Image Recognition Method of High Intensity Sports Injury in Fish Algorithm

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Keyword: Fish School Algorithm, Sports Injury, Image Recognition.

Abstract: In today's society, image recognition technology is widely used and plays an extremely important role in various fields. Good recognition technology is the key. How to improve the recognition rate and speed is of great significance, which directly relates to the practicality and security of image recognition. Athletes will inevitably be injured after high-intensity sports training, and their injury images need to be recognized during treatment. However, some current recognition methods are not efficient and accurate. Therefore, this paper will study the image recognition of sports athletes' high-intensity sports injury based on fish swarm algorithm. First, extract the contour of the injured part, then obtain the preliminary recognition of the injury image, and finally further recognize the image based on fish swarm algorithm.

1 INTRODUCTION

The development of modern science and technology has greatly promoted the progress of sports science and technology. High-tech means are widely used in sports training, improving the scientific level of training, and promoting the continuous improvement of sports technology level and competition results. With the development of sports science and the gradual deepening of sports practice, the use of scientific training methods and monitoring methods in sports training to improve the effect of sports training and improve sports performance has become one of the important development directions of sports. Scientific sports training is a kind of sports training mode based on the feedback information of functional monitoring indicators and technical monitoring indicators to control the intensity of sports training. Sports biomechanics is to monitor sports training from the perspective of technical monitoring, and the main means of monitoring is to measure the kinematic parameters and dynamic parameters of athletes during sports in real time, and make technical diagnosis and evaluation in time, so as to improve technical actions for athletes Provide theoretical basis and technical guidance for improving sports performance. The research of sports biomechanics in kinematics mainly depends on the analysis system of sports video. With the rapid development of computer technology and the emergence of the Internet, the motion video analysis system has made great progress. From the film analysis system mainly used in the 1970s and 1980s to the video analysis system used at home and abroad in the 1990s; From the study of single camera plane at the beginning to the study of three-dimensional space of two or more cameras at present; The camera's shooting frequency ranges from dozens to hundreds or even thousands per second, and the image is also clearer; With the application of OPENGL, 3DMAX and other software, the data analysis methods are more flexible and diverse, and the display is more realistic and detailed.

Image recognition is also called image pattern recognition. It is a specific application of pattern recognition technology in the image field. It is a technology that establishes an image recognition model for the input image information, analyzes and extracts the characteristics of the image, and then establishes a classifier to classify and recognize according to the characteristics of the image. The main purpose of image recognition is to process and recognize images, pictures, scenes, characters and other information to solve the direct communication process between the computer and the external environment (Yuan, Zhu, et al. 2017).

The development of image recognition has gone through three stages: character recognition, digital image processing and recognition, and object

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recognition. In short, it is a recognition process from simple to complex. The improvement of computer processing speed and the improvement of corresponding algorithms provide foundation and convenience for this. Image recognition mainly focuses on the commonality of "classification". According to certain standards, objects with the same attribute are classified into one category and objects with another common attribute are classified into another category (Tao, 2019). For example, Arabic numerals need to be divided into 10 categories, English letters need to be divided into 26 categories, and thousands of Chinese characters need to be divided into thousands of categories. In addition, different classification standards will result in different classification results, such as classification by color, classification by shape, classification by other attributes, etc (Hamlin, Lizamore et al. 2017).

After high-intensity training, athletes will inevitably suffer from a certain degree of physical damage, and athletes will repeat a certain action, which will also cause wear and tear of body joints or skin. When there is damage, it needs to be treated. Identifying the damaged position of the damaged image is conducive to improving the treatment effect. And many scholars have proposed different recognition methods. Chen Hua et al. proposed a recognition method based on linear discrimination and ultrasonic image features. This method has good recognition efficiency, but its recognition accuracy is relatively low. Cai Shuyu et al. Proposed a recognition method based on improved spectral clustering, which has a certain recognition effect, but its accuracy is not high. Yan Pei et al. Proposed a recognition method based on wavelet coefficient Hu, which can obtain more accurate recognition results, but it takes a long time. So this paper will study a recognition method based on fish swarm algorithm, aiming to improve the accuracy and efficiency of recognition (Chen and Yuan, 2021).

2 RELATED WORKS

2.1 Research Status of Fish Swarm Algorithm

Fish Swarm Algorithm (FSA) is a new and efficient swarm intelligence algorithm proposed by Li Xiaolei, which has good robustness and strong searching ability. Once the algorithm was proposed, it has attracted the attention of many researchers. On the one hand, researchers have conducted in-depth research on the algorithm itself. For example, Ma Xuan proposed a dual domain model fish swarm algorithm. The algorithm first uses the coding method directed by the precursor node to form a multicast tree to represent individuals, and divides the search space into feasible and infeasible regions. Then, the feasible and infeasible regions are given different swimming targets respectively to make full use of the swimming behavior of feasible and infeasible fish individuals, Improve the performance of the algorithm; Shi L has made an empirical study on the performance of the fish swarm algorithm, and has adaptively modified the field of vision and the moving step size of the individual fish during the implementation of the algorithm, effectively balancing the local search ability and the global search ability of the algorithm; Xian S introduced the chemotactic behavior of bacterial foraging optimization into the foraging behavior of fish school, and improved the optimization method of fish school algorithm (Petushek, Sugimoto et al. 2019). On the other hand, researchers have further expanded the application scope of the algorithm. For example, Zhu Qiang used the fish school algorithm in the network virtualization mapping research, established a binary combination optimization model based on the constraint relationship between virtual network requests and the underlying network nodes and links, and used the fish school algorithm to achieve the approximate optimal mapping of virtual network resources to the underlying network resources; Liu Ding proposed a multi-objective optimization fish swarm algorithm and applied it to the threshold segmentation of silicon single crystal diameter detection image to improve the segmentation accuracy of bright halo in the detection image; Zhu X proposed a selective integration algorithm based on extreme learning machine and discrete fish swarm algorithm, and applied the fused algorithm to haze weather prediction; The minimum mean square error (MMSE) and fish swarm algorithm are combined and applied to the research of multiple access interference suppression in multi-user detection (Young, Gap-Taik, et al. 2017). As mentioned above, researchers at home and abroad have conducted more in-depth research on fish swarm algorithm, but how to further improve the performance of the algorithm and expand the scope of application is still a research hotspot in this field.

The structure of artificial fish includes such factors as perception, behavior, behavior evaluation, execution, parameters and data. When external stimuli are added to the artificial fish, it makes corresponding response by its fins. In order to reach the global extreme, the artificial fish is always

swimming, but it does not swim aimlessly. The artificial fish makes judgments according to its own vision and the surrounding environment, and swims in a better direction. As shown in Figure 1, it represents the visual concept of artificial fish.

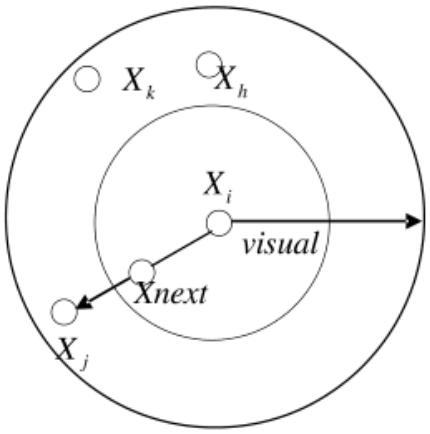

Figure 1: Visual concept of artificial fish

The current status of artificial fish i is X_i which is represented by $X_i = (x_{1i}, x_{2i}, , x_{ni})$. The field of vision of artificial fish is visual, X_h, X_k, X_j. which is the status of other artificial fish in the visual field of vision of the current artificial fish i, X, which is the status of the current artificial fish in the visual field of vision, which is represented by $X_j = (x_{1j}, x_{2j}, , x_{\eta_j})$. Compare the food concentration of state X_j and state X_i if the latter is greater than the former, then the current artificial fish is in state X_i The corresponding artificial fish moves forward one step, and the state after moving forward is Xnext. X_j and Xnext can be expressed by the following formula:

$$X_j = X_i + \text{visual} \cdot \text{rand}() \quad (1)$$

$$Xnext = X_i + \frac{X_j - X_i}{\| X_j - X_i \|} \cdot hand() \quad (2)$$

Where, step represents the step length of the artificial fish, rand() is a random number, ranging from 0 to 1. The food concentration is expressed as an objective function value, let Y=f (X), where X is the state of the artificial fish mentioned above, that is, the function value of X, that is, the food concentration corresponding to X. According to the above process, the three behaviors of artificial fish swarm algorithm, namely, foraging, crowding and rear-ending, always tend to the places with high food concentration.

2.2 Research Status of Image Recognition Technology

The development of image recognition technology has gone through many stages, from traditional recognition technologies such as classification and extraction to the introduction of Artificial Intelligence AI, now image processing has become an important topic in the AI field. The most basic part of image processing includes image segmentation and recognition technology, which is also a difficulty in image processing. The analysis and processing of image data is very difficult, and it is a key point of current research to imitate human image operation. Researchers have developed different computer programs to simulate the recognition process of human image information (Liu, and Ji, 2021). Pattern recognition is one of the important means of image recognition. The method based on this recognition technology needs to analyze a large number of data and information. At the same time, combining expert experience and existing knowledge, it makes corresponding judgments on numbers, characters, curves, shapes, etc. through mathematical reasoning and a large number of computer calculations to complete the recognition, evaluation and operation of pictures similar to human beings (Shi, Guo, et al. 2017). The information processing flow of the image recognition system is shown in Figure 2, specifically including graph segmentation, image feature extraction, classifier recognition and other processes.

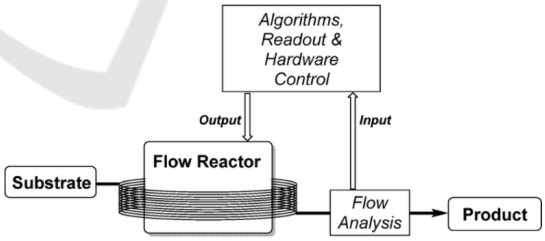

Figure 2: Flow of image recognition system

(1) First, convert the image into a grayscale image.

(2) Normalized gamma space

In order to reduce the impact of illumination on the image and normalize the image, the gamma compression formula is as follows:

$$I(x, y) = I(x, y)^{gamma} \quad (3)$$

Generally, gamma is 1/2.

(3) Calculate the gradient size and direction of each pixel in the image

Use the horizontal gradient operator [- 1,0,1] and the vertical gradient operator $[1,0,-1]^T$ to convolution the image to obtain the horizontal gradient and the vertical gradient. The formula is as follows:

$$G_x(x,y) = H(x+1,y) - H(x-1,y) \quad (4)$$

$$G_y(x,y) = H(x,y+1) - H(x,y-1) \quad (5)$$

Where $G_x(x,y)$, $G_y(x,y)$ represent the gradient in the horizontal and vertical directions at the point (x,y) respectively, and H(x,y) represents the pixel value at the point (x,y). The gradient size and gradient direction from point (x,y) are expressed by the following formula:

$$G(x,y) = \sqrt{G_x(x,y)^2 + G_y(x,y)^2} \quad (6)$$

$$\alpha(x,y) = tan^{-1}(\frac{G_y(x,y)}{G_x(x,y)}) \quad (7)$$

The gradient direction is divided into two types: signed and unsigned. The unsigned gradient direction range is (0, 180 °) and the signed gradient direction range is (0, 360 °). The unsigned gradient direction is adopted in this paper.

Gabor features have the following advantages:

1) It is not sensitive to changes in local illumination.

2) The filter with small frequency can reflect the global information and reduce the influence of noise; The filter with high frequency reflects local information for image filtering, but is sensitive to noise.

3) The image rotation, stretching and other transformations have little impact on it.

4) Because of these advantages, Gabor features have been widely used in face recognition. But at the same time, Gabor features also have certain limitations, mainly including:

1) Computing Gabor features requires convolution of the image, which will take time.

2) Because Gabor filters with different frequencies and directions convolve the image, each convolution operation will eventually get a column vector, and the final feature dimension is large, resulting in a large amount of computation.

3 FISH SCHOOL ALGORITHM

In a piece of water, the place where fish gather most is generally the place where food is most abundant. When no food is found, fish will search for food by randomly swimming. When they find food, they will swim in the direction of food, and other fish will also swim with the fish that find food. According to the characteristics of fish looking for food, fish are constructed, and the activity behaviors of fish in the process of searching for food are defined: foraging behavior, crowding behavior, tail chasing behavior, and random behavior. Each fish corresponds to an optimization solution, the virtual water area where the fish lives corresponds to the solution space of the optimization solution, and the food concentration corresponds to the objective function value. The optimization is achieved by executing the defined behavior of the fish in the virtual water area. This is also the basic idea of fish school algorithm (Kahlenberg, Nair et al. 2016).

A fish is an entity that encapsulates its own data and has the ability to perform behavior. The flow chart of the fish swarm algorithm is shown in Figure 3. It can receive the stimulus information of the environment through its senses, evaluate and select the appropriate behavior, execute and make corresponding stress behavior by controlling its tail fin. The environment in which the fish lives is the solution space of the problem. The behavior it chooses to perform at the next moment mainly depends on the current individual's own state and the state of the surrounding environment. Any behavior activities it performs will also serve as a feedback to the surrounding environment. This feedback will be used to affect the surrounding environment, thereby affecting the behavior choices of other nearby peers, so as to ultimately achieve the goal of optimization.

Aggregation mechanism: in the process of searching for food, fish will spontaneously gather together to avoid injury and ensure their survival. For any artificial fish, when the fitness of the central position of its field of vision is high and not too crowded, the artificial fish moves forward to the central position, otherwise, the foraging mechanism is implemented. Wherein, the expression of the individual advancing to the central position is as follows:

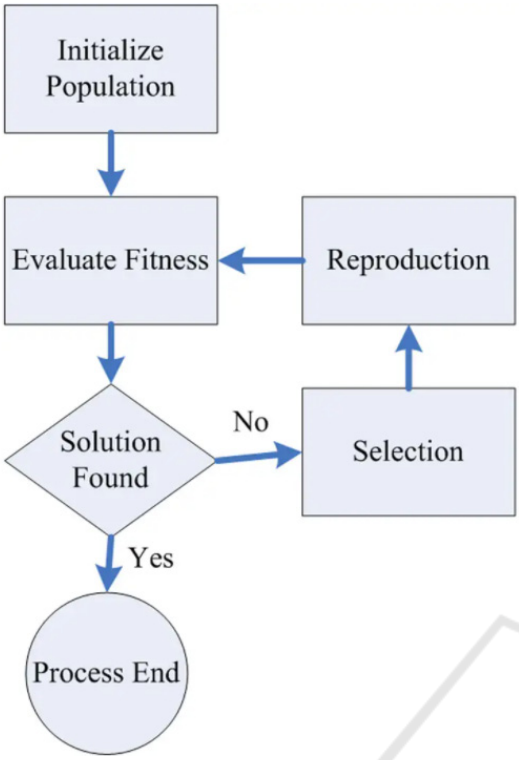

Figure 3: Flow chart of fish school algorithm

$$u_{k+1}(t) = u_k(t) + L(t)(\dot{e}_{k+1}(t) + e_{k+1}(t)) \quad (8)$$

Tail chasing mechanism: when one or several fish in the school find food, the fish in the vicinity will follow them to the location of the food quickly. For any artificial fish, when the fitness of an artificial fish within its field of vision is high and not too crowded, the artificial fish will move forward to the position of the better individual, otherwise, the foraging mechanism will be implemented. Wherein the expression for the individual to advance toward the better fish individual is as follows:

$$\sup_{0 \le t \le T} \|I - L(t)C(t)P^{-1}(t)B(t)\| \quad (9)$$

3.1 Pixel Calculation of Damaged Image Damage Location Based on fish Swarm Algorithm

Based on the above analysis, the damaged position can be preliminarily identified, but the accurate position cannot be obtained. Therefore, the paper will further identify the damaged part by using the fish school algorithm, so as to obtain more accurate damaged part and calculate the damaged area.

Fish swarm algorithm is used in image damage recognition, that is, each solution is regarded as a fish, and then all solutions form a solution set of 7%. There are two ways to find the final solution in the solution set, namely taking the cluster center as the solution and the clustering result as the solution. In order to improve the recognition accuracy, this paper uses the method of cluster center as the solution (Tan, Song, et al. 2020). Then, the vectors of all the cluster center points are regarded as each fish, and any pixel point in the image can be represented by the position state of the fish. Then the objective function of fish can be expressed by the following formula:

$$j_g = \sum_{i=1}^{R} \|V_i - x_k\|^2 \bullet d(x, y) \quad (10)$$

Where, g represents the number of cluster centers, x represents the cluster object, and V represents the pixel cluster center. When j is the minimum value in the formula, it is set as the best clustering point, which is helpful to achieve the goal of damage graph segmentation.

The gray pixel value of the clustered image will correspond to the original pixel. After clustering results, color description of pixels is realized, so different colors in the image will represent different representations. The pixel RGB representation value can then be calculated by summing the GRB flux of each type of pixel value and dividing it by the total number of pixels.

In the process of sports, athletes may suffer injuries at various positions of the human body, such as shoulder joint injury, back injury, eye injury, etc. The above fish school based algorithm can accurately identify the injured parts of athletes, and can improve the efficiency of identification.

3.2 Segmentation Method of Digital Motion Injury Image

The motion injury image segmentation divides the motion injury image according to the similarity criteria of some features or feature sets of the digital motion injury image, and divides the image into several specific non-overlapping regions with unique properties (Wang, 2019), (Han, Tang et al. 2020). The motion injury image segmentation algorithms are mainly divided into the following categories: threshold type motion injury image segmentation, regional type motion injury image segmentation and

edge detection type motion injury image segmentation.

The threshold-type segmentation method of sports injury image determines an appropriate threshold, and classifies the pixel value of sports injury image by comparing the pixel gray value with the threshold value. The contrast threshold can accurately distinguish the target area from the background area, but if the threshold is too low, the information will be redundant, and if the threshold is too high, the information in the target area will be lost. Therefore, selecting the appropriate threshold is the key point to achieve (Gharaat, 2016). Threshold-based segmentation is the most common segmentation method because of its advantages of high efficiency and speed. However, it is difficult to use a single threshold for simple segmentation of motion damage images with similar contrast between the target area and the background area. Therefore, this method is not applicable when the background of the motion damage image is complex or there are many noises in the motion damage image.

The basic idea of the region-based segmentation method is to first find a pixel as the pixel point in the original target area, which is called the seed pixel. If the pixel around the seed pixel is similar to its pixel value, then merge this pixel point into the target area, and then judge the pixels around the pixel point. In this way, gradually expand the target area until no eligible pixels can be merged, and the target area is selected. This method of growing from small to large has ideal segmentation effect for relatively uniform connected objects (Xu, 2021). Another method of growing from large to small is called region splitting and merging method. In contrast to the order of the former method, the range is gradually reduced from the whole motion damage image, and the sub-region is segmented and then merged with the previously segmented region. When it is judged that the pixel is no longer similar to the previous pixel, it will stop splitting, The previously divided area can be used as the target area. The split-merge method is more complex and has the risk of destroying the region boundary, but the segmentation effect is good.

4 DAMAGE SAMPLE COLLECTION SIMULATION ANALYSIS

Although motion tracking based on human model matching has advantages in identifying the stability of joint points when the image quality is poor, it also has the complexity of application and the inaccuracy of joint point recognition due to individual differences (Naoko, Terasawa, et al. 2019). The accuracy of the human body model, the model parameters and the amount of computation are in direct proportion, that is, the higher the accuracy of the model describing the human body, the more the model parameters, and the greater the amount of computation in the tracking process, reflecting the complexity of the application. Although the improvement of automatic scaling is adopted, the scale of each link has been determined after the model is established. Due to individual differences, the model cannot be completely consistent with the moving human body, which will cause certain errors. However, the traditional method of determining joint points directly from feature points on the contour line is easy to use, but the contour features caused by poor image quality are not obvious, especially for the method of determining feature points based on the curvature of the contour line, and even cannot be recognized (Kojima, Kasai, et al. 2017), (Kahlenberg, Nair, et al. 2016), (Singh, Gupta, et al. 2022). This sample collection method provides a clearer and intuitive real-time image of the damage in the underground movement. Through the collection, a total of 180 sample images, including three types of damage images, are obtained in this paper. As shown in Figure 4.

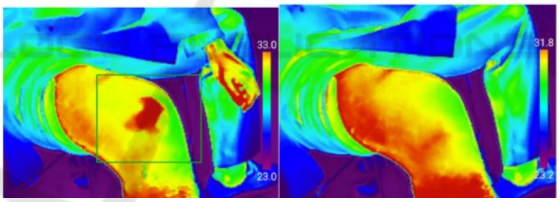

Figure 4: Example of damage type image

Because the experiment in this paper needs to build a deep learning network model for recognizing sports injury images, the size of the data sample set will affect the level of the model learning rate. In order to prevent the over-fitting situation caused by the small amount of sample data in the training process, the obtained training sample library needs to be enhanced by data to expand the image sample library (Wang, Bin, et al. 2019). First, the original image is grayed out, and then the expansion of the sample database is considered to be divided into two steps: first, the training sample image is translated into four directions of pixels, and then moved 30 pixels in the direction of 45 ° clockwise shift to the horizontal and vertical axes, and the original position after the movement is filled with the pixel value 255,

which can expand the sample data by four times. On this basis, the sample image is horizontally mirrored, Vertical image and horizontal vertical image can also expand the number of sample databases by three times (Zhu, Sun et al. 2020). The number of motion injury image samples collected in this paper is expanded to 3600, from which 3000 (1000 perforation, 1000 crack, 1000 deformation) are selected as the experimental training samples, 600 (200 perforation, 200 crack, 200 deformation) are used as the experimental test samples, and the size is normalized to 224 × two hundred and twenty-four × 3 pixel size. The simulation results are shown in Figure 5 below.

Figure 5: Simulation result

In order to meet the requirements of fast feedback and simple operation for the technical analysis of sports injury, and provide convenient digital images for the automatic recognition of the joints of the subsequent moving human body of the analysis system, this study adopts the method of first segmenting the ghosted moving human body, then removing the image ghosting and frames by filling, merging the processed moving human body with the background, and finally obtaining the image sequence without ghosting and shaking.

5 CONCLUSIONS

Athletes will inevitably be injured when they are playing sports. Identifying their injury pictures will help improve the therapeutic effect of athletes. In this paper, the damaged part of the image is recognized based on the fish swarm algorithm. Compared with the other two recognition methods, the method in this paper helps to improve the recognition efficiency and accuracy. Athletes are very vulnerable to injury during sports. In order to reduce the degree of injury, they should strictly follow the action standards during training to avoid serious injury.

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