Research on Image Retrieval Technology based on PAM Algorithms

Youjun Dong

Monta Vista Christian School, United States

Abstract. With the rapid development of computer vision technology and image processing technology, image retrieval has also developed from simple text information query to complex content-based image retrieval, which is a process from low-level to high-level development. This paper mainly focuses on the content-based image retrieval method, to analyze the application of an optimized PAM algorithm based on fireworks particle swarm optimization in image retrieval.

Keywords: image retrieval; PAM algorithm; fireworks particle swarm optimization algorithm; clustering algorithm.

1. Introduction

Image retrieval has been studied since 1970s. Due to the limitation of the development level of computer technology, the image retrieval technology that appeared at that time was mainly text-based image retrieval technology, namely TBIR technology. The retrieval methods are mainly based on the image text description, such as the author, age, size and genre of the image works. Since 1990s, CBIR technology, a content-based image retrieval technology, has emerged. The retrieval method is mainly based on the color feature, texture feature or layout feature of the image. This paper focuses on content-based image retrieval.

2. Content-based Image Retrieval Process

Content-based image retrieval is different from text-based retrieval, not only because it is more difficult, but also because the most important difference is that content-based image retrieval can input images as retrieval objects, so as to retrieve result images with similar content to the target image. In this process, in fact, some related technologies, such as image approximation matching technology, machine vision technology and image processing technology, are also used, and even related to the technical achievements of image database and other related research fields. Before carrying out content-based image retrieval, two preparations should be made: one is to acquire the basic features of the image database, the other is to establish the index of the image database. Of course, in order to improve the efficiency of retrieval and overcome the subjective error of manual indexing, the preparation of these two aspects is usually done automatically by the system. The specific image retrieval process is shown in Figure 1.

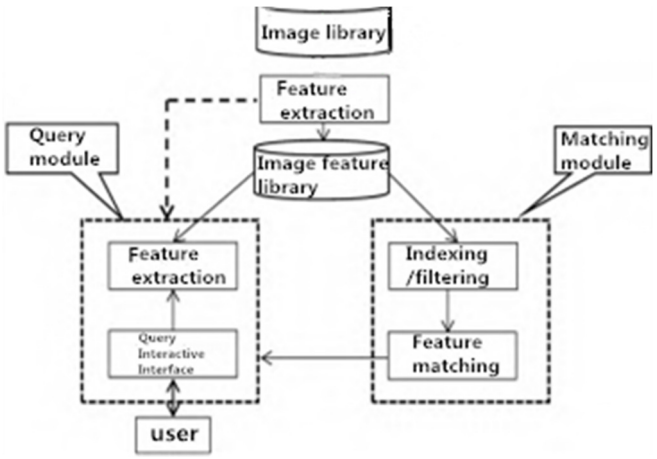

Figure 1. Content-based image retrieval process

3. Feature Extraction in Image Retrieval

In the process of image retrieval, we need to acquire image feature information, such as color, texture and shape.

3.1 Image Color Features

At present, there are two main color models: RGB color model and HSV color model. Both models have their own characteristics. The former can be expressed directly by pixels, which is very convenient, but is quite different from human vision. The latter is mainly expressed by the use of hue, saturation and brightness. This color model can directly see the relevant information of excellent color, and is very suitable for color contrast. At the same time, the color model is closer to human vision. Regardless of which color model is used, the color histogram or color matrix can be used to represent the color feature vectors. Among them, the color histogram depends on the proportion of each color channel and the whole image color channel, while the color matrix is described by probability method, such as mean, variance or skewness probability distribution method.

3.2 Texture Features of Images

If we want to accurately express the surface feature information of an object, we usually use texture features to describe it. Although there are many methods to describe texture features, this paper mainly uses the gray level co-occurrence matrix method to describe texture.

3.3 Image Shape Characteristics

There are not many methods for describing image shape features. There are two kinds of methods commonly used at present. One is geometric moment invariant method and the other is Fourier method. The former is mainly used to describe regional characteristics, and it is also a very important method. As early as 1962, some people began to use this method to represent the shape features of images. The latter is mainly one-dimensional transformation, which represents the shape characteristics of the image by calculating the complex number of points on the boundary.

4. Application of PAM Optimization Algorithm in Content-based Image Retrieval

4.1 Particle Swarm Optimization 3. Application of PAM in Content-based Image Retrieval

As early as 1995, particle swarm optimization (PSO) was proposed as an excellent representative of swarm intelligence algorithm. The key of this algorithm lies in the information exchange and cooperation among the particles in particle swarm optimization, through which the optimal solution can be found. At first, it is just a group of randomly distributed particles, and then let the particles learn the results of information exchange, so as to find the optimal solution. In addition, in each update process, the particles need to learn from the optimal solution found before the update, so as to adjust their position, and finally find the final result. The flow chart of the algorithm is shown in Figure 2.

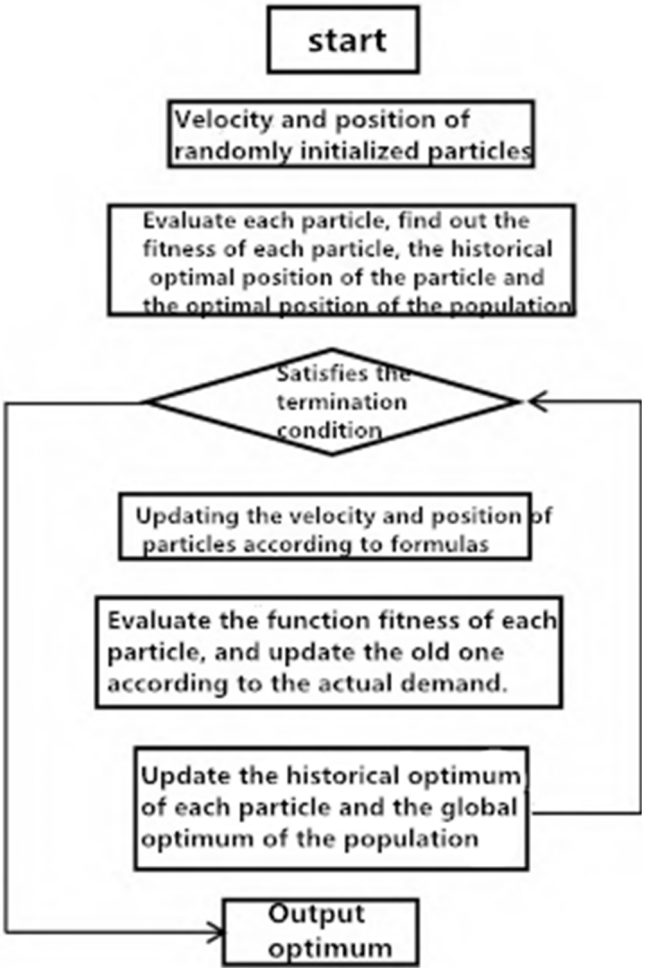

Figure 2. Detailed flow chart of particle swarm optimization

4.2 Optimized PAM Algorithm based on Fireworks Particle Swarm Optimization

4.2.1 Fireworks Algorithm

The fireworks algorithm is an optimization algorithm proposed in 2010. It mainly uses the sparks and radius generated by the fireworks explosion to adjust the ability to explore the global or local population. Because in the fireworks algorithm, the number of sparks produced each time has a specific rule, and the radius of the explosion also has a specific rule. According to the law, particles with good function value can generally produce a lot of sparks in a very short radius, which is usually used for local exploration. Particles with worse function values can produce very few sparks in a longer radius, which is used for global optimization.

4.2.2 Fireworks Particle Swarm Optimization

Particle swarm optimization (PSO) has some shortcomings in practical application, especially in image retrieval. In order to get the best performance in image retrieval, this paper proposes a fireworks particle swarm optimization algorithm which combines particle swarm optimization and fireworks algorithm. The optimized PS0-FWA algorithm can achieve the balance between local exploration and global exploration, thus avoiding the situation that local exploration achieves the optimal value while global exploration achieves the very poor effect. In this way, the optimal solution in the whole exploration space can be obtained.

In the whole process of fireworks particle swarm optimization, the particle swarm optimization algorithm is used to explore the best solution. After N generation exploration, in order to prevent the generation of local optimum solution, the spark explosion effect of fireworks algorithm is used to generate new population particles, and then the optimization solution is carried out, finally the optimal solution of the whole exploration space is obtained.

To sum up, the whole process of the optimized PSO algorithm is as follows:

Individual size is determined for the first step dispersion of a single particle. (2) Computing the fitness of each particle and updating the Pbest and Gbest in time. (3) Particle swarm optimization (PSO) is used to realize group iterative evolution, with N cycles. (4) Calculate the fitness of each particle with the help of fireworks algorithm, and then calculate the number of sparks and the radius of explosion. (5) Generating new population particles. (6) Judge the number of cycles, output the final combination if it has been completed, and restart the cycle if it has not been completed.

4.3 Application of Optimized PAM Algorithm in Content-based Image Retrieval

4.3.1 Image Retrieval Flow of PAM Optimized Algorithms

According to the above optimized PAM algorithm, in order to achieve the best effect of image retrieval, its retrieval process needs to follow the following steps.

(1) Collect the color feature information of all target images in the image database to be searched and store it in the specified database. (2) The optimized PAM algorithm proposed in this paper is used to cluster the target color feature information in the searched image database. (3) The color feature information of the query target image is compared with the clustering color feature information to determine which kind of target image is searched. (4) Find the target image in the corresponding clustering, and finally output the result image.

4.3.2 Simulation Results

In order to highlight the advantages of the improved optimization algorithm, in this paper, in the simulation experiment, besides using the proposed algorithm for simulation experiment, we also use K-means image retrieval method and PSO-K-Means image retrieval method for simulation experiment. In the simulation experiment, we choose 20 main classifications in Coral image database as the experimental object, because each sub-point is used. In order to verify the performance of the proposed optimization algorithm, 10 images of each class are randomly selected for performance calculation. The results of the retrieval are shown in Table 1.

Table 1. Performance Statistics of Three Algorithms for Random Extraction of 10 Images for Each Class

Retrieval	**Accuracy/%**		
Image class	PSO-FWA-PAM	PSO-K-Means	K-means
Africa	68.7	66.8	65.2
Cars	77.3	72.6	74.3
Architecture	52.5	48.3	49.1
Flowers	73.2	68.3	68.9
Dinosaurs	72.8	68.5	69.2
Food	52.4	47.3	48.5
Peak	48.8	45.6	43.9
Flag	73.2	70.3	68.9
Desert	60.6	57.3	56.9
Sunset	56.5	53.9	53.4

5. Conclusion

From the above, we can see that the performance of the proposed firework particle swarm optimization algorithm has some advantages compared with other image retrieval algorithms, but there are also some problems. For example, the image database used is relatively single. If conditions permit, simulation experiments should be carried out on other image database platforms. In short,

image processing research has become an important subject under the current situation, and its role in the application of computer science is becoming more and more powerful.

References

[1]. Zhang X. Research on Optimal Algorithms in Image Processing Technology [D]. Taiyuan: Zhongbei University, 2018.

[2]. Chai QQ, Lin QB, Lin SJ. Evaporation process optimization control based on fast particle swarm optimization [J]. Journal of Process Engineering, 2017 (3): 539-544.

[3]. Jin YX, Zhang XW, YL, and so on. Improved particle swarm optimization algorithm incorporating optimal leaf nodes [J]. Microelectronics and computer, 2016 (9): 64-69.

[4]. Zhu Q, Zhang PZ, Li HL, et al. Research on image matching algorithm based on global and local feature fusion [J]. Journal of Instruments and Instruments, 2016 (1): 170-176.

[5]. Lul, ZJ, Sun H. Particle swarm optimization algorithm with reverse learning and adaptive escape function [J]. Computer application, 2015 (5): 1336-1341.

[6]. Zhu R, Jin YX, Fan WH. Particle swarm optimization algorithm integrating high-quality particle distribution [J]. Minicomputer system, 2015 (3): 576-580.

[7]. Ma JJ, Zhang W, Li CF, et al. New image retrieval method based on improved K-means algorithm [J]. Microelectronics and Computer, 2014 (12): 148-151.