The Wireless Sensor Monitoring System of Track and Field Training Intensity in Physical Education

Zhihong Yin(✉)

Nanchang Institute of Technology, Nanchang 330044, Jiangxi, China
964012041@qq.com

Abstract. In view of the existing monitoring system can only carry out local monitoring of athletes, the detection accuracy is not high, the signal wave frequency change is inconsistent and other problems, this project plans to carry out the research of sports teaching and track and field intensity monitoring system based on wireless sensor. Based on the advantages of wireless sensing technology and the characteristics of training intensity signal, the overall framework of the monitoring system is obtained. The external form of the system is a terminal strength signal monitor, which is composed of power supply source, data sensor, signal display based on sports physiological characteristics, data acquisition module and monitoring circuit [1].

Keywords: wave-frequency variation difference · Wireless sensing technology · Physiological characteristics · Damage localization

1 Introduction

At the present stage, physical education has become an important educational project of the country. In this case, a special training intensity monitoring equipment based on track and field sports is needed, which can monitor the various signal characteristics displayed by the athlete's body in the training process in real time, and make use of the sensors and various node determination mechanisms in the equipment to carry out detailed analysis of the position points that send out high-intensity signals and judge whether there is damage signal. Based on the effective analysis of wireless sensor technology, the overall framework of track and field training intensity monitoring system based on physical education is proposed, and its specific distribution is shown in Fig. 1 [2].

1.1 Terminal Monitor

Because, in the physical education of track and field training, often because of training intensity is too much, and cause athletes muscle injury or other injuries. Therefore, [3] a terminal monitoring node device can be installed on the athletes to collect real-time body data and judge the damage, so as to detect whether the athletes' training intensity

F. Huang et al. (Eds.): ICAIE 2023, AHCS 15, pp. 234–240, 2024.
https://doi.org/10.2991/978-94-6463-242-2_29

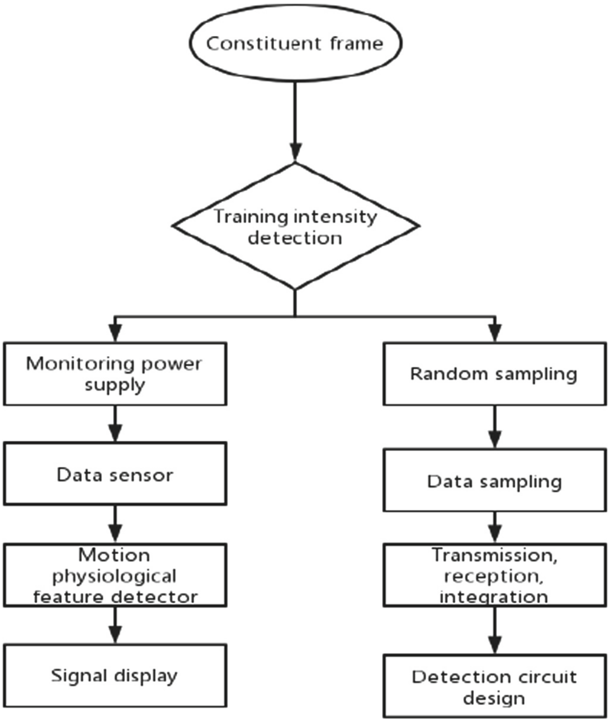

Fig. 1. The overall framework of the system

exceeds the standard and ensure their safety and health. The device is composed of monitoring power supply, data sensor and signal display of physiological characteristics of movement. Moreover, the chip of the terminal monitor adopts low power mode, which can prolong certain service life by reducing consumption time. The specific module design is shown in Fig. 2.

1.2 Monitoring the Power Supply

Because the wireless sensor server must be worn on the athlete's body, in order to ensure the safety of the athlete, there are certain restrictions on its power supply. Therefore, after all aspects have been fully considered, this paper will use a small energy type power supply to ensure implementation. The energy of the power supply can be constantly regenerated, and various power supply modes can be converted to ensure long-term power supply and storage. The specific power supply mode is shown in Fig. 3.

1.3 Data Sensor

In this paper, the data sensing part of the wireless sensing terminal monitoring equipment discussed above will be analyzed and explained in detail. In general, in terminal equipment, the technical support of receiving, storing and sending of data sets is mainly

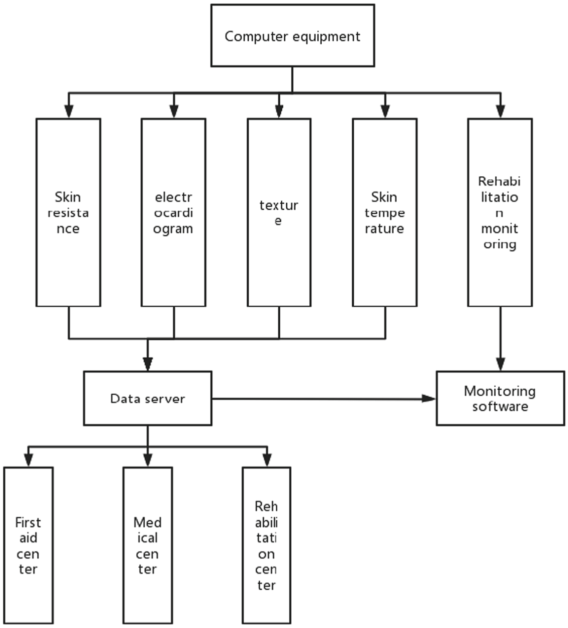

Fig. 2. Terminal detector framework

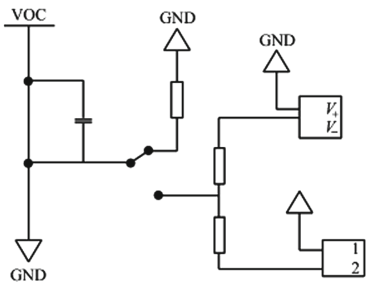

Fig. 3. Monitor power supply circuit

provided by two special technology chips: data processing chip and signal RF chip. Its function is to control and transmit the resource information obtained by the wireless receiver. The basic processing operations are as follows: Information standardization [4], subsequent transceiver, transmission and storage, etc., so as to realize the measurement, transmission and record of wireless sensor data, and then communicate with the information data receiving mechanism through specific standardized signal interfaces, so as to avoid signal loss or change during signal transmission and ensure the completion and timeliness of information. The specific description of the sensor wire plate at the interface is shown in Table 1.

In addition, a power supply is provided on the wireless interface to power all lines in the sensor to ensure the efficiency of signal transmission and reception processing. In

Table 1. Wireless sensor data interface

Interface number	Mainfunction
A0orA11	Analogchannelinputport7orpositiveport6
A1orA12	Analogchannelinputport8orpositiveport12
A2orA13	Analogchannelinputport2ornegativeport13
A3orA14	Analogchannelinputport3ornegativeport15
A4orA15	Inputport4orpositiveport1fortheanalogchannel
A5orA16	Inputport10fortheanalogchannel
A6	Inputport5fortheanalogchannel

general, due to the repeatability of the data characteristics, the data sensor will produce the problem of increasing the error rate of signal search. Therefore, to solve this problem, we put forward a method, that is, to calculate the feature repetition rate of data. The specific formula is as follows:

$$\gamma = \pm \frac{\Delta R_{max}}{yFS} \times 100\% \tag{1}$$

Among them, ΔRmax represents the deviation value based on the maximum data repetition feature during signal search.

Where, γ represents the repetition rate of static features, and n represents the number of data detections. In this way, the number of data to be measured is input into the above formula, and the repetition rate γ of the data in the sensor is calculated according to the static characteristic attributes, as well as the error value. It makes the data transmission more accurate, reduces the difficulty of monitoring, makes the system have higher reliability and accuracy, and keeps the stability of the system state.

1.4 Signal Display of Sports Physiological Characteristics

In wireless sensing terminal monitoring equipment, signal display is one of the key components, it can record the athletes' training intensity in real time, and adjust and synthesize it, so as to get the final result. It mainly refers to the ECG signal, which contains the information of the physiological indicators of the athletes. On the basis of the ECG characteristics, a display module is established. The contraction and diastole of the heart will lead to the changes of the ECG characteristics, and also lead to the changes of the electric charge generated by the trace current on the skin. Through the fluctuation degree and amplitude of the curve of ECG characteristics recorded in real time, we can judge the real-time changes of athletes' heart rate and other physiological indicators under different training intensity, and then mark and display them on the signal display, as shown in Fig. 4. The fluctuation effect of ECG characteristics is shown in Fig. 4.

As can be seen from Fig. 4, the aging cycle of ECG frequency generally includes several segments. In the figure, they are the 5 pulsation waveforms of A, B, C, D and E

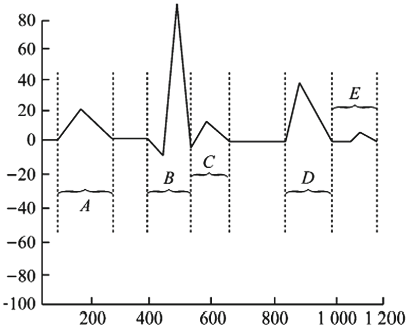

Fig. 4. ECG frequency fluctuation in athletes

Table 2. Data acquisition mode based on random sampling

Serialnumber	Startingtime	Endtime	Totaltime/s
1	12: 30	12: 41	11
2	15: 15	15: 28	13
3	9: 02	9: 17	15
4	10: 30	10: 39	9
5	13: 35	13: 45	10
6	14: 00	14: 12	12

respectively, which represent the region and range of activity of the real-time pulsation of the heart.

Segment A waveform represents real-time changes in the left and right atrial potentials in the heart.

Waveforms in segment B and segment C represent time and potential changes of the left and right atria during deelectrode (Table 2).

In view of the requirements of the system for low voltage and low power consumption, this paper adopts the above viewpoints to establish a circuit model based on bridge type, as shown in Fig. 5.

As can be seen from the figure, the circuit takes the power for the 2N222 transistor current regulation, input resistance R and voltage V1 voltage regulator TL431 to provide efficient working current, and then through the resistance R1, R2 real-time regulation makes the voltage stable at V0 = 3V. Thus complete the adjustable circuit signal power supply line design.

2 Simulation Experiment Analysis

In order to verify the effectiveness of the physical education and track training intensity monitoring system designed based on wireless sensor technology in practical application, 300 students from a physical education school were selected for simulation experiment

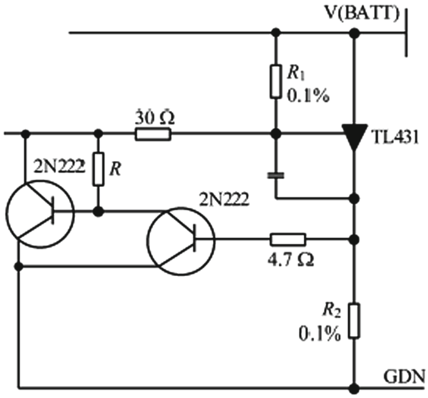

Fig. 5. Bridge type circuit pattern

test. The test subjects are treated at 6km/h (a), 600 groups of data were collected under three different track and field speeds of 8km/h (b) and 10km/h (c), and the performance was tested through the data sensing structure topology. The 1–16 endpoints in the figure are electrical barriers made of fiber materials, and every 4 intersections can form a resistance grid based on the vertex. The resistance grid in the figure is attached to the left and right arm and left and right thigh respectively, and there are 3 electrical barriers in each resistance grid, attached to the upper arm muscle, forearm muscle, elbow and thigh muscle, calf muscle and knee. Two primitive wireless sensing supply node devices and 10 data collection nodes are configured in the area channel, in which the simulated damage locations are 3, 7, 8, 10, 11 and 14.

3 Conclusion

In this paper, the wireless sensor technology based on the physical education, track and field training intensity monitoring system for effective research and analysis, [6] finally obtained the following conclusions: The terminal server based on wireless sensor monitoring can obtain athletes' body data in real time, and reduce energy consumption through the design of low power supply, thus extending its service life. Among them, the data sensor through the special interface processing, can effectively avoid the loss of signal and abnormal, so as to ensure the safety of information.

References

1. Evergreen. Design of real-time monitoring System for Children's physical Condition in Sports Training Based on video image [J]. Journal of Zhoukou Normal University, 2019, 36 (2):114–117.
2. Zheng Xiangping, Yuan Weihua, Sun Wei, et al. Construction of Special Physical Quality Evaluation Index System of Chinese Female Gymnasts [J]. Journal of Capital Institute of Physical Education, 2019, 31 (1): 80–85.

3. Sun Jian, He Jiaxin, Yan Qi. Research and Progress of Special Physical Training in Physical Education Colleges Based on “Data-driven Decision-making” [J]. Journal of Guangzhou Institute of Physical Education,20, 40 (3): 1–3.
4. Wang Pei. Design of a portable sports training real-time data analysis system[J]. Microcomputer Applications, 2019,35 (6): 107–110. (in Chinese)
5. Han Yongxi, Fan Bitian. Discussion on the Wrong Action Judgment Method in Sports Training Based on 3D Modeling Detection [J]. Modern Scientific Instruments, 2019(5): 159–161,165.
6. Zhu Wenxue. Design and Implementation of Intelligent Sports System Based on Wireless Sensor Network Technology [J]. Automation & Instrumentation, 2019 (2): 76–79.