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The Research Sports Management Monitoring System Based on WSN

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Abstract

With the rapid development and improvement of public life and social economy, the whole society has entered into the age of information, which can use common computer assisted control system more and more widely. For the demand of the sports management with efficient and safe operation, the wireless sports management monitoring management system of a sports management is designed based on MCP2515/CAN bus in this paper. In order to monitor the operation state information of the sports management real-time, the system monitor front-end is designed by using the platform with Cortex A8 and WinCE6. MCP2515 driver and Wireless communication message is designed by using Modbus/TCP protocol and the remote sports management monitoring and unified management of the sports managements are realized by the two-way communication of GPRS and remote management center. The stable and reliable of the system is proved by the field operation and the system has good application prospect.

Keywords: *Computer aided; Sports management system; MCP2515 driver Model*

1. Introduction

In recent years, with the widespread use of the vigorous development of China's economic construction and sports management, sports management major accidents caused by increased year by year [1]. Internet of Things (IOT) is a huge network through various information sensor devices, such as radio frequency identification (RFID), infrared sensors, global position system, laser scanners and other information sensor devices, according to the agreement to connect any items with the Internet, so as to form a system. Then we can exchange information and communicate to realize the intelligent identification, location, tracking, monitoring and management. In the Internet of things "object" has a logo, with physical properties as well as the essence of personality, which can use intelligent interface so as to realize the seamless integration with the information network. So the Internet of things can be widely used in national defense, production control, environmental monitoring, city management, transportation, medical education, public security, house life and some other fields. The Internet of things is also known as the third wave of global information industry following the computer, the Internet, which is a new round of market competition in information industry. Therefore, the study of the Internet of things is widespread concerned.

Therefore, the development of stable and efficient wireless sports management safety sports management monitoring system for security applications sport equipment is important. Important parameters of the system through the sensor will affect the operational safety of the sport equipment, such as the tilt angle, dynamic anti-collision information, torque, amplitude, height and other information in real-time collection and sports management monitoring, on the one hand through the touch screen display to the field device drivers reference; another aspects of using the Mod bus / TCP protocol through GPRS to achieve a seamless link with the remote sports management monitoring

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center managers to achieve through the Internet for all sport equipment's within the jurisdiction of online sports management monitoring and unified management [2].

Wireless Sensor Network Introduction

Wireless sensor network (WSN) refers to the nodes which can sense and collect data network, It is usually divided into gathering node, user management center and three parts of sensor node, as shown in Figure 1.

The constituents of the wireless sensor network, the node usually adopt Ad Hoc way of organization, the data transmission is its core competencies. Node is mainly used as acquisition and monitoring data, the data wireless transmission to the gathering node, then reach to user's regulation, evaluate the situation of the monitoring area according to these data analysis.

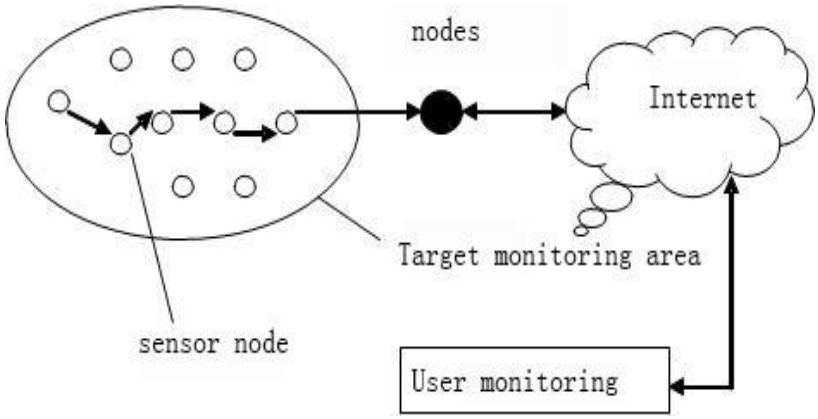

Figure 1. Wireless Sensor Network Architecture

2. The Principles of Constructing Expert Sport System

With a further recognition on the experimental features of economic management, we have a deep thinking about the principles of constructing sports system, and summarize the following principles:

(1) Systemic Principle

Due to involving many disciplines and covering many majors, the construction of sports informatics sports system is a complex systemic project. In order to build a complete and reasonable system, we must follow the system theory, especially the points of view about the integrity, the interrelation, and the dynamic evolution. In addition to the orderly planning and integration among the knowledge in the sports, the sports must be combined with other practice s, such as theory, teachers' scientific researches, and advantages of school disciplines and the development of local economy.

(2) Modular Principle

The sports of sports informatics should include the s of computer software and hardware technique, database technology, data acquisition technology, information retrieval, data mining technology, artificial intelligence technology, simulation technology and other disciplines and relevant professional experiment s. According to the objective differences among contents of various disciplines and majors and the unified planning based on the disciplines, breaking traditional methods based on courses, the system divides the integrity into modules scientifically and reasonably, therefore the students of different disciplines and different majors can choose related modules to learn [3]. In the process of dividing the modules, we should abide by the principles of high aggregation

and low coupling of module contents to fully embody the differences and relations among disciplines.

(3) Hierarchy Principle

In addition to making a lateral distinction, according to the different aims and the deep analysis of sports, we should map out different vertical hierarchies scientifically and reasonably, and build a hierarchical and gradual sports system to meet different learning needs of students in different grades, different periods and different purposes.

(4) Profitability Principle

No matter how to divide horizontally or vertically, the standard to check the sports system is reasonable is benefit. There are three aspects of benefit: first, it is the technical benefit to meet the talent target; second, it is the economic benefit under the software and hardware environment; the last one is the social benefit that can demonstrate, radiate and lead the development [4]. If the three aspects are noticed, the integration and completion of constructing sports informatics sports system can be guaranteed.

3. The Overall Structure and Function of a System

System consists of sports management monitoring instruments terminal, remote sports management monitoring center and TCP / IP wireless network consists of three parts. After sports management monitoring instruments using ARM Cortex A8 core CPU, main tower machine running real-time sensor data collection to the instrument terminal, GPRS module UART RS485 connection using TCP / IP mode via CAN bus transmission to send data to a remote sports management monitoring center platform; Remote sports management monitoring center is bound with a fixed IP address and port number, sent via Internet GPRS network to receive and manage the sports management monitoring data, and management personnel responsible for sending operational instructions to the appropriate sports management terminal; TCP / IP wireless network using standard industry MODBUS communication protocol, to ensure data security and stability on the basis of good ductility, very suitable for complex field conditions. The functions are further detailed to network interface, data extraction and classification as well as localization algorithm interface *etc.* They are mainly responsible for receiving the data packet from wireless sensor network node, processing relevant data after decomposing the data packe, completing environment monitoring and managing sensor network. Localization algorithm interface reads related configuration files of node location and transforms node location. After the server starts up, it waits for client request. The client makes a request to the server. The server accepts the request and judges the request type. The main request types include indoor and outdoor environment real-time monitoring, historical records query, control WSN command, node location and general commands. When the server receives client request for indoor and outdoor environment real-time monitoring, the server monitors WSN data packet via Socket. If the monitoring is unsuccessful, it will continue to monitor; if the monitoring is successful, it will accept the data packet, analyze it, feedback the data packet analyzed to the client and type it into the database. When receiving the request of other types, the server will maker corresponding processing according to different requests. The server feeds back the processing results to the client. If the serve receives service off command, it will quit the service. The overall structure of the system shown in Figure 2.

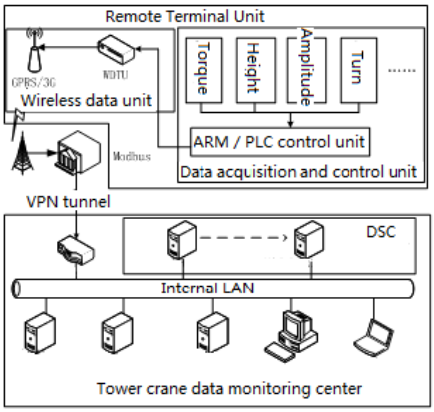

Figure 2. Overall System Architecture

4. Sports Management Monitoring Terminal Hardware Design

The hardware of the data base station uses a MSP430F1611 as the main processor to control the data base station; CC2430 is used as a co-processor to transmit monitoring data based on the ZigBee protocol between the data base station and data monitoring sub-network; a GPRS module is used to realize remote data communication between the data monitoring center and data base station; An AT45DB081D is used as the system's solid memory to store historical data, and the buttons and LCD are supplemented as a man-machine interface. The software of the data base station uses μC/OS-II embedded operating system as the software platform of the MSP430F1611 to improve the real-time performance of the system; a ZigBee 2004 stack from Chengdu Wireless Dragon Information Technology Company is used as the software platform of the CC2430 module. Hardware platform using ARM9 Cortex A8 microprocessor core CPU, mainly collected by the sensor network, CAN communication module, alarm control circuit, consisting of 10.4-inch touch screen display, GPRS / GPS / ZigBee wireless communications and other components, the hardware structure of the system shown in Figure 3.

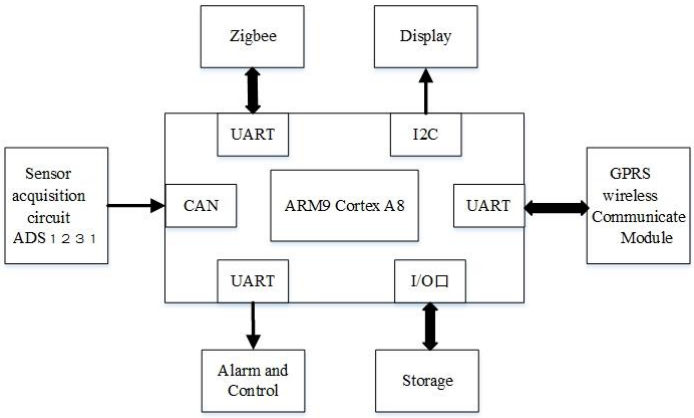

Figure 3. Sports Management Monitoring Terminal Hardware Architecture

The system uses the latest high-performance ARM9 Cortex A8 microprocessor to control the core, based on S5PV210 core, standard operating frequency is 1G, using single-channel 32bit data bus, 512M DDR2 memory, the perfect support Wince6, Linux and other embedded operating systems [5]. CAN communication module using Microchip's MCP2515 chip, is a stand-alone controller area network protocol controller that supports CAN V2.0B technical specifications, can send and receive standard and

extended data frames and remote frames [6]. GPRS module embedded TCP / IP, UDP and other protocols, stable wireless, remote, networked communication, seamless connectivity and Internet.

In the process of the hardware circuit design needs to consider how the circuit anti-interference, how to protect when collecting current or voltage. In addition, the selection of main chip to meet can achieve real-time performance, high precision and the ability for dealing with data.

CC2430 positioning algorithm is based on the received RSSI (received signal strength indication) value. RSSI value will decrease with increasing distance:

$$RSSI = -(10\, n \log_{10} d + A)$$

Where, n is signal propagation constant, d is the distance between the sender, A is signal strength a meter far from the sender. Output and input relationship based on the RSSI localization algorithm,

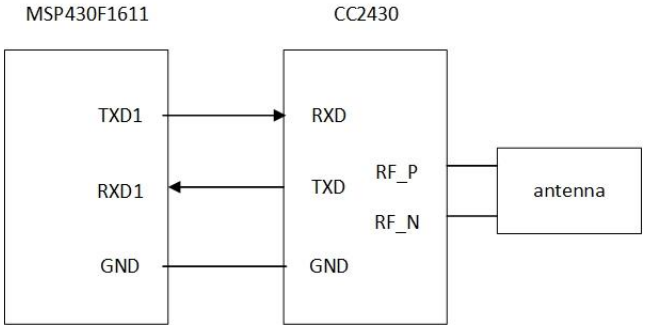

Figure 4. Interface Circuit

The ZigBee module design uses the CC2430 module from Chengdu Wireless Dragon Technology. The CC2430 contains 8 K SRAM and 64 K Flash memory, so it is no longer needs to increase memory. The UART 1 interface circuit which is used to connect the ZigBee module and MSP430F1611 is shown in Figure 4. The CC2430 connects with the MSP430 through the serial port. In order to ensure that the two modules have a same voltage reference, a ground is needed to connect the two modules.

Figure 5 shows the schematics of ROIC. Rs presented heat-transfer microbolometer in Sports management monitoring systems which change under infrared irradiation. Vref, Vsk, Vfid, Tint, and Cint are the reference voltage, blind pixel bias voltage, bias voltage, integrated time, and integrated capacitance respectively: Rb is the resistance of the blind pixel, which is constant and did not change under infrared irradiation;

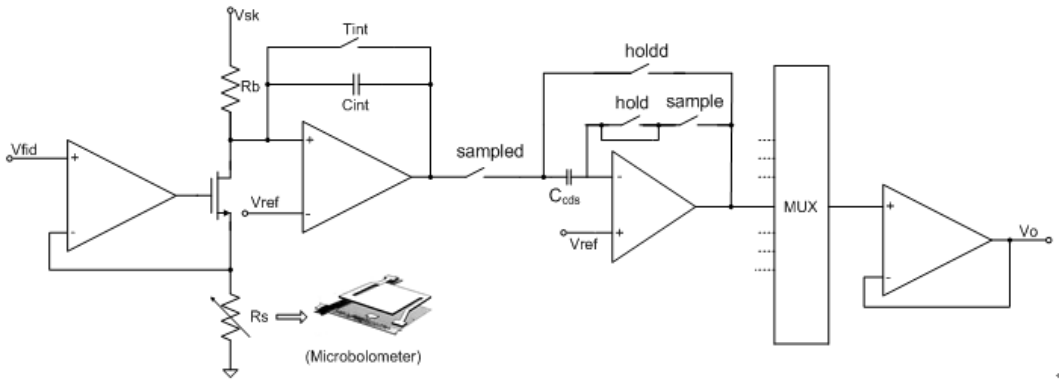

Figure 5. Schematics of the Read-Out Integrated Microbolometer in Sports Management Monitoring System Circuit

The output voltage V_0 is given by Eq. (1):

$$V_o = V_{ref} - \frac{T_{\text{int}}\left(\frac{V_{sk} - V_{ref}}{R_b} - \frac{V_{fid}}{R_s}\right)}{C_{\text{int}}} \quad (1)$$

Then sensitivity is a key parameter of microbolometer in Sports management monitoring system which is defined as the output voltage divided by the incident radiant power [7] can be expressed as Eq. (2):

$$S_v = \frac{\partial V_o}{\partial P} = \frac{\alpha \cdot \eta \cdot V_{fid} \cdot T_{\text{int}}}{\sqrt{G_{eff}^2 + \omega^2 C^2} \cdot R_s \cdot C_{\text{int}}} \quad (2)$$

Where, α is the temperature coefficient of resistance, η is the IR absorption coefficient of the microbolometer in Sports management monitoring system, V_{fid} is bias voltage of microbolometer in Sports management monitoring system, Tint is integration time, G_{eff} is Effective thermal conductance, ω is modulation frequency, C is thermal capacitance, R_S is resistance of microbolometer in Sports management monitoring system, C_{int} is integration capacitance.

Effective thermal conductance,thermal capacitance and R_s of microbolometer in Sports management monitoring system had significant impact on performance as well as parameters of ROCI. During system level simulation, all these aspects should be taken into.

4.1. MCP2515 Driver Design

Microchip's MCP2515 is a stand-alone controller area network (Controller Area Network, CAN) protocol controller, which comes with two acceptance masks and six acceptance filters can be realized on the wrong message filtering [8]. WinCE6 system based system design and the preparation of the driver, the device driver, the kernel cannot be directly due to identify a physical address, shall be mapped to the physical address space of the virtual address, to determine the physical address decoder [9] from the address bus by using MmMapIoSpace () function of the physical and virtual addresses linked to the key code is as follows:

v_pIOPregs=(S3C6410_GPIO_REG*)MmMapIoSpace(ioPhysicalBase,sizeof(S3C6410_GPIO_REG),FALSE);

Will be conducted after the implementation of the relevant IO MCP2515 initialization mode conFigureurations: standard loopback mode two, the former cannot be more than one CAN line for testing; latter is used for standard CAN online communications.

MCP2515_Write(CLKCTRL,MODE_LOOPBACK|CLKEN|CLK8); // Loopback mode

MCP2515_Write(CLKCTRL,MODE_NORMAL|CLKEN|CLK8); // Standard Mode

Followed MCP2515 baud rate settings, CAN bus all nodes must have the same nominal bit rate. Modbus protocol uses NRZ (Non Return to Zero, NRZ) coding. Therefore, the receiving node shall receive clock recovery and synchronization with the transmitter clock. The median time from non-overlapping time segments, using the nominal bit rate (NominalBit Rate, NBR) in the CAN, said it can be used the following equation:

$$NBR = f_{bit} = \frac{1}{t_{bit}}$$

$$t_{bit} = t_{SyncSeg} + t_{\text{Pr}opSeg} + t_{PS1} + t_{PS2}$$

In the above formula, the four time periods in turn expressed as a synchronization segment, dissemination section, phase segment PS1, phase segment PS2. In the driver, must meet the PS1> PS2 conditions, the key code is as follows.

```
MCP2515_Write(CNF1,SJW1|BRP3);//Tbit=20TQ
MCP2515_Write(CNF2,0xbb);//PS1=8TQ PSeg=4TQ
MCP2515_Write(CNF3,0x06);//PS2=7TQ SYNC=1TQ
```

After writing a good drive configuration other load files, add in the project Platform.reg in CAN1.dll, then add the binary image of the code in the project Platform.bib; drive file, create a name for the Makefile, CAN1.def and sources, *etc.* file for the application layer interface function definition to be output to generate dynamic library specified dynamic library and specify the source file to be compiled, *etc.*, preferably Sysgen command will drive NK.bin compiled into the kernel system in Platform Builder , NK.bin kernel via USB / Jlink programming tools such as the hardware platform to run.

4.2. Design of the Power Module

A good power module is the foundation of a reliable system. Because of the high peak current of the GPRS module and the strong interference with the other modules when the GPRS module is in wireless communication, the design of the power module must include high power isolated chips in order to reduce this interference. The design of the power module is shown in Figure 6. It uses LM2596 and TPS79533 power chips. LM2596 is a power management integrated circuit, and its largest output current is 3 A. At the same time it has a good linearity and load regulation characteristics. TPS79533 is a single-output LDO with a fixed voltage (3.3 V). Since the data base station works outdoors, an external power supply can be a battery pack with 6 Ni-MH batteries (7.2 V) or two lithium batteries (7.4 V).

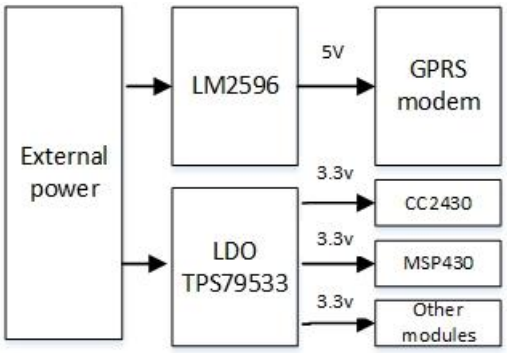

Figure 6. Power Module

5. Modbus / TCP protocol-Based Transmission Network

Modbus protocol is developed by an industrial communications protocols and distributed control systems, is a master-slave network, is an application layer packet based transport protocol, the protocol uses a host for one or more slave communication, using the command / answer mode. Where between the host server and the sports management sports management monitoring terminal via a link TCP / IP way to interact, build the server TCP / IP listener, the terminal is responsible for issuing Kai registration request, after the connection is established by the receiving terminal server reported heartbeat packet to determine the state of a TCP connection. Packet type using Modbus and

Modbus request frame response frame to achieve the command / response packet transmission.

Modbus RTU supports two frame structure and ASCⅡ mode, ASCⅡ mode, each byte packet information unit is divided into two nibbles units, each unit is converted to nibble 7 ASCⅡ character transfer [10]. In the data frame structure, including header, frame length, frame serial number, protocol number, the command character, data payload, CRC checksum and frame tail and other sub-domains, where the data payload type character selected by the command. Communication frame structure of the system control center and sports management remote sports management monitoring terminal as shown in Table 1.

Table 1. Modbus Protocol Frame Structure

Header	Frame length	Frame serial number	Agreement No.
2byte	1byte	2byte	1byte
0x5A55	0x00~0xFF	0x0000~0xFFFF	0x00~0xFF
Command breaks	Data load	CRC check	Data Frame End
1byte	nbyte	1byte	2byte
0x00~0xFF		0x00~0xFF	0x6A69

6. Sports Management Monitoring Testing

Based on ARM CortexA8 hardware platform, combined with the touch screen to build friendly interface, to achieve a good impact on the real-time sports management monitoring and recording crane safety data sports management monitoring terminal instrument operating results shown in Figure 7. Through field tests showed that the frequency of large sports management strong interference conditions, current sensor weight, torque data will appear occasionally jump, malfunction-prone control circuit into account, the system uses the mean filter coefficient select 24 cycles, the test data stable and reliable. Press to write data via RS485 Modbus protocol and GPRS modules for wireless sports management remote sports management monitoring and management, Internet users can run real-time sports management monitoring and management of the sports management through the browser interface.

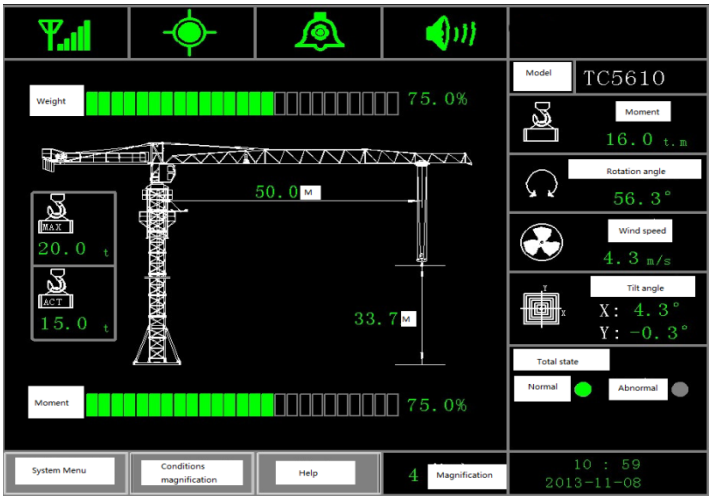

Figure 7. Touch Screen Interface

7. Conclusion

Sports management wireless remote monitoring system for the safe operation of the sports management and unified management has an important role in most of the domestic like product for the current poor real-time performance of a single, low accuracy, lack of remote monitoring and other issues, is designed based on Modbus/sports management wireless TCP traffic monitoring and management system, design a stable, efficient, scalable good Modbus communication protocol, developed based on the RS485 device driver wince6 embedded systems design to build a friendly human-machine realization of construction site acquisition and local management running the data through GPRS WEB server and build to achieve a fleet of remote monitoring and unified management, through on-site commissioning, the system is stable and reliable, and has broad application prospects. The monitoring system presents useful characteristics as large network capacity, flexible disposition, low power consumption, low cost, and minor influence on the natural environment.

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