Hindawi
Wireless Communications and Mobile Computing
Volume 2023, Article ID 9754302, 1 page
https://doi.org/10.1155/2023/9754302

Retraction

Retracted: Sensor Action Recognition, Tracking, and Optimization Analysis in Training Process Based on Virtual Reality Technology

Wireless Communications and Mobile Computing

Received 26 September 2023; Accepted 26 September 2023; Published 27 September 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

In addition, our investigation has also shown that one or more of the following human-subject reporting requirements has not been met in this article: ethical approval by an Institutional Review Board (IRB) committee or equivalent, patient/participant consent to participate, and/or agreement to publish patient/participant details (where relevant).

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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[1] H. Wan, "Sensor Action Recognition, Tracking, and Optimization Analysis in Training Process Based on Virtual Reality Technology," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 1564390, 7 pages, 2022.

Hindawi
Wireless Communications and Mobile Computing
Volume 2022, Article ID 1564390, 7 pages
https://doi.org/10.1155/2022/1564390

Research Article

Sensor Action Recognition, Tracking, and Optimization Analysis in Training Process Based on Virtual Reality Technology

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Received 5 July 2022; Revised 19 July 2022; Accepted 1 August 2022; Published 19 August 2022

Academic Editor: Aruna K K

In order to solve the problem of improving the training efficiency and competition performance of athletes, a system of sensor action recognition, tracking, and optimization analysis based on virtual reality technology is proposed. After using the perceptual interaction subsystem to build a three-dimensional training scene through the virtual environment producer, the picture in the three-dimensional scene is rendered through the view module in the model operator system. At the same time, the logic module calculates the physical attenuation of athletes and sends the calculation results back to the perceptual interaction subsystem effect generator through the interface to present the interactive effect of athletes' training. The experimental results show that the maximum improvement of the performance of five randomly selected athletes in the 100-meter, 200-meter, and 400-meter dash competitions after using the system can reach 5 s, 4.5 s, and 6 s, respectively. *Conclusion*. The system can effectively complete the calculation of athletes' physical fitness attenuation and has good carrying capacity. It can improve athletes' physical fitness training effect and competition simulation efficiency and can improve athletes' competition performance after application.

1. Introduction

Artificial intelligence technology has attracted great attention from all sectors of society. For the sports field, automatic data analysis technology has become a strategic field for the development of sports scientific knowledge. Traditional statistical methods can no longer meet the development of the times. Careful analysis of sports activity data, improving the cognitive level in sports scientific training, improving the quality training plan, and improving the decision-making ability in optimizing training and competitive strategies are important ways to improve the current situation of sports training [1]. Artificial intelligence technology is applied in the stage of training and competition, mainly through hardware terminals such as camera equipment and sensors for in-depth learning. In the process of sports training and competition, maintaining a peaceful mind is the basic element to obtain excellent results. The machine is used to recognize facial expressions in videos and images and predict emotions according to the facial features detected by the machine. The machine needs to be based on public data such as face detection image processing tools and basic emotional states and has mature machines for complex face recognition tasks. Many scholars use some methods to use this tracking data to build a data-driven ghosting model. This model mainly learns from the reliable basketball behavior sequence generated from the first person image in an unsupervised way. It is widely used in the field of sports, increases the research on targeted models, and understands the training and competition through artificial intelligence technology [2, 3].

Human action analysis and recognition based on inertial sensors is an emerging field of pattern recognition, which overcomes many shortcomings and limitations of traditional video-based action recognition, and has higher operability and practicability. The inertial sensor of the part collects the motion information of the human body and transmits it to the PC through the wireless transmission module and then preprocesses the data, extracts and selects features, and classifies the action. These inertial sensors include accelerometers, magnetometers, and gyroscopes, integrated together as a single node; each node forms a wireless sensor

network through wireless communication to form a motion capture system to capture human motion information. Artificial intelligence technology is applied in athlete training. Sports training statistics are based on figures. Automated digital reporting is the development direction of sports training, which can only be realized through artificial intelligence technology. Artificial intelligence technology can completely change the live broadcast. According to the events on the scene of sports training, artificial intelligence technology can choose the correct perspective, understand the real-time situation of athletes, and timely find out the emergencies in the training process. In the process of integrating artificial intelligence technology into physical training, the effect of physical training continues to improve, and artificial intelligence technology continues to develop. At present, important research breakthroughs have been made in basketball training, tennis training, skiing training, and other activities. Integrating artificial intelligence technology into physical training is an important development direction [4, 5].

2. Literature Review

Virtual reality (VR) is the abbreviation of virtual reality technology. It is also called Lingjing technology. It uses computer graphics, simulation technology, multimedia technology, artificial intelligence, network technology, parallel processing, and multiparameter environment to perceive and simulate human visual, auditory, tactile, and other sensory organs. People are immersed in the virtual world. In addition to creating a multidimensional data space for people with broad application prospects through the real-time interaction of language and gestures [6–8], virtual reality technology contains three basic characteristics: immersion, interactivity, and visualization. With the rapid development of VRT technology, it has been widely used in CAD, simulation, and other fields: modeling, visual computing, remote control robots, computer art, advanced technology and concept demonstration, education and training, visual data and models, entertainment and art, design and planning, remote manipulation, etc. In recent years, many countries have paid much attention to and invested in the Olympic Games and other large-scale sports events. Training simulation is also called simulation training, which refers to the means of constructing the required virtual scene or some special conditions for training through modern scientific and technological means [9, 10]. It has the characteristics of high simulation, strong pertinence, high security, and high training efficiency. Simulation training is one of the main methods of athlete training. It usually includes real scene simulation, simulation of overcoming various obstacles of athletes, athlete state simulation, etc. It is used to train the adaptability or sensitivity of athletes. Its purpose is to improve the on-the-spot adaptability of athletes in the competition, quickly adapt to the competition environment, ensure the normal play of the competition, and improve the competition results [11]. Aha et al. designed a motion simulation system based on ADAMS. The system uses dynamic simulation software to complete motion simulation but cannot set the motion scene specifically [12]. Chang et al. designed a motion simulation system based on sliding mode control. The system completes the motion simulation based on the six degree of freedom motion equation, which cannot calculate the physical fitness of athletes during the simulation. Therefore, in order to solve the above shortcomings, this paper designs an athlete training simulation system based on artificial intelligence technology to complete the athlete simulation training [13].

3. Research Methods

3.1. Athlete Training Simulation System Based on Artificial Intelligence Technology

3.1.1. System Structure. The athlete training simulation system based on artificial intelligence technology adopts virtual reality technology to complete the construction of athlete training simulation system. The system can set different training modes and innovative training means according to the situation of athletes to ensure that athletes achieve the best training effect. The athlete training simulation system based on VR technology has the advantages of multiformal output, processing of a variety of input devices, modeling of complex behaviors, collision detection, athlete physical fitness detection, and real-time interaction. It can help athletes scientifically enhance their training level and improve their overall strength. The athlete training simulation system based on artificial intelligence technology consists of two subsystems, namely, v-sense interaction subsystem and model operator system. Its structure is shown in Figure 1. (1) VR perception interaction subsystem: its main function is to build the most authentic and reliable competitive sports simulation environment to experience at any time and realize training interaction. (2) Model operator system: in order to ensure the authenticity of athlete training simulation, the simulation of training content and competition process is more important while ensuring the lifelike simulation of training environment and athlete's human body, which should be close to the actual situation, such as athlete's physical attenuation and collision in actual training [14]. Therefore, in order to make the system closer to the real situation, the model operator system is used to calculate the physical attenuation of athletes during training.

3.1.2. VR Perception Interaction Subsystem. The subsystem is composed of virtual environment generator, signal converter, and effect generator, as shown in Figure 2. The virtual environment generator is composed of user system, computer interface, simulation manager, three-dimensional model database, three-dimensional model processor, and multifunctional ports to build a realistic virtual training or reasonable competition environment. The three-dimensional model processor collects and reorganizes the field data to form a three-dimensional scene and complete the construction of the virtual training environment. The signal converter is composed of converter, input control, etc. The main function is to complete the signal conversion in the virtual training environment [15]. The effect generator is composed of position and direction tracker, display, and

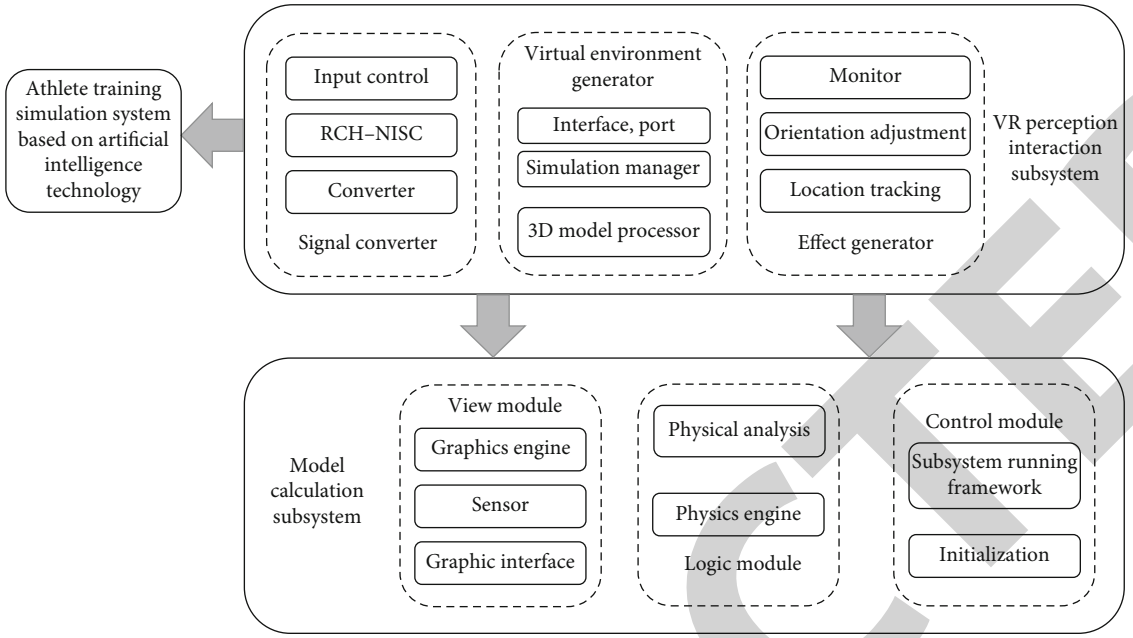

Figure 1: System architecture.

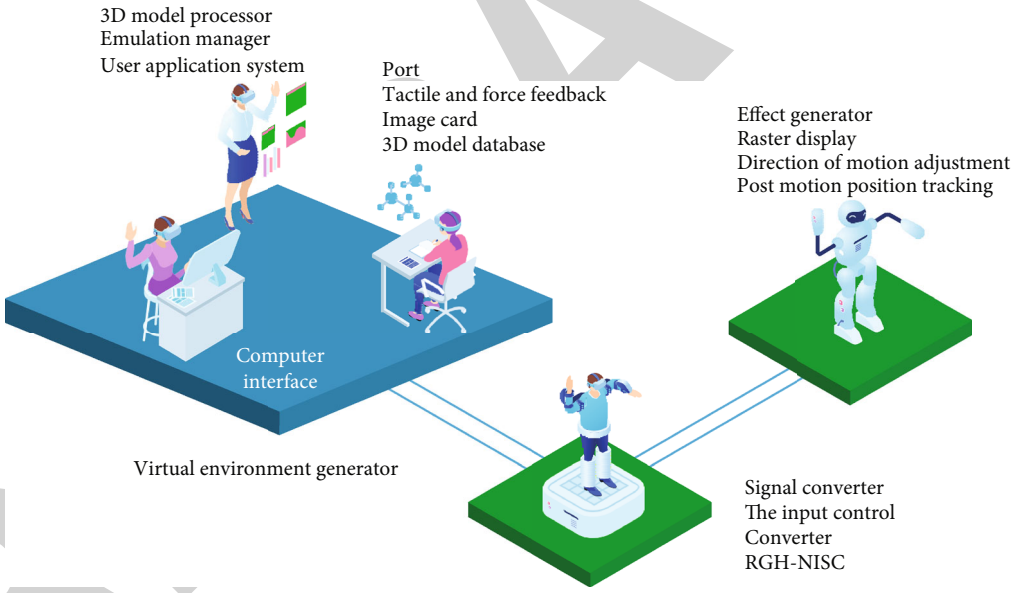

Figure 2: VR perception interaction subsystem structure.

other parts. After receiving the calculation results of the logic module in the model operator system, it can achieve a more realistic environment presentation, enabling athletes to realize an immersive natural interaction process between their own feelings and the virtual environment [16].

3.2. Model Operator System. Physical fitness value is the embodiment of each athlete's physical fitness, and the physical fitness value will decrease with training or competition, which will affect the athletes' play. Therefore, it is necessary to calculate the physical fitness attenuation of athletes [17]. The model operator system completes the calculation of athletes' physical attenuation through the physical attenuation model. The model simulates the physical energy consumption of athletes during the competition, designs the physical energy attenuation formula and the overall energy calculation formula, and makes the athletes' performance more realistic through the impact of physical energy changes on athletes' acceleration, tactical decision-making, and competition results.

3.2.1. Subsystem Structure. The model operator system consists of view module, logic module, and control module. Its structure is shown in Figure 3. The view module is composed of a graphics engine, a sensor, and an image interface. Its main function is to complete the graphical display of the

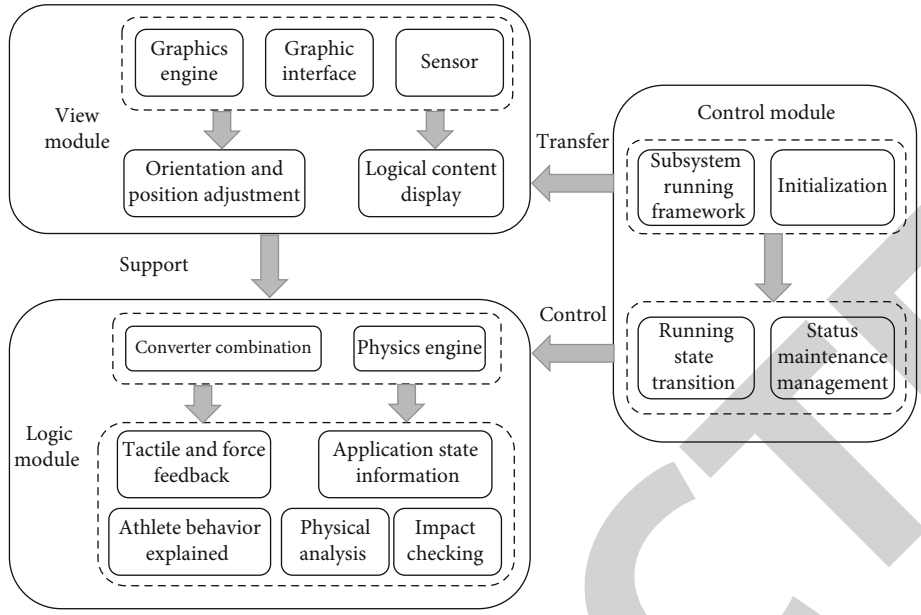

Figure 3: Structure diagram of model operator system.

content of the logic module of the model operator system [18]. The engine renders the graphics information on the screen and completes the adjustment of the rendering position and direction in combination with the running instructions of the subsystem. The graphical interface controls the graphical controls that interact with users in the subsystem and provides a programming interface for the handling of control events. The logic module is the core part of the subsystem, and the function realization of the physical engine subsystem is its main function. The module includes virtual athlete, athlete management, competition environment, competition information display, physical analysis, training or competition data management, and collision calculation and can realize the interaction of data required for subsystem operation through data management. The control module contains the subsystem framework and initialization, subsystem state management and maintenance of different states of subsystems, and completion of subsystem state operation to ensure the operation of other functions in the subsystem. The main initialization function is to establish the rendering window, the root node of the resource manager, and the graphics engine required by the subsystem [19].

3.2.2. Physical Fitness Analysis

(1) Physical Attenuation Calculation. The physical fitness attenuation of athletes is the energy consumption of sports. The physical fitness attenuation is calculated according to the work done by athletes in the process of sports [20]. Athletes need to overcome the ground friction resistance and air resistance to do work. Divide the process of simulated competition into time periods with very short intervals (the time of rendering a picture), and within this time, formula (1) for calculating the work ΔW done by athletes is

Table 1: Physical fitness attenuation results of 400 m race training athletes (kw).

Score ranking	Athlete number	Attenuation results
1	B	13143.290
2	D	13378.915
3	A	12937.054
4	C	12889.817
5	E	12858.801

$$\Delta W = (f + F_{\text{air}} + F_{\text{R}}) \times \Delta S. \tag{1}$$

In formula (2), the ground friction resistance and air resistance are f and F_{air}, respectively. The resultant force received by athletes is F_R ; f . F_{air} and F_R to form the force used by athletes. The distance the athlete passes during this period is ΔS. The ground friction calculation formula (2) is

$$f = \mu m g. \tag{2}$$

In equation (2), the ground friction coefficient and athlete mass are μ and m, respectively, and the gravitational acceleration is g.

The calculation formula (3) of resultant force is

$$\text{Fclose} = ma. \tag{3}$$

In equation (3), the acceleration ratio of the athlete is a.

The physical energy consumption of athletes is calculated based on the work done by athletes in each frame, and the work consumed between two frames is subtracted from the total. In the above formula, except for the air resistance, other parameters can be obtained from the system.

Table 2: Physical fitness test results before and after use.

Athlete number	Endurance training		Flexibility training		Coordination training		Speed training	
	Before application	After application	Before application	After application	Before application	After application	Before application	After application
1	41	64	21	30	130	153	11.35	9.6
2	38	57	23	29	118	143	10.37	8.8
3	40	61	22	26	121	141	12.6	10.5
4	35	52	18	27	119	146	11.4	8.6
5	40	54	30	38	124	151	10.86	8.2

Therefore, only the air resistance can be obtained to calculate the work done by the athlete in this time period.

(2) The Impact of Physical Fitness on the Game. According to the physical fitness attenuation formula, the calculation formula (4) of the athlete's initial overall energy W is

$$W = \left(\mu mg + \frac{1}{2}AC_wPV_{\max}^2\right)S_0 + \left(\mu mg + \frac{1}{2}AC_wPV_a^2\right)(S - S_0). \tag{4}$$

In equation (4), the athlete's movement distance is S_0; the total distance is S; the maximum speed of athletes is $V_{\max}$; and the average speed of the athlete in this competition is V_a.

When predicting the overall energy, after the work done by the resultant force part is removed, the part that cannot be predicted does not exist in the corresponding physical attenuation. Therefore, the final physical attenuation calculation formula (5) is

$$\Delta W = (f + F_{\text{air}}) \times \Delta S. \tag{5}$$

In combination with the actual competition situation, athletes cannot continue to accelerate after accelerating for a certain period of time. Similarly, when athletes keep moving fast for a certain period of time, they cannot continue to move at the same speed, and they will continue to move at a relatively low speed level after slow deceleration.

The upper limit of acceleration time that athletes can maintain and the threshold of extreme speed movement will be affected by physical fitness. The maximum maintenance time and current speed threshold are T_1 and V_1, which will be affected by the athlete's remaining physical fitness W_1 and initial physical fitness W_0. When the remaining physical ability is not less than zero, the maximum sustained acceleration time may be affected. The calculation formula (6) of the influence method is

$$T_1 = T_0\left(\frac{k_1W_1}{W_0} + (1 - k_1)\right). \tag{6}$$

In equation (6), the initial maximum maintenance acceleration time is T_0, and the scale factor is k_1.

When the remaining physical ability is not greater than zero and the absolute value is not greater than the initial physical ability, the current speed threshold will be affected by

$$V_1 = V_0 \times \left(1 + \frac{W_1}{2W_0}\right). \tag{7}$$

In equation (7), the initial extreme speed threshold is V_0. When the remaining physical fitness is not greater than zero and the absolute value is not less than the initial physical fitness, the treatment will not be carried out. The logic module in the simulation operator system continuously adjusts the speed of athletes through the above process and simulates the physical energy consumed by athletes when participating in the competition, which is basically the same as the remaining physical energy, which can ensure the simulation of the actual situation of athletes during the competition, so as to improve the performance of athletes.

4. Results and Discussion

4.1. Rationality Test. 150 athletes of a sprint team in a sports university are selected as the experimental research object to test the performance and application effect of the system. In order to test the rationality of the physical attenuation calculation of the system in this paper, five athletes in the experimental object are randomly selected. According to the measurement data of athletes in the 400-meter sprint competition, the system in this paper is used to simulate and test the physical attenuation of five athletes in the same 400-meter race. The results are shown in Table 1. It can be seen from Table 1 that the greater the physical attenuation, the better the performance. This situation is consistent with the actual situation, so it shows that the system has the rationality of physical fitness attenuation calculation and can realize the simulated physical fitness attenuation calculation of athletes in competition.

4.2. Simulation Performance Test. In order to test the simulation training effect of the system in this paper, the simulation training is carried out for four physical fitness training items of sprinters, which are endurance training (the athletes' sustainable time under the condition of running at a constant speed), flexibility training (the number of tumbling movements), coordination training (the average frequency

Table 3: Comparison of competition results before and after the application of the system.

Athlete number	200 m (s)		400 m (s)	
	Before application	After application	Before application	After application
A	27.7	24.1	58.6	53.2
B	27.6	23.8	58.8	53.4
C	28.1	24.2	58.4	53.3
D	27.9	24.1	58.6	53.2
E	28.2	23.7	59.1	53.1

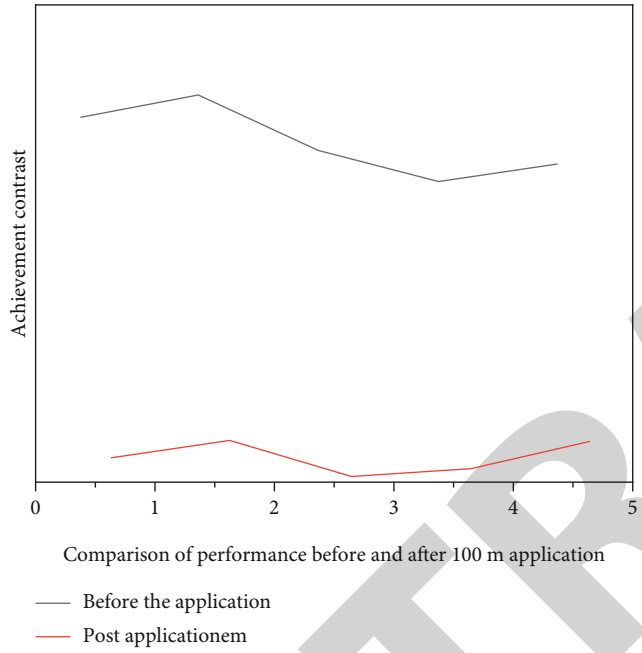

Figure 4: Comparison of performance before and after 100 m application.

of rope skipping), and speed training (the time required for five accelerated turnaround runs at a fixed distance). Test the four items of physical fitness of the five athletes before and after the use of the system. The results are the average results of the five tests, as shown in Table 2. It can be seen from Table 2 that after the application of the system in this paper, the four physical abilities of the five athletes have been improved to varying degrees compared with those before the use of the system in this paper, which shows that the simulation effect of the system in this paper is good and can improve the physical abilities of the athletes to a certain extent.

4.3. Applicability Test. Test the performance improvement of the five athletes before and after the application of the system in the 100 m, 200 m, and 400 m sprint competitions. The results are shown in Table 3. By analyzing Table 3 and Figure 4, it can be seen that the results of the five athletes in the 100 m, 200 m, and 400 m sprint competitions have improved to a certain extent after the system simulation training. This is because the system in this paper has the function of physical fitness attenuation calculation, which can get the results of physical fitness attenuation during athletes' sports. The results are fed back to athletes through the interaction layer of the system, providing reliable adjustment basis for athletes to reasonably plan their own sports programs, so as to improve athletes' competition performance. Therefore, the application of this system is high, which can improve the training effect and competition performance of athletes.

5. Conclusion

In this paper, a sensor action recognition, tracking, and optimization analysis system based on virtual reality technology is proposed in the training process. Virtual reality technology integrates computer hardware, software, and virtual world technology, which can dynamically simulate the real world. Dynamic environment can react instantly according to human form and language, so as to realize real-time communication, which is formed between human and virtual world. Therefore, virtual reality technology has been applied in sports training, competitive sports, and so on, which plays an important role in the development of competitive sports.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

Acknowledgments

The study was supported by the 2021 Henan Province Higher Education Teaching Reform Research and Practice General Project "Research and Practice on the Training Path Reform of Outstanding National Traditional Sports Talents Based on the Trinity of 'De, Skill and Literature,'" Public Number: 2021SJGLX494, and Danwei System Routines, "Provincial Ideological and Political Model Course, November 2021" (No. 110).

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