The Application of Artificial Intelligence Technology in Sports Competition

Jianhua Zhang* and Dan Li
Nanchang Institute of Science & Technology, Nanchang 330108, Jiangxi, China

*Corresponding author e-mail: zhangjianhua@ncpu.edu.cn

Abstract. In order to respond to the call of the country to build a strong sports country, the workers in the sports industry should speed up the pace of sports development. Artificial intelligence is a high-end industry, but also a key technology to guide the construction of sports power. Artificial intelligence technology can not only help social development, but also help human autonomy and self-reliance development. The combination of artificial intelligence technology and sports has been common, the future application scope will be more and more extensive, the integration will be deeper and deeper, this paper takes the sports competition as an example, This paper briefly analyzes the application advantage and application status of artificial intelligence technology in sports competition.

Keywords: Artificial Intelligence Technology, Sports Competition, Badminton

Introduction
Artificial intelligence technology, as a frontier technology, can simulate human intelligence, extend human intelligence, expand human intelligence, and accelerate the development of scientific and technological revolution. With the development of computer technology, the combination of artificial intelligence technology and sports competition is becoming more and more close. Artificial intelligence technology can make the audience capture the wonderful moment of sports competition, can also make a more fair and objective evaluation of sports competition, to a certain extent reduce the disputes between referees and athletes. Therefore, it is of great significance to study the application of artificial intelligence technology in sports competitions.

1. The Advantages of Applying Artificial Intelligence Technology in Sports Competitions

1.1 Technical Advantages
The technical support for the deep fusion of artificial intelligence technology and sports competition mainly includes the rapid development of computer technology, the continuous acceleration of computing speed, and the continuous progress of camera technology. The speed of calculation can improve the response speed of real-time referee system, so as to meet the needs of the audience, and the improvement of camera technology can solve the problem of dispute and punishment in sports competition [1].

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
1.2 Talent Advantage
In recent years, the development speed of national physical education has been gradually accelerated, and good results have been achieved in the training of talents in the field of artificial intelligence. The talent team of sports scientific research work is growing, which supports the wide application of artificial intelligence technology in sports competitions in China from the perspective of talents [2].

1.3 Market Advantages
With the continuous development of national economy, the free time of our people has gradually become more and more, and their requirements for watching sports competitions have gradually improved. It is not only expected that sports athletes will have higher technology, but also that the referees of sports competitions will have a higher level, and the judgment of artificial referees will be judged by artificial intelligence technology. So that the audience can see a higher level of sports events on the large display screen, but also from the market point of view to support the wide application of artificial intelligence technology in sports competitions in China [3-5].

2. Present Situation of the Application of Artificial Intelligence Technology in Sports Competitions

2.1 Boundary Digital Detection System and Piezoelectric Sensing Technology in Badminton Stadium
For ball games, the main components of the boundary digital detection system include optical 3D motion tracking and capture equipment, digital display equipment, sound and luminous warning equipment, data information processing system. In the process of badminton competition, the optical 3D motion real-time tracking and capturing device can capture the image of the space position of badminton in real time, and the device can also calculate the 3D target of badminton ball center. After the badminton is out of bounds, the information processing system can process the badminton graphics information, the digital display equipment, the sound and the luminous warning equipment will immediately send out the boundary warning, and display the coordinates after the badminton is out of bounds. After using the out-of-boundary ball digital detection system, the referee and the audience can directly determine whether the badminton is out of bounds by numbers, such as judging whether the badminton is out of bounds when the player serves. However, there are also many defects in the boundary digital detection system: first, the badminton used in the competition needs to be sprayed by infrared, or it needs special treatment to be continuously captured by the equipment [6-9]. This is undoubtedly a transformation of badminton standard structure. Secondly, the accuracy of the detection system judgment will be seriously reduced by infrared interference. Finally, most importantly, because the data information processing system uses a circular ball in calculating the three-dimensional coordinates of badminton, it can not be equated with real badminton, and the shape difference between the two is not small. Errors in estimating contact point size and deciding whether to make warning sounds and lights will inevitably exist [10].

For badminton, the working principle of its piezoelectric sensing technology system is to make badminton contact the piezoelectric material on the floor, make the piezoelectric material have mechanical pressure, and detect the electrical signal of the floor pressure. You can determine the position of contact between badminton and the floor. The piezoelectric material used in piezoelectric sensing technology should be combined with the side floor [11-15]. The friction of piezoelectric material is different from that of the competition floor. The piezoelectric material should be connected to the output part of the electrical signal. The accuracy of its judgment will also be affected by the environment. The weight of badminton is very light, only when the athletes are forced to kill, its pressure on the floor will detect a strong electrical signal, its shortcomings include: first, for the purpose of making the court boundary and badminton contact electrical induction, The contact position between badminton and ground must be made of conductive material or conductive material. Secondly, in low wet weather, people's body surface and object surface often have static electricity, which will seriously affect the accuracy of line audit auxiliary device in judgment. Finally, the sweat
produced by athletes after sweating will also adversely affect the accuracy of the line review auxiliary device in judgment.

2.2 Hawkeye System on Tennis Court
The term "eagle eye technology" is often referred to as "instant playback systems ". The technical principle of Eagle Eye technology is not complicated, but it is very precise [16-17]. The Eagle Eye system consists of a large screen, four computers, eight high-speed cameras, and some with ten high-speed cameras. First, with the powerful help of computer computing power, the Eagle Eye system can divide the three-dimensional space of the field into countless units of measurement in millimeters. Second, the Eagle Eye system can capture the data of the flight trajectory of tennis balls at multiple angles at the same time with the help of a high speed camera, and then calculate and generate three-dimensional images on the computer [18]. Third, under the action of instant imaging technology, the tennis track and the final landing point of tennis are clearly presented on the large screen. The advantage of using Eagle Eye technology is that it can overcome the inherent disadvantage and blind area of human eye in observing things, and then assist the referee to make accurate and fair judgment. At present, there are still defects in the application of Eagle Eye Technology in tennis court. For example, every player can only use two Eagle Eye Challenge opportunities in every game [19]. If you win seven games, you can use Eagle Eye Technology once more to challenge the referee's judgment. At this stage, Eagle Eye Technology has been applied to tennis competitions around the world, not only by many coaches and players, but also by the audience [20].

2.3 Electronic Generators in Football Field
Generally speaking, the side flag of the football match has an electronic generator, which can inform the referee of the penalty in time [21]. The so-called "football electronic referee" refers to the system of judging the occurrence of goals and offside phenomena in football matches in time. Its components can be divided into hardware and software. In addition to football positioning, player positioning, football field corner directional transmitter, football field referee vibration receiver, there are cameras and radar velocimeter, and the development of software system is based on the previous hardware. The rules are based entirely on FIFA's principle of offside. After extracting the feature line, reconstructing the plane coordinate, detecting the football player and detecting the football, we can automatically judge the offside situation in the game. In designing the offside algorithm, the basis is the plane coordinate of the football player. Therefore, people can restore the plane coordinate of football field without using multiple cameras and complicated analysis and calculation. After the course is obtained, the course image is binarized, the binarized image is processed from the morphological point of view, the noise is removed by closed operation, the field is extracted by open operation, the area independent of the course is removed with the assistance of area analysis, the binarized image and the original image of the football field are multiplied, and the RGB image about the course is subtracted. In the main control computer, not only the storage module, but also the image information processing module. The storage module can store the video scene from the camera and the result of the offside judgment, while the image information processing module can detect the players, football and court lines, and can also reconstruct the course coordinates. With the help of the algorithm to judge offside, the position of offside and the consciousness of offside are judged. This method can better monitor the offside phenomenon in football field, reduce the difficulty of referee's work by assisting the way of punishment, and the most important thing is to reduce the misjudgment in football match.

2.4 The Off-Boundary Ball Digital Detection System in Football Matches and Volleyball Matches
In football matches and volleyball matches, the capture equipment can send the captured information to the information processing system in the process of setting the field sports, and judge whether the football and volleyball have been out of bounds after operation and processing. In the relevant rules, only the ball out of bounds can be called the out-of-bound ball, so we should compare the center of the
ball and the position of the side line when the ball landed. At the moment of the ball landing, the device will capture, process and calculate. After a series of comparisons, the system will decide whether to alarm or not.

3. Conclusion
With the joint efforts of the staff in the field of sports research and the participants in sports events, the combination of artificial intelligence technology and sports field is gradually deepening. However, if artificial intelligence technology is applied in all competitions, the result is fair. At present, artificial intelligence technology is not perfect, there is still a lot of room for progress, such as hardware and software matching problems, sports workers still need to explore.

References
[1] Guo Shuang. Discussion on the Application of Artificial Intelligence Technology in College Students' Physical Education Classroom Construction. Computer Products and Circulation, 2020, (05):266-267.
[2] Wang Shiyuan. Application of artificial intelligence technology in sports training. and Digital World, 2020,(01):121.
[3] Zou Xiaojian. A Review of the Application of Artificial Intelligence Technology in Sports. Technology Information, 2019, 17(08):119-120.
[4] Accelerometers for the Assessment of Concussion in Male Athletes: A Systematic Review and Meta-Analysis. Brennan J, et al. Sports Medicine. 2017.
[5] Biomechanics of Training and Testing. Oschnach C, et al. 2018.
[6] Borges P, Conci N, Cavallaro A. Video-Based Human Behavior Understanding: A Survey. IEEE Transactions on Circuits and Systems for Video Technolo- gy, 2013, 23(11):1993-2008.
[7] Matthews C E, et al. Best Practices for Using Physical Activity Monitors in Population-Based Research. Medicine & Science in Sports & Exercise, 2012, 44(1):68-76.
[8] Freedson P, et al. Assessment of Physical Activity Using Wearable Monitors. Medicine & Science in Sports & Exercise, 2012, 44(1):1-4.
[9] Zhang S, et al. Physical activity classification using the GENEA wrist-worn accelerometer. Medicine & Science in Sports & Exercise, 2012, 44(4):742-7488.
[10] Agbinya J I, Rees D. Multi-Object Tracking in Video. Real-Time Imaging, 1999, 5(5):295-304.
[11] Bartlett R. Artificial intelligence in sports biomechanics: new dawn or false hope?. Journal of sports science & medicine, 2006, 5(4):474-479.
[12] Vales A, et al. Ambient Intelligence Systems for Personalized Sport Training. Sensors, 2010, 10(3):2359-2385.
[13] Crouer S E, Clowers K G, Bassett D R.A novel method for using accelerometer data to predict energy expenditure. Journal of Applied Physiology, 2006, 100(4):1324-1331.
[14] Devries S I, et al. Evaluation of Neural Networks to Identify Types of Activity Using Accelerometers. Medicine & Science in Sports & Exercise, 2011, 43(1):101-107.
[15] Trost S G, et al. Artificial Neural Networks to Predict Activity Type and Energy Expenditure in Youth. Medicine & Science in Sports & Exercise, 2012, 44(9):1801-1809.
[16] Skotte J, et al. Detection of Physical Activity Types Using Triaxial Accelerometers. Journal of Physical Activity and Health, 2014, 11(1):76-84.
[17] Montoye A H, et al. Wrist-independent energy expenditure prediction models from raw accelerometer data. Physiological Measurement, 2016, 37(10):1770-1784.
[18] Felzenszwalb P F, Huttenlocher D F. Pictorial Structures for Object Recognition. International Journal of Computer Vision, 2005, 61(1):55-79.
[19] Felzenszwalb P F, et al. Object Detection with Discriminatively Trained Part-Based Models. IEEE Transactions on Pattern Analysis and Machine Intelligence, 2010, 32(9):1627-1645.
[20] Pfeiffer M, Hohmann A. Applications of neural networks in training science. Human Movement...
Science, 2012, 31(2):344-359.

[21] Girshick R B. Object Detection with Grammar Models. Proceedings of the 24th International Conference on Neural Information Processing Systems, 2011: 422-450.