Frontiers in Computing and Intelligent Systems
ISSN: 2832-6024 | Vol. 6, No. 3, 2023

Research on Gymnastics Teaching and Training Simulation System under Computer Internet of Things Technology

Qinsheng Li, Qingfeng Shi

College of Physical Education Taishan University, Tai'an 271000, China

Abstract: With the rapid development of information technology, the application of computer and Internet of Things (IoT) technology is becoming increasingly widespread in various fields. This study aims to explore the application of computer IoT technology in gymnastics teaching and training, as well as to develop an efficient gymnastics teaching and training simulation system. By utilizing IoT technology to collect and analyze athletes' movement data, this system can provide more accurate and personalized training suggestions, thereby improving the effectiveness of teaching and training. The study shows that this system can not only effectively enhance athletes' training efficiency and skill level but also reduce the risk of injury, making it significantly relevant and valuable for gymnastics teaching and training. Additionally, this research offers a new perspective and possibility for the application of computer IoT technology in other sports projects.

Keywords: Computer; Internet of Things; Gymnastics Teaching; Training Simulation; Simulation System.

1. Introduction

In today's era of rapid development of information technology, computers and Internet of Things technology have shown their unique value and potential in many fields. Especially in the field of sports, the application of these technologies has opened up new methods of training and teaching[1]. In gymnastics, a sport requiring high precision and skill, traditional training methods face many limitations, such as low efficiency and difficulty in accurately analyzing athletes' movements[2]. Therefore, the introduction of computers and IoT technology to enhance the scientific and safety aspects of training has become an urgent need in this field[3].

This study aims to use computer IoT technology to develop a simulation system specifically for gymnastics teaching and training[4]. The design of this system focuses on the precise capture and evaluation of gymnasts' movements through advanced data collection and analysis technologies, providing coaches with more scientific training suggestions. The scope of this research includes the application of IoT technology in gymnastics training, the specific design and implementation of the simulation system, and the evaluation of the system's effectiveness in actual teaching and training[5].

As computer science and IoT technology continue to advance, their application in sports training is becoming more widespread, revolutionizing traditional methods of sports training. Particularly in high-risk and skill-demanding gymnastics training, the application of these technologies not only improves training efficiency and quality but also effectively reduces the risk of injury during training. Therefore, this study is innovative not only technically but also practically significant, offering new perspectives and methods for gymnastics teaching and training [6].

2. Application of IoT Technology in Gymnastics Teaching

Internet of Things (IoT) technology involves connecting various information sensing devices through the internet to collect, exchange, and analyze data[7]. These devices include various sensors, cameras, wearable devices, etc., capable of collecting real-time data about the environment and user behavior. In gymnastics training, these technologies can be used to monitor the quality of athletes' movements, muscle activity, heart rate, and other physiological parameters, providing comprehensive data support for coaches[8].

In gymnastics teaching, the application of IoT technology can significantly enhance the precision and personalization of training. By analyzing collected data, coaches can more accurately assess athletes' technical movements and physical condition, thereby devising more scientific and effective training plans. Additionally, IoT technology can also be used to monitor the training environment, such as temperature, humidity, and equipment status, ensuring optimal training conditions[9].

For example, in a case of using IoT technology for gymnastics training, data collected through wearable devices helped coaches analyze issues in an athlete's power distribution and body balance while performing a certain movement. This in-depth data analysis allowed coaches to provide more targeted guidance, helping athletes improve their technique and avoid injuries (figure 1).

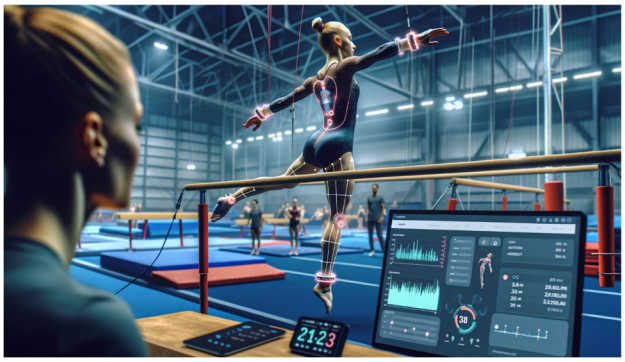

Figure 1. High-Tech Gymnastics Training with IoT Wearables

3. Design of the Gymnastics Training Simulation System

3.1. System Architecture

The data collection module of the gymnastics training simulation system forms the foundation of the entire system. This module uses a variety of sensors and wearable devices to collect various physical and physiological parameters of athletes during training, such as movement trajectory, muscle activity, heart rate, and energy consumption[10]. Precise collection of these data is crucial for subsequent analysis and training optimization. To ensure the accuracy and reliability of data, the module employs advanced sensor technology and data transmission protocols.

The data processing and analysis module is the core of the system, responsible for processing and analyzing the large amount of data collected. This module uses complex algorithms and machine learning technology to perform in-depth analysis, extracting valuable information for training and teaching. These analysis results help coaches better understand athletes' performance and training needs, while also providing personalized training suggestions. Additionally, the module can identify potential injury risks, further enhancing training safety.

The user interface is the bridge connecting the system and users. This interface is designed to be simple and intuitive, ensuring that coaches and athletes can easily access and understand the data and analysis results provided by the system. Users can view real-time updates of training data, historical trend analysis, and customized training plans through this interface. The design of the interface focuses on user experience, offering various interaction methods, including touchscreen operations and voice control, to meet the needs and preferences of different users.

3.2. Functional Modules

Motion capture analysis is one of the key functions of the gymnastics training simulation system. This module uses high-precision sensors and advanced image processing technology to capture every movement of the athlete in real-time. Detailed analysis of these data can accurately reflect the quality of athletes' movements, including the accuracy, smoothness, and deviation from standard movements. This is crucial for guiding athletes to make technical adjustments and improvements.

Based on the data obtained from motion capture analysis, the training plan customization function can provide personalized training schemes for each athlete. The system intelligently generates training plans suitable for each athlete by considering their physical level, technical characteristics, and progress speed. This personalized training not only improves training efficiency but also better meets the individual needs and goals of athletes.

The progress tracking function allows coaches and athletes to monitor training progress in real-time. By recording and analyzing various data during the training process, such as athletes' physical performance, technical progress, and training intensity, the module provides a visual way to track the overall training effect of athletes. This not only helps athletes and coaches adjust training plans in time but also helps maintain athletes' motivation and focus.

The feedback mechanism in the system provides real-time training feedback for athletes and coaches. This feedback is based on the system's continuous analysis of training data, including instant assessment and improvement suggestions for movement execution. This not only helps athletes adjust in real-time during training but also promotes interaction and communication between coaches and athletes, thereby improving the efficiency and effectiveness of the entire training process.

3.3. Technical Implementation

One of the core aspects of the gymnastics training simulation system is its efficient data processing algorithms. These algorithms are responsible for extracting useful information from a large amount of complex training data and conducting in-depth analysis. The system uses machine learning and artificial intelligence technology, particularly in pattern recognition and predictive analysis, to ensure accurate assessment of athletes' movements and performance. These algorithms can process real-time data and learn and adapt from historical data, continuously improving analysis accuracy and efficiency.

Artificial intelligence technology plays a crucial role in this system. Using AI technology, the system can simulate the judgment and experience of professional coaches, providing more detailed and in-depth analysis of athletes' movements. Additionally, AI technology is also used for generating personalized training plans and implementing real-time feedback mechanisms, ensuring that each athlete receives the most suitable training guidance for their specific needs.

The design of the system's user interface is also crucial. To ensure that users—whether coaches or athletes—can easily access and understand complex training data, the interface design emphasizes intuitiveness and ease of use. The interface features a clear layout, simplified operation process, and is equipped with intuitive charts and animations to help users quickly understand information. Additionally, to adapt to the needs of different users, the interface design also considers customizability and adaptability, providing a more personalized user experience.

4. System Evaluation and Analysis

During the development of the gymnastics training simulation system, a series of testing methods were used to assess the system's performance and effectiveness. These testing methods include functional testing, performance testing, user experience testing, and actual application testing. Functional testing ensures that each module of the system works as expected. Performance testing focuses on the system's ability to process large amounts of data and response speed. User experience testing involves real coaches and athletes to assess the system's practicality and ease of use. Finally, by applying the system in actual gymnastics training environments, its performance in real scenarios is comprehensively evaluated.

Performance evaluation mainly focuses on the system's data processing speed and accuracy. By comparing the system's analysis results with professional coaches' assessments, the system's accuracy in technical movement analysis can be verified. At the same time, the system's response time is also a key indicator in the evaluation, ensuring that the system can provide feedback without delay in real-time training environments. Additionally, the system's stability and reliability have also been verified in long-term operation tests, ensuring that there is no performance degradation during continuous use.

The result analysis phase focuses on the system's

effectiveness in actual application. By comparing with traditional training methods, the system's effectiveness in improving training efficiency, reducing the risk of injury, and enhancing athletes' skills is evaluated. Additionally, the system's adaptability to different training stages and athletes of different levels is also examined. By collecting user feedback, further improvements to the system design are made, making it more in line with the actual training needs.

User feedback is an important part of evaluating the system. By collecting feedback from coaches and athletes, the system's advantages and shortcomings in actual application can be understood(figure 2). This feedback not only covers the system's functionality and efficiency but also includes the user-friendliness and convenience of the user interface. Based on this feedback, the development team can continue to optimize the system, making it more aligned with users' actual needs and usage habits.

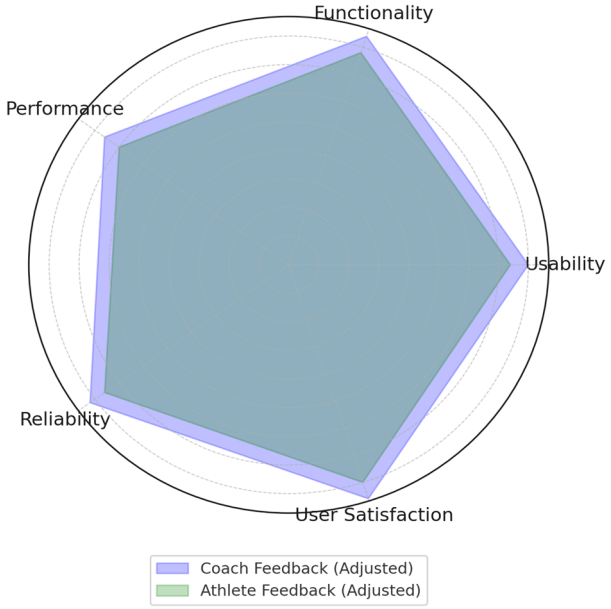

Figure 2. Gymnastics Training Simulation System User Feedback

5. Conclusion

This study has successfully developed gymnastics teaching and training simulation system based on computer IoT (Internet of Things) technology. The design and implementation of this system have broken through the limitations of traditional gymnastics training, providing coaches and athletes with an efficient and precise training assistance tool. Through real-time data collection, in-depth analysis, and the generation of personalized training plans, this system significantly enhances the scientificity and efficiency of gymnastics training.

The evaluation results of the system demonstrate its positive impact on improving training quality, reducing the risk of injuries, and enhancing athletes' skills. User feedback also confirms the practicality and user-friendliness of the system, particularly in the aspects of sports technique analysis and personalized training recommendations. However, it should be noted that the effective utilization of the system still depends on the adaptability and acceptance of the technology by coaches and athletes.

Future research can expand and deepen in several areas. Firstly, the system's data processing capabilities and user interface can be further optimized based on user feedback. Secondly, exploring the potential value of the system in a broader range of sports training domains could be considered, examining its applicability to other sports disciplines. Finally, as technology advances, future research can explore the integration of more advanced technologies, such as augmented reality and virtual reality, into the training simulation system to provide a richer and more interactive training experience. This study not only achieved innovation at the technological level but also offered new perspectives and approaches to gymnastics teaching and training. We look forward to further research and development building upon this foundation, bringing more possibilities to the field of sports training.

References

[1] Perera C , Zaslavsky A , Christen P ,et al.Sensing as a Service Model for Smart Cities Supported by Internet of Things [J]. European Transactions on Telecommunications, 2014, 25 (1): 81-93.DOI:10.1002/ett.2704.

[2] Sun Q B , Liu J , Li S ,et al.Internet of things: Summarize on concepts, architecture and key technology problem[J].Journal of Beijing University of Posts and Telecommunications, 2010, 33(3):1-9.DOI:10.3724/SP.J.1238.2010.00585.

[3] Weber R H .Internet of Things – New security and privacy challenges[J].Computer Law & Security Review the International Journal of Technology & Practice, 2010, 26(1): 23-30. DOI:10.1016/j.clsr.2009.11.008.

[4] Zanella A , Bui N , Castellani A ,et al.Internet of Things for Smart Cities [J].IEEE Internet of Things Journal, 2014, 1(1): 22-32.DOI:10.1109/JIOT.2014.2306328.

[5] Miorandi D , Sicari S , Pellegrini F D ,et al.Internet of things: Vision, applications and research challenges[J].Ad Hoc Networks, 2012, 10(7):1497-1516.DOI:10. 1016/j. adhoc. 2012. 02.016.

[6] Graafland M , Schraagen J M , Schijven M P .Systematic review of serious games for medical education and surgical skills training[J].British Journal of Surgery, 2012, 99(10): 1322-1330.DOI:10.1002/bjs.8819.

[7] Banks P A , Bollen T L , Dervenis C ,et al.Classification of acute pancreatitis—2012: revision of the Atlanta classification and definitions by international consensus[J].Gut, 2013, 62(1):102-111.DOI:10.1136/gutjnl-2012-302779.

[8] Hua L , Junguo Z , Fantao L .Internet of Things Technology and its Applications in Smart Grid[J].Telkomnika Indonesian Journal of Electrical Engineering, 2013, 12(2):940-946.DOI:10.11591/telkomnika.v12i2.4178.

[9] Salah S , Alyouzbaky B A .Assessment of the Acceptance of Internet of Things Technology in the Health Field Using TAM2: A Survey Study of Medical Staff in Nineveh Governorate [J].International Journal of Innovation and Technology Management, 2023, 20(08). DOI: 10.1142/ S0219877023500554.

[10] Liu S .Research on the application of internet of things technology in digital sports and community fitness[J].Boletin Tecnico/Technical Bulletin, 2017, 55(4):139-145.