

Application of Wireless Sensor Network in Intelligent Building

Peng Liu

College of Computer Science, Yangtze University, Jingzhou, Hubei 434023, China

Abstract: ZigBee technology is a low cost, low power consumption, high reliability, multi reflection network wireless technology, which has high reliability, wide coverage and is easy to integrate into the existing home control products. Due to these features, ZigBee technology can be considered as a potential solution for home automation. This paper discusses the design and implementation of an intelligent building automation system based on ZigBee wireless sensor network, which has the characteristics of low cost, high efficiency, simple installation and high scalability. Finally, a typical example of intelligent building automation system for control and monitoring is successfully applied to IU building.

Key words: wireless sensor network, intelligent building, monitoring network, node design

1 Introduction

In recent years, Home Furnishing automatic system is becoming more and more popular, with intelligent automatic system in room Home Furnishing hopes, intelligent bedroom system can not only provide people with convenient, comfortable and safe shelter, but also through such programs to help people reduce their daily expenses Home Furnishing. People's growing demand for home automation products, which also provides a potential market for future trends. Because wireless sensor network (WSN) is stable, reliable, low cost, low power consumption and other characteristics can be used as a potential solution for home automation. Many studies have begun to use WSN to achieve home automation. However, most of the experiments were conducted in small rooms or single storey buildings. Today, there are still many disputes and discussions about the design and implementation of intelligent building wireless sensor network automation system. This paper discusses the design and implementation of a practical intelligent building wireless sensor network control and monitoring system.

2 System Design

The ZigBee of the control and monitoring system of intelligent building based on wireless sensor network is composed of three main parts: building control and monitoring network, gateway node and internal remote control, as shown in figure 1.

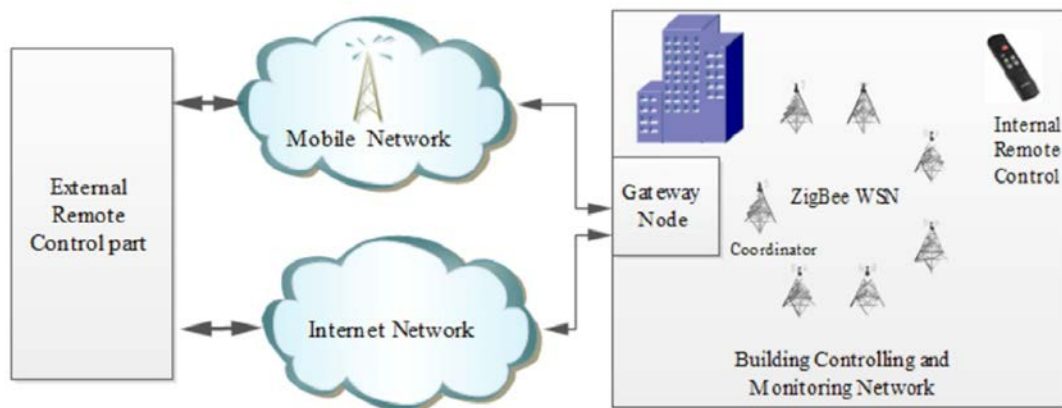


Figure 1 The system structure

Design of ZigBee wireless sensor network for building control and monitoring network. The system consists of sensor node, execution node, routing node and a coordination node. The router has the function of sending and receiving information, and the other nodes can transmit and control. These nodes are distributed in the different layers and rooms of the IU building, which form a cluster tree topology. All communications between devices are transferred from the source device to the destination device via the coordinator and router.

The gateway node is designed to improve the operability of existing building automation systems and external networks. Remote users can access the system information via the Internet and mobile networks. This feature allows users to leave the real-time control and monitoring of the task process. The gateway node supports three function interface, ZigBee can access the wireless sensor network, also can through the indoor local wireless LAN or ASDL access to the Internet, or you can communicate through the GPRS terminal and mobile phone network. The gateway integrates the secure data program and detects and processes the information through the nodes. The state data of all access devices is integrated into the gateway node. In this way, all the states of each device in the system are continuously stored and updated in real time. Remote users can control and detect the status of all devices in the building.

In order to realize the indoor remote control function, designed a special node when the node moves to another place, with its mobile node and network transmission protocol makes the system to maintain good links. This node feature enables users to use remote control nodes to control various devices in the building.

3 Hardware Design

3.1 Site node design

All nodes in the system design are based on the same site node architecture. The purpose of these designs is to improve the interactivity of all the nodes in the system. Various sensors and execution modules can be added to the application of building automation system. In the project, the temperature sensor, humidity sensor, motion sensor, smoke sensor and channel state window are used to realize the control function. The wireless power supply socket, light control switch is used to achieve the start of executive function. Site node structure shown in figure 2. Typically,

each node is composed of a power supply module, a microcontroller, a ZigBee transceiver, a system serial port program and some other extensions.

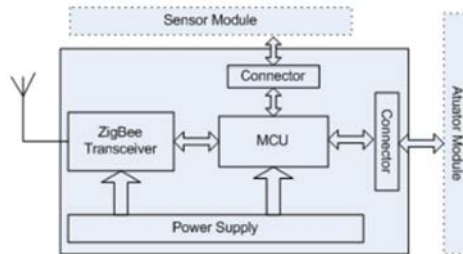


Figure 2 The site node structure

3.2 gateway node design

The interior gateway consists of a coordinator, GPRS data module, Internet data module and power module, as shown in figure 4. The power supply module is used to supply the different components of the required voltage value in the gateway node, and complete the power management function. In order to simplify the network joint between the communication protocol, each module is provided with a micro control unit (MCU) to handle the communication of information and control tasks, the ZigBee node is provided with a high speed MCU and large capacity storage space. UART serial port to complete the communication between the coordinator and the Internet data module, GPRS data module.

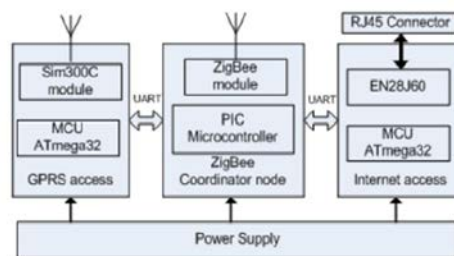


Figure 3 The gateway node structure

GPRS data module is composed of a single chip microcomputer and a GPRS interface module SIM300C of SINCOM company, which is used to complete the data communication between GSM and the network. SMS can also achieve the function of sending and receiving sms. The text information received by the microprocessor is then converted to the ZigBee wireless sensor network. If the user sends the status request information, you can get the relevant state of the equipment in the building. The Internet data module is composed of a single chip microcomputer and a ENC28J60 chip with an Internet interface circuit. Through the operation platform, users can operate the ZigBee control and monitoring network through the Internet data module. Figure 4 is the gateway node hardware design.

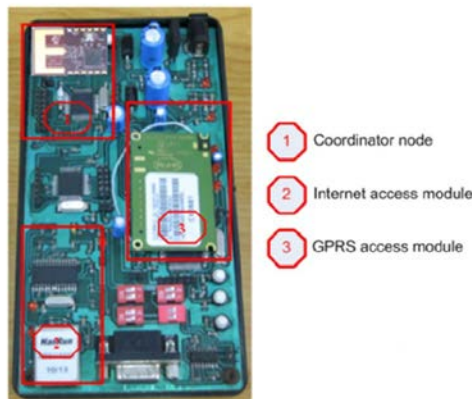


Figure 4 The gateway node hardware

3.3 sensor and execution node design

In order to establish the sensor and the execution node, each kind of sensing interface and the control circuit are designed. When one of the circuits is connected to the site node, the sensor and execution node for this particular function is set up, as shown in figure 5.

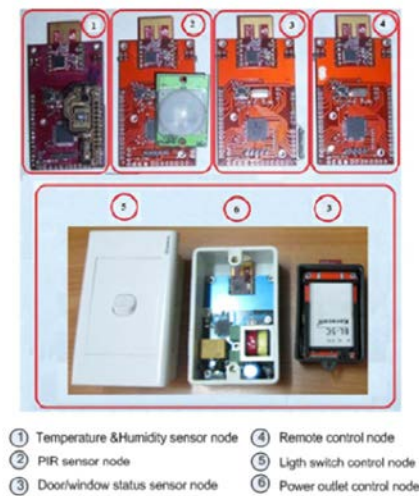


Figure 5 The sensor and execution node hardware

The function of the environment and safety sensor node is to monitor the safety and environment of the building. Some, such as temperature sensors, humidity sensors, motion sensors, smoke sensors and channel sensors are also applied to the node. All of these sensor nodes are designed to use rechargeable batteries as power supply. In order to increase the service life of the battery, the energy saving mode is applied to the operation control of each node. Optical switch is integrated into the ZigBee site node. In this standard node where the user can manually or remotely control and monitor the optical switch (on or off) state. The size of optical switch node is designed to be very small, small enough to be loaded into the box appliance switch on the wall. A typical automatic power socket node is built to integrate the ZigBee site node.

4 Software Design

The development of software design of ZigBee wireless sensor network is the transmission protocol stack based on microchip ZigBee. The transport protocol stack supports various types of node programs. However, the protocol is mainly limited to the network layer. In order to improve the function of each node type, it is necessary to improve the application and network layer.

The software design of the whole automatic system consists of five software components: coordinator software design, router software design, terminal equipment software design, Internet gateway software design, GPRS gateway software design. Each part of the design is focused on two levels, the software layer is the guarantee of the exchange stack protocol, help to achieve the data acquisition and transmission. Application layer run user programs and application interface programs.

5 System Implementation

Figure 6 is the application of wireless sensor network technology in intelligent building. The system consists of a coordinator node installed in sixth layers, 6 router nodes and more than 25 terminal devices installed in different places of the building fifth, 6, and 7 layers. In a cluttered indoor environment, the communication range can be mapped from one point to 30 meters away.

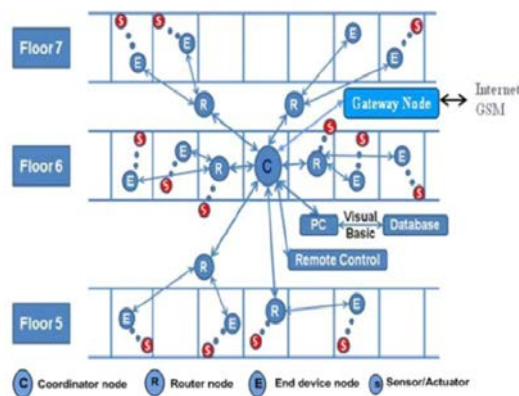


Fig. 6 The realization of automatic building system

In order to run and debug the system, it is necessary to configure the ZigBee wireless sensor network. The coordinator node needs to be pre installed on the PANID. Although it is possible for the coordinator to dynamically access the existing network PAN ID at the same frequency and generate a PAN ID, there is no conflict between the two. All devices connected to the ZigBee home automation network will be assigned a fixed 64 bit MAC address. In the network initialization phase, the coordinator assigns a short address to 0x0000. When each device is connected to the system, it will be assigned a dynamic 16 bit short address with a fixed network lifetime. After the initialization is complete, the data can be sent from any node to a higher level of the user terminal through a wireless connection, and vice versa. The network node will also be initialized and configure a static address that supports access to the Internet via a local wireless or ASDL connection. The GPRS module is a device that supports hot swap. When the power is turned on, it is automatically connected to the mobile phone network and ready to send messages.

6. Conclusion

This paper discusses the application of wireless sensor network in intelligent building automation system. This system can be widely used in indoor environment data acquisition, construction safety monitoring, control human tracking etc.. The performance of the system shows that the WSN based on home automation system can be applied to the intelligent building environment, and the system can run stably in the existing WiFi environment. In addition, the system can remotely control home appliances through the Internet and mobile phone network. The system is expected to be developed to other applications such as intelligent communication management system, remote industrial control system and remote patient monitoring system.

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