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Image Retrieval System with User Relevance Feedback

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Image Retrieval System with User Relevance Feedback

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Abstract – Image retrieval approach by proposing a new image feature detector and descriptor, namely the micro-structure descriptor (MSD). We present a computational model of creative design based on collaborative interactive genetic algorithms. This Paper test our model on floor planning. This Paper guide the evolution of floorplan based on subjective and objective criteria. The subjective criteria consists of designers picking the floorplan they like the best from a population of floorplans, and the objective criteria consists of coded architectural guidelines. The results demonstrate that it is much more efficient and effective than representative feature descriptors, such as Gabor features and multi-textons histogram, for image retrieval.

Keywords - *Content-based image retrieval (CBIR), human–machine interaction, interactive genetic algorithm (IGA), HSV color space Edge orientation, Micro-structure, Micro-structure descriptor, low-level descriptors.*

I. INTRODUCTION

With the rapid development of digital imaging techniques and internet, more and more images are available to public. Consequently, there is an increasingly high demand for effective and efficient image indexing and retrieval methods, and image retrieval has become one of the most popular topics in the field of pattern recognition and artificial intelligence.

An image retrieval system is a computer system for browsing, searching and retrieving images from a large volume of digital images. Generally speaking, there are three categories of image retrieval methods, i.e., text based, content-based and semantic-based methods.

Content-based image retrieval (CBIR) is a rapidly developing multimedia application and has been intensely studied in the past decade [7]. The main approaches to CBIR involved constructing image signatures that represent the image's contents in terms of color, shape, sketch, and texture. In most cases, the image signatures have to be extracted from the decompressed image. But if the signature can be extracted directly from the compressed domain, the speed up would be an obvious and welcome advantage especially in applications involving very large databases.

In the next section, we provide a review of the current state-of-the-art wavelet-based image characterizations. Then, in Section III, we introduce our bit-plane-based signatures and discuss their advantages over existing techniques for modeling the wavelet sub band histograms. Since the wavelet-based approach has been shown to be particularly powerful for texture image characterizations, we shall compare our method with this benchmark using the well-known Brodatz texture images. The experimental results are reported in Section IV, which is followed by the conclusions.

II. RELATED WORK

Various algorithms have been designed to extract the color and texture features for image retrieval. Color histogram is invariant to orientation and scale and this makes it powerful in image classification. Hence, color histogram-based image retrieval has been extensively studied and widely used in CBIR systems for its simplicity and effectiveness. However, color histogram is difficult to characterize image spatial structures. Therefore, color descriptors have been proposed to exploit the spatial information, e.g. compact color moments, color coherence vector and color correlograms [5]. In the MPEG-7 standard, the color descriptors consist of a number of histogram descriptors, such as dominant color descriptor, color layout descriptor (CLD) and scalable color descriptor (SCD) [6].

This review paper in contrast is the First review that concentrates on image retrieval in the medical domain and that does a systematic overview of techniques used, visual features employed, images indexed and medical departments involved. It also Offers future perspectives for image retrieval in the medical domain and will be a good starting point for research projects on medical image retrieval as useful techniques for certain sorts of images can be isolated and past errors can be avoided.

It consists of several phases, which differ in details such as the depth of design, kind of input data, design strategy, procedures, methodology and results [19]. Usually the first stage of any design process is the preliminary or the conceptual design phase, followed by detailed design, evaluation and iterative redesign [3].

Computers have been used extensively for all these stages of design except the creative conceptual design phase. We are interested in supporting the creative conceptual design phase by not only saving and disseminating the initial ideas of designers, but also by providing the support for initial design ideas to serve as the seeds on which new designs are founded. Interactive genetic algorithms (IGAs) have been proposed as user guided innovation pumps [13].

The students were asked to evaluate the floor plans in terms of “practicality” and “originality”. The pretest results showed that floor plans designed collaboratively were ranked higher in “originality” than those created individually. In this paper we conduct further evaluation of the computational model of creative design.

Our hypothesis is that the support of collaboration through the exchange of design solutions between participating peers will result in designs that are more creative than designs created individually.

CBIR:

Although early systems existed already in the beginning of the 1980s [13], the majority would recall systems such as IBM's QBIC1 (Query by Image Content) as the start of content{based image retrieval [1, 5]. The commercial QBIC system is definitely the most well known system. Most of these systems have a very similar architecture for browsing and archiving/indexing images comprising tools for the extraction of visual features, for the storage and efficient retrieval of these features, for distance measurements or similarity calculation and a type of Graphical User Interface (GUI).

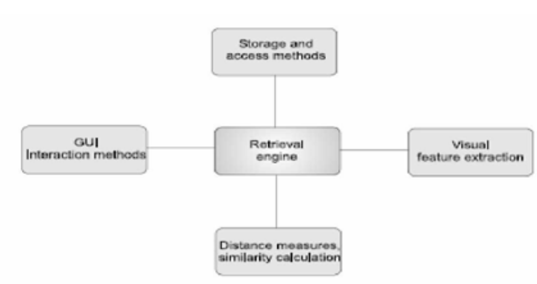

Fig 1.Content based Image Retrieval components

This general system setup is shown in Figure 1. All shown components are described in more detail further on.

III. INTERACTIVE GENETIC ALGORITHM AND IMAGE FEATURES

The design process consists of an exploration through the design solution space. Evolutionary computation techniques, Specifically genetic algorithms (GAs) have been used and proven in various problem domains to be effective search techniques [12]. We are trying to provide computer support for the conceptual design phase, which tends to be one of the most creative phases in the design process. Thus, we face the challenge of providing support for subjective evaluation of alternative conceptual designs. When there is no better fitness measure to a solution other than the one in the human mind, then we use interactive genetic algorithms (IGAs) [2].In our work, the use of IGAs during conceptual design allows designers to evaluate subjective criteria and to incorporate aesthetic preference into the explorative evolutionary process

One of the key issues in querying image databases by similarity is the choice of appropriate image descriptors and corresponding similarity measures. In this section, we first present a brief review of considered low-level visual features in our approach and then review the basic concept of the IGA.

Color Descriptor

A color image can be represented 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 intuitive color space in the sense that each component contributes directly to visual perception, and it is common for image retrieval systems [11], [2].The color distribution of pixels in an image contains sufficient information. The mean of pixel colors states the principal color of the image, and the standard deviation of pixel colors can depict the variation of pixel colors. The variation 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 properties of an image. The mean (μ) and the standard deviation (σ) of a color image are defined as follows:

$$\mu = \frac{1}{N}\sum_{i=1}^{N} P_i$$

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

Edge Descriptor

Edges in images constitute an important feature to represent their content. Human eyes are sensitive to edge features for image perception. One way of representing such an important 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) [7] 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:

1) An image is divided into 4 × 4 sub images.
2) Each sub image is further partitioned into non overlapping image blocks with a small size.
3) The edges in each image block are categorized into five types: vertical, horizontal, 45^0 diagonal, 135^0 diagonal, and non directional edges.
4) Thus, the histogram for each sub image represents the relative frequency of occurrence of the five types of edges in the corresponding sub image.
5) 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 constitute the EHD.

Genetic Algorithms

GAs [8], within the field of evolutionary computation, are robust, computational, and stochastic search procedures modeled on the mechanics of natural genetic systems. 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 each iteration, called a generation, a new population is created based on a preceding one through the following three steps:

1) Evaluation—each chromosome of the old population is evaluated using a fitness function and given a value to denote its merit;
2) Selection—chromosomes with better fitness are selected to generate the next population; and
3) 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 has the following advantages over traditional search methods:

1) They directly work with a coding of the parameter set;
2) The search process is carried out from a population of potential solutions;
3) Payoff information is used instead of derivatives or auxiliary knowledge; and
4) Probabilistic transition rules are used instead of deterministic ones.

IV. PROPOSED SYSTEM

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, as shown in Fig. 3. 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.

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.

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.

Correlogram of bins vs. subdivisions

Sub-divisions	1	2	3	4
Bin 1	1181	1019	834	820
Bin 2	782	610	582	585
Bin 3	554	510	432	730
Bin 4	452	672	584	549

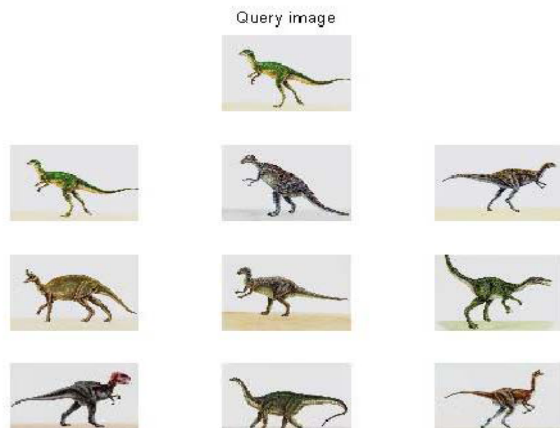

Fig 2. Sample Output

V. CONCLUSION

This paper has presented a user-oriented framework which 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 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. Further work considering more low-level image descriptors or high-level semantics in the proposed approach is in progress.

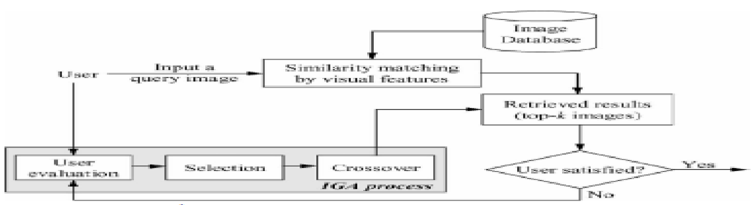

Figure 3 General system flowch rt of the proposed approach.

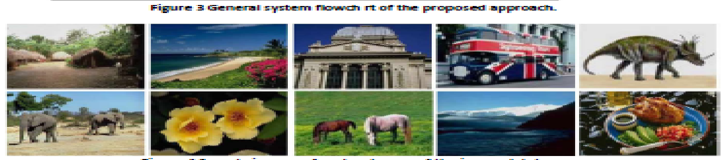

Figure 4 Sample images of each category of the image database

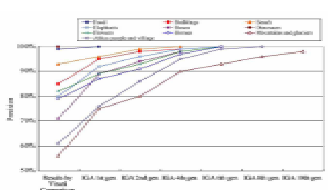

Figure 6 Retrieval average precision of the proposed approach.

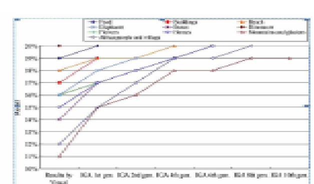

Figure 7 Retrieval average recall of the proposed approach.

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