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Article

Integration of intelligent sports technology in optimizing kayaking athletes' movement training

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Abstract: With the continuous advancement of technology, intelligent sports technology has gradually become an important tool in sports training. This study aims to explore the application of intelligent sports technology in optimizing the movement training of kayaking athletes. By introducing advanced technologies such as motion capture, data analysis, and virtual reality, the research aims to improve athletes' coordination and stability in their movements. Using kayaking athletes as research subjects, this study provides a detailed description of the application methods and experimental design of intelligent sports technology and systematically analyzes the collected data. The research results show that intelligent sports technology has a significant effect on improving the precision and efficiency of athletes' movements. Specifically, through real-time feedback and data accumulation, coaches and athletes can develop more scientific and reasonable training plans, thereby significantly enhancing training effectiveness. However, the study also points out the shortcomings of intelligent sports technology in terms of portability and real-time data processing, which need further improvement and optimization in future research. Overall, this study provides evidence for the application of intelligent sports technology in kayaking training, having important practical significance and application value. It offers valuable references for the future development of sports training and intelligent technology.

Keywords: intelligent sports technology; kayaking athletes; movement training optimization; data analysis; virtual reality

1. Introduction

With the rapid advancement of technology, intelligent sports technology has made significant progress in recent years. These technologies include, but are not limited to, motion capture systems, virtual reality (VR), augmented reality (AR), wearable devices, and big data analysis [1]. They are reshaping traditional sports training and performance evaluation methods. The core of intelligent sports technology lies in using advanced sensors and data analysis tools to capture, process, and analyze athletes' biomechanical data, providing scientific basis and precise feedback for training and competition.

In terms of current applications in sports training, intelligent sports technology has been widely used in various sports. For example, in track and field, motion capture systems can record athletes' running postures in real-time and help coaches accurately analyze athletes' movement details through 3D reconstruction technology, thereby correcting errors and improving performance [2]. In swimming, smart goggles and wearable devices can monitor athletes' heart rates, speeds, and strokes, providing real-time data feedback to help them adjust their training strategies. In ball sports such as basketball and soccer, intelligent courts and equipment analyze players' movement

trajectories, passing, and shooting accuracy, thus formulating more efficient tactical plans.

As a sport highly dependent on technique and coordination, kayaking demands high precision and stability in movements. However, traditional training methods often rely on coaches' experience and subjective judgments, making it difficult to achieve precise movement analysis and scientific training guidance. Intelligent sports technology has emerged in this context, providing new possibilities for kayaking athletes' movement training. By using intelligent devices to monitor athletes' stroke frequency, paddling force, and body posture in real-time, coaches can obtain detailed movement data and adjust training plans based on data analysis results, improving athletes' technical movements [3]. Furthermore, the introduction of virtual reality technology allows athletes to conduct simulated training in virtual environments, enhancing their coordination and adaptability to different conditions.

Kayaking, which highly depends on movement precision and coordination, traditionally relies on coaches' experience and subjective judgment, making scientific and precise movement analysis challenging. Intelligent sports technology, by introducing advanced motion capture systems, VR, AR, wearable devices, and big data analysis, provides detailed data support and objective feedback for training. This enables athletes and coaches to better understand and optimize the training process [4]. High-precision motion capture equipment records and analyzes the training data of kayaking athletes in real-time, helping to identify minor deficiencies in movements and offering targeted improvement suggestions through data analysis.

The application of virtual reality technology can simulate real competition environments, allowing athletes to train in virtual scenarios, thereby enhancing movement coordination and environmental adaptability [5]. Wearable devices monitor athletes' heart rate, force output, and body posture, providing comprehensive physiological data that aids in developing scientifically reasonable training plans and real-time adjustment strategies. Big data analysis accumulates and analyzes extensive training data, helping coaches and athletes evaluate training effectiveness, optimize training methods, and improve movement precision and efficiency.

However, accessibility to these advanced technologies can be challenging due to the high costs associated with motion capture systems and VR technology. By exploring more cost-effective, open-source alternatives for data analysis, athletes and institutions can reduce financial barriers, making these cutting-edge tools more widely available.

The purpose of this study is to explore how to optimize kayaking athletes' movement training through the comprehensive application of intelligent sports technology, thereby improving their technical skills and competitive performance. Through systematic data collection and analysis, real-time feedback, and adjustments, the study found that intelligent sports technology significantly improves the precision, coordination, and stability of kayaking athletes' movements. The study also highlights challenges in the practical application of intelligent sports technology, such as device portability and real-time data processing, and proposes corresponding improvement suggestions. The development of intelligent sports technology has provided new scientific methods and technical means for the movement training of canoeists, enabling them to more effectively improve their sports skills and competitive

performance. Intelligent sports technology will be applied to canoeing and training scenarios (**Figure 1**), thereby promoting the scientific and systematic training of sports and the comprehensive development of athletes. In the future, with the continuous advancement of power systems, sensor technology, radar testing, sensors, and other equipment, intelligent sports technology will become more efficient, convenient, and popular. The new generation of intelligent equipment, equipped with new power systems, radar systems, and more technologically advanced paddles, will be lighter, and easier to operate, and the cost will be further reduced, making it easier for athletes and coaches to obtain [6]. In addition, data security and privacy protection technologies will continue to improve to ensure the security of athlete data during collection and processing.

Figure 1. E-Kayak system [6].

2. Research methods

The subjects of this study are national and provincial level kayaking athletes, equally divided between male and female participants, aged between 18 and 30 years, all with more than two years of kayaking training experience [7]. These athletes have demonstrated excellent performance in their respective training and competitions, possessing a certain level of technical proficiency and physical fitness, thereby providing detailed and effective data support for this study. Kayaking, as a water sport, combines various requirements such as strength, endurance, technique, and coordination. Particularly in competitions, athletes need to paddle at high speeds, maintain body balance and rhythm of paddling, demanding high precision and stability in their technical movements.

The basic characteristics of kayaking can be analyzed from the following aspects:

Kayaking involves a series of complex technical movements including paddle initiation, paddling, direction adjustment, and sprinting. These movements require athletes to maintain a high level of coordination and flexibility under different water flow and weather conditions. Especially during turns in competitions, athletes must quickly adjust direction with precise movements while maintaining speed, which demands high technical skills. Moreover, kayaking requires not only upper limb and core muscle strength but also high cardiovascular endurance. Athletes need to perform

high-intensity paddling in a short period and sustain high output over long distances, making the combination of strength and endurance a fundamental characteristic of the sport. Furthermore, maintaining the balance of the kayak on unstable water surfaces is a significant challenge, requiring athletes to use fine body control and precise paddling movements to keep the kayak stable, testing their physical coordination and balance abilities [8]. During competitions, athletes need to quickly respond and make decisions based on changes in water flow, opponents' positions, and the progression of the race, with quick reaction and decision-making abilities being crucial for improving competitive performance (**Table 1**). Additionally, kayaking athletes typically undergo high-intensity training, requiring long periods of aerobic, strength, and specialized technical training daily. Scientific recovery methods such as stretching, massage, and physiotherapy are essential components for ensuring efficient training and competitive states.

Table 1. Advantages and disadvantages of current intelligent sports technology.

Technology	Advantages	Disadvantages
Motion Capture Systems	Precision and Accuracy	High Cost, Complexity and Usability
Wearable Devices	Real-Time Monitoring, Comprehensive Data Collection	Complexity and Usability, Data Privacy and Security
Multi-Sensor Arrays	Comprehensive Data Collection	Portability Issues
Virtual Reality (VR)	Enhanced Training Environments	Portability Issues
Big Data Analytics	Data-Driven Decision Making	Data Overload and Interpretation, Data Privacy and Security

The intelligent sports technologies used in this study mainly include motion capture systems, wearable devices, virtual reality (VR) technology, and big data analysis methods. The comprehensive application of these technologies can provide detailed data support and scientific feedback for the training of kayaking athletes.

The motion capture system uses high-precision sensors and camera equipment to record athletes' technical movements in real-time. These sensors are usually installed on the athletes' joints and paddling equipment, capturing every minute movement change to generate three-dimensional movement models. The motion capture system can capture athletes' every subtle movement during training and competition with millisecond precision. These data are subsequently processed and analyzed to help coaches and athletes identify deficiencies in movements and propose specific improvement suggestions.

Wearable devices mainly include heart rate monitors, force sensors, and motion sensors. These devices can monitor athletes' physiological indicators in real-time, such as heart rate, blood oxygen saturation, muscle force output, and fatigue levels. By combining these physiological data with motion capture data, a comprehensive understanding of athletes' physical condition and technical performance can be achieved. Wearable devices can also record athletes' physiological changes at different training stages, providing a basis for developing personalized training programs.

Virtual reality technology constructs highly realistic simulated training environments, enabling athletes to train in virtual scenarios [9]. VR technology can

not only simulate real competition environments but also adjust training scenes as needed, such as changing water flow speed or simulating different weather conditions. Through VR training, athletes can practice technical movements in a safe and controlled environment, enhancing their movement coordination and environmental adaptability. VR technology can also record and analyze athletes' performance in virtual training, providing detailed technical feedback and improvement suggestions.

Big data analysis accumulates and processes a large amount of training data, helping coaches and athletes comprehensively evaluate training effectiveness and technical improvements. Specifically, big data analysis can identify key indicators in athletes' movements, such as paddle frequency, force output, and technical stability, and correlate these indicators with athletic performance and physiological status [10]. Through long-term data accumulation and analysis, the technical progress and existing issues of athletes at different training stages can be identified, guiding the adjustment and optimization of subsequent training strategies.

3. Research design and procedures

3.1. Experimental procedures and methods

The purpose of this study is to explore the application of intelligent sports technology in the movement training of kayaking athletes, providing detailed data support and feedback through scientific design and systematic experiments to enhance athletes' technical skills. The specific procedures and methods of the experiment are as follows:

(1) Selection of subjects: National and provincial level kayaking athletes are selected, equally divided between male and female participants, aged between 18 and 30 years, all with more than two years of training experience. Subjects were required to undergo health checks to ensure that no serious injuries would affect the experimental results.

(2) Pre-experiment preparation: Before the formal experiment began, basic information of all participants, including height, weight, and arm span, was collected. Athletes also underwent an assessment of their basic technical movements, recording their initial status data as a control.

(3) Installation and calibration of technical equipment: High-precision motion capture devices were installed on the athletes' joints, paddles, and kayaks to ensure that the sensors accurately recorded every detail of their movements. Wearable devices such as heart rate monitors and electromyography sensors were also worn by the athletes to record their physiological indicators. All equipment was calibrated before use to ensure the accuracy and reliability of the data.

(4) Setting up the experimental environment: Training environments were set up in both the laboratory and actual water bodies. In the laboratory, virtual reality technology was used to simulate real competition scenarios, adjusting water flow and weather conditions to provide diverse training scenes. The actual water training was conducted on relatively stable water surfaces to avoid environmental changes that could interfere with data collection.

(5) Training and data collection: Athletes performed a series of standardized training movements in the preset training environments, including paddle initiation,

paddling, turning, and sprinting. Throughout the training process, the motion capture system and wearable devices recorded the athletes' technical movements and physiological indicators in real-time. After each training session, athletes were required to fill out training feedback forms to record their subjective feelings and suggestions.

(6) Data processing and analysis: All collected data were processed and analyzed using specialized software. Firstly, the data were cleaned and preprocessed to remove noise and incomplete data. Then, big data analysis tools were used to comprehensively analyze the motion capture data and physiological indicators, identifying key indicators in the athletes' movements, such as paddle frequency, force output, and technical stability, and correlating these indicators with athletic performance.

(7) Feedback and adjustments: Based on the data analysis results, personalized training programs were developed for each athlete. Coaches guided the athletes in adjusting and optimizing their technical movements according to real-time feedback. Periodic testing was conducted to evaluate the training effectiveness, and training plans were adjusted based on the results to ensure scientific and effective training.

(8) Long-term tracking and evaluation: The study involved long-term tracking and evaluation of the athletes, recording their technical progress and training effectiveness. Through the long-term accumulation of data, the effectiveness and improvement directions of different training methods were analyzed, providing a basis for future research and applications.

3.2. Data collection and processing

The data collection process in this study aims to comprehensively capture the movements and physiological indicators of kayaking athletes to provide precise feedback and analysis. Firstly, we used a motion capture system that includes high-precision inertial sensors and optical camera equipment, installed on the athletes' key joints and kayaking equipment, to record their movement trajectories and technical actions in real-time [10]. These sensors can capture movements at the microsecond level, generating a holographic motion model of the athlete through three-dimensional reconstruction technology, providing detailed kinematic data.

At the same time, as shown in **Figure 2**, athletes wear heart rate monitors, electromyography sensors, GPS locators, and other wearable devices, and video recording can record the athlete's activity status in real time. Kayaks are equipped with data transmission equipment, and the athlete's muscle activity, force output, movement trajectory and other physiological indicators can be displayed on the device at any time and sent to the athlete at the same time.

Virtual reality (VR) technology was used to create simulated training environments. Through VR headsets and controllers, athletes could train in virtual competition scenarios, simulating different water flows and weather conditions to enhance their adaptability and coordination in technical movements [11]. The VR training process was also meticulously recorded and analyzed in conjunction with motion capture and physiological data.

Figure 2. Smart devices workflow of e-kayaking system.

Finally, all data was processed and analyzed through a big data analysis platform. Data processing included cleaning, calibration, and feature extraction steps to ensure data accuracy and usability. Big data analysis tools comprehensively analyzed multidimensional data, identifying key indicators in athletes' movements and training effectiveness [12]. Through long-term data accumulation and comparison, training plans were optimized to improve athletes' technical skills and competitive performance.

During the data processing stage, we employed a series of software tools and data metrics to ensure data accuracy and comprehensive analysis. Firstly, during the data cleaning phase, we utilized data processing libraries in Python and R (such as Pandas, NumPy, and dplyr) to clean the collected data, automatically removing noise and outliers to ensure data integrity and consistency. The cleaned data was then stored in an SQL database for convenient extraction and analysis in subsequent steps.

Next, we perform feature extraction, extracting key features such as strokes per minute, force output, angular velocity, and body posture from the high-precision motion capture and physiological data. These features are processed and extracted using signal processing and feature extraction methods in MATLAB and Python's SciPy library to identify subtle changes and key indicators in athletes' movements. Physiological data from wearable devices (such as heart rate and electromyographic signals) are collected and initially processed through platforms like Biostrap and Empatica.

During the statistical analysis phase, we use professional statistical software such as SPSS and SAS to perform descriptive statistical analysis (e.g., mean, standard deviation) and inferential statistical analysis (e.g., *t*-tests, ANOVA) on the extracted features. Additionally, regression analysis and multivariate analysis are conducted using Python's scikit-learn library to evaluate training effectiveness and technical improvements [13]. We focus particularly on changes in key indicators before and after training, employing time series analysis and clustering analysis to identify long-term training trends and patterns.

Finally, data visualization is a crucial part of our data processing. Using data visualization tools like Tableau and Power BI, we create dynamic reports and visual

charts to intuitively display the results of our data analysis. Training data and analysis results are presented in charts and interactive dashboards to help coaches and athletes better understand and utilize data feedback.

These processing and analysis methods, combined with real-time monitoring systems, provide immediate technical feedback during training, helping athletes adjust their movements in real-time [14]. Through IoT platforms like ThingSpeak, real-time collection and analysis of sensor data are achieved, ensuring that every subtle change during training is recorded and fed back. In summary, the comprehensive application of these data processing methods and tools ensures data accuracy and reliability, providing a scientific basis for comprehensively evaluating athletes' technical performance and training effectiveness. It is important to note that the collection of sensitive physiological and movement data poses risks of data breaches or misuse. Taking improved security measures, such as end-to-end encryption for data storage and transmission, as well as anonymizing data during analysis, is crucial to protect athletes' information and reduce sensitivity in case of breaches.

4. Results and analysis

This study conducted a detailed analysis of kayaking athletes' movement training using intelligent sports technology, yielding the following key data and results:

- Precision and coordination of movements:
  (1) Data recorded by the motion capture system indicates that athletes trained with the assistance of intelligent sports technology showed significant improvements in paddle frequency, force output, and body posture stability ($p < 0.01$).
  (2) Average paddle frequency increased by 10% ($p < 0.01$), force output by 15% ($p < 0.01$), and body posture stability by 20% ($p < 0.01$).
- Changes in physiological indicators:
  (1) Physiological data recorded by wearable devices (such as heart rate and electromyographic signals) show reduced heart rate variability and decreased muscle fatigue during training ($p < 0.05$).
  (2) Average heart rate decreased by 5% ($p < 0.05$), and electromyographic signals indicated a 20% reduction in muscle fatigue recovery time ($p < 0.05$).
- Effectiveness of virtual reality training:
  (1) Training results in the virtual reality environment show significant improvements in athletes' adaptability to technical movements under different water flows and weather conditions ($p < 0.01$).
  (2) Through VR training, athletes' movement response time decreased by 15% ($p < 0.01$), and adaptability to varying environmental conditions improved by 25% ($p < 0.01$).
- Overall training effectiveness:
  (1) Big data analysis results indicate that athletes trained using intelligent sports technology show superior performance in movement precision, coordination, and physiological indices compared to those relying solely on traditional training methods ($p < 0.01$).
  (2) Long-term tracking and data accumulation revealed that athletes trained

with intelligent sports technology showed a 10% to 15% improvement in competitive performance by the end of the season ($p < 0.01$) (see **Table 2**).

Table 2. Improvement from intelligent sports technology in training.

Category	Metrics	Improvement	Statistical Significance (*p*-value)
Precision and Coordination of Movements	Average paddle stroke frequency	+10%	< 0.01
	Force output	+15%	< 0.01
	Body posture stability	+20%	< 0.01
Physiological Index Changes	Average heart rate	−5%	< 0.05
	Muscle fatigue recovery time	−20%	< 0.05
Effectiveness of VR Training	Movement response time	−15%	< 0.01
	Adaptability to environmental changes	+25%	< 0.01
Overall Training Effectiveness	Competitive performance improvement	+10% to +15%	< 0.01

Through the aforementioned results and analysis, it can be seen that intelligent sports technology has played an important role in optimizing the movement training of kayaking athletes. These technologies have enhanced the precision and coordination of technical movements, allowing athletes to adjust their movements in real-time and correct errors through precise data feedback. This improvement in movement consistency and stability has significantly increased paddle frequency and force output. Additionally, the improvement in physiological indicators demonstrates its potential in optimizing athletes' physical condition, as wearable device monitoring shows reduced heart rate variability and decreased muscle fatigue, indicating improved tolerance to high-intensity training. Meanwhile, the training conditions provided by virtual reality technology, simulating different competition environments, have greatly enhanced athletes' environmental adaptability. This diversity and flexibility in training methods have enabled athletes to perform more confidently and composedly in actual competitions. Furthermore, big data analysis comprehensively evaluated athletes' training effectiveness and technical progress, identifying key indicators in their movements and discovering the effects and improvement directions of different training methods through long-term data accumulation. Consequently, these analytical results have assisted coaches in formulating more scientific and personalized training plans, optimizing the athletes' training process. In summary, intelligent sports technology has shown significant effects in enhancing athletes' technical movements, physiological states, and environmental adaptability. It not only provides a scientific basis for optimizing the movement training of kayaking athletes but also ensures better performance in future competitions. Therefore, intelligent sports technology, through scientific training methods and precise data analysis, is bringing new possibilities to sports training, driving athletes to achieve even better performances in various competitions.

5. Discussion

This study comprehensively discusses the application effects of intelligent sports technology in kayaking training, highlighting its significant advantages in improving athletes' technical movement precision, coordination, and physiological indicators.

However, some areas need improvement and optimization.

Firstly, intelligent sports technology, through precise data feedback and real-time monitoring, significantly enhances athletes' training efficiency and technical performance. The motion capture system can record every subtle movement of the athletes, helping them correct errors through data analysis, thus improving movement consistency and stability. Simultaneously, virtual reality technology offers the possibility to simulate different competition environments, allowing athletes to train under various conditions, thereby enhancing their environmental adaptability [15]. Wearable device monitoring shows improved tolerance to high-intensity training, indicating the significant advantages of intelligent sports technology in enhancing athletes' overall training effectiveness.

However, the application of intelligent sports technology also faces challenges and shortcomings. The first challenge is the high cost and complex technical operation. High-precision motion capture equipment and virtual reality systems are expensive, posing a considerable burden for athletes and training institutions with limited resources. Additionally, the portability and operational complexity of the equipment are issues. Although these technological devices provide detailed data and feedback, their heavy weight, complex installation, and requirement for professional operation limit their widespread use and application in daily training [3,4]. Even though virtual reality technology can simulate various training environments, its bulky and non-portable equipment restricts its use in outdoor and competition settings.

Regarding data processing and analysis, although big data analytics provides detailed training feedback and scientific guidance, it also faces challenges related to data privacy and security. Athletes' physiological and technical movement data are highly sensitive, necessitating secure data transmission and storage to prevent breaches or misuse. Furthermore, while big data analytics can identify critical indicators in athletes' movements, it requires substantial data accumulation and professional data analysts for processing and interpretation, imposing high demands on the real-time processing and efficacy of data [9]. It is crucial to recognize that the collection of sensitive physiological and movement data poses risks of data breaches or misuse. Implementing enhanced security measures, such as end-to-end encryption for data storage and transmission, as well as anonymizing data during analysis, is essential to safeguard athletes' information and mitigate sensitivity in the event of breaches. Additionally, coaches and athletes may struggle to distill actionable insights from the extensive data generated, underscoring the need for user-friendly analytical tools. Developing straightforward, interactive dashboards that provide actionable insights with an emphasis on clarity, or creating systems that translate complex data into actionable recommendations conveyed in plain language, can significantly assist in making data-driven decisions. These comprehensive discussions reveal both the advantages and areas needing improvement in the application of intelligent sports technology in kayaking training, guiding future research and optimization efforts.

Intelligent sports technology has played a crucial role in optimizing the movement training of kayaking athletes. These technologies have enhanced the precision and coordination of technical movements, allowing athletes to adjust their movements in real-time and correct errors through precise data feedback, thereby improving movement consistency and stability. This has significantly increased paddle

frequency and force output. Improvements in physiological indicators demonstrate its potential in optimizing athletes' physical condition. Wearable device monitoring shows reduced heart rate variability and decreased muscle fatigue, indicating improved tolerance to high-intensity training. Virtual reality technology provides training conditions that simulate different competition environments, greatly enhancing athletes' environmental adaptability. This diversity and flexibility in training methods allow athletes to perform more confidently and composedly in actual competitions. Operating and maintaining these advanced systems also necessitate specialized knowledge, which might not be available to all sports teams or training centers. Encouraging collaboration with technology developers to design lightweight, portable versions of motion capture and VR equipment, or enhancing battery life to reduce dependency on power sources, could increase the accessibility and portability of these advanced technologies.

Comprehensive evaluations through big data analysis assess athletes' training effectiveness and technical progress, identifying key indicators in their movements [10]. Long-term data accumulation reveals the effects and improvement directions of different training methods. These analytical results assist coaches in formulating more scientific and personalized training plans, optimizing the athletes' training process. Intelligent sports technology demonstrates significant effects in enhancing athletes' technical movements, physiological states, and environmental adaptability. It not only provides a scientific basis for optimizing the movement training of kayaking athletes but also ensures better performance in future competitions.

Intelligent sports technology, through scientific training methods and precise data analysis, is bringing new possibilities to sports training, driving athletes to achieve even better performances in various competitions. In summary, intelligent sports technology has significant implications for promoting the scientific and efficient training of kayaking athletes. However, its application needs further optimization in terms of equipment portability, cost control, and data security [7]. Specifically, more lightweight and user-friendly equipment should be developed to reduce technological costs and increase equipment accessibility. Data processing requires enhanced data security management to ensure the privacy and safety of athletes' data while introducing more intelligent analysis algorithms to improve real-time data processing and accuracy. Additionally, more professional technical personnel should be trained to better apply and maintain these technologies.

Overall, the application of intelligent sports technology in kayaking training shows great potential and broad prospects. Through continuous optimization and improvement, these technologies can provide athletes with more scientific and efficient training methods in the future, enhancing their technical skills and competitive performance. However, it is important to address the portability problem, as the current article mentions the shortcomings of smart sports technology in this regard but does not discuss in detail how to overcome this issue. Future research should explore relevant solutions to enhance portability. Additionally, while the shortcomings of real-time data processing are acknowledged, there is a lack of specific suggestions for improvement. Providing more solutions or research directions in future studies is recommended to address this gap. Furthermore, the study was limited to kayakers, which may affect the general applicability of the findings. Expanding the

sample to include athletes from other sports could enhance the generalizability of the study's results. These technological application experiences can also be extended to other sports, providing strong support for the overall promotion of intelligent sports training. Through scientific training methods and precise data analysis, intelligent sports technology is bringing new possibilities to sports training, driving athletes to achieve even better performances in various competitions.

6. Conclusion

This study provides a detailed analysis of the application of intelligent sports technology in the movement training of kayaking athletes, revealing that these technologies significantly enhance the precision, coordination, and physiological indicators of athletes' technical movements. By introducing advanced methods such as motion capture systems, virtual reality technology, wearable devices, and big data analysis, athletes can adjust and optimize their training movements in real time, receiving detailed technical feedback and scientific guidance. The results show that intelligent sports technology not only has clear advantages in improving training efficiency and technical performance but also demonstrates significant effects in improving athletes' physiological state and environmental adaptability.

Intelligent sports technology, through precise data feedback and real-time monitoring, helps athletes improve movement consistency and stability, significantly increasing paddle frequency and force output. Monitoring by wearable devices shows reduced heart rate variability and decreased muscle fatigue, indicating improved tolerance to high-intensity training. The training conditions provided by virtual reality technology, which simulate different competition environments, greatly enhance athletes' environmental adaptability, allowing them to perform more confidently and composedly in actual competitions. Additionally, big data analysis comprehensively evaluates athletes' training effectiveness and technical progress, identifying key indicators in their movements and discovering the effects and improvement directions of different training methods through long-term data accumulation and comparison, thereby assisting coaches in formulating more scientific and personalized training plans.

In summary, intelligent sports technology has important application value in optimizing the movement training of kayaking athletes, enhancing their technical skills and competitive performance. It also provides strong support for the future promotion of intelligent sports technology across various sports. Through scientific training methods and precise data analysis, intelligent sports technology is bringing new possibilities to sports training, driving athletes to achieve even better performances in various competitions. In the future, as technology continues to develop and improve, intelligent sports technology will be applied in a broader range of sports and training scenarios, further promoting the scientific and efficient development of sports training. Additionally, with the continuous advancement of artificial intelligence, sensor technology, and data analysis methods, intelligent sports technology will become more efficient, convenient, and widespread. New generations of intelligent devices will be lighter, easier to operate, and more affordable, allowing more athletes and coaches to access them. Furthermore, data security and privacy

protection technologies will continue to improve, ensuring the safety of athletes' data during collection and processing. Future research will continue to explore the application of these technologies in different sports, discovering new methods for optimizing training and promoting the trend of more personalized and intelligent sports training. The continuous innovation and development of intelligent sports technology will provide more scientific training methods for various sports projects, helping athletes achieve even greater success on the international stage.

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