

**Two way Communication Wireless Sensor Network between Teacher-Student
Interaction System based on WI-FI and RFID**

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Abstract

Based on analysis of features of WI-FI Wireless sensor networks and RFID technology, we implemented a protocol stack of WI-FI using method of module dividing. From the perspective of improving teaching methods, combining teaching practices, a teacher-student interaction system based on WI-FI 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.

Keywords: Wireless sensor networks module; WI-FI; RFID; teaching interaction system

Introduction

The RTX4140 Wi-Fi Module is a small form-factor, single stream, 802.11b/g/n Wi-Fi module with on-board low power application processor. It is targeted at applications that send infrequent data packets over the network. Typically, these 802.11 applications will place a higher priority on system cost, power consumption, ease of use, and fast wake-up times as compared to high throughput.

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 has three functions as "tag", "address number" and "sensing".

WI-FI & RFID Technology and their Characteristics

A.WI-FI Technology

802.11 b/g/n single stream @ 2.4 GHZ Supports WEP, WPA/WPA2 and WPS modes of security (Wi-Fi drivers and WPA s) On-board application processor with flexible interfaces Designed for ultra low power operation through use of Energy Micro Gecko EFM32GG230F1024 MCU and Adheres AR4100 Wi-Fi SiP. it is also suitable for security applications. The below figure shows the block diagram of WI-FI

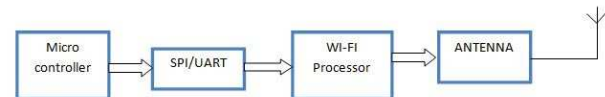


Figure 1:Block diagram of WI-FI

B. RFID Technology

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. For some special 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.

Overall System Function

The teacher-student interaction system consists of RFID systems with WI-FI 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 WI-FI 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.

A. The structural design of system 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 WI-FI 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 WI-FI 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.

B. Teachers end system architecture design

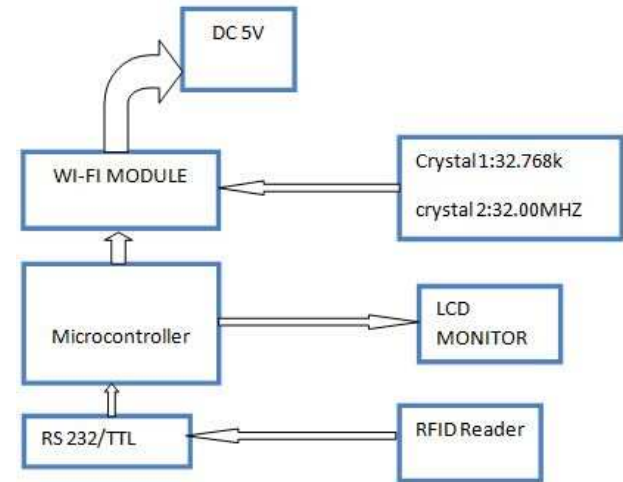


Figure 2. Teachers end system architecture

Function: the teacher's card correspond to the teacher's limits of authority, under the authority of the teacher, RFID information can be read, for students to ask questions, polls, check attendance numbers, record class attendance and a list of persons who did not list attendance. All results from the LCD display. Teachers end system architecture shown in Figure 2.

C. Students end system architecture design

Hardware equipment: WI-FI wireless transmission module, button, RFID reader. **Function:** questions request, Answer questions Y/N, RFID information send. Students end system architecture shown in Figure 3.

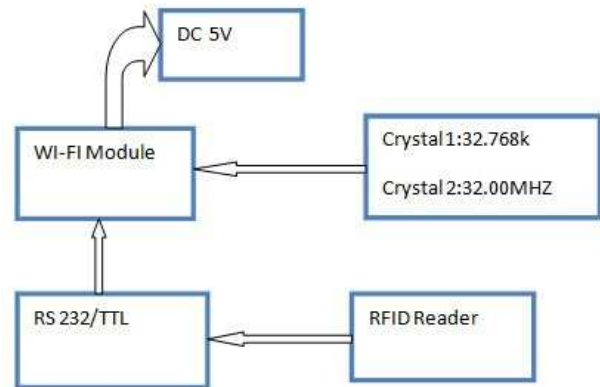


Figure 3. Students end system architecture

D. The WI-FI network has the following features:

- 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.

- Low-cost. 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 WI-FI protocol is a royalty-free.
- Low rates. WI-FI 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) 100m 1km. 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.
- Short delay. The WI-FI 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 WI-FI 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. WI-FI 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 sequence spread spectrum in the industrial scientific medical 2.4GHz (global) (ISM) license-free frequency bands.

E .The main parameters of the system:

Frequency band: 2.4-2.475 GHz;
Communication protocol: The standard IEEE 802.15.4;
Network topologies: Mesh, star; Modulation: DSSS;
Data transfer rate: 250KBps; Receiver sensitivity: -94 dBm;
Communication distance: 50m - 70m; Data Encryption: 128-bit AES; Channel access methods: CSMA/CA; Number of channels: 1-16; Emission current: About 28mA; Receive current: About 28mA; Sleep Current: 20uA the following; Operating temperature: 40 ~ 85

Conclusions

In this paper, the combination of RFID and WI-FI way to achieve the interaction between students and teachers. RFID technology used for data acquisition and transmission, WI-FI 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 WI-FI 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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