldots(2)$$

$$\sigma=\left[\frac{1}{M-1}\sum_{i=1}^{M}(Pi-\mu)2\right]^{1/2}.(3)$$

Where $\mu= [\mu R\mu G\mu B]\ T$ and $\sigma = [\sigma R\sigma G\sigma B]\ T$ , each component of $\mu$ and $\sigma$ indicates the RGB information, respectively.

**ii) *The Texture Feature***

Texture is an important image feature that has been used for characterization of images. If choose appropriate texture descriptor, the performance of the CBIR must be improved. In this paper, the *entropy* is used to capture texture information in an image and is defined as follows.

$$\text{Entropy (E)} = - \sum_i \sum_j C(i,j) \log C(i,j)\ldots\ldots(4)$$

Where $C(i, j)$ is the gray level co-occurrence matrix. The $C(i, j)$ is obtained by first specifying a displacement vector and then counting all pairs of pixels separated by the displacement and having gray levels *i*and *j*.

In other paper author proposed, a user-oriented mechanism for CBIR method based on an interactive genetic algorithm (IGA). Color attributes like the mean value, the standard deviation, and the image bitmap of a color image are used as the features for retrieval. In addition, the entropy based on the gray level co-occurrence matrix and the edge histogram of an image is also considered as the texture features. Furthermore, to reduce the gap between the retrieval results and the users" expectation, the IGA is employed to help the users identify the images that are most satisfied to the users" need. In this paper the author used three types of descriptor. i).Color descriptor, ii).Texture descriptor, iii).Edge descriptor. In another paper [6] author developed a wide variety of algorithms have been proposed to tackle re ranking by emphasizing its different aspects. A study of the development of state-of-the-art re ranking methods is able to facilitate our understanding of the essentials of visual re ranking, offer a clear view of what user have achieved, and inform how to resolve emerging obstacles in future. As such, this paper presents an introduction of multimedia visual re ranking, including its objective, features utilization, re ranking strategy, and user interaction. Author used for relevance measurement, many criterions have been proposed, *e.g.*, precision, recall, non-interpolated average precision (AP) and normalized discounted cumulated gain (NDCG). The most popular ones in relevance based re ranking are AP and NDCG. The AP averages the precision values obtained when each relevant sample occurs.

## III. FEATURES EXTRACTION OF IMAGE DATABASE

One of the key problems in querying image databases by resemblance is the choice of relevant image descriptors and corresponding resemblance degrees. In this segment, we first present a brief revise of considered low-level visual features in our approach and then revise the fundamental idea of the IGA.

### *A) Color Descriptor:*

A color image can be expressed using three primaries of a color space. Since the RGB space does not correspond to the human way of perceiving the colors and does not separate the Luminance component from the chrominance ones, we used the HSV color space in our approach. HSV is an instinctive color space in the sense that each component contributes directly to visual perception, and it is familiar for image retrieval systems.

Hue is used to distinguish colors, whereas saturation gives a degree of the percentage of white light added to a pure color. Value mentions to the perceived light intensity. The primary benefits of HSV color space are as follows: good compatibility with human intuition, reparability of chromatic and achromatic components, and possibility of preferring one component to other. The color distribution of pixels in an image contains adequate data. The mean of pixel colors states the primary color of the image, and the standard deviation of pixel colors can depict the contradiction of pixel colors.

The contradiction degree of pixel colors in an image is called the color complexity of the image. We can use these two features to represent the global functions of an image. The mean ($\mu$) and the standard deviation ($\sigma$) of a color image are defined as follows:

$$\mu = \frac{1}{N}\sum_{i=1}^{N} Pi \qquad (1)$$

$$\sigma = [\frac{1}{N-1}\sum_{i=1}^{N} (Pi - \mu)^2]^{1/2} \qquad (2)$$

Where $\mu = [\mu H, \mu S, \mu V]^T$, and $\sigma = [\sigma H, \sigma S, \sigma V]^T$, each component to $\mu$ and $\sigma$ indicates the HSV data, respectively, and $Pi$ indicates the i[th] pixel of an image. In addition to the global property of an image, the local color functions in an image play also a primary role to enhance the retrieval accomplishance. Hence, a feature called binary bitmap can be used to capture the local color data of an image. The fundamental idea of binary bitmap comes from the block truncation coding [25], which is a relatively simple image coding technique and has been in triumph practiced in many image processing applications.

There are three steps to implement the image binary bitmap. This method first separates an image into many non-overlapping blocks. Let B*j*= {b1, b2, . . . ,bk}be the $j^{th}$ block of the image, where $1 \leq j \leq m$; *k* represents the total number of pixels in the block, and *m* is the total number of blocks in the image. The second step is to compute the mean value for each block. Let μB*j*be the mean value of the block Bj, which is defined as follows:

$$\mu Bj = \frac{1}{k}\sum_{i=1}^{k} bi \quad \textbf{(3)}$$

Where $\mu Bj = [\mu HBj, \mu SBj, \mu VBj]^T$. In the final step, comparing μBjwith the image mean value (*μ*) is accomplished to determine the characteristic of the block Bjand to implement the image binary bitmap. Hence, suppose that *I* = [IH, IS, IV ]is the binary bitmap of the given image. Each component in I is expressed as IH = [IH1, IH2, . . . ,IHm], IS =[IS1, IS2, . . . ,ISm], and IV = [IV1, IV2, . . . , IVm], respectively. The entries are expressed by

$$IHj = \begin{cases} 1, \\ 0, \end{cases} \text{if } \mu HBj \geq \mu H \text{ otherwise,} \quad \textbf{(4)}$$

$$ISj = \begin{cases} 1, \\ 0, \end{cases} \text{if } \mu SBj \geq \mu S \text{ otherwise,} \quad \textbf{(5)}$$

$$IVj = \begin{cases} 1, \\ 0, \end{cases} \text{if } \mu VBj \geq \mu V \text{ otherwise,} \quad \textbf{(6)}$$

### B) Texture Descriptor:

Texture is a primary attribute that mentions to innate surface functions of an object and their relationship to the surrounding environment. If we could choose relevant texture descriptors, the accomplishance of the CBIR should be enhanced. We use a gray level co-occurrence matrix (GLCM), which is a simple and effective method for representing texture [26]. The GLCM represents the probability $p\ (i, j;\ d, \theta)$ that two pixels in an image, which are located with distance *d* and angle *θ*, have gray levels *i*and *j*. The GLCM is mathematically defined as follows:

$$P(i, j; d, \theta) = \#\{(x1, y1)(x2, y2) | g(x1, y1) = i, g(x2, y2) = j,$$

$$|(x1, y1) - (x2, y2)| = d, \angle((x1, y2), (x2, y2)) = \theta\} \quad \textbf{(7)}$$

(1) Where # denotes the number of occurrences inside the window, with iand j being the intensity 1 levels of the first pixel and the second pixel at positions (*x*1*, y*1) and (*x*2*, y*2), respectively.

(2) In order to simplify and reduce the computation effort, we computed the GLCM according to one direction (i.e., *θ* = 0◦) with a given distance *d* (= 1) and calculated the entropy, which is used most frequently in the literature. The entropy (*E*) is used to capture the textural data in an image and is defined as follows:

$$E = -\sum_{i,j} C_{i,j} \log C_{i,j}$$

Where $C_{i,j}$is the GLCM. Entropy gives a degree of complexity of the image. Complex textures tend to have higher entropy.

### C) Edge Descriptor:

Edges in images comprise a primary feature to represent their content. Human eyes are sensitive to edge features for image perception. One way of representing such a primary edge feature is to use a histogram. An edge histogram in the image space represents the frequency and the directionality of the brightness changes in the image. We adopt the edge histogram descriptor (EHD) [17] to describe edge distribution with a histogram based on local edge distribution in an image.

The extraction process of EHD consists of the following stages.

- An image is divided into 4 × 4 sub images.
- Each sub image is further partitioned into non-overlapping image blocks with a small size.
- The edges in each image block are categorized into five types: vertical, horizontal, 45◦ diagonal, 135◦ diagonal and non-directional edges.
- Thus, the histogram for each sub image represents the relative frequency of occurrence of the five types of edges in the corresponding sub image.
- After examining all image blocks in the sub image, the five-bin values are

normalized by the total number of blocks in the sub image.

Finally, the normalized bin values are quantized for the binary representation. These normalized and quantized bins comprise the EHD.

$$AP@k = \frac{1}{zk}\sum_{i=1}^{k}[p(i) \times rel(i)] \text{ ...................(5)}$$

Where $p(i)$ is the precision at rank $i$and $rel(i)$ is the binary function on the relevance of the $i$-th ranked sample with "1" for relevant and "0" for irrelevant. This is a normalization constant that is chosen to guarantee AP@$k$=1 for a perfect ranking result.

## IV. PROPOSED SYSTEM

***Interactive Genetic Algorithm:***

GAs, within the field of evolutionary computation, are robust, computational, and stochastic search procedures modelled on the mechanics of natural genetic systems. GA's are well known for their abilities by efficiently exploring the unexplored regions of the search space and exploiting the knowledge gained via search in the vicinity of known high quality solutions.

In general, a GA contains a fixed-size population of potential solutions over the search space. These Potential solutions of the search space are encoded as binary or floating-point strings, called chromosomes.

The initial population can be created randomly or based on the problem specific Knowledge. In eachiteration, called a generation, anew population is created based on a preceding one through the following three steps:

**Evaluation**—each chromosome of the old population is evaluated using a fitness function and given a value to denote its merit

**Selection**—chromosomes with better fitness are selected to generate the next population.

**Mating**—genetic operators such as crossover and mutation are applied to the selected chromosomes to produce new ones for the next generation. The aforementioned three steps are iterated for many generations until a satisfactory solution is found or a termination criterion is met. GAs have the following advantages over traditional search methods:

- They directly work with a coding of the parameter set;
- The search process is carried out from a population of potential solutions.
- pay-off information is used instead of derivatives or auxiliary knowledge.
- Probabilistic transition rules are used instead of deterministic ones. Recently ,since the computation abilities of computers have become enormously enhanced, GAs have been widely applied in many areas of engineering such as signal processing, system identification ,and information mining problems [15].The author [18] proposed a genetic-based solution for a coordinate transformation test of Global Positioning System positioning.

Designed robust D-stable IIR filters by using GAs with embedded stability criterion. On the other hand, GAs also has been successfully applied in their search of CBIR [17]–[19].For a detailed description on the aforementioned approaches, interested readers may directly refer to them. IGA is a branch of evolutionary computation.

The main difference between IGA and GA is the construction of the fitness function, i.e., the fitness is determined by the user's evaluation and not by the predefined mathematical formula. A user can interactively determine which members of the population will reproduce, and IGA automatically generates the next generation of content based on the user's input.

Through repeated rounds of content generation and fitness assignment, IGA enables unique content to evolve that suits the user's preferences. Based on this reason, IGA can be used to solve problems that are difficult or impossible to formulate a computational fitness function, for example, evolving images, music, various artistic designs, and forms to fit a user's aesthetic preferences.

**Solution representation:**

In order to apply GA to a given problem, one has to make a decision to find an appropriate genotype that the problem needs, i.e., the chromosome representation. In the proposed approach, a chromosome represents the considered three types of image features (i.e., color, texture, and edge) in an image.

**Initial population:**

The IGA requires a population of potential solutions to be initialized at the beginning of the GA process. Usually, the initialization process varies with the applications; here, we adopt the first query results of a sample image as initial candidate images.

**Fitness function:**

The fitness function is employed to evaluate the quality of the chromosomes in the population. The use of IGA allows the fusion of human and computer efforts for problem solving [5]. Since the objective of our system is to retrieve the images that are most satisfied to the users' need, the evaluation might simultaneously incorporate users' subjective evaluation and intrinsic characteristics of the images. Hence, in our approach, the quality of a chromosome *C* with relation to the query *q* is defined as

$$F(q,C) = W1.\mathrm{sim}(q,C) + W2.\delta \qquad \textbf{(9)}$$

where sim(q,C) represents the similarity measure between images, δ indicates the impact factor of human's judgment, the coefficients w1 and w2 determine the relative importance of them to calculate the fitness, and$\sum Wi = 1$. In this, they are both set to 0.5. The similarity measure between images is defined as

$$\begin{aligned}\mathrm{sim}(q,C) = \sqrt{\sum_{t\in\{H,S,V\}} \left(\mu_t'^q - \mu_t'^C\right)^2 + \sum_{t\in\{H,S,V\}} \left(\sigma_t'^q - \sigma_t'^C\right)^2} \\ + \frac{H(BM^q, BM^C)}{3\times m} \\ + \left|E^q - E^C\right| \\ + \frac{\left|EHD^q - EHD^C\right|}{5\times 80} \qquad (10)\end{aligned}$$

Where $\mu_t|^I$ and $\sigma_t|^I$ represent the normalized mean value and standard deviation of the image I in t color space, respectively.BMI means the image bitmap feature of the image I; meanwhile, EI and EHDI represent the entropy and the EHD of the image I, respectively. For two images, the hamming distance used to evaluate the image bitmap similarity is defined by

$$H(BM^q, BM^C) = \sum_{j=1}^{m}\left(IH_j^q - IH_j^C\right) + \sum_{j=1}^{m}\left(IS_j^q - IS_j^C\right) + \sum_{j=1}^{m}\left(IV_j^q - IV_j^C\right). \qquad (11)$$

A user's preference is included in the fitness evaluated by the user .We use an impact factor to indicate the human's judgment or preferences, and the values of the impact factor are carried out with constant range from 0.0 to 1.0with an interval of 0.1.

**Genetic operators:**

The selection operator determines which chromosomes are chosen for mating and how many offspring that each selected chromosome produces. Here, we adopt the tournament selection method [18] because the time complexity of it is low. It does not require a global fitness comparison of all individuals in a population; therefore, it can accelerate the evolution process.

The crossover operator randomly pairs chromosomes and swaps parts of their genetic information to produce new chromosomes. We use the one-point crossover [10] in the proposed approach. Parts of the two chromosomes selected based on fitness are swapped to generate trait-preserving off springs. The mutation operator creates a new chromosome in order to increase the variability of the population. However, in order to speed up the evaluation process, we do not consider the mutation operator.

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**IGA Algorithm**

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**Input:** population

1 **for** each chromosome in population **do**

```
    repeat
        found ← 0
for all the routes of current tour do
for all the edges on current route do
if feasible insertion then
                        found← 1
endif
endfall
endfall
if found = 1then
        insert customer
else if multiple route are feasible then
        insert customer into new route
else
        create new current tour
        create new first route
endif
until all chromosomes are routed
 repeat
endfch
```

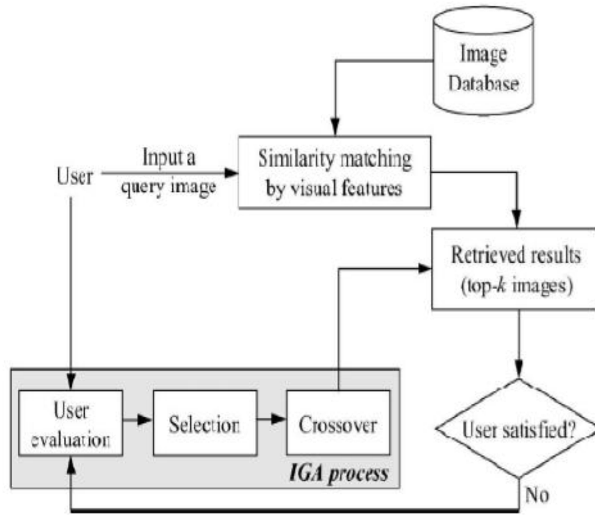


Fig. 1. General system flowchart of the proposed approach.

## V. RESULTS TESTING

### SYSTEM TESTING:

System testing performs whole components of the project implementation. It is mainly used in input to output data flow whether the flow is correct or not. For example data flow is to give the image and to obtain better efficient image according to users input.

In user interface client gives the image as input to retrieve the similar images from the image database. After taking the image as query by the user interface the system will extract the image low level visual features such as color, texture and edge.

After considering all the values of the query image, the new image data set is retrieved based on the low level visual features of the image data base. This is process is done under module of Feature extraction of image database.

In GA, it will produce new set of chromosomes which are familiar to the given query image using Genetic algorithm.

Finally retrieved results are displayed in the retrieved results by ranking images different set of iterations are done. Such as first, second, third and fourth generation of Iterations of IGA. If the user is satisfied with the obtained results the images are displayed as output.

### VALIDATION TESTING:

These testing is used for entry of query image and its features are correct or not and getting output is correct or not for example whether the below results are forming with similar features or not.

The final images of the results obtained are as shown in the following Figures.

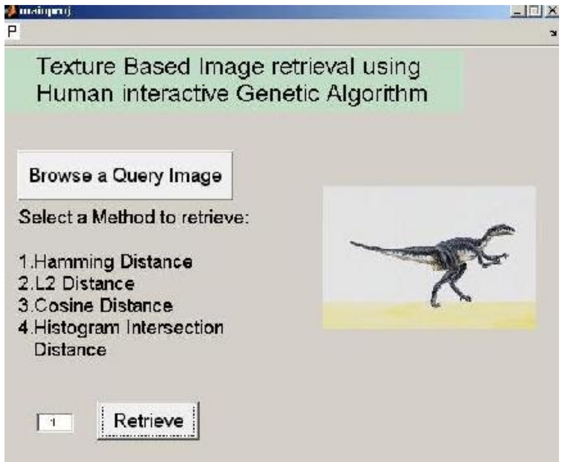


Figure 2: Client providing query image

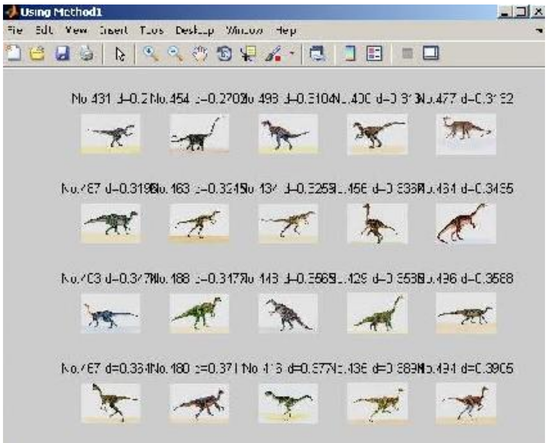


Figure 3

The above resulted image is displayed after the client has given the query image. Now user has to enter from the above shown methods. By giving the input at “Enter Method”.

Figure 4

The above images are some of the sample images available in the image database among them the client picks one as query image. Here, the user can randomly select the image.

## VI. CONCLUSION

In this System we have presented a Content Based image Retrieval (CBIR) which is new approach based on user oriented method with the support of interactive genetic algorithm (IGA). Here we have created two tier architecture of implicit and explicit feedback. Conventional methods are based on visual features which are not producing efficient result but our approach reduces the gap between the visual features and human perception.

Further, in future we can develop more Content Based Image Retrieval (CBIR) Systems which, includes more visual features of image adding with the proposed approach, by using better optimization algorithms we can reduce the error rate up to very low percent. Such a way the user can deal with the efficient retrieve methods in CBIR.

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