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Design and Implementation of a Teacher-Student Interaction System Based On ZIGBEE and RFID

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ABSTRACT
Based on analysis of features of ZIGBEE Wireless sensor networks and RFID technology, From the perspective of improving teaching methods, combining instruction practices, a teacher-student interaction system based on ZIGBEE and RFID technology was designed and implemented for the application of actual teaching. Results show that the system achieved the basic functions of a teacher-student interaction system. ZIGBEE wireless sensor network is based on the ZIGBEE technology. It has great application potential. Radio Frequency Identification, RFID is the use of radio frequency signals through space coupling (alternating magnetic field or electromagnetic field) to achieve non contact transmission of information through the message to the purpose of automatic identification technology. The teacher-student interaction system consists of RFID systems with ZIGBEE subsystems, can enhance the learning interaction between students and teachers. Students may also rely on this system to effectively communicate and interact with teachers, to unfamiliar places for learning and ask questions at any time, to avoid face to face embarrassing questions or omission may be a key.
Keywords **–** ARM Processor, AT89S52 Micro-controller, RFID, ZIGBEE

I. INTRODUCTION

Wireless sensor network is an integrated intelligent information system that assembles, information transmission, information processing, it has the characteristics of low cost, energy consumption, low data rate, self-organizing networks. The ZIGBEE technology is the standard wireless network protocol stack for low-rate sensor and control network design, is the suitable standard for wireless sensor network. ZIGBEE wireless sensor network is base on the ZIGBEE technology. It has great application potential. Radio Frequency Identification, RFID is the use of radio frequency signals through space coupling (alternating magnetic field or electromagnetic field) to achieve non-contact transmission of information through the message to the purpose of automatic identification technology. In recent years, RFID technology in the logistics field has been widely adopted, it is recognized as one of the industry's most important industry and application technology in this century. The unique function of RFID is to mark anything or person of the real world, in the virtual world of network, it have three functions as "tag", "address number" and "sensing".

In this system, RFID and ZIGBEE combination, use RFID data for wireless interactive communication, to achieve the interaction between students and teachers, such questions, answers, voting, attendance, assessment and other functions. This system consists of two units one is teacher monitoring unit and another is student data collecting unit. Student unit consists of controller, RFID module, ZIGBEE, LCD, yes or no buttons. Students attendance is taken by RFID reader and the data is passed to teacher through ZIGBEE module, if student present status led will glow.

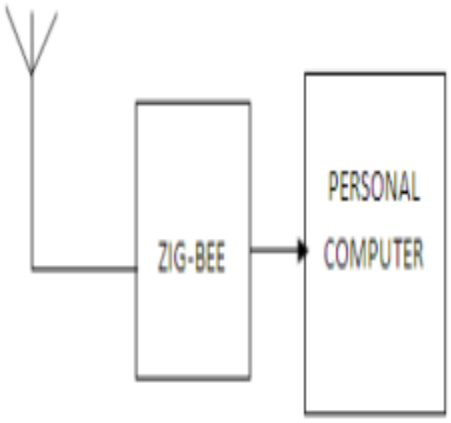

Fig. 1 Central Monitor unit for students (teacher side)

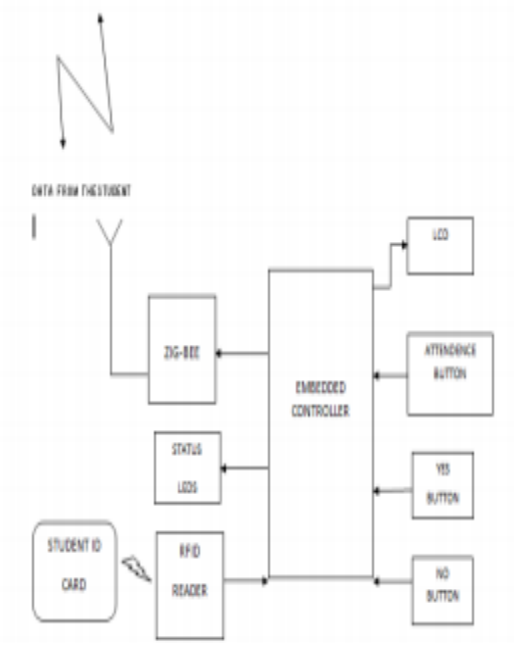

Fig. 2 Student System

Then teacher asks questions from monitoring unit which is interfaced with ZIGBEE and the questions are displayed in the LCD at student side. Student will reply yes or no through buttons. And the information is passed back to the teacher through ZIGBEE. Wireless sensor network is an integrated intelligent information system that assembles information acquisition, information transmission, and information processing; it has the characteristics of low cost, energy consumption, low data rate, self-organizing networks. The ZIGBEE technology is the standard wireless network protocol stack for low-rate sensor and control network design, is the suitable standard for wireless sensor network. ZIGBEE wireless sensor network is based on the ZIGBEE technology.

II. RELATED WORK

2.1 RFID

RFID technology uses radio frequency non-contact way of two-way data transmission between the reader and the RF card to achieve the objectives of target identification and data exchange. The workflow of RFID Read-write device is: Read-write device sent a certain frequency RF signals through the transmitting antenna, When RF card goes into the transmitting antenna work area, resulting in induced current, the RF card obtains energy, is activated. Then the RF card, sends out owns code and other information through the card built-in antenna. Read-write device's receiving antenna received carrier signals from the RF card, the carrier signals then transmitted by the antenna regulator to the RF card; Read-write device demodulates and decodes received signals. The coupling (inductive-electromagnetic), communication processes (FDX, HDX, SEQ), from RF card to reader device from, the method of data transmission (load modulation, backscatter, high harmonic), and the frequency range, etc, different methods of non-contact transmission are fundamentally different. However, all reader devices from the functional principle to the resulting design structures are very similar; all reader devices can be simplified into two basic modules as High-frequency interface and control unit. High frequency interface contains the transmitter and receiver, its features include: produce high frequency transmission power, activate RF card, and provide energy, modulate the transmitted signal, convey data to the RF card; receive and demodulate the high frequency signal from the RF card. Control unit functions include: communicate with the application system software, and implement commands sent from application software; control of the communication process with the RF card (master - slave principle); encode and decode signal systems, execute anti-collision algorithm, encrypt and decrypt data transported between RF card and reader device, As well as authenticate between the RF card and reader device and other additional features.

III. ZIGBEE WIRELESS SENSOR

3.1 Software architecture

The software on the ZigBee wireless sensor network devices is mainly composed of embedded operating system software, ZigBee protocol stack and application program, embedded operating system kernel provides a simple and efficient task transfers, interrupt handling and time queue management, also includes all the underlying hardware driver. Applications program include serial communications, RF communications, and signal strength detection. It uses modular design protocol stack, makes the whole System-level clear, good scalability, conducive to the secondary development of ZigBee technology.

3.2 Stack Design

ZigBee protocol stack is to ensure that wireless devices are low-cost, low power and low speed network interoperable. ZigBee protocol stack of different layers communicate through the service access point, most layer has two interfaces: data entity interface and management entity interface. Data entity interface goal is to provide top service routine data. Management entity interface goal is to provide the mechanisms including access to the

upper inside layer parameters, configuration and data management. ZigBee technology has defined the standard specification of the physical layer, link layer and network layer, therefore, the realization of these three layers are usually similar. Wireless sensor network's different applications are composed from the basic application, such as join the network, break away the network, send data, etc. This article uses the IAR Embedded Workbench for 8051 software to program the physical layer, media link layer and network layer code of the system platform, each of the header file defines each layer of the support of the services and application program interface. Meanwhile, the platform also provides a number of application interface, for example aplFormNetwork ( ), plJoinNetwork ( ), aplSendMSG ( ), etc. Users can call these functions to achieve their development and application.

3.3 Overall System Function

The teacher-student interaction system consists of RFID systems with ZigBee subsystems, can enhance the learning interaction between students and teachers, also can effectively manage students in class attendance and student learning outcomes and the progress to absorb knowledge. Teachers can keep abreast of the progress of students and enhance the students less familiar course content. Students may also rely on this system to effectively communicate and interact with teachers, to unfamiliar places for learning and ask questions at any time, to avoid face to face embarrassing questions or omission may be key. In this paper, RFID and ZigBee combination, use RFID data for wireless interactive communication, to achieve the interaction between students and teachers, such as questions, answers, voting, attendance, assessment and other functions. Each elective course students are assigned to a student tag, every seat in the class room table with a simple reader (Reader) subsystem, after students enter the classroom, the table reader subsystem can automatically sense and read the student tag, then the reader will send the information via ZigBee wireless to the podium of the main system, through the main system, teachers can know how many students school, attendance records of students, and make statistics. Students subsystem is equipped with 3 buttons and LEDs, students can push the yes or no button on the subsystem, (to know or do not know) to answer teachers questions, by ZIGBEE wireless, the answer back to the main system on the podium, the main system with a display subsystem to display the corresponding keyboard keys and control, student status and location can be displayed through the display, teachers can monitor the students' real-time understanding of the course and to grasp the situation, give supplement according to the situation, through the button, to call a student(each subsystem (for example: A ~ Z) corresponds to the buttons on the main system A ~ Z). The subsystem table lamp (LED) of the students called will light up or flash, until the student presses the yes button. Low power consumption. In the low-power standby mode, two AA size batteries can support one node to work 6 to 24 months, if use lithium batteries, such as L71 and other industrial batteries, the capacity can be achieved 3AH, its use of time up to 10 years. By dramatically simplifying protocol, reducing the requirements for communication controller, 8051 8-bit micro-controller to measure, sub function nodes as small as 4KB code, and the ZIGBEE protocol is a royalty free. Low rates. ZIGBEE communication work in the rate of 250kbps, can meet the application requirements of low-rate data transmission. Short distance transmission range is generally between (open range) 10 ~ 100m, after the increase in RF transmit power can also be increased to (open range) 100 km. This refers to the distance between adjacent nodes. If the communication between nodes and routing by relay, the transmission distance can be further. It can fully meet the requirements of teaching system. The ZIGBEE is fast response, In general, from sleep into the work state needs just 15ms, and nodes connect into the network needs only 30ms, further save energy. High capacity. This ZIGBEE network using star network topology, Manage 254 sub nodes through the master node; at the same time, the master node can be managed by upper layer network node, composed of up to 65,000 node network. High security ZIGBEE provides a three-tier security model, Including non security settings, use the access control list (ACL) to prevent illegal access to data and the use of Advanced Encryption Standard (AES128) for symmetric encryption, to ensure its security attributes with flexibility. License free frequency bands. Direct subsequent spread spectrum in the industrial scientific medical 2.4GHz (global) (ISM) license-free frequency bands.

IV. ADVANTAGES

1. Replacing the man power.
2. Continuous monitoring system.
3. Cost effective.

V. DISADVANTAGES

- Short Distance Communication Only

VI. APPLICATIONS

1. Industrial applications.
2. Military applications.

VII. FIGURES

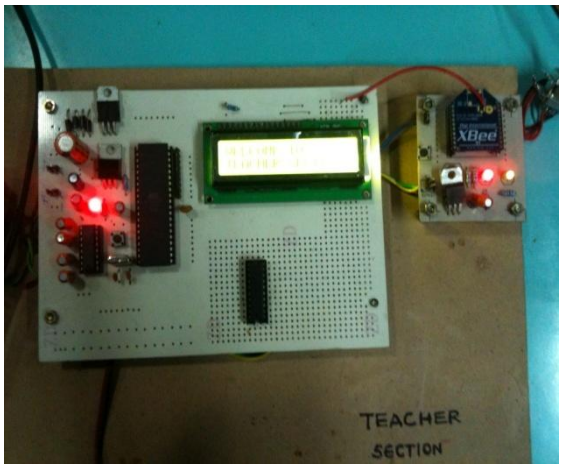

Fig. 3 Teacher Section

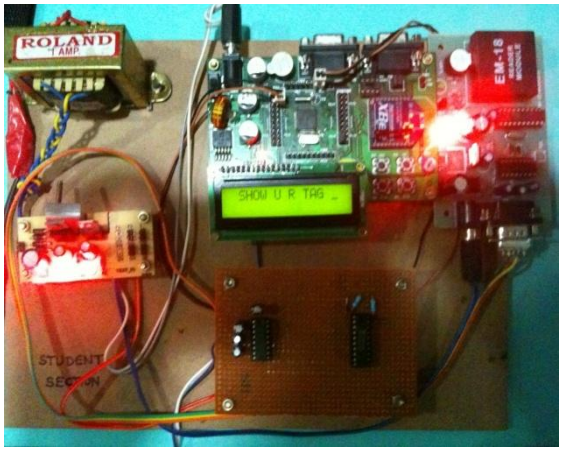

Fig. 4 Student Section

VIII. CONCLUSION

In this system, the combination of RFID and ZIGBEE way to achieve the interaction between students and teachers. RFID technology used for data acquisition and transmission, ZIGBEE wireless transmission module using a star network topology to achieve the data from students end to teachers end node for wireless transmission. Choose low-power hardware equipment and transport protocol, add the node sleep mechanism, so that the system has low energy consumption, large communication range, high stability characteristics. Using the teacher-student interaction platform, can realized the application of practical teaching. The results show that, the system can implement the basic functions of student-teacher interaction system. The system of ZIGBEE wireless sensor networks and RFID radio frequency identification technology, modular design, with the characteristics of scalable. Slightly modified, the application can be ported to other systems.

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