A Dynamic Image Retrieval Method Based On Genetic Algorithm

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ABSTRACT : A dynamic image retrieval algorithm, which tolerates the imperfection of feature expressions, is presented in this paper. It is based on an interactive genetic algorithm (GA) that can address the image features of the physical, graphical and semantic layers.

KEYWORD : Genetic algorithm, image feature, genome, choromosomes, mutation.

1. INTRODUCTION

Every nook and corner of this world is flooded with the sea of knowledge and information .As result information retrieval technologies become more important than ever. Thus in turn it comes to the aid of users in a more efficient and a user-friendly manner. In this modern world of science, where its users while searching for images come across a variety of implications in an image, a method for making no superficial inferences regarding each user's intentions is required, particularly when a system handles abundant and diversified images. In the near past, different techniques have been introduced to facilitate the communication in between the user and the retrieval system. Undoubtedly these techniques have fetched great attention. In particular, genetic algorithms (GA), an evolutionary interactive method, can be used to automatically provide very effective solutions by assigning a fitness value to images, based on user estimations, without requiring the definition of complex estimation functions. The various applications of this type of image retrieval system are been used in photomontages of wanted criminals, images of nature and some geometric drawing.

The conventional image retrieval methods suffer from the following problems: (1) The conventional image retrieval methods lessen the domain of image features in accordance to the area of its application. Moreover, only the physical and geographical image features such as color, geometry and position are used in most of the cases. (2) They fail to address image features as fragmentary expressions typical of complex mental states.

Let us for instance, make it possible for the user to consciously control the image retrieval process, and believe that the complexities of the mental states cannot be regarded as static quantities, and therefore they are not subject to precise expression. Actually a dynamic approach is needed to reach the human mind, so that it can dynamically infer the user's intentions based on information derived from a communicative process between the user and the system, while at the same time leaving behind an "ambiguity".

This paper is organized as follows:

2. GA ALGORITHM

In fact, this technique with the help of an interactive GA technique in order to control the image retrieval process based on the user's mind actually performs image retrieval while selecting the features. So, while GA controls the selection results through numerous generations, on the other hand every individual users motive is interactively

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taken into system as "environment. These results are internally represented as an "individual "indicate clues of the user's intention.

The algorithm is composed into the following steps:

Step-1: Coding

As each emerging chromosome describes the result of feature selection in GA, the gene, the smallest operational unit in GA, is defined as a feature, namely, a pair of a feature axis and a feature value. When n (n>=1) genes have been collected, a chromosome is formed and becomes the feature selection result. The length of a chromosome n is determined when the user enters the initial key. One generation consists of as many as m (m>=1) chromosomes. The population size m may change. Here feature of all the physical, graphical and semantic layers may be treated as "genes"

Step-2: Initial Population

An initial population is composed from the initial key entered by the user at the start of the search, as the initial population in GA can describe a retrieval condition. If the user does not enter an initial key, up to m chromosomes are randomly generated and used as the initial population.

Step-3: Genotype and Phenotype

The relationship between the genotype and phenotype in GA is analogous to that between feature expression and image in image retrieval. Although an image is an object/ entity of which a feature can be uniquely described as a collection of pixels, this method is based on the assumption that an image can be endowed infinite meanings by the complex user's mind, and that the feature expression and image are related by the set theory.

Step-4: Fitness

Fitness is assigned to each chromosome. A forms population, is placing priority on the chromosomes of the highest fitness, and proceeds to evolve generations. To select features that provides clues for inferring user's minds. Thus, in assigning fitness, an interactive method is adopted to seek out the user's direct estimation of system during retrieval .At this time, it is important for the system to present output in the form of an image (phenotype).

Step-5: Genetic Operations

Chromosomes to which fitness are assigned in the population are subject to genetic operations like selection, cross- over, and mutation.

3. Outline of the Proposed Algorithm

To achieve an image retrieval method, we propose a technique that improves the degree of "subjectivity reflection". This image retrieval system consists of four units: (1) image database unit, (2) user interface unit, (3) initial input processing unit, and (4) image retrieval unit. The image database unit stores/manages information on the image data including defined features. It exchanges the required information with the initial input processing unit and the image retrieval unit. The user interface unit is a site at which the system and the user interact directly. Future challenges will include further upgrades of the user interface and more sophisticated handling of knowledge base. The initial input-processing unit converts the search conditions entered through the user interface into a form used in GA. The proposed method generates an initial population based on the search conditions, determines the length of the chromosome, and provides a normal population consisting of pairs of non-contradicting features for the image retrieval unit.

The image retrieval unit consists of a matching image control unit, feature selection unit, and mind-inferring unit, and executes the feature selection reflecting the user's mind by repeating generation processing and performing image retrieval.

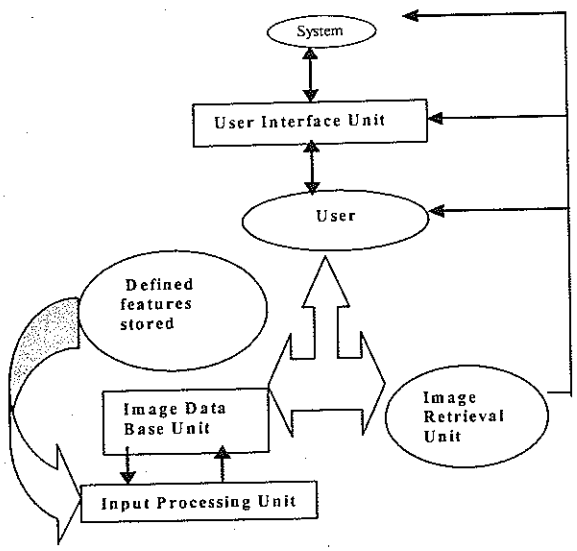

Fig 1. Diagram of the proposed algorithm using Genetic algorithm.

4. Improvement of Subjectivity Reflection

In order to improve the accuracy of subjectivity reflection in the basic method and control image retrieval with the user's mind, the feature reference amount has been newly defined as a quantity that reflects the user's mind. The feature references amount is a statistical quantity that reflects not just the user estimation of each image presented by the system upon the current chromosome in a form of fitness, but also strongly reflects it within the genes compromising the chromosome. The feature reference amount is a quantity added to each feature defined in the feature space with an initial value of zero, which emerges as genes across generations. When each feature emerges as a gene, the feature reference to the fitness assigned to the chromosomes upon its emergence.

5. Computer Simulations

Computer simulations have been performed to simulate improvements in subjectivity reflection and retrieval efficiency obtained by the proposed method. For qualitative estimation of the flexibility of the interface unit, some 2300 color images such as illustrations and photographs were used. In other quantitative experiments, for comparison against the basic method, 100 binary images (32 x 32 pixels) were used as stored images, as in the case of Reference.

6. Experimental Results and Discussion

The degree of subjectivity reflection can be determined from five requisite properties: Individuality, Situation dependence, Autonomy, Diversity, and Reproducibility. Individuality, Situation dependence are central properties for reflecting one's mind. In the proposed method, through interactions between the user and the system, the user can enter search conditions representing his- her mind and estimate the presented images on a real time basis at any time during image retrieval. The image that fits user intentions can be provided on each occasion by incorporating the user estimation into the GA fitness and feature reference amount.

Autonomy is a property of finding an image that matches the user intention without being restricted by initial keys entered by the user. The proposed method is provided with autonomy. A is characterized by emergence, with an original mechanism that ensures the high probability of survival into the next generation of high fitness chromosomes.

Diversity is a latent ability indicating system adaptability, appearing when various users try to reflect their mind's on the system. Considering that the present method reflects the users mind upon the system in a form of the feature selection, the degree of diversity of feature combination seen in the feature selection results should be related to the readiness to reflect ones mind. This heavily draws on the diversified search ability of GA, and its crossover method is an important factor in setting its abilities. We have recognized the diversity of the proposed method based on the frequency of fitness maximum feature patterns (the rate of emergence of chromosomes that have a fitness of 100% and differ in

the combination of features). Figure (1) shows the cumulative frequency of fitness maximum feature patterns plotted against the consecutive number of chromosomes (chromosome consecutive number) that have emerged through all generations, wherein the following four types of crossover T0 – T3 are compared.

T0: No selection or crossover. Chromosomes are randomly generated through all generations.

T1: No feature reference amount is set in each feature. Simple uniform cross over is performed. (Basic method)

T2: Fa (the average of the fitness values obtained until the feature has emerged as a gene)is adopted as feature reference amount , and a dominant conditioned uniform crossover is carried out.(proposed method)

T3: Fm (is a method for adopting the largest of the fitness values as the feature reference amount) is adopted as feature reference amount, and a dominant conditioned uniform crossover is carried out. (Proposed method)

7. Conclusion

This paper places our GA – based image retrieval as a method of controlling image retrieval by each user's mind. The proposal for the improvement of subjectivity reflection has also been proposed.

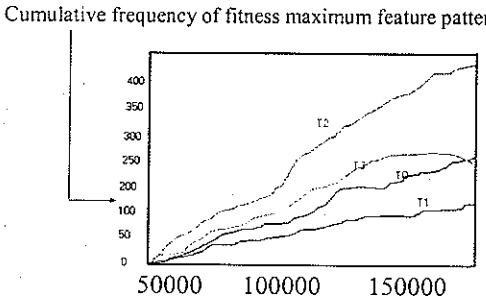

Fig.2 . Simulation results.

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Author's Biography

Saurabh Mukherjee, is a regular faculty of computer applications, in Prestige Institute of Management, Gwalior. He is pursuing research work in Virtual reality using Genetic Algorithm Paradigm. Recently, IEEE Computer Society, US, has published one of his contributions in ITNG-NG-06, in Las Vegas, US.

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