Research on Motion Intensity Monitoring and Motion Scheme Recommendation Based on Internet of Things

Yu Chen, Jiadong Zhu, Mengnan Wang*

Author Introduction:
Chen Yu (1986-9), Male, Han, Hengyang, Hunan Province, Lecturer, Master.
Research Direction: Physical Education;
Zhu Jiadong (1989-1), Male, Han, Hengyang, Hunan Province, Associate Professor, Master. Research Direction: Application of the Internet of Things;
Wang Mengnan (1990-12), Female, Han, Shangqiu, Henan Province, Teaching Assistant, Master. Research Direction: Physical Education.

Fund Project: Youth Innovation Talent Project in Ordinary Universities in Guangdong Province "Research on Physical Practice Load Monitoring Based on Internet of Things Technology" (No.: 2018KQNCX177); and Guangdong College Students Innovation and Entrepreneurship Training Project"Research and Application of Multi-Functional Sports Monitoring Bracelet"

Email:yuchen@gdei.edu.cn

Abstract: With the development of Internet of Things technology, digital sports training will become a hot topic in the field of sports science. Digital exercise training is a training mode of monitoring the quality of the training in real time in the process of using technology to train practitioners and adjusting the physical training process according to the data. By combing the main application of international Internet of technology in sports training, this paper proposes the use of technology to monitor the movement intensity, and realizes the sports scheme intelligently recommended technical scheme, and implements it, and carries out the practical application and achieves commercial benefits according to the monitoring results.

1. Introduction
With the rapid development of Internet of Things technology, many scholars in the world are committed to realizing digital physical training research through Internet of Things technology, believe that using digital technical monitoring to athletes can help observe athletes' response to sports training, determine their fatigue, and thus timely adjust the training plan to reduce the risk of excessive training and injury. Digital physical training technology which has been widely recognized mainly focuses on sports ability measurement and strength and explosive force training, neural response speed training, high intensity intermittent endurance training real-time monitoring and realizes the athletes competitive status evaluation and big data platform management based on the Internet of Things technology information means.

This paper builds a sports intensity monitoring system based on the application of Internet of Things technology and combining the expertise of sports training; At the same time, an intelligent decision-making model is constructed based on machine learning technology to analyse and process
the obtained monitoring data, to provide scientific guidance for users' sports training, to recommend reasonable sports plan, and to "escort" for professional training or strength training of daily fitness users. This paper adopts two steps to monitor the movement intensity and recommend the movement plan: one is to use the Internet of Things technology to obtain the key body measurement indicators (such as heart rate) during exercise training; the other is to intelligently analyse the acquired body measurement indicators to provide scientific guidance for users and recommend sports programs. The overall structure is shown in Figure 1.

2. Acquisition and Transmission of Exercise Training Intensity Monitoring Data

This paper focuses on two intensity data: heart rate data and exercise intensity data. Heart rate data is an important indicator of trainer training. The size of the heart rate and the speed that the heart rate returns to normal all reflect the physical condition and training effect of the trainer. At the same time, the heart rate data should be matched with specific sports training programs to analyze. The heart rate changes of device training and the heart rate changes of dumbbell training respectively reflect different information and need to be fully excavated. This paper uses heart rate sensor to obtain trainer heart rate data and to obtain training program information through RFID technology.

2.1. Exercise Heart Rate Data Acquisition

Heart rate sensor is a sensor that measures the human heart rate by using the principle of light reflection. When a beam of a certain wavelength hits the finger skin surface, the beam is transmitted to the photoelectric receiver by transmission or reflection, where the light intensity that the detector detects decreases due to the absorption and attenuation of the finger skin muscles and blood. The light absorption of skin, muscle tissue and other tissue is always the same throughout the blood circulation and the blood in the skin, and the volume is pulsating under the action of the heart. The peripheral blood volume also has the maximum light absorption and the minimum light intensity detected when the heart contracts. In cardiac diastolic, on the contrary, the detected light intensity is maximum, making the light intensity received by the light receiver pulsating, and then can restore the user's heart rate data. When the user's heart beats, more blood flows through the user's wrist. Therefore, the project integrates the heart rate sensor into the intelligent wristband, and the obtained heart rate data is uploaded to the intelligent processing terminal (such as a mobile phone) through Bluetooth for subsequent processing. The data acquisition process is as shown in Figure 2.
2.2. Sports Device and Equipment Data Acquisition
Wireless RF identification (RFID) technology through the radio communication without contacting the fast information exchange and storage technology, through the wireless communication combined with the data access technology, and then connects to the database system, to realize the non-contact two-directional communication, thus achieving the purpose of recognition for data exchange, and series up an extremely complex system. In the identification system, reading and communication of electronic labels are realized through electromagnetic waves. According to the communication distance, it can be divided into near field and far field, and thus the data exchange mode between the reading and writing device and the electronic label is also correspondingly divided into load modulation and backscattering modulation. RFID has many characteristics like fast reading speed, does not need manual help, strong penetration, strong reliability, high efficiency, low cost, easy to make, etc. It is widely used in commodity sales, authentication, tracking and traceability and other fields. In the fitness exercise monitoring system, users can quickly identify the name of the exercise device by using a bracelet installed with a reader and writer close to the RFID label on the fitness device. Combined with the user login information, you can know the information of the user fitness exercise.

3. Quantitative Analysis and Evaluation of Exercise Training Data
Two types of data are collected through the Internet of Things technology. The first is the sports device information, which analyzes the specific situation of the practitioner's exercise training plan according to the device information, so as to evaluate the effect of the exercise, and give scientific guidance through the multiple training data of the athlete; The second is the exercise heart rate data in which the exercise is evaluated by changes in heart rate data combined with the needs of the practitioner.

3.1. Analysis and Evaluation of the Exercise Training Program
The American Sports Medicine Association defines "health body fitness" as a physical state with the following characteristics: With sufficient energy and ability to engage in daily activities, the risk of early underexercising disease is low. It can be said that health fitness elements are closely related to our efficient work, enjoying leisure, health status, preventing insufficient exercise conditions caused by static lifestyle and the ability to deal with emergencies, including cardiopulmonary endurance, muscle strength and endurance, flexibility and body components. Fitness exercise is to improve people's fitness, all the gym is divided into aerobic area, strength area and stretching area, which respectively exercises cardiopulmonary endurance, muscle strength and endurance and flexibility, the radio frequency identification is labeled on various fitness equipment according to the division of area. Collect the practitioners in the area through the data analysis of aerobic exercise in the exercise, strength exercise and stretching exercises, so as to know that the user the fitness training plan. By monitoring the exercise training data, the users obtain the exercise training plan, and the multiple training information reflects the user's common exercise program as the whole, and gives scientific guidance on big data analysis. Big data reflects that the user only pays attention to the development of upper limb and trunk strength in strength training, does not pay attention to lower limb strength...
exercise, you can evaluate the user's lower limb strength deviation to recommend to strengthen lower limb strength exercise. Obtaining practice equipment information through RFID technology, you can evaluate the user's choice of one's practice items and the collocation of the body practice part and give scientific guidance.

3.2. Analysis and Evaluation of the Motion Heart Rate Data
Exercise can effectively improve health, too low heart rate exercise will not have a very good training effect, and too high heart rate increases the risk of training. The basic information of the practitioner can be read through the intelligent device: name, gender, age, height, weight, etc. The maximum heart rate is calculated based on age and quiet heart rate. Four stages are divided according to the impact of different heart rate intervals on exercise:

- Warm up (50% -60%HRmax) The heart rate in this interval generally appears when we take low intensity exercise, such as walking, stretching, etc. Our bodies are in a more comfortable state, breathing evenly. This state is generally our warm-up before exercise and our body stretching after exercise;
- Fat burning exercise (60% -70%HRmax) Regardless of what exercise the body is doing, the main source of energy respectively comes from fat and carbohydrate (glycogen). That is in other words, no matter how much your heart rate when you exercise, you consume fat, just a different proportion of fat and glycogen consumption. When the exercise heart rate reaches from 60% to 70%, the rate of fat burning reaches the highest. Therefore, this interval is also known as the fat-burning exercise interval;
- Endurance Exercise (70% -80%HRmax) As the intensity increases, the body increases energy and the heart accelerates beats to perform the nutrient supply. However, the rate of body fat burning decreases, relying more on glycogen decomposition for energy supply. The glycogen reserves in humans are limited. Therefore, the persistence of movement in this interval is much lower than the oxygen fat-burning interval. But it can stimulate cardiopulmonary function to exercise the heart and lung organs. However, for friends with heart disease or other metabolic diseases, it is recommended to exercise under the guidance of a doctor. Keep your heart rate below this range when you exercise, which can avoid causing cardiopulmonary pressure.
- Extreme Exercise (> 80%HRmax) Extreme Exercise is related to a relatively high range, which may be local strength exercise (devices, muscle building, etc.). In this interval, the body produces lots of lactic acid, increasing muscle fatigue, and breathing shortness of breath. It has a large burden on local muscles, and is prone to muscle soreness and other problems after exercise, but it can also stimulate muscle growth. Get heart rate data through Internet technology and conduct systematic analysis according to user needs. The heart rate interval for users who need fat reduction suggests in 60% -80%HRmax, which is fat burning exercise and aerobic endurance stage. The heart rate interval for users who need muscle increase suggest in the extreme exercise stage (> 80%HRmax). It can improve exercise effect to reduce exercise risk, make fitness exercise more scientific and professional through the monitoring of exercise heart rate.

4. Integration, Implementation and Application of the Recommended System for Motion Intensity Monitoring and Motion Scheme
The entire motion intensity monitoring and motion scheme recommendation system conforms to the structure of the Internet of Things application system, which is divided into perception layer, transmission layer, and application layer. The perception layer mainly includes the acquisition of the user identity information, the acquisition of the device type (based on the RFID), and the acquisition of the user heart rate data (through the heart rate sensor). The transmission means used by the transmission layer include Bluetooth, 485 communication and WiFi technology, which transmit the user's identity information and device type information to the Internet of Things gateway via cable, and conduct data communication with the user mobile terminal by means of WiFi. The application layer is divided into two modules: the background service program and the user mobile terminal application. The background service program realizes the management of the movement monitoring data, the operation recommended by the motion scheme, the data push, etc. The user mobile terminal
is mainly responsible for the display of the data and results. The structure of the entire system is as shown in Figure 3:

![Figure 3 Schematic Diagram of Motion Intensity Monitoring and Motion Scheme Recommendation System](image)

Based on this technical route, a motion intensity monitoring and motion scheme recommendation system is finally integrated. This study results cooperate with the related fitness intelligent garden institute and to construct a motion recommendation system to conduct trial operation and promotion application. After actual operation, it takes practical commercial application to achieve good commercial benefits by constantly improving the system function.

5. Conclusion

Based on this technical route, a motion intensity monitoring and motion scheme recommendation system is finally integrated. The exercise recommendation system is built through this study cooperate with related fitness smart institute which takes conduct trial operation and promotion application. The research results are applied to relevant fitness institutes and technology companies, and carry out exercise intensity monitoring and exercise guidance application of members of the fitness business music department. Finally, it significantly improves the customer acquisition rate of enterprises and achieves commercial benefits.

References

[1] Yan Qi, Liao Ting, Zhang Yujia. the Concept of Digital Physical Training, Progressive Rain Practice [J]. Sports Science, 2018 (11): 3-16.

[2] Ji Liu. Interpretation of China’s 《Physical Education and Health Curriculum Standards for Ordinary High School》 (2017 Edition) [J]. Sports Science, 2018 (2): 3-20.

[3] Yang Wexuan. Research on School Sports Reform and Development under the Background of Curriculum Reform [J]. Athletics Journal, 2018 (9): 1-4.

[4] Zhang Xiqian, Zhang Renyi. Optimization of the implementation path of sports and health courses under the core literacy orientation [J]. Athletics Journal, 2018 (3): 76-80.

[5] Zhuang Bi. How to implement the Core Literacy of Physical Education and Health Courses in Physical Education Teaching [J]. Physical Education Teaching, 2018 (3): 11-15.

[6] Dou Li, Chen Huawei. Value and Model of "Smart Sports Classroom" in Universities [J]. Sports Culture Guide, 2018 (11): 136-140.

[7] Zhao Song, Xu Xiaoli. Application of Wearables in Physical Education Teaching- -Analysis Based on the SWOT Model [J]. Sports Culture Guide, 2016 (11): 111-115.

[8] Yuan Shoulong. Physical Training Development Trends and Digital Transformation [J]. Sports Studies, 2018 (2): 77-85.