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Review Article

Application of Virtual Reality Technology Based on Artificial Intelligence in Sports Skill Training

Jiyong Lv,[1] Xiangzhi Jiang,[2] and Ang Jiang[2]

[1]*National Traditional Sports Institute, Harbin Sport University, Harbin, 150008 Heilongjiang, China*
[2]*Physical Education and Training Institute, Harbin Sport University, Harbin, 150008 Heilongjiang, China*

Correspondence should be addressed to Xiangzhi Jiang; jxzeagle2008@163.com

With the rapid development of science and technology and economy, it has a great impact on people's lifestyle and habits. Fewer and fewer people will actually carry out offline sports activities, and some will choose gyms and other places for offline exercise, but the high cost of gyms limits most people's desire to exercise. Our country has been actively introducing policies or measures to advocate physical exercise, but people's enthusiasm is not high or improper training leads to frequent physical injury. In view of the current situation and pain points of sports skill training, this paper first discusses the possibility of the overall application of virtual reality technology based on artificial intelligence in sports skill training. Secondly, it explores the application of virtual reality technology based on artificial intelligence in tennis, which is a highly skilled sports training. Finally, combined with the practical application of virtual reality technology based on artificial intelligence in sports skills training, it proves the advantages and influence of applying virtual reality technology based on artificial intelligence in sports skills training in the future.

1. Introduction

At present, the society is full of various Internet activities, such as video games, short videos, and online social networking, which constantly squeeze people's less affluent leisure time. People generally hope to release the pressure in video games, experience all kinds of new things in short videos, and use online social instead of offline meeting [1]. The current situation of almost not taking part in any physical exercise, coupled with unreasonable diet structure, hypertension, hyperlipidemia, obesity, low vision, low cardiopulmonary function, and other diseases, gradually appears to have younger status in some overnourished people [2]. China's relevant departments attach great importance to people's health. The CPC Central Committee and the State Council have successively issued and implemented "healthy China 2030" program outline, national fitness implementation plan, and other program outlines [3]. At the 19th National Congress of the Communist Party of China and the 13th National Games, General Secretary Xi also constantly emphasized the important role and significance of developing mass sports

[4]. In this context, our citizens have a new understanding of the importance of physical exercise to health. More and more people begin to plan for sports training in their spare time but encounter the problems of time, venue, and training skills [5]. First of all, in the fast-paced life, people's leisure time is "fragmented," few people can spend a large period of time for sports training. At the same time, the improper understanding of training skills does not play the role of physical training but causes irreversible damage to the body [6]. Based on the above problems, it has greatly hit the enthusiasm of the people for sports training. With the continuous development of science and technology, virtual reality technology based on artificial intelligence can well avoid these problems in sports skills training. This paper introduces and demonstrates this.

This paper first introduces the application of artificial intelligence virtual reality in physical education and then, combined with the case of the role of artificial intelligence virtual reality technology in tennis training skills, specifically discusses the promotion and grasp of artificial intelligence virtual reality technology in sports training skills. Finally,

according to the above analysis and discussion, we come to the conclusion that the use of artificial intelligence virtual reality technology can play a positive role in sports skills training, and through the specific cases of artificial intelligence virtual reality technology in table tennis and other sports skills training, it shows the current application of artificial intelligence virtual reality technology in sports training skills. This paper hopes that through the introduction and discussion of virtual reality technology under artificial intelligence in sports skill training, we can promote the application of virtual reality technology in sports teaching and have certain guiding significance for sports skill training.

2. Related Work

2.1. The Research Status of Artificial Intelligence Virtual Reality Technology in China. The application of artificial intelligence virtual reality technology in physical education has only been applied in recent years. Almashat and others believe that artificial intelligence virtual reality technology with its virtuality can effectively prevent the inevitable collision and other injuries in physical education. At the same time, the required teaching conditions can be presented and realized visually through the writing of computer code, which can make up for the lack of teaching conditions. A computer and a pair of glasses can be used to start sports training, which completely breaks the time and space restrictions on sports training. Using the 3D effect of artificial intelligence virtual reality technology, we can watch sports actions and skills in multiple directions without dead angle, which is conducive to tap the potential of physical education teaching [7]. Sadeghi et al. think that artificial intelligence virtual reality technology in physical education teaching can effectively avoid irreversible sports injury caused by improper operation of difficult movements by making viewers fully understand and put themselves in the training. At the same time, the real field can be set in a relatively safe field, so as to avoid accidents in sports training [8]. Pushparajah et al. also pointed out that the application of artificial intelligence virtual reality technology can effectively avoid sports accidents, reduce physical injury caused by improper sports movements, and save and make up for the cost and shortage of sports facilities [9].

Based on the research results of the above scholars, we find that the academic circles generally believe that the role of artificial intelligence virtual reality technology in sports training has the following points, to avoid irreversible body injury caused by improper or not in place actions in the training process [10], break the limitation of time and space in physical training [11], and Fully tap the teaching potential in the process of training [12]. But at the same time, most of the domestic research on virtual reality technology in sports training mostly stays at the theoretical level and lacks the analysis combined with specific cases [11]; At the same time, for the application of artificial intelligence virtual reality technology in sports training, it only expounds the advantages and application role of relevant research [13]; rarely analyzes the problems encountered in the practical application process, such as the computer hardware settings, the

uneven products of artificial intelligence virtual technology, and the public consumption concept, and puts forward the countermeasures [14].

2.2. International Research Status of Artificial Intelligence Technology. The United States first began to study artificial intelligence virtual reality technology. As early as the 1940s, the U.S. military began to simulate the training of astronauts and pilots through artificial intelligence virtual reality technology. Later, it gradually extended to civilian, such as user interface, perception, hardware, and background software. So far, the United States has established artificial intelligence virtual reality training system and virtual reality education system for space station, aviation, and satellite maintenance. In the field of simulation, George Mason University developed a simulation system in dynamic virtual environment. In terms of game software and office, Boeing and Xerox of the United States and NEC of Japan have designed a knowledge base system based on artificial intelligence virtual reality technology on the existing basis, which can effectively improve the user's sense of body and improve the application efficiency. In Europe, the United Kingdom, Germany, Sweden, and other more developed countries also actively participate in the research and application of artificial intelligence virtual reality technology, but mainly in the field of hardware and software.

To sum up, artificial intelligence virtual technology has been widely studied by researchers all over the world. The research and application of virtual reality technology focus on different countries, mostly in industry, military, medicine, entertainment, education, and so on. Among them, there is less research on sports training, but it has a good prospect.

3. Method

The basic operation scene of artificial intelligence virtual reality technology (VRT) is to bring the subjects an electronic helmet with an eye screen. The electronic helmet is equipped with an impression. The eye screen is made of liquid crystal with two micro screens. The subjects can see the virtual image on each eye screen. At the same time, the hand is equipped with a data glove, which can be used to control or issue commands to users or display graphics. According to the positioning sensor which detects the position of human body on the user's clothing, the real-time position of the subject or the position in the virtual space can be transmitted in two directions. At the same time, the user's trajectory can be recorded, and the position in the model can be modified according to the user's motion trajectory. In addition, if necessary, the subjects also need to wear foot transmission equipment. Through the above equipment, the subjects saw a computer-generated three-dimensional space, with a full-color stereo image and stereo sound, and felt the feedback force of the virtual environment, so they had a real experience in the virtual environment. The artificial intelligence virtual reality technology working scene is shown in Figure 1.

FIGURE 1: Artificial intelligence virtual reality technology working scene demonstration.

3.1. Sports Training of Virtual Reality Technology Based on Artificial Intelligence.

Sports skills require athletes to be proficient and standard when doing specific actions. Therefore, in order to achieve proficiency and standard, on the one hand, athletes must continue to train; on the other hand, instructors' demonstration and training methods should be perfectly absorbed, so as to finally achieve the improvement of training level. But taking the result level of professional sports economic training as an example, most coaches mainly rely on the naked eye and experience to judge the athletes' movements in the training process, which is more dependent on the subjective consciousness of coaches, affected by the angle, distance, and lighting. Therefore, athletes need to go through repeated actions and correction or in actual operation to realize the ignored problems in training, which leads to the poor quality of economic sports training in China. The national team with the best training resources is still like this, not to mention for the public, there is no coach guidance, no professional action correction demonstration, and no sufficient and appropriate training time and training ground for athletes. We can imagine the process and result of physical training.

We can combine the actual human movement with sports biomechanics into the virtual coordinate system of digital three position human movement, so as to record the movement track in the space of combination of virtual and reality, correct the movement track to achieve the purpose of sports training, and avoid the injury caused by improper operation in the whole process. The whole process is divided into two parts. One part configures the motion capture action database and stores the data records of action modification and design. The other part generates the corresponding parameters through the trajectory of the mover and combines the two parts of data to test the action. In this part, we define the trajectory of the mover and the corresponding action by establishing a coordinate system and Euler angles in the X and Y directions. And according to the data in the database to correct and arrange the action, the final output of correct data to the specific action of the line of movement and the corresponding parameters are stored in the three-dimensional standard simulation action library for the next preparation.

Through the above system, first of all, the sports training of the volleyball team in a certain area is simulated, and the application performance of the Chinese system is tested through the training effect. Firstly, we input the data of athletes' standard service action effect through three-dimensional modeling and set them as standard parameters. Then, the space coordinate system is established for the actual movements of the athletes, and the Euler angles in the x-axis and y-axis directions are used as the reference to detect the trajectory differences between the athletes and the standard movements and record them (see Figure 2). Finally, through the system calculation results, the standard action track and the correction action track are sent back to the perspective of the athletes, and the specific correction of the athletes' movement is carried out through the control equipment such as data glove and pedal. In order to achieve the practical application of artificial intelligence virtual display technology in volleyball skill training. According to this scheme, we conducted artificial intelligence virtual reality simulation training for 10 athletes and compared the results before and after training. The results are shown in Figure 3.

It can be seen from Figure 2 that the Euler angle of the corrected trajectory is basically below 1 compared with the standard trajectory, which indicates that the simulation effect of the technology is better, and the simulation effect can be used in actual training. It can be seen from Figure 3 that the average time used to reach the same training level for 1-5 months after training is often lower than that before using the simulation training technology system. For 6~8 levels, no one can reach the level before training, but after training with the simulation system, the athletes can reach 6~8 levels, and the time is less than the time to reach 1~5 levels before training.

In the same way, the above scheme is different. For the randomly selected 10 divers, the standard action parameters are still collected first. Combined with the real diving trajectory of the athletes, the difference between the two Euler angles is calculated, and finally, the correction parameters are generated to correct the movements of the athletes. Specific data are shown in Figures 4 and 5.

As can be seen from Figure 4, after using artificial intelligence virtual technology to simulate training, the difference between the actual action parameters and the standard action parameters is about 2. Considering the complexity of diving action, combined with the actual situation, we still think that the simulation effect of artificial intelligence virtual simulation system is better, and the simulation effect can be used in practical application. It can be seen from Figure 5 that all the time, when the system reaches the same level after 1-4 is less than that before the system simulation, and for 5-7 levels, the system can reach the same level after the system simulation, and the average time is 1-4 before the system simulation, and no one has reached the level before the system simulation.

To sum up, it can be concluded that after using the artificial intelligence virtual reality technology simulation system, the effect of athletes in sports training is better; the action standard is longer; the mastery degree is better; the
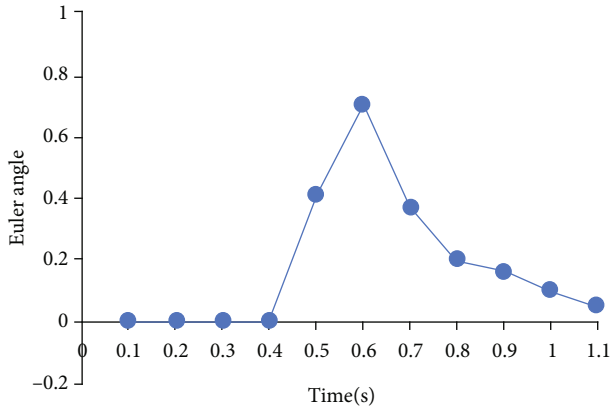
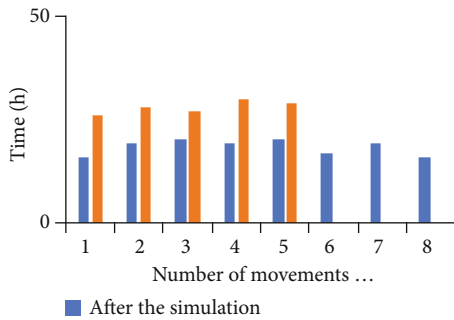FIGURE 2: The Euler angle is indicated in volleyball.
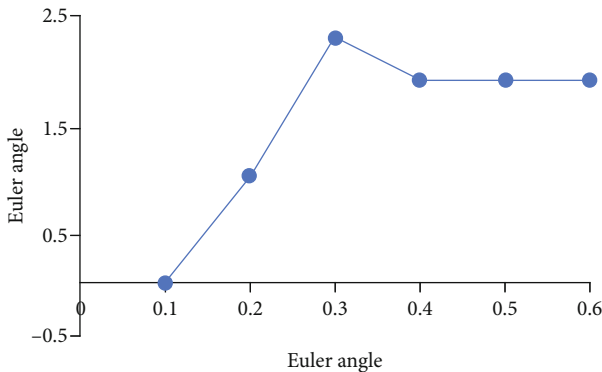

FIGURE 3: Volleyball action training effect.

FIGURE 4: The Euler angle is indicated in diving.

FIGURE 5: Diving action training effect.

time to reach the same level is shorter, that is, the action efficiency is higher; and the application of the system can effectively improve the level of athletes' sports training skills.

3.2. Virtual Reality Technology Based on Artificial Intelligence in Tennis Skills Training. With the emergence of Li Na, Deng Jie, and other world-class players of Chinese women's tennis team in the past two years, tennis is gradually known and sought after by the public. However, due to the complexity and confrontational limitations of the venue and teaching content, it is easy for the athletes to have negative emotions and suppress their learning enthusiasm
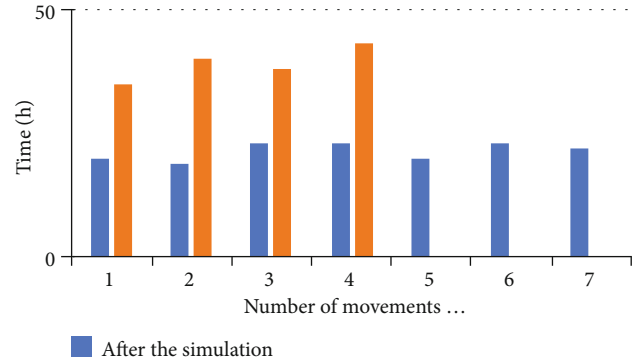
and initiative. This situation is typical of the current situation of people's exercise, so through the application of artificial intelligence virtual reality technology in tennis, we hope to discuss the application of virtual reality technology in sports skills training.

In order to avoid the influence of the existing Tennis Foundation on the training effect, we randomly selected 40 subjects without tennis learning foundation as the research object and divided them into the control group and the experimental group, with the male to female ratio of 1 : 1 in each group. The control group was trained by traditional training methods, and the experimental group was trained by artificial intelligence virtual reality technology. Finally, through the comparison of the results, we hope to see the difference of the effect of virtual reality technology of artificial intelligence on tennis in interest training, sports skills training, and psychological motivation, so as to demonstrate the application of virtual reality technology of artificial intelligence in sports skills training and the application in the current situation of sports skills training in China.

After controlling the relevant irrelevant variables such as the physical fitness of the subjects, the randomness of the training and testing teachers, the teaching content, the testing content, the progress time, and the homogeneity of the place, we started the experiment according to the process. The main process is as follows: firstly, the two groups of subjects were tested in terms of body shape and physical fitness to ensure that the subjects can carry out the experiment and avoid accidents in the process of the experiment. Secondly, the tennis learning interest test is carried out as a comparison with the tennis learning interest test after training. Finally, we test the initial technique of tennis. On the one hand, we can prevent the difference of initial level between subjects from affecting the effect of different training methods. On the other hand, we can make a comparison between the initial reference data and the training effect after the completion of subsequent training. After the above tests, we officially entered the experiment. After the test, the above experimental process was measured and the data were recorded in order.

It can be seen from Figure 6 that everyone likes tennis very much. Except for a few who like or dislike tennis very much, most of them prefer tennis. We first record the distribution of likes before the experiment and then compare the
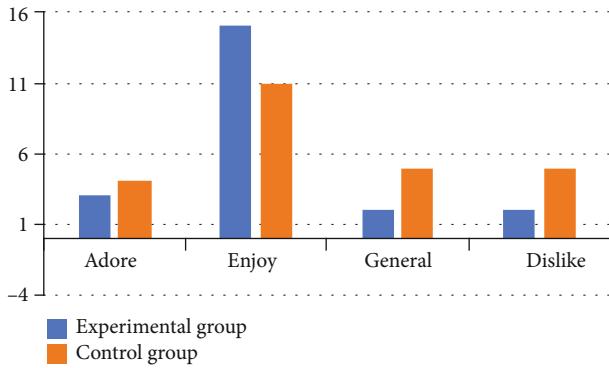
FIGURE 6: Contrast of interest in tennis before experiment.

FIGURE 8: Virtual reality table tennis human-computer interaction scene.

higher efficiency and results in teaching and improving tennis technology. In order to further verify this result, we will further split the process and data of training skills. Due to the influence of space, I will not repeat it here.

To sum up, under the two different training methods, it is found that the effect of virtual reality technology based on artificial intelligence is far more than that of traditional training in the aspects of interest cultivation, enthusiasm promotion, and sports skills training, and the difference is significant. Therefore, in real sports training, we can try to promote the use of artificial intelligence virtual reality technology.

3.3. Application of Table Tennis Training Skills Based on Artificial Intelligence and Virtual Reality Technology. Table tennis, as one of the sports with the highest audience and popularity in China, will also have new effects after the application of virtual reality technology, such as allowing the trainer to enter the role quickly, effectively improving the boring learning process and frustration after failure. Therefore, it is more persuasive to explore the practical application of virtual reality technology based on artificial intelligence in table tennis training.

Table tennis is one of the most advantageous sports in China. A large number of excellent talents are added every year. With the deepening of education reform, a lot of experience and methods that can be copied and popularized have been created. But there are some problems in this system, such as single teaching means and training methods always copy the previous methods, regardless of the actual situation and innovation of training. As a result, the trainers' theoretical knowledge is weak, their interest in learning gradually declines with the training process, and their enthusiasm is hit. After the introduction of artificial intelligence virtual reality technology, it can effectively stimulate the interest and enthusiasm of the trainers, as well as the theoretical basis and practical practice of training. On the successful case of the practical application of artificial intelligence virtual technology in table tennis training, this paper introduces and analyzes its reasons and characteristics, hoping to use this as a template to promote the virtual reality technology of artificial intelligence to other sports skills training.

In table tennis training, the trainers are mainly equipped with data gloves with sensors, which can accurately locate
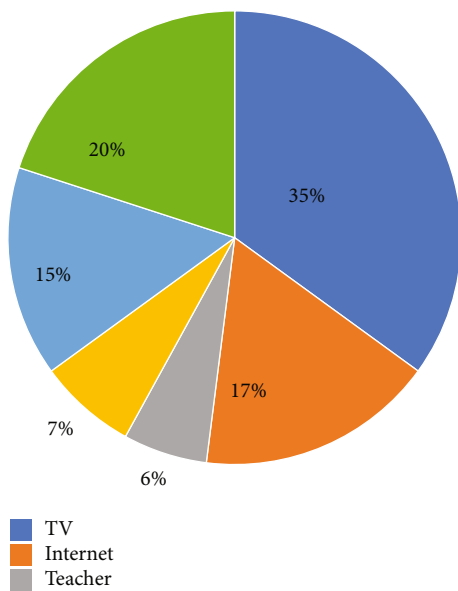

FIGURE 7: Approaches for participants to acquire tennis knowledge.

results after the follow-up and training. It can be seen from Figure 7 that the main channel for people to understand tennis is through television, followed by the Internet, which benefits from the good results of China's National Women's tennis team in the world in recent two years.

Finally, we will position the training score below 60 as failing, 60 to 69 as passing, 70 to 79 as average, 80 to 89 as good, and 90 to 100 as excellent. Through the statistics of the results, we found that 35% of the experimental group trained by artificial intelligence virtual reality technology got excellent, while only 10% of the control group got the evaluation. There was no significant difference between the control group and the experimental group in the general and good range, but 35% of the experimental group in the excellent group got the evaluation, while only 10% of the control group got the evaluation. For this result, we think that the average score is also normal distribution. Affected by the sample size, it is normal that there is no difference between the two groups. But the difference between the experimental group and the control group shows that the virtual reality technology based on artificial intelligence has

TABLE 1: Analysis of application effect of the simulation system.

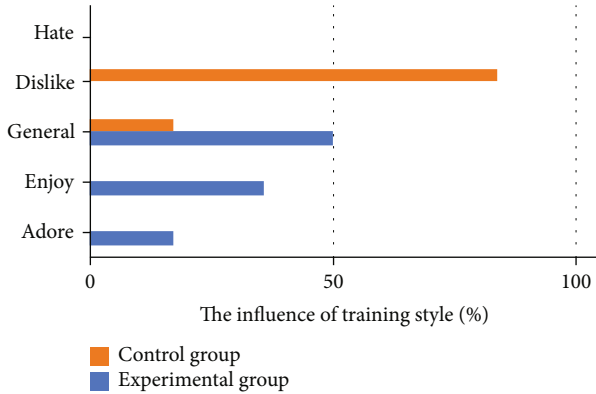| Action name	Correlation data	After applying the simulation system	Before applying the simulation system
The diving movement	Master the number of movements	7	4
The diving movement	The average time to master the movements	21.7	38.4
Delivery of service	Master the number of movements	8	5
Delivery of service	The average time to master the movements	18.2	27.8

FIGURE 9: The influence of training style.

the position and movement track of the trainer's hand and send it back to the computer host, so as to obtain the interactive scene and track between the ball and the trainer in the simulation space. At the same time, the trainer's head is equipped with an electronic eye screen, which can visualize the computer simulation scene, so that the trainer can carry out table tennis training personally (schematic diagram), as shown in Figure 8.

4. Result Analysis and Discussion

To sum up, we explore the application of artificial intelligence virtual reality technology in the process of sports skills training. We found that after the application of artificial intelligence virtual reality technology, the diving movement of athletes changed from 4 before training to 7, and the average time changed from 38.4 to 21.7, nearly 70% higher. The service action technology has changed from 5 to 8, and the average time used has changed from 27.8 to 18.2, which is nearly 80% higher than 40% and 50% before using the system, indicating that the artificial intelligence virtual reality technology has very high use value and obvious use effect (see Table 1).

Similarly, in the application of artificial intelligence virtual reality technology in tennis, through the comparison and analysis of the experimental results, we found that after learning artificial intelligence virtual reality technology and traditional training technology for a period of time, it has a great impact on the interest of the subjects. The control group is from the original most like to general and not interested from 0% to 84%, while the experimental group data is from interested to very interested; at the same time, the

number of interested is also on the rise. This shows that artificial intelligence virtual reality technology plays a great role in fully mobilizing the enthusiasm of trainers and maintaining their nature (as shown in Figure 9).

In addition to the problems discussed above, artificial intelligence virtual technology in sports skills has a role that has not been widely discussed, that is, to reduce injury. In the traditional offline training, there are many reasons, such as insufficient warm-up activities, lack of standardization of technical actions, and lack of reserve of safety knowledge, which often lead to accidental injury, even irreversible injury to the body. This is also one of the current situations of sports skill training, but through the artificial virtual reality technology, we can import the standard action in advance, and then through the positioning sensor, we can locate and analyze the shortcomings of the trainer and refer to the standard action to correct the trainer. At the same time, artificial intelligence virtual reality technology is more used for operation and training in virtual three-dimensional space, which effectively avoids the injury caused by the site. There are few people to explore this aspect. I hope that this paper can attract attention after introducing and raising questions and pay attention to this issue while promoting artificial intelligence virtual reality technology.

5. Conclusion

Through the above discussion, we find that artificial intelligence virtual reality technology has gradually been promoted in the field of education and teaching, because of its immersion, interaction, and conception. Facing the current situation and problems of the training of the social mass sports skills, this paper first expounds the role of artificial intelligence virtual technology in the field of education and teaching through the general application and principle of artificial intelligence in the training of sports skills. Secondly, through the application of artificial intelligence virtual technology in tennis, it fully proves that the use of artificial intelligence virtual reality technology to solve the problems of students, athletes, people, and other different groups in sports skills sports is facing the shortcomings of the decline of enthusiasm, accidental injury, irregular movement skills, and low efficiency. Finally, the successful case of artificial intelligence virtual technology in table tennis training is given. The function and advantages of artificial intelligence virtual technology in sports skill training are illustrated by practical application. It is hoped that the application of artificial intelligence virtual

reality technology in sports training can be accelerated and played a guiding and reference role in it.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

References

[1] T. Richesin, R. Baldwin, and L. A. M. Wicks, "Art making and virtual reality: a comparison study of physiological and psychological outcomes," *The Arts in Psychotherapy*, vol. 75, p. 101823, 2021.

[2] S. Skard, E. Knudsen, H. Sjåstad, and H. Thorbjørnsen, "How virtual reality influences travel intentions: the role of mental imagery and happiness forecasting," *Tourism Management*, vol. 87, p. 104360, 2021.

[3] S. M. C. Loureiro, J. Guerreiro, and A. Japutra, "How escapism leads to behavioral intention in a virtual reality store with background music," *Journal of Business Research*, vol. 134, pp. 288–300, 2021.

[4] N. A. Baker, J. Baird, and M. Driscoll, "Integrating virtual reality into a comprehensive chronic pain program," *Pain Medicine*, vol. 2, pp. 77–79, 2021.

[5] P. Yeh, C. Liu, M. H. Sun, S. C. Chi, and Y. S. Hwang, "To measure the amount of ocular deviation in strabismus patients with an eye-tracking virtual reality headset," *BMC Ophthalmology*, vol. 21, no. 1, pp. 1–5, 2021.

[6] J. Pang, X. Li, and X. Zhang, "Retracted article:Coastline land use planning and big data health sports management based on virtual reality technology," *Arabian Journal of Geosciences*, vol. 14, no. 12, pp. 73–75, 2021.

[7] R. Almashat, R. Baakdah, T. Justinia et al., "Pediatric dentists' perception on the effect of virtual reality on patients," *Computer Methods and Programs in Biomedicine*, vol. 205, p. 105988, 2021.

[8] H. Sadeghi, A. Maat, Y. Taverne et al., "Virtual reality and artificial intelligence for 3-dimensional planning of lung segmentectomies," *JTCVS Techniques*, vol. 7, pp. 309–321, 2021.

[9] K. Pushparajah, K. Chu, S. Deng et al., "Virtual reality three-dimensional echocardiographic imaging for planning surgical atrioventricular valve repair," *JTCVS Techniques*, vol. 7, pp. 269–277, 2021.

[10] M. Parger, C. Tang, Y. Xu et al., "UNOC: understanding occlusion for embodied presence in virtual reality," *IEEE Transactions on Visualization and Computer Graphics*, vol. 43, pp. 1–237, 2021.

[11] D. Baur, C. Pfeifle, and C. E. Heyde, "Cervical spine injury after virtual reality gaming: a case report," *Journal of Medical Case Reports*, vol. 15, no. 1, pp. 11-12, 2021.

[12] M. Takac, J. Collett, R. Conduit, and A. De Foe, "A cognitive model for emotional regulation in virtual reality exposure," *Virtual Reality*, vol. 12, pp. 22–26, 2021.

[13] D. Colombo, A. Díaz-García, J. Fernandez-Álvarez, and C. Botella, "Virtual reality for the enhancement of emotion regulation," *Clinical Psychology & Psychotherapy*, vol. 34, pp. 65–68, 2021.

[14] K. Meyerbröker, "Virtual reality in clinical practice," *Clinical Psychology & Psychotherapy*, vol. 29, pp. 82–85, 2021.