Sensors & Transducers

Realization and Design of Sports System Under the Background of Wireless Sensor Network

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Abstract: Nowadays, the sports have brought in information technology. The center of sports information is to establish a network which can detect the real-time data. So, first we should use the most advanced information collection methods with the lowest cost to obtain the motion data, and then choose the useful information from huge amounts of data and to provide data for athletes science management system, so as to make reasonable scientific management decision-making to sports training, finally using a variety of intelligent devices and play a role, in order to enhance the tactical level of athletes. This paper mainly studies the movement under the background of wireless sensor network system design and implementation. *Copyright © 2013 IFSA.*

Keywords: Wireless sensor network, Sports system, Design, Node, Base station.
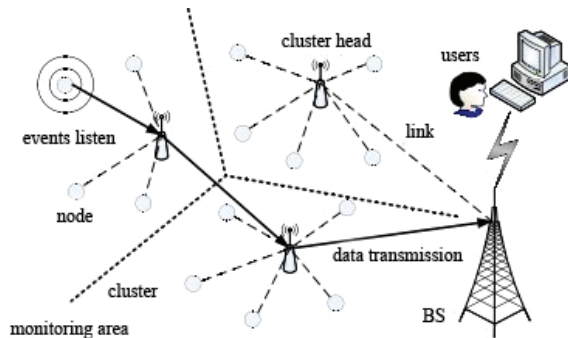
1. Wireless Sensor Network

1.1. Introduction

Wireless sensor network (WSN) is a kind of self-organizing network, mainly by the monitoring area a set of micro sensor nodes deployment, its function is varied, such as gathering information, processing data and sending and receiving wireless, etc. It put the sensor nodes in the monitoring scope for manual deployment or immediately spread, to perceive objects in this way for real-time monitoring and data collection, and then with the help of a node embedded system integration of the information processing. Cluster-heads node sends the collected data to the cluster head node to converge, the data in the cluster heads after fusion with multiple hops communication way is routed to the base station, base station and then take various ways to put the

data to the user terminal, user monitor remote target task. General schematic diagram as shown in Fig. 1.

Wireless sensor network (WSN) involves many technology such as computer, network communications, semiconductor manufacturing, in today's society, not only can obtain a variety of media information and analysis processing, can also use local network routers and gateways to the Internet connection, make its scale constantly expanding, has become the focus of research around the world [1].

In the late 90s, the wireless sensor network in the United States formally, arose, and is mainly used in military. Through constant development, has been applied in more fields, so as to cause the attention of countries all over the world. Intel, Microsoft and other IT industry giants start the related research work. Japan, Germany, Britain, Italy and other developed countries also stepped up investment,

expand long-term in-depth research work on the issue. In this area is still in its infancy in our country, at present, some colleges and universities and research institutions have been actively carry out the related research work of wireless sensor network, such as Qinghua University and Harbin Industrial University and Renmin University of China, etc. Research focus at home and abroad, mainly concentrated in wearable computing, context-aware environment, smart classrooms, etc., in support of pervasive computing operating system or software architecture of the system research is still rare [2, 4].

Fig. 1. Structure of sensor network.

1.2. Characteristics of Wireless Sensor Network

1.2.1. The Network is Self-Organizing

Randomness of sensor nodes deployment time going on, and there is usually no infrastructure monitoring area, such as desert, forest, the position of the node information is unable to determine ahead of time. So, node must be able to manage itself, through good design network protocol, to form a self-organization network, can collect information and forwarding data, but also has many jumps linear.

1.2.2. A Great Number of Nodes which Distributed Widely

In order to ensure the comprehensiveness of information, often a large number of tiny sensor nodes, the dense deployment in addition to being able to guarantee the accuracy of the information obtained, also can reduce the network rely on a single node, even if the individual node fails, the network can work normally. But at the same time, there are still some shortcomings, such as information redundancy, a signal conflict easily.

1.2.3. Take the Data as the Center of the Network

In sensor networks, people care about the often is not all the nodes monitor the data, but a certain target information, therefore, nodes of the physical address

of the network transmission of data does not have much impact. Unlike traditional network, sensor network for data center can quickly send formed by the fusion of information to users.

1.2.4. Network Topology is Dynamical

As a dynamic network, the node due to various factors change can cause the change of sensor network topology. Network to maintain normal work, must allow node failure, with the adjustment and reconstruction.

1.2.5. Energy is Limited

Sensor nodes of low cost, wide distribution, small volume, and work environment is relatively bad, the battery energy is limited, and not easy to change after deployment. Network lifespan depends on the battery directly, to prolong its life cycle, must try to reduce the energy consumption of the battery.

1.2.6. Low Safety

Wireless sensor network (WSN) is a distributed structure, vulnerable to invasion, or even tampered with data delete, in addition, in the open layout of sensor nodes, it is easy to be intercepted by the enemy, the data safety is guaranteed.

2. Realization and Design of Sports System under the Background of Wireless Sensor Network

In the development of modern competitive sports, often with the aid of information technology services for athletes, helping them scientifically training. Before the training method of vulnerable to outside interference, error is big, and strong subjectivity, the experience and information technology integration, set up a perfect network monitoring system, can quickly and accurately obtain related data, filtering, choose the management of the athletes helpful information, based on scientific management decisions, so as to improve athlete's skill level.

The study well integrated into modern high-tech, can urge the athletes' potential into full play, is a great reform in sports field, at present many countries all have different degree of research. This paper designed the movement system and closely related to wireless sensors, and from three aspects as nodes, base station and the database is discussed.

2.1. The General Frame of the Sports System

As shown in Fig. 2 represents the motor system's overall structure, motion system with the help of wireless communication, athlete's physical

parameters (such as blood pressure, speed, ecg, etc.) monitoring. In sports fields or athletes of different types of installation node, after collecting the related parameters, using radio frequency module sends the data to the base station, again by the base station of the internal management software to analyze its processing, and finally displayed on the LCD screen. Base station can be collected data information stored for a long time, save to the database system, to facilitate later for analysis.
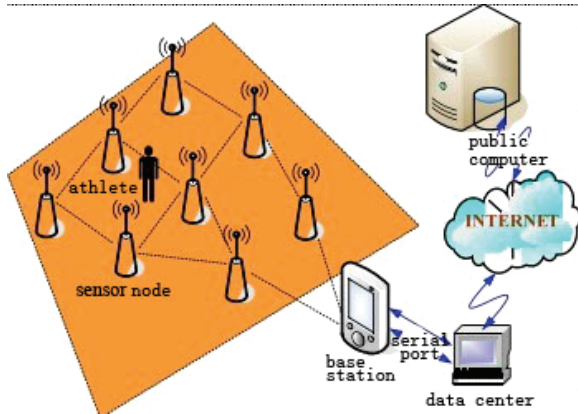

Fig. 2. Structure diagram of the system.

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Motor system mainly has three nodes, base stations and the data management center.

Nodes, is mainly responsible for data collection and transmission. In motor system, the node is responsible for collecting the athletes' physiological parameters and motion parameters, when the base station sends the query command, the node information to data obtained from the base station. In practice, according to the instructions of base station and node automatically open the buzzer, in collecting data at the same time, also for athletes played a supplementary role [3].

Base station, the main is to accept data and send corresponding instructions and requirements. Processing data there are two main methods: one is to use a serial port communication module to send the data of base station keep to data management center, the staff can browse and management; 2 it is directly displayed on the LCD screen. At the scene, coaches in order to work more convenient, and often

with base station, can touch the LCD screen to control the working state, and browse the information of athletes.

Data management center, in terms of motor system, the data management center can be deployed in any position, the premise is must be connected network. Coaches can use related software to grasp athlete's motion parameters, and real-time monitor the running status of sensor networks. Motor system introduction of wireless sensor network, various aspects have greatly improved, the factors needed to consider when designing have real-time operating ability; Safety, reliability and stability; Friendly user interface.

2.2. Realization and Design of Nodes

2.2.1. Hardware Design of Nodes

Node design including the design of software and hardware design, including hardware design has four parts, one is the sensor module. Second, processor module, the third one is Rf module, the last one is power supply module. Fig. 3 is the design of nodes in motor system [5].
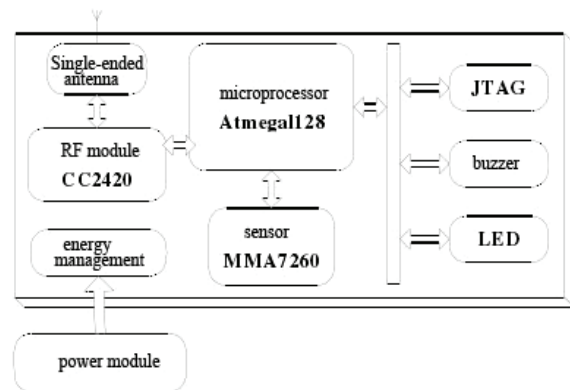

Fig. 3. Nodes structure diagram.

Sensor module, mainly be responsible for the measurement of various physical quantities, system requirements determine the sensor type. Because the measurement of physical quantities is more, all the node circuit integration, which requires, in the design of sensor node module only integrated acceleration sensor MMA7260, extension and obligate sensor interface, can be based on specific situation to expand the corresponding types. MMA7260 is one of the three axis capacitive acceleration sensor, low power consumption, its circuit connection as shown in Fig. 4:

Processor module, right in the heart of node position, responsible for coordination of various modules work, therefore, when designing node must choose appropriate processor chip, the requirements are as follows.
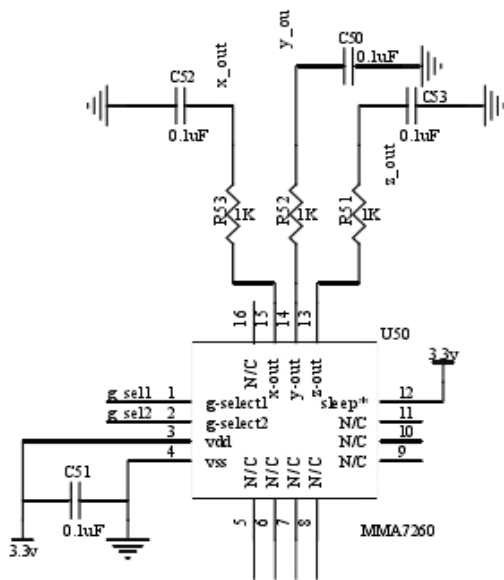
Fig. 4. Circuit connection diagram of MMA7260.

Working mode to low power consumption, and to support sleep mode; Communication interface or external I/O ports should be enough; Have higher peripheral integration and faster running speed, processing after the event, in the shortest time to sleep, the peripheral circuit often should keep clean and tidy; Low cost, small size, a large number of nodes deployed, must reduce the cost, and the size of the node determines the size of the processor.

RF module, node and nodes and between nodes and base station of wireless communication is accomplished by radio frequency module, RF module is capable of detecting channel conflict, and modulation link data for sending and receiving. This system chooses the CC2420 RF device.

Power supply module, mainly to provide energy to the whole node, is the first premise of nodes in the work. The voltage required for the purpose of this system, 2.6 - 3.6 V DC, the power supply is two AA batteries, the power supply circuit diagram as shown in Fig.5.

2.2.2. Realization of Nodes Function

Collect data in this system, and wireless communications is a node of the two big functions, should be designed according to the programming, in order to realize the node. Fig. 6 is its functional module chart.

Using the sensor module, for athlete's physiological parameters and motion parameters for real-time collection, after get stored in the storage unit. Running programs, read the stored data regularly, and decode, calibration, analysis, coding, and then save the send buffer, waiting for sending station instruction again. In Fig. 7 and Fig. 8 for the node working flowchart of program and data collection to send.

Node after electrify, start the initialization process, within the scope of communication to send registration information to the base station, and waiting for reply base station. When the base stations, after reply to node start networking process, as shown in Fig. 9. If the request was rejected, because of interference or other reasons should once again send the request information.
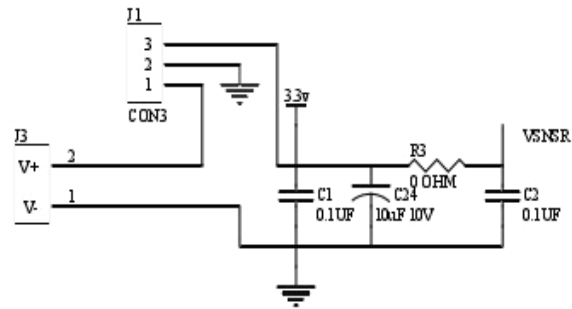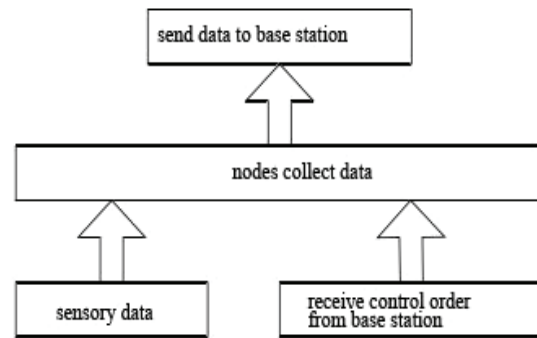

Fig. 5. The node power supply circuit.

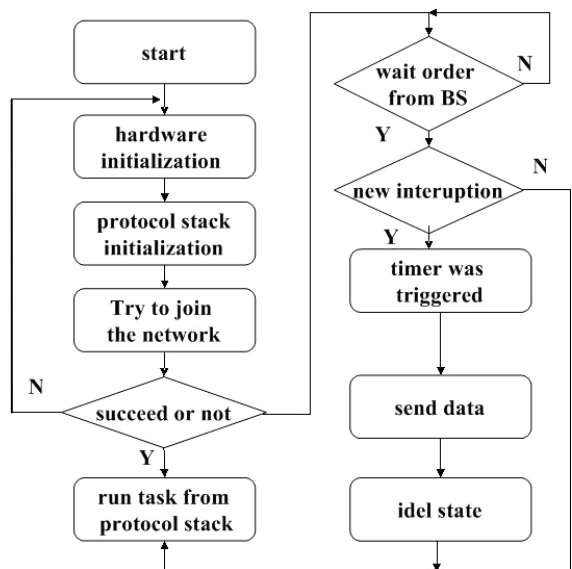**Fig. 6.** Function Block of nodes.
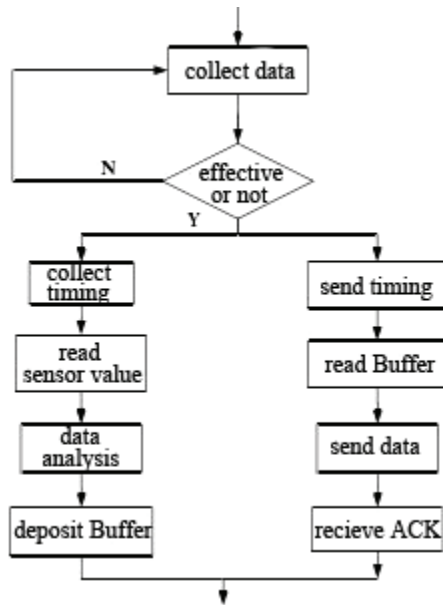

Fig. 7. Flow chart of nodes.

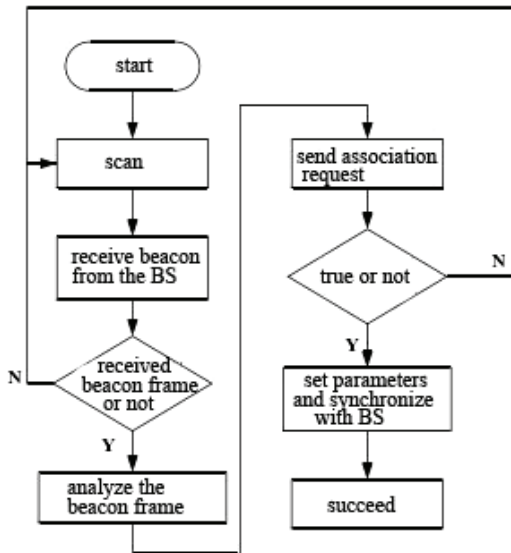**Fig. 8.** Collecting and sending flow chart of nodes.

Fig. 9. Networking process of nodes.

2.3. Realization and Design of Base Station

2.3.1. Hardware Design of Base Station

Base station is the control center of the whole system and processing core, the main function, network maintenance, operation management and data processing, etc. Fig. 10 is a block diagram of the base station hardware, divided into the keyboard, the processor module, RF module, data communication module, storage module, LED display module and so on. In this system, base station at the heart of the processor selects the S3C2410, and with 256MBNAND FLASH and 64 MB SDRAMM storage space. Base station of small volume, strong processing ability, and easy to extend.
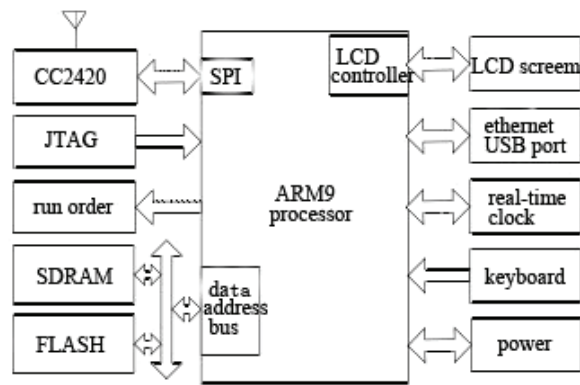

Fig. 10. Block diagram of base station.

Processing module, the system can run normally and easily expand to movement base station, the kernel processor S3C2410, its main ingredients are: independent 16 KB instruction Cache and 16 KB of data Cache; NAND flash memory controller; Virtual MMU memory management unit; 3 UART interface and four road DMA channels and four road with PWM timer; In support of TFT LCD controller; 2 SPL and 8 road 10 bit ADC channel; Real time clock RTC unit; SD and MMC host interface; Two USB host interface, a USB interface.

S3C2410 on-chip resource is very rich, is more suitable for occasions that are sensitive to power consumption.

RF module CC2420 RF chip transmission agreement consistent with the node, in order to improve the safety and reliability of the transmission.

Storage module, choose the NAND FLASH K9F1208U0A act as base stations, with the aid of S3C2410 K9F1208U0A internal NAND FLASH memory controller, speaking, reading and writing. Base stations of the data storage to two pieces of SDRAM chip series, to meet the requirements of the operating system and the complex data processing algorithms.

S3C2410 USB interface, there were two socket, a USB host interface, a USB master-slave reuse, using jump hat to choose. The machine stand, design two USB interface for the host interface, as a connection interface of base station and data management center, another is used to connect the storage device, USB interface circuit as shown in Fig. 11.

2.3.2. Realization of Base Station Functions

Base station to deal with the work mainly has five parts: data acquisition, all nodes from the sensor data information gathering;

Data processing mainly includes the calculation and analysis of node data and control commands to set the sensor nodes.

LCD display module mainly has two parts, one is the real-time display system data, the second is system parameters setting;

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Keyboard control, the man-machine interaction is to use the keyboard to complete work;

Data transmission, data communications between means and data management center.

The keyboard driver flow chart shown in Fig. 12.

LCD display driver process is as shown in Fig. 13.

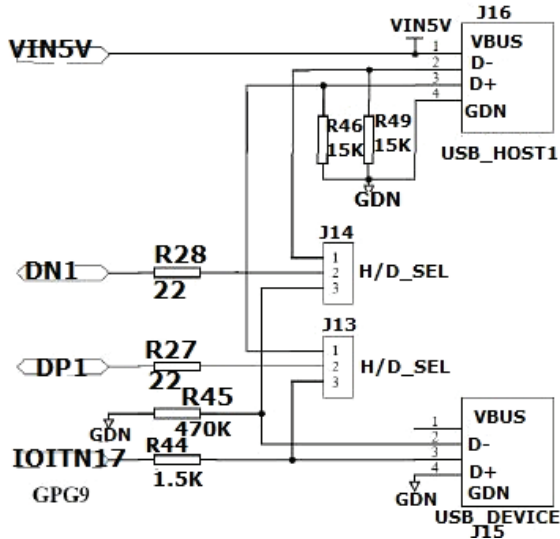The serial ports communication program design process is as shown in Fig. 14.

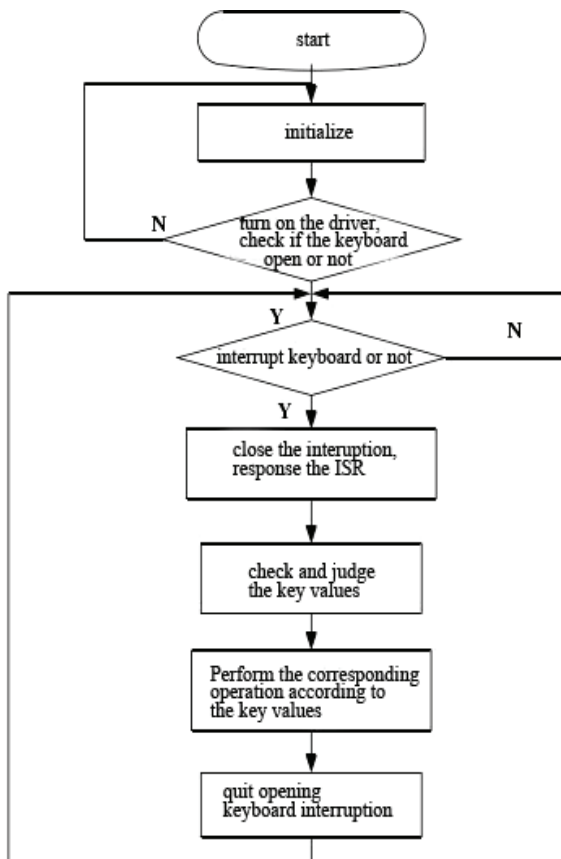

Fig. 11. USB interface circuit.

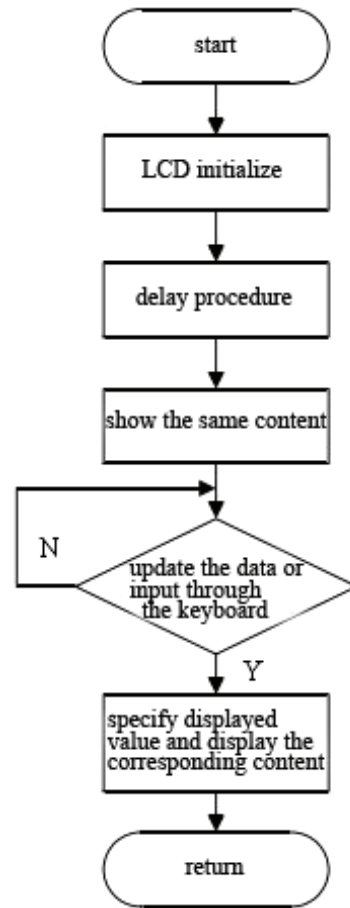**Fig. 13.** Flow chart of LCD display module.

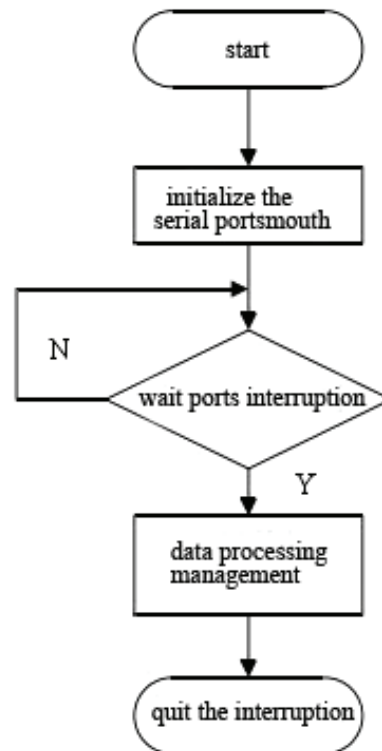**Fig. 12.** Keyboard flow chart.

Fig. 14. Communications flow chart between serial ports.

2.4. Data Management Center

Its function modules as shown in Fig.15, there are four main functions: the system configuration, status detection, data acquisition, data display.
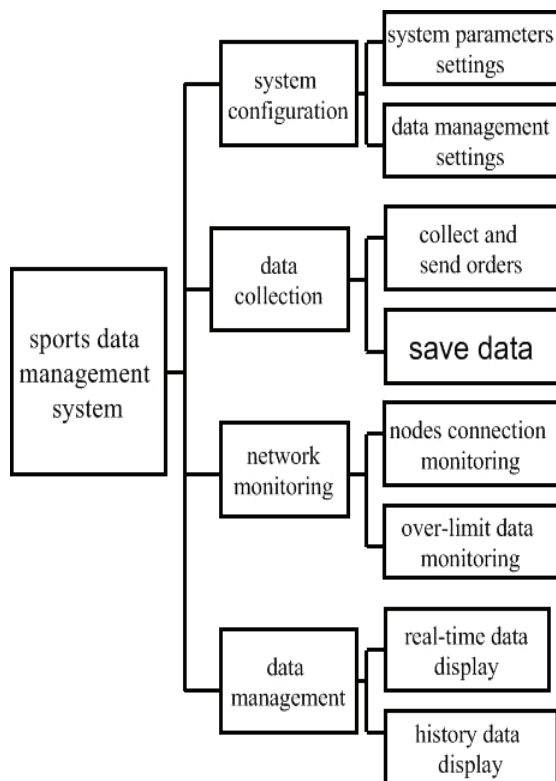

Fig. 15. Management module of sports database.

2.4.1. System Configuration Module

And can be divided into three categories, one is the user parameter Settings, and second, the system parameter configuration, three is the database connection parameters configuration. Such as on the number of nodes, number set parameters, such as athletes, in order to meet the different requirements of different types.

2.4.2. Data Acquisition Module

This module is the core of the whole software, data management center using the USB connection station, after the base station agreed to request, receive data, in the custom package deal, under the action of complete data parsing, and stored in the database of the corresponding field [6].

2.4.3. Network Monitoring Module

This module mainly reflects the monitoring function of the sensor network database management center, including the node status of overrun detection and network detection, data collection to take off at work.

2.4.4. Data Display Module

Including athletes current data display, historical data query and statistical reports print, etc.

3. Conclusions

Wireless sensor network applications, the potential is tremendous, associated with the sport, this article has carried on the motor system under the background of wireless sensor network research design, the main tasks include introduction to wireless sensor network (WSN), as well as some discussions in the sport, and puts forward motion system design scheme, roughly the nuclear core processor, radio frequency chips to do the right choice. From the current situation, the node can also be expanded to other parameters, the wireless sensor network will become the mainstream of the future trend, in many fields including sports can also puts glorious greatly in the system.

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