Temperature and humidity controller system based on single chip microcomputer

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Abstract: In simple terms, the design is expected to be completed: temperature and humidity acquisition, processing, and control. The STC89C52 MCU is connected to the display, alarm light, buzzer and other equipment through circuit connection, and the structure is clear. Enter the upper and lower limits of temperature and humidity by pressing the key.

Keywords: DHT11 sensor; STC89C52 single chip; temperature and humidity; control.

1. Introduction

The components used in this design are regulated and commanded by the single-chip STC89C52. The threshold storage device is 24C02 (the threshold can be automatically saved in case of power failure to avoid loss), and the display component is LCD1602 liquid crystal display. A new generation of DHT11 that measures both temperature and humidity is used as the sensing part. When the corresponding upper and lower limits of temperature and humidity are exceeded, the alarm command is executed, and the corresponding relay enters the energized state to make the external connector act[1].

The main work is as follows:
(1) The sensor DHT11 collects real-time temperature data and transmits the data to the STC89C52 in time for processing. The two components basically complete the collection of temperature and humidity data.
(2) LCD1602 displays the temperature data transmitted by the MCU.
(3) Set the highest and lowest temperature humidity limit by pressing the key, and the system is quickly saved in the AT24C02 in case of sudden power failure to protect the
data from damage. In the setting interface, if the button is not pressed within 15 seconds, the system will exit at this interface.

(4) When the detected temperature and humidity data exceeds the set limit, the buzzer alarm will sound and the alarm light will be on. The accurate temperature measurement can reach 0.1 degrees Celsius. At this time, the alarm action is completed. At the same time, the system relays pull in and the corresponding external load reacts.

2. DESIGN CONTENT OF EACH FUNCTION MODULE

2.1 Main control module design

The minimum system of the MCU mainly refers to the system consisting of the fewest components that enable the MCU to operate normally [2]. The minimum system can generally implement self-power supply, generate clock signals, and implement reset functions. The total MCU minimum system of this design and the reset, crystal and power supply circuits are shown in Figure 1 and Figure 2.

![Fig. 1 MCU minimum system diagram](image1)

![Fig. 2 Crystal oscillator circuit diagram of the minimum system of single chip microcomputer](image2)

2.2 DHT11 sensor module design

The connection between the DHT11 sensor and the microcontroller in this design only needs to be connected according to the functional properties of the two device pins. The P3.1 port of the MCU is connected to the Pin1 and Pin2 of the sensor, and is used...
as a sensor to transmit the measured real-time temperature and humidity data to the MCU. The P1 and P4 ports of the DHT11 are connected to the high level and ground of the STC89C52 as power ports. The P3 port of the DHT11 is placed in suspension. The schematic diagram of the temperature and humidity sensing module of this design is shown in Figure 3. The four buttons in the figure simulate the changes of external temperature and humidity respectively:

![Fig. 3 DHT11 circuit principle](image)

2.3 LCD module design

Figure 4 below shows the connection between the LCD1602A liquid crystal display and the microcontroller in this design. The 7th to 14th pins of the display are connected to the P0.0 to P0.7 ports of the MCU as a data port, and a row of pull-up resistors are connected to realize the action of the MCU transmitting temperature and humidity data to the LCD. The VO pin in the LCD 1602 is connected to the resistor R3 to achieve the system’s contrast requirements for the display[3].

![Fig. 4 LCD1602A liquid crystal display connection circuit](image)
3. System software program design

After completing the previous circuit connection, the software writing part of the system is started to realize the data transmission and mutual control between the components. The software part of the design mainly realizes: real-time display of temperature and humidity information, and if it exceeds, the temperature and humidity are displayed on the display, and the corresponding relay and alarm light are on, which is used to remind the user; while the relay is sucked and driven to drive the external load to realize automatic control. When the external temperature and humidity return to normal due to the external load, the rest of the system also enters the normal working state[4]. Part of the procedure shown in Figure 5.

```c
if (Mode==0)
{
    L1602_int(1,3,temperature);
    L1602_int(1,7,Status);
    L1602_int(1,12,humidity);
    if(humidade>100)
        L1602_string(1,1," It's very hot !");
    else if(humidity<100)
        L1602_string(1,1," It's very cold !");
    else if(humidity>80)
        L1602_string(1,1," It's very humid !");
    else if(humidity<20)
        L1602_string(1,1," It's very dry !");
    else if(humidity>30)
        L1602_string(1,1," It's very dry !");
    else if(humidity>40)
        L1602_string(1,1," It's very humid !");
    else if(humidity>50)
        L1602_string(1,1," It's very humid !");
    else if(humidity>60)
        L1602_string(1,1," It's very humid !");
    else if(humidity>70)
        L1602_string(1,1," It's very humid !");
    else if(humidity>80)
        L1602_string(1,1," It's very humid !");
    else if(humidity>90)
        L1602_string(1,1," It's very humid !");
    else if(humidity>100)
        L1602_string(1,1," It's very humid !");
    else if(humidity<0)
        L1602_string(1,1," It's very dry !");
    else if(humidity<20)
        L1602_string(1,1," It's very dry !");
    else if(humidity<30)
        L1602_string(1,1," It's very dry !");
    else if(humidity<40)
        L1602_string(1,1," It's very dry !");
    else if(humidity<50)
        L1602_string(1,1," It's very dry !");
    else if(humidity<60)
        L1602_string(1,1," It's very dry !");
    else if(humidity<70)
        L1602_string(1,1," It's very dry !");
    else if(humidity<80)
        L1602_string(1,1," It's very dry !");
    else if(humidity<90)
        L1602_string(1,1," It's very dry !");
    else if(humidity<100)
        L1602_string(1,1," It's very dry !");
    L1602_string(1,1," It's good environment");
}
```

Fig. 5 Partial program

In this module programming, the main function is to display the temperature and humidity data normally in the upper and lower lines. When the temperature and humidity exceed the threshold, there are different display contents. When the temperature exceeds the upper threshold, the first line displays the temperature and humidity values, and the second line displays the corresponding characters to remind the user of the high temperature environment. If the humidity exceeds the upper threshold, the second line of the display alerts the user to the ambient temperature: "It's very humid !". Similarly, when the temperature is outside the lower threshold, it shows: "It's very cold !". When the humidity is outside the lower threshold, it shows: "It's very dry !".

4. Conclusion

The design is characterized by simple and flexible construction, and it can be easily modified and debugged if problems occur, and the system's response capability is rapid. In the detection of this design, the upper and lower thresholds of temperature and humidity are successfully set, and when the threshold is exceeded, the display of the
display and the suction of the corresponding relay can also be performed according to the design requirements. Therefore, the temperature and humidity controller system meets our expected results.

**References**


