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Design of Multi-point Wireless Temperature and Humidity Real-time Monitoring System

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Abstract

With the rapid development of today's society, people's life is becoming more and more convenient, but with the emergence of more demands. In modern society, the production of all walks of life will have certain requirements on the range of temperature and humidity. Now a lot of real-time monitoring of temperature and humidity are mostly dependent on manual operation, not only will waste a lot of human and material resources and financial resources, but also easy to cause accidents. In the study of multi-point wireless temperature and humidity real-time monitoring system, the purpose is to solve the related problems in life.

Keywords

STC12C5A60S2 Microcontroller; Temperature and Humidity Monitoring; Wireless Communication.

1. Introduction

This design is a multi-point wireless temperature and humidity real-time monitoring system integrating multiple points, wireless transceiver and temperature and humidity measurement functions. The system includes LCD display, NRF24L01 wireless module, DHT11 temperature and humidity sensor module and so on. The system design is to measure the temperature and humidity data to LM016L display as the media to display the data information, and complete the wireless transceiver and alarm function. Use Keil software to operate and assemble the program of this system design. The simulation module uses Proteus software to carry out relevant operations. DHT11 is used to collect the data information of temperature and humidity, and then the collected data information is transmitted to STC12C5A60S2 single chip computer, and the data information is processed, and then the temperature and humidity data information is sent through NRF24L01 of the wireless module. Then through the display screen LM016L will be processed completed data information display.

2. The Hardware Design

2.1 System Hardware Composition

In this system, we split the whole system into two parts, STC12C5A60S2 is placed in the primary node and child node. The sub-node uses the temperature and humidity sensor to collect ambient temperature and humidity data, and transmits the collected temperature and humidity numerical information to the master node using the wireless module, and then the master node uses the wireless module to transmit the information to the computer [1]. The main node is composed of MCU, wireless transceiver module, serial communication module, DS1302 chip and LM016L display screen.

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2.2 Design Each Module of the System

2.2.1 Main Control Unit Module

This design chooses to use STC12C5A60S2, because the performance of general 8051 microcontroller can not be compared with it, and has many functions, has the characteristics of fast speed, low energy consumption and strong anti-interference ability. Although the instruction code it uses is fully compatible with the traditional 8051, its speed is far faster than the traditional 8051 series microcontroller to respond. The integrated 1280BRAM and up to 60KB Flash ROM on the chip support the programming function of the serial port [2].

2.2.2 Power Supply Module

Power supply is an essential part of a circuit. In this design, the electric energy is supplied by the power supply; The consumption of electrical energy is a function achieved by electrical appliances. This design uses external power supply as a whole. The power supply voltage of the whole system is 5V DC power supply, and the power supply needs to be connected to USB, so we use DC socket. One end is inserted from DC, and the other end is directly connected to the computer (such as USB, charging board or portable charger). SW is the automatic lock switch [3].

2.2.3 Wireless Transceiver Module

Wireless transmission plays an important role in this design, which uses nRF24101 module [4]. When the system needs to be in the sending state, the system starts initialization, and then automatically changes to the transmitting mode to send related data information. If the sending is not complete, the system returns to resend. Sending completion completes a sending part of the process. When the system needs to be in the receiving state, the system starts initialization and automatically changes to the receiving mode. If no data needs to be received, the system returns to the receiving mode again. If there is data to be received, it will receive, if not received, it will return to receive again, receiving successful completion of a receiving part of the process.

2.2.4 Serial Communication Module

Serial communication is a necessary step for the microcontroller and computer to send and receive messages in association. MAX232 chip is used in this system design. MAX232 chip is a single power level conversion chip manufactured by MAXIM Company. In addition, the MAX232 chip meets all RS-232 technical standards, requiring only a single +5V power supply, and the partial charge pump is capable of boosting voltage and voltage polarity reversal, which can generate +10V and -10V voltages V+ and V-. The power consumption is low, the typical power supply current is 5mA, and two RS-232C drivers are integrated.

2.2.5 Liquid Crystal Display Module

LM016L has the advantages of 0 radiation, low power consumption, strong heat dissipation and small volume. In this design, the child node and the main node use LIQUID crystal display to display the temperature and humidity data. LCD is the most commonly used character based Hitachi based controller, the controller has a very powerful function, we can use it to move self-reading, flashing and other functions, and his use is very convenient. The function of DDRAM is to store data characters, and its storage is to display data represented by 8-bit character codes. Can store 80 character codes. The part of RAM used for display can be used as general data [5]. At present in the market is the most common single line and double line or four line LIQUID crystal display, with 14 pins; The LM016L has two HD44780 controllers and 16 lead LCD modules.

2.2.6 Temperature and Humidity Detection Module

Because this design requires to measure the temperature and humidity two data information, so decided to use the temperature and humidity sensor is DHT11 sensor. DHT11 is a single temperature and humidity sensor manufactured by Ao Song. Humidity measurement range is 20% to 90% RH, measurement accuracy is ± 5.0% RH. The sensor uses new technology including procurement technology. Make the sensor very stable. Moreover, its size is very small, and the power consumption is very low, because the sensor is suitable for working in a variety of demanding and extreme

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environments. Finally, the sensor is a 4-pin single-row pin package, which is more convenient for installation and operation [6]. The sensor can achieve and produce comparison benchmark data information, and has resistive humidity sensing element and Nic temperature measuring element, the product quality is high, fast speed, strong anti-interference, cost-effective is also very high.

2.2.7 Clock Display Module

DS1302 is a charged clock chip from DALLAS company, which contains 31 bytes of static data memory such as calendar parts, and communicates with SCM through serial interface. The real-time clock/calendar part can provide the time of seconds, minutes, hours, days, weeks, months and years. The days of each month and special years can be adjusted automatically. The clock operation can determine the time format of 24 hours or 12 hours through the AM/PM flag bit [7].

2.2.8 The Keyboard Module

Use keyboard to control the system and set the temperature and humidity threshold, which is an essential part of the design, the operator can use it to control the system input instructions. This design uses a four-digit keyboard, and each key is connected to a different I/O port. Each I/O port does not affect each other. The first key controls switching mode, the second performs adding instruction, the third performs subtracting instruction, and the fourth switches setting and display [8]. It can be connected to any GPIO. As long as the initial configuration is input, the level state of the GPIO can be collected in the program to judge the state of the key. You can also use GPIO's external interrupt function to determine key status. The buzzer can be controlled by configuring GPIO as output.

2.2.9 Audible and Visual Alarm Module

When the temperature and humidity exceeds the preset threshold value, the level function change of the P1.7 port of the MCU can generate an alarm. When the temperature and humidity exceeds the set threshold, the transistor turns on, the buzzer starts to work, and the light-emitting diode also emits light. Otherwise, the transistor cuts off, the buzzer does not change, and the diode does not shine. When the P07 and P17 ports are powered down, the corresponding indicator is on. In summary, the working principle of acoustooptic alarm circuit is shown above [9].

3. General Idea of System

3.1 Main Programming

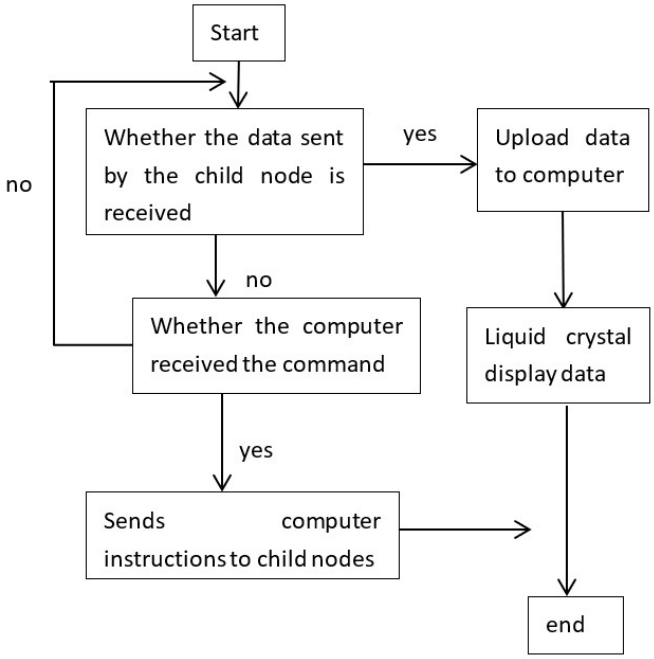

Figure 1. Main block diagram

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In the part of the main program, the system changes to the initial state after the power is started, and the measurement is carried out after returning to zero. The system will measure the data information displayed on the display screen, and then compare with the threshold value selected at the beginning. Assuming that the threshold value is not the same as the threshold value selected at the beginning, then the buzzer will give an alarm at last.

3.2 System Programming

The system program design is divided into the following modules: temperature and humidity information acquisition module, sound and light alarm module, data display module, buzzer alarm module.

(1) Temperature and humidity information collection module: After the system starts, the buzzer sounds and the LED screen starts to display data for data collection.

(2) Sound and light alarm module: because the single chip microcomputer selected in this topic has its own AD converter, so in the design process can reduce our many external circuit design. After the voltage of the current circuit is calculated, it is compared with the threshold value set by us to determine whether to send the information to the buzzer for alarm.

(3) Data display module: if the LED display works normally, it is necessary to write command control words first, and then write the data that needs to be displayed. Before writing command control words, check whether the display is working properly.

(4) Buzzer alarm module: After data collection by DHT11 sensor is converted into digital signal through A/D processing, and then compared with the threshold value selected at the beginning. Assuming that the threshold value is different from the threshold value selected at the beginning, the buzzer will alarm at the end. After initialization, the master controller STC12C5A60S2 selected in this design uses the temperature and humidity sensor DHT11 to test the temperature and humidity information. Then the master controller starts to process the data collected by the sensor, and finally obtains the temperature and humidity value and compares it with the threshold value set by us. If the expected value is exceeded, the information will be transmitted to the buzzer and LCD.

3.3 Each Software Design Module of the System

3.3.1 Software Design for Threshold Setting

Set and display the temperature and humidity thresholds. Press the button to enter the interface for setting the upper and lower limits of temperature and humidity. TH and TL are the upper and lower limits of temperature, HH and HL are the upper and lower limits of humidity, and press the button to set the upper and lower limits of temperature and humidity.

3.3.2 Wireless Module Software Design

Wireless transmission plays an important role in the design of this design is to use nRF24101 module. When the system needs to be in the sending state, the system starts initialization, and then automatically changes to the transmitting mode to send related data information. If the sending is not complete, the system returns to resend. Sending completion completes a sending part of the process. When the system needs to be in the receiving state, the system starts initialization and automatically changes to the receiving mode. If no data needs to be received, the system returns to the receiving mode again. If there is data to be received, it will receive, if not received, it will return to receive again, receiving successful completion of a receiving part of the process.

3.3.3 Keystroke Programming

In this design, the keyboard module is used to realize human-computer interaction. After the initialization of the system, the key scan is carried out to determine whether the key is pressed. If so, the jitter is eliminated and the key is detected again[11].

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4. Conclusion

The main purpose of this design is the design of multi-point wireless temperature and humidity real-time monitoring system. Firstly, STC12C5A60S2 microcontroller is used as the main body, and then the child node uses DHT11 sensor to collect temperature and humidity data information in different states. Then NRF24L01 wireless module will send the temperature and humidity values collected by the child node in different states to the master node, and finally the computer will receive the data information sent by the master node. The system has a wide coverage, the main node and the child node through wireless transmission, more flexible, more practical.

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