

Research on construction of normative ideological instruction teaching management system based on ZigBee wireless sensor network

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Abstract

In the process of standard ideological and political teaching management, teaching quality management, teacher management, student management and education environment management etc are all very important links. In order to establish and perfect the management system of ideological and political teaching in school, management utility should be developed. And the system optimizing should be comprehensively enhanced in teaching. We are to construct a management system on the basis of ZigBee through wireless sensor, RMON (remote monitoring) of ideological instruction teaching supervision, multimedia teaching and classroom environment management etc. will be designed through coordinating with Go-Ahead technology. The corresponding hardware and software facilities will be designed and developed. The role of wireless sensors in teaching management will be reflected through the image of flow image. Standardized teaching management would be genuinely realized with its advantages of convenience, utility, high efficiency, and energy conservation.

Keywords: teaching management, wireless sensor, ZigBee, RMON (remote monitoring)

1 Introduction

Teaching management includes plan management, teaching target management, the didactical process management, quality control, teacher management, student management, teaching archives management. Teaching process is bilateral activity process composed of teacher's teaching and students' learning according to certain social requirement, teaching purpose and the characteristics of students' physical and mental development. This process is composed of such elements as teachers, students, teaching content and means etc. The management of teaching process is also to determine the order of teaching work according to the rule of teaching process. The activities process of teaching objectives is realized through establishing corresponding method and such measures as plan, entertaining, check and summarization. However realizing them through relying on manpower merely with above management method is not enough obviously. With the rapid development of wireless sensor network in current world, and they have merged into various industries effectively. This paper is to suggest bringing the concept standardization of teaching management into wireless sensor system, thus better and more effective supervision and management will come true. This paper is to construct the system on the basis of ZigBee wireless sensor network [1], this is an intelligent system constructed by wireless communication technology ZigBee and flushbonading Web server Go-Ahead technology in short distance.

2 The introduction of ZigBee technology and go-ahead technology

2.1 ZIGBEE TECHNOLOGY

ZigBee technology is a kind of software protocol, which takes IEEE802.15.4 as the basis, and takes network security and application as guidance [2]. ZigBee is a kind of wireless communication technology with short distance, low transfer rate low energy consumption, low complexity and low power consumption [3]. It has high scalability and reliability. ZigBee is widely applied in various industries; especially it is prominent in consumer electronics, automotive automation and industrial control. It also has certain effect in medical equipment, home gateway and the enterprise gateway. Its development prospect is very broad. ZigBee protocol stack is very simple, its realization is relatively easy, and the needed system resources are less occupied. Complete ZigBee protocol stack is composed of physical layer, medium access control layer, network layer and application layer. The physical layer and MAC are defined by IEEE802.15.4, the network layer and application layer are defined by ZigBee alliance.

ZigBee takes independent work nodes as basis; it is a kind of wireless network type in stellate, cluster tree and mesh constructed through wireless network. The network is composed of three nodes: coordinator, router and terminal equipment. Coordinator is the centre network node, which is responsible of network composition and maintenance. Router is responsible of information

frame's route inside the internet; terminal equipment is to realize specific functional units [4]. ZigBee could also be divided into full function device and reduced function device, the nodes of reduced function device are only taken as the network terminal equipment. They are not communicated with each other, send and receive data through full function nodes. They do not have the function of routing and relay function. Full function device is used as three mid-nodes, which are responsible of communicating with all control child nodes, collecting data and releasing control, etc. ZigBee network has very strong reliability; this paper adopts ZigBee technology to improve instructional management system.

2.2 GO-AHEAD FLUSHBONADING WEB SERVER TECHNOLOGY

Flushbonading Web server is operated in embedded device on the basis of Web protocol server, it provides the condition and parameters information of embedded device in the form of webpage in computer, then transplants Web server into embedded system and accesses Internet. Flushbonading Web server could not only use browser to provide graphical user interface for users, realize the function of remote management and embedded monitoring system, but also make further development at server-side through combing with flushbonading Web service [5]. Flushbonading Web server has changed the remote control and management mode of embedded device, which does not need, dedicated communication lines, transmittal information will not be limited to data information.

The common flushbonading Web server includes Https, Go-Ahead and Boa. The Iot gateway used in standardized education management system adopts Go-Ahead server, by which to realize the connection of ZigBee network and external Internet network, as well as information exchange and control. Go-Ahead is a kind of open source embedded Web server with more comprehensive function. It supports ASP, flushbonading JavaScript, CGI as well as HTML format of static page. The server could give fast response, process more than 50 requests for every second, and support a variety of operating systems such as Vx-works, Linux, WinCE and so on.

CGI (Common Gateway Interface)'s common gateway interface is a kind of communicating tool between Web server and browser. CGI procedure makes the webpage have interaction function; its procedure must operate on Web server. Most of the CGI procedure is used to explain and process the input information from browser forms, and corresponding processing would be generated in server or it will feedback corresponding information to browser.

3 The construction of standardized teaching management system

This paper is to realize the standardization of teaching management, construct a set of advanced administration system with high efficiency and low investment through using wireless sensor network model. As a kind of relatively intelligent supervisor mode used to replace traditional mode of labour management, it is able to create a new learning environment for students and teachers, as well as management system.

The system is composed of the students and teachers' handheld one-card, information acquisition node in classroom, wireless sensor coordinator, gateway server in classroom, web access terminal, and executing agency and so on. It could also be comprehended as typical B/S structural ZigBee system of perception layer, network layer, application layer [6]. Wireless sensor nodes and the processing chip of coordinator adopt TI Company's CC253, and wireless communication adopts ZigBee technology. Intelligent classroom gateway takes Cortex -A8 processor and Linux operating system as the core, flushbonading Web server is constructed through adopting Go-Ahead.

The information nodes of wireless gathering in classroom include temperature, humidity, illumination and voice etc. Wireless execution node has light switch, air-conditioning switch, curtain switch, multimedia projector switch and so on, all these equipment could accept the order of control centre. According to the parameters such as intensity of light, the number of people in classroom etc., the brightness of the light will be of automatic adjustment, controller would make automatic adjustment. Controller could rate the classroom according to the noise level in the period of individual study; his handheld device designated with RFID tag should be available both in class and after class. The gateway of classroom accesses information about students and teachers makes statistical rating for the information of attendance, lateness and early leaving. Teachers could carry on the statistics for students' grade through the statistical functions of the system, thus the management will be convenient and real-time communication would be available, as it is shown in Figure 1.

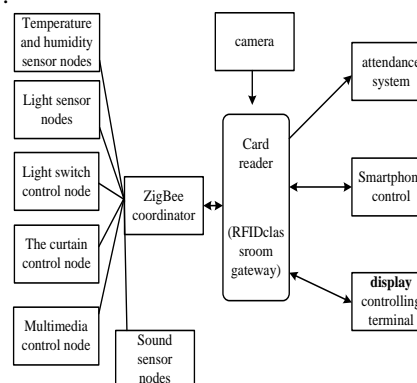


FIGURE 1 The structure of standardized teaching management system

In this system, ZigBee network topology model is of stellate type. ZigBee coordinator is the organizer of the network, which is responsible for network establishment and message routing. The sensing information in the classroom can be accessed wirelessly and sent to the classroom gateway through a serial port. User requests can be received at the Go-Ahead server-side and information data can be processed through CGI procedures, then the processed information will be fed back to the user control and display terminal.

4 The Realization of hardware system and software system

4.1 THE HARDWARE OF TEACHING MANAGEMENT

Hardware facilities involved in this paper include the classroom gateway and ZigBee wireless sensor node. The gateway of the classroom is the transfer station for all kinds of information data, attendance data, image data, audio data, and remote display control terminal, statistical data of attendance system performance. All wireless node data, RFID data, and camera data should be sent to the gateway, which performs protocol conversion to data, and then it is transmitted to the network display control terminal through the Internet, or sent to a handheld device through GPRS. The control data transmitted through the Internet or GPRS by the display control terminal will be equally sent to all wireless control nodes after address and protocol conversion. The gateway hardware adopts the microprocessor Samsung S5PV210, which is based on the ARM-CortexTM-A8 core, dominant frequency 1GHz. Peripheral resources include modules of 512MB internal storage, 1GB NAND Flash, 7 inch LCD touch screen resistance, ZigBee transceiver, RFID card reader, camera.

The communication module of ZigBee applied by us in teaching management is CC2530. It is a solution of a real system on chip (SoC) applied for 2.4GHz IEEE802.15.4, ZigBee and RF4CE [7]. In the design of the overall ZigBee network, how to reduce power dissipation, especially reducing the power consumption of terminal nodes is the key of consideration. A typical terminal node of a wireless sensor network is usually composed of a sensor module, processor module, wireless communication module, and power module. Processor module and wireless communication module adopt CC2430 chip, which would greatly simplify the design of radio-frequency circuit. As shown in Figure 2 and 3, the information acquisition module of the sensor takes STM8S103F3 as the microprocessor, the sensing information will be sent to CC2530 through AD conversion and serial port.

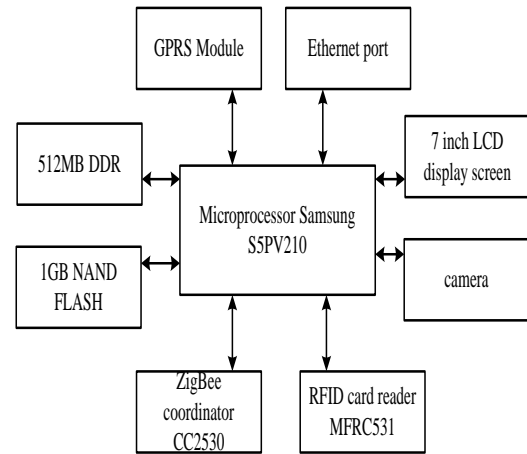


FIGURE 2 The structure of gateway hardware

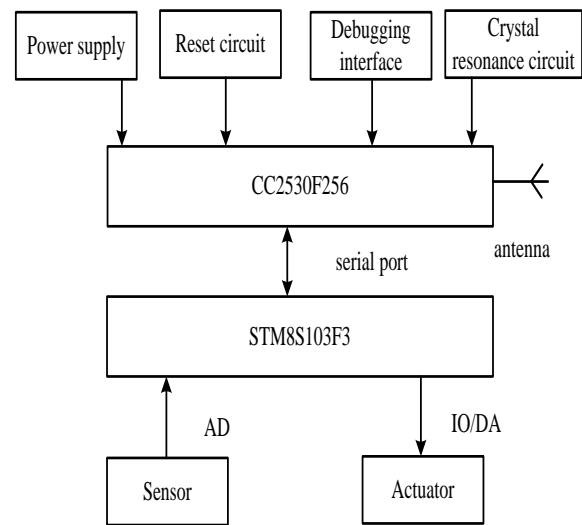


FIGURE 3 The structure of node hardware

From Figure 3, we can see that the effects of RBF neural network improved by two algorithms are better than that of normal PID control. In the starting process of the electromotor, it can effectively avoid starting overshoot, which is brought by normal PID control. Moreover, the time needed for the electromotor from start to stable work becomes shorter, thus improving the electromotor's working efficiency.

4.2 TEACHING MANAGEMENT SOFTWARE

The software facilities involved in this paper include classroom gateway, ZigBee coordinator, and ZigBee node program design.

4.2.1 The design of classroom gateway software

The software systems' development of gateway is as follows:

- (1) The transplanting of bootstrap program. Bootloader is the first section of the program operated on hardware system after power-on. It is to realize the initialization of hardware equipment and establish the mapping of memory space, prepare good environmental

for calling operating system nucleus and user program. The Boot-loader used in this system is uboot.

(2) The transplanting of flushbonading operating system. Flushbonading operating system Linux has advantages of source code development, good stability, good transferability, powerful network function and so on, thus this system kernel is transplanted into the gateway of system. After downloading linux-2.6.35.7. tar.bz2, the kernel configuration file is modified, then cross compiling is performed and compressed, finally it is downloaded to the flash of gateway platform after generating uImage core files.

(3) The transplanting of root file system. The first loaded file system when starting operating system nucleus is root file system. Commands and tools in the file system are generated through applying busybox, and bin, sbin, user catalogue are also generated, then subdirectory of dev, etc, lib, proc, tmp, var, mnt, home are created. Files of inittab, rcS, fstab, profile etc. are prepared to be started under etc catalogue. Then all of the catalogue files are made into root file system file-yaffs format through using mkyaffs2image tool, finally it is downloaded to flash.

(4) The transplanting of flushbonading Web server – Go-Ahead. Its structure of catalogue could be observed through downloading Go-Ahead source packages and decompression. Transplant subdirectories containing a variety of operating systems include CE, ECOS, LINUX, LYNX, MACOSX, NW, QNX4, VXWORKS, WIN. Web catalogue could store html file, executable file of CGI cgi-bin procedure is stored under catalogue. In each operating system directory of Go-Ahead source code, there is main.c file, which is the entrance of overall system procedure and responsible of accomplishing server initialization, service monitoring and setting of relevant interface. Figure 4 represents the work process.

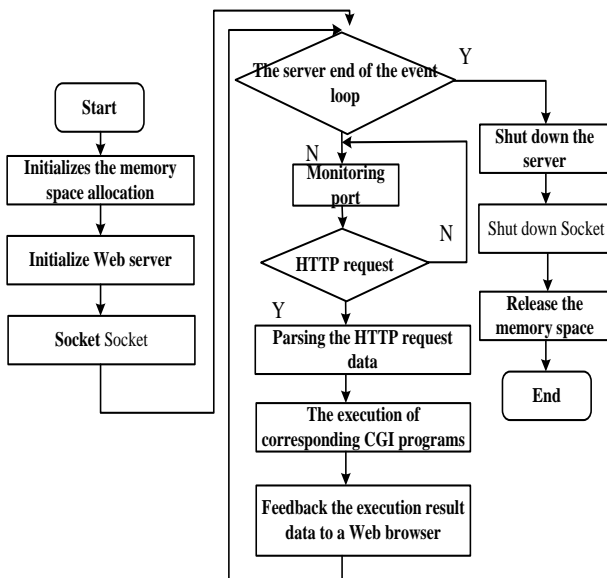


FIGURE 4 GoAhead workflow chart

(5) The transplanting of gateway application program. The gateway of this system could not only act as Web server, but also take charge of directly indicating various information parameters of classroom and controlling various actuating equipment of classroom on gateway LCD at the same time. The GUI control program in this system could be accomplished by Qt.

4.2.2 The design of ZigBee coordinator software

The task of ZigBee coordinator linked with gateway serial port of classroom includes initializing CC2530F256 and protocol stack, constituting ZigBee network with the information sensing nodes of distributed temperature and humidity, illumination intensity, sound transducer etc.; detecting ZigBee wireless signal. If the network has route or there is terminal node entering network, then the address of network will be allocated to nodes. Network terminal node data will be accepted and transmitted to classroom gateway through UART, the control information sent by gateway will be accepted. Specific ZigBee terminal control node will be constructed after recombining data analysis [8]. It is shown as Figure 5.

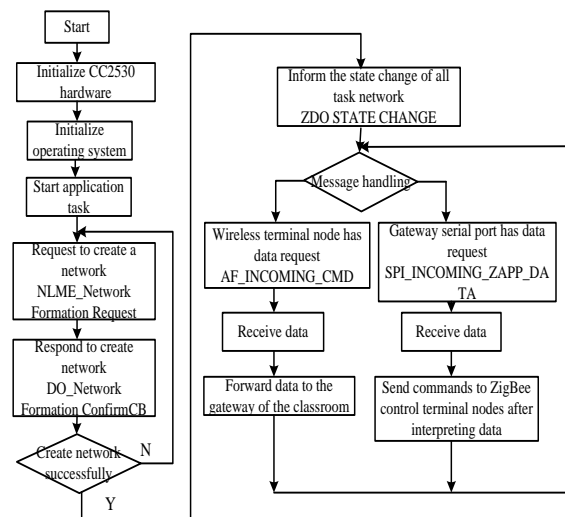


FIGURE 5 The workflow of coordinator software

4.2.3 Zigbee terminal node and remote control interface

The main work of ZigBee terminal node in this teaching management system is to apply for entering ZigBee network and performing data communications with ZigBee coordinator. Software workflow of terminal node is shown as Figure 6.

In the remote display control interface, any display control terminal could access the address of gateway through browser. Administrative staff with related jurisdiction not only could check parameters' information of specified classroom through verification of user name and password, but also realize the control of various equipment's in classroom. It is shown as Figure 7.

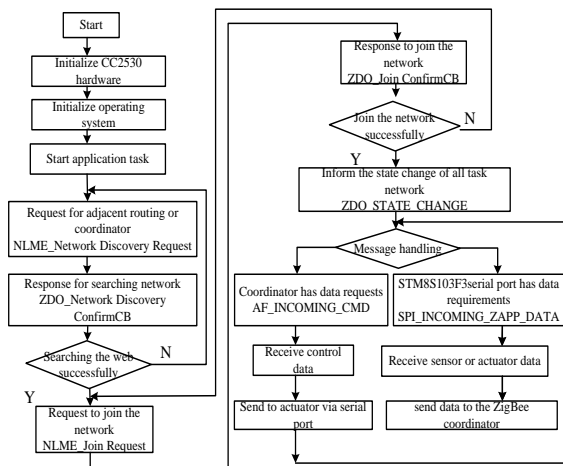


FIGURE 6 Workflow of terminal node software

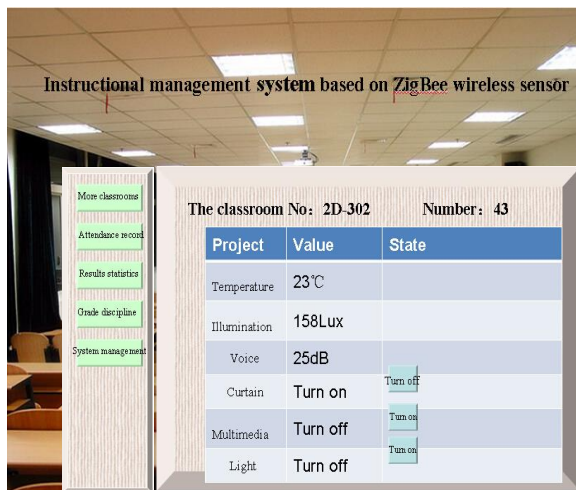


FIGURE 7 Control interface of remote classroom

6 Conclusion

We are to combine wireless ZigBee technology and flushbonading Web server –Go-Ahead with low cost and low energy consumption, and then apply them in the system of standard teaching management. Through performing experiment on this equipment in ideological and political class, the writer has not only realized the remote management of classroom equipment, teachers' and students' attendance, discipline of classroom etc. through Internet, but also substitute traditional wired network with wireless sensor in obtaining classroom information. Thus, system application flexibility is enhanced; the efficiency of teaching management is strengthened. The experiment results indicate that technology based on ZigBee has represented certain feasibility in the management of standard education teaching management. Its performance is good and reliable, energy saving, convenient, it is a set of wireless control system with high quality and worthy of popularization.

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