Design of Storage and Monitoring System for Medical Dangerous Chemicals Based on Wireless Sensor Network

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Abstract. Medical hazardous chemicals storage system is a special storage system. Its management basically relies on getting rid of a lot of manpower and increasing the safety and reliability of management. Using information management is a necessary way to improve storage efficiency, reduce storage cost and improve storage security. This design adopts wireless sensor network technology according to the characteristics of storage system of medical dangerous chemicals (Wireless Sensor Networks, WSNs). The wireless sensor network node design scheme is proposed. Based on IEEE802.15.4/ZigBee protocol, the wireless sensor network node is designed and implemented by PIC18F4620 single chip microcomputer and wireless radio frequency chip CC2420. Realize low cost to improve the security and real-time of monitoring, realize information sharing and network remote monitoring.

1. Introduction

Domestic major hospitals and medical institutions have emergency rescue plans for medical hazardous chemicals accidents, and regularly organize drills to strengthen the effective control of hazardous chemical accidents and prevent accidents, so medical hazardous chemicals storage management has been paid attention to by medical institutions at all levels[1,2]. At present, most of the storage problems of dangerous chemicals in medical institutions are simply relying on people, which not only has a high management cost, but also has a great relationship with the quality and experience of managers, which makes the management process have some potential safety hazards. In order to solve the security problem of medical dangerous chemicals storage, the use of modern information technology to achieve storage management, wireless sensor network with its miniaturization, low cost, flexibility provides a reliable management scheme for tracking, monitoring and management of medical dangerous chemicals storage[3].

This test is based on the design of wireless sensor network node system based on IEEE 802.15.4 and ZigBee protocol. The experiment is mainly based on ZigBee/IEEE802.15.4 wireless communication protocol[4,5]. The radio frequency chip CC2420 and the micro-control chip PIC18F4620 are selected to design the radio frequency transceiver controlled by the micro-controller to realize the networking communication between nodes. This test only monitors the temperature information of the monitoring environment. MCU processes the information, WSN carries out data communication and uploads it to PC.

In this design, the sink node receives the temperature data from the terminal node after completing the generation and management of the network, and transfers the data to the PC through the serial port.
2. Hardware and software part design of wireless sensor networks

Wireless sensor network node consists of data processing unit, radio frequency transceiver unit, sensor unit and power supply.

In this design, the radio frequency transceiver CC2420, which meets the IEEE802.15.4 standard of 2.4 GHz, is selected from TI company for comprehensive functions and costs. DS18B20 temperature sensor is selected to collect data from analog storage environment. PIC18F4620 and CC2420 modules are selected to process and send data[6].

The design of transmitting and receiving module includes power module design, interface module design and reset circuit design. The difference between them is that ordinary nodes need to implement data collection functions, so they should include the design of the data acquisition module; the aggregation node needs to implement control and display data on the computer[7]. The design block diagram is shown in Figure 1 and Figure 2.

![Figure 1. Overall block diagram of the transmitting module.](image1)

![Figure 2. Overall block diagram of receiving module.](image2)

The software design of the wireless sensor network node selects the MAPLAB IDE integrated development environment, and selects the C18 compiler for simulation debugging. Temperature monitoring by temperature sensor-DS18B20, because DS18B20 adopts "first-line bus" protocol mode, PIC18F4620 single-chip hardware does not support single bus protocol, and software method is used to simulate single-bus protocol timing to complete access to DS18B20 chip [8].

In this design, the aggregation node creates a network, allows ordinary nodes to join, and forms a network. The data of the common node is obtained by pressing the aggregation node button [9]. The flow chart of the aggregation node is shown in Figure 3.
Figure 3. Wireless temperature measurement system aggregation node program flow chart.

The aggregation node will first detect whether it has formed a network. If it does not form a network, it will automatically establish a new network and allow other devices to join the network [10]. The ordinary node transmits the collected data to the aggregation node, and simultaneously receives the data and performs corresponding operations. After the network node is powered on, scan all available channels to find the neighboring aggregation node and apply to join the network [11]. In order to reduce power consumption, the design uses a timed wake-up method to connect to the aggregation node to receive or transmit data, and the idle time is in the sleep mode [12]. In this test, the common node collects the temperature value, and then combines the temperature sensor data into a data packet and sends it to the receiving end.

3. System Testing

Run the aggregation node to run, connect the node to the serial port on the PC through the RS-232 connector, and use HyperTerminal to communicate with the aggregation node. Powering up the aggregation node, in the HyperTerminal window, displaying the message: Microchip ZigBee(TM) Stack – v1.0–3.5, the ZigBee Coordinator aggregation node will automatically try to find available wireless channels to form a network. If successful, the following message will be displayed:

Trying to start network..., PAN #### started successfully. #### is the network PAN ID of the group. When other nodes access the network, a message is displayed: Joining permitted. Power on the data collection node and display the message: Microchip ZigBee(TM) Stack – v1.0–3.5, ZigBee RFD, RFD attempts to access the network. Access network display message:

Trying to join network as a new device..., Network(s) found. Trying to join ####. Join successful!

The aggregation node displays the following message to confirm the new node access: Node #### just joined, #### Assign a short address to the new node. The aggregation node sends a data request to the ordinary node, requests the data of the ordinary node, and sends the success display information: Node #### sending message. Message sent successfully. When receiving the data of the ordinary node, the following message will be realized: Received DS18B20 = #### °C. The result graph of the wireless sensor network node is shown in Figure 4 and Figure 5.
The research results show that the wireless sensor network based on ZigBee protocol integrates the characteristics of ZigBee technology, such as flexible networking, wide coverage and good security. The storage and monitoring system of dangerous chemicals based on wireless sensor network has strong applicability. By adding different types of sensors in the system, it can achieve medical application. The storage of dangerous chemicals requires various functions of data detection, so as to meet the requirements of saving manpower, reducing costs and improving the safety of management.

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