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Image Retrieval System Based On Interactive Soft Computing Method

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ABSTRACT
The multimedia databases and digital image libraries have been drasically expanded in recent years. In order to effectively and precisely retrieve the desired images from a large image database, the development of a content-based image retrieval (CBIR) system has become an important research issue. However, most of the proposed approaches emphasize on finding the best representation for different image features. Furthermore, very few of the representative works well consider the user's subjectivity and preferences in the retrieval process. In this paper, a user-oriented mechanism for CBIR method based on an Interactive Genetic Algorithm (IGA) is proposed. Colour attributes like the mean value, the standard deviation, and the image bitmap of a colour 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. Experimental results and comparisons demonstrate the feasibility of the proposed approach.
***Keywords*:** Content Based Image Retrieval (CBIR), Genetic Algorithm

I. INTRODUCTION

In recent years, rapid advances in science and technology have produced a large amount of image data in diverse areas, such as entertainment, art galleries, fashion design, education, medicine, industry, etc. We often need to efficiently store and retrieve image data to perform assigned tasks and to make a decision. Therefore, developing proper tools for the retrieval image from large image collections 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.

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 construct meaningful descriptions of physical attributes from images to facilitate efficient and effective retrieval.

CBIR has become an active and fast-advancing research area in image retrieval in the last decade. By and large, research activities in CBIR have progressed in four major directions: global image properties based, region-level features based, relevance feedback, and semantic based. Initially, developed algorithms exploit the low-level features of the image such as colour, 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 visual features, and these algorithms have many limitations when dealing with broad content image database. Therefore, in order to improve the retrieval accuracy of CBIR systems, region based image retrieval methods via image segmentation were introduced. These methods attempt to overcome the drawbacks of global features by representing images at object level, which is intended to be close to the perception of human visual system. However, the performance of these methods mainly relies on the results of segmentation.

Yoo *et al.* proposed a signature-based colour-spatial image retrieval system. Colour and its spatial distribution within the image are used for the features. In CBIR scheme based on the global and local colour distributions in an image is presented. Vadivel *et al.* [13] have introduced an integrated

approach for capturing spatial variation of both colour and intensity levels and shown its usefulness in image retrieval applications. Texture is also an essential visual feature in defining high level semantics for image retrieval purposes. In, a novel, effective, and efficient characterization of wavelet sub bands by bit-plane extractions in texture image retrieval was presented. In order to overcome some limitations, such as computational expensive approaches or poor retrieval accuracy, in a few texture based image retrieval methods, Kokare *et al.* concentrated on the problem of finding good texture features for CBIR. They designed 2-D rotated complex wavelet filters to efficiently handle texture images and formulate a new texture-retrieval algorithm using the proposed filters.

Liapis and Tziritas explored image retrieval mechanisms based on a combination of texture and colour features. Texture features are extracted using discrete wavelet frame analysis. Two- or one-dimensional histograms of the CIE Lab chromaticity coordinates are used as colour features. Chun *et al.* Proposed a CBIR method based on an efficient combination of multi resolution colour and texture features. As its colour features, colour auto correlograms of the hue and saturation component images in HSV colour space are used. As its texture features, block difference of inverse probabilities and block variation of local correlation coefficient moments of the value component image are adopted. The colour and texture features are extracted in multi resolution wavelet domain and then combined.

In order to well model the high-level concepts in an image and user's subjectivity, recent approaches introduce human–computer interaction into CBIR. Takagi *et al.* [4] evaluated the performance of the IGA-based image retrieval system that uses wavelet coefficients to represent physical features of images.

Medical image description is an important problem in content-based medical image retrieval. Hierarchical medical image semantic features description model is proposed according to the main sources to get semantic features currently. Hence we propose the new algorithm to overcome the existing system. In existing system, Images were first annotated with text and then searched using a text-based approach from traditional database management systems. There are inconsistencies between user textual queries and image annotations or descriptions. The limited retrieval accuracy of image centric retrieval systems is essentially due to the inherent semantic gap. In this paper, we propose a CBIR system for a specific application domain, the retrieval of coats of arms and altogether 19 features, including a colour histogram, symmetry features. Content-based image retrieval uses the visual contents of an image such as colour, shape, texture, and spatial layout to represent and index the image

II. INTERACTIVE GENETIC ALGORITHM

In general, an image retrieval system usually provides a user interface for communicating with the user. It collects the required information, including the query image, from the user and displays the retrieval results to him. However, as the images are matched based on low-level visual features, the target or the similar images may be far away from the query in the feature space, and they are not returned in the limited number of retrieved images of the first display. Therefore, in some retrieval systems, there is a relevance feedback from the user, where human and computer can interact to increase retrieval performance.

According to the aforementioned concept, we design a user oriented image retrieval system based on IGA. Our system operates in four phases. 1) Querying: The user provides a sample image as the query for the system. 2) Similarity computation: The system computes the similarity between the query image and the database images according to the aforementioned low-level visual features. 3) Retrieval: The system retrieves and presents a sequence of images ranked in decreasing order of similarity. As a result, the user is able to find relevant images by getting the top-ranked images first. 4) Incremental search: After obtaining some relevant images, the system provides an interactive mechanism via IGA, which lets the user evaluates the retrieved images as more or less relevant to the query one, and the system then updates the relevance information to include as many user-desired images as possible in the next retrieval result.

The search process is repeated until the user is satisfied with the result or results cannot be further improved. When we apply the IGA to develop a content-based color image retrieval system, we must consider the following components:

- A genetic representation of solutions to the problem
- One way to create the initial population of solutions
- An evaluation function that rates all candidate solutions according to their "fitness"
- Genetic operators that alter genetic composition of children during reproduction

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.

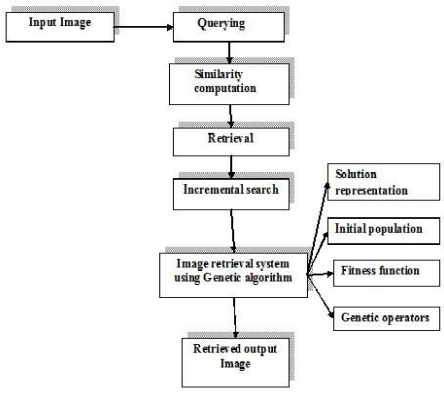
Initial population: The IGA requires a population of potential solutions to be initialized at the beginning of the GA process. Usually, the initialization process varies with the applications; here, we adopt the first query results of a sample image as initial candidate images.

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. 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.

Genetic operators: The selection operator determines which chromosomes are chosen for mating and how many off- we adopt the tournament selection method 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 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.

III. IMAGE RETRIEVAL SYSTEM BASED ON IGA



3.1 List of Modules

- Querying
- Similarity computation
- Retrieval
- Incremental search
- Image retrieval system using Genetic algorithm
- Performance evaluation

Querying

In this module the user provides a sample image as the query for the system. This process is called the querying.

Similarity computation

In this module the similarity is computed. The system computes the similarity between the query image and the database images according to the aforementioned low-level visual features.

Retrieval

In this module, the system retrieves and presents a sequence of images ranked in decreasing order of similarity. As a result, the user is able to find relevant images by getting the top-ranked images first.

Incremental search

After obtaining some relevant images, the system provides an interactive mechanism via IGA, which lets the user evaluates the retrieved images as more or less relevant to the query one, and the system then updates the relevance information.

The search process is repeated until the user is satisfied with the result or results cannot be further improved. When we apply the IGA to develop a content-based color image retrieval system, we must consider the following components:

1) A genetic representation of solutions to the problem;
2) One way to create the initial population of solutions;
3) An evaluation function that rates all candidate solutions according to their "fitness"; and
4) Genetic operators that alter genetic composition of children during reproduction.

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.

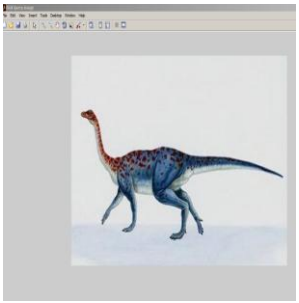
Fitness function: The fitness function is employed to evaluate the quality of the chromosomes in the population. The use of IGA allows the fusion of human and computer efforts for problem solving. Since the objective of our system is to retrieve the images that are most satisfied to the users' need, the evaluation might simultaneously incorporate users' subjective evaluation and intrinsic characteristics of the images.

Genetic operators: The selection operator determines which chromosomes are chosen for mating and how many off- we adopt the tournament selection method 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.

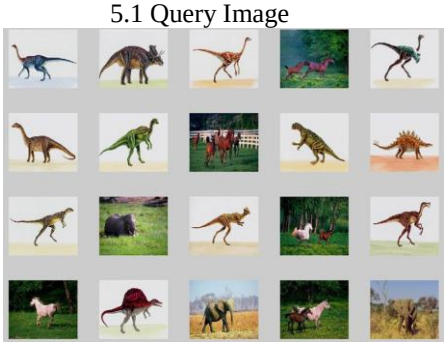
Performance evaluation

In this module, the performance is evaluated for proposed system with the existing system. This evaluation compares and defines the following parameters such as average precision, average recall, and retrieval average precision with the existing system. Thus the experimental results show that the proposed method having the minimum cost than the existing system. The proposed system is more reliable and scalable system for complex applications.

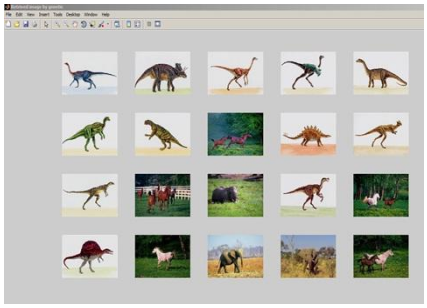
IV. RESULTS



5.1 Query Image



5.2 Recovered Image By Colour



5.3 Retrieved Image by Genetic algorithm

V. CONCLUSION

Thus this system has presented user-oriented framework in interactive CBIR system. In contrast to conventional approaches that are based on visual features, our method provides an interactive mechanism to bridge the gap between the visual features and the human perception. The color distributions, the mean value, the standard deviation, and image bitmap are used as color information of an image. In addition, the entropy based on the GLCM and edge histogram are considered as texture descriptors to help characterize the images. In particular, the IGA can be considered and used as a semi automated exploration tool with the help of a user that can navigate a complex universe of images. Experimental results of the proposed approach have shown the significant improvement in retrieval performance.

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