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Design of Temperature Control System for Computer Rooms Based on AT89C51 Single-chip

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A temperature control system is designed based on AT89C51 single-chip microcomputer (Abbreviation SCM, MCU) that is able to monitor computer room temperature and indicates, according to the temperature, when to turn on the cooling system. The low-cost system is simple to operate and control and can well ensure the environment for learning and teaching in the room. Also, it saves the electric energy that would otherwise be wasted if the cooling fan is constantly working. The system has certain use values.

1. Introduction

With lowering computer prices, ordinary schools are gradually equipped with large amounts of computers for teaching and student practicing. However, computers generate high quantities of heat in a limited space. In summer especially, when computer room temperature is high (Baptiste Durand-Estebe et al (2014), Yamamoto Seiichi et al (2011)), the computer will operate at a lower speed. Also, due to high temperature, students may fail to concentrate and have lower learning efficiency (Franken D R et al (2011)).
Based on AT89C51 MCU (Abhijit V et al (2014), A.T. Rêgo, S.M et al (2013), Ahlers Malte T (2013)), this research has designed a temperature control system that is able to monitor computer room temperature and indicates, according to the temperature, when to turn on the cooling system. Also, it saves the electric energy that would otherwise be wasted if the cooling fan is constantly working. The system has certain use values (TU Ji-hui (2014)).

2. System design

The MCU processed the data of measured temperature and room temperature data set by keyboard control circuit based on temperature measurement circuit. The real-time temperature of the room is shown in the LCD screen. Also, the measured temperature is compared to the set temperature. If the temperature exceeds the limit, the warning system of the MCU will give a warning and the cooling fan will be turned on. When the temperature is below the set value, the fan stops spinning (Qi Fa-Qun et al (2011)). The design is shown in figure 1.

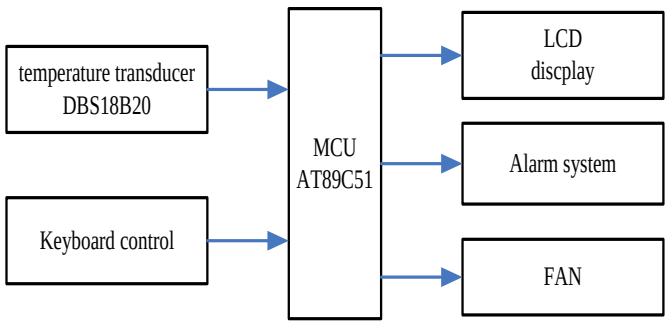

Figure 1: System Diagram

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3. Hardware design

In order to monitor and show room temperature and control warning and cooling, the hardware needs to include the MCU minimum system, a temperature measurement circuit, a keystroke system, an alarm system, an automatic start fan circuit and a display circuit (Li Yang-jun et al (2015)). The designs are shown below.

3.1 MCU minimum system

Figure 2 shows the MCU minimum system, where RST is an automatic power connection restoration; XTAL1 and XTAL2 connect to crystal oscillator circuit, so that the single-chip clock pulses can use the internal clock circuit can be used to ensure the operation of the microcomputer. Pins P0.0-P0.7 and P2.4-P2.6 from port I/0 connect to the drive circuit of the screen to transmit data to the screen. P3.0 and P3.1 connect to the keystroke circuit to receive data from the circuit. P1.2 connects to the temperature measurement circuit to receive temperature data from temperature measurement circuit. P1.1 connects to the alarm circuit to transmit data to turn on the warning system. P1.0 connects to the automatic start fan circuit to control the fan cooling.

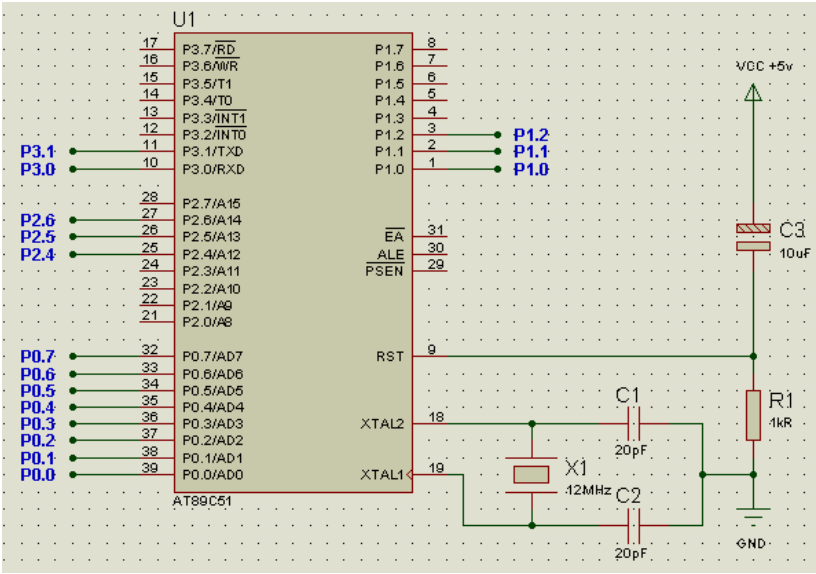

Figure 2: MCU minimum system

3.2 Temperature measurement circuit

The temperature measurement circuit uses temperature sensor DS18B20 to monitor the room temperature (Limin Cai (2009)). The circuit connects to a superordinate resistance. P1.2 receives the temperature data. The circuit is shown in figure3.

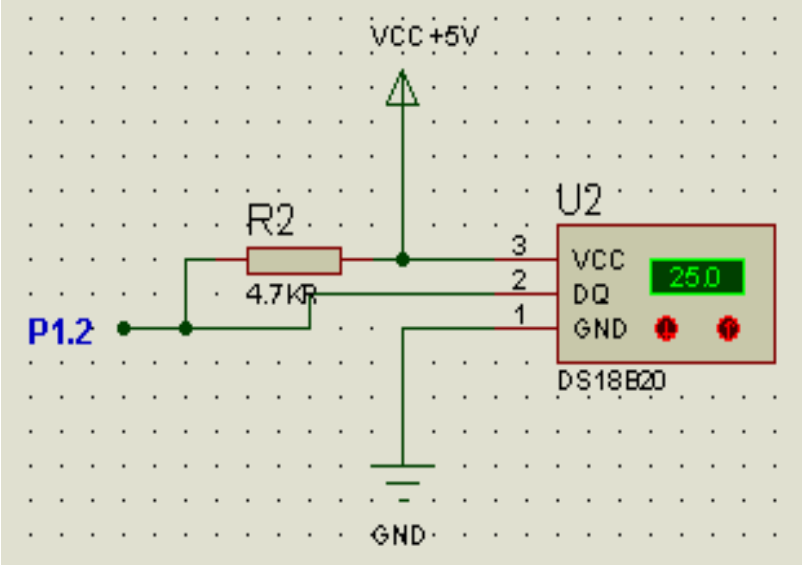

Figure 3: Temperature measurement circuit

3.3 Keystroke system

The keystroke system changes the information inside the microcomputer through keystrokes (Cheng Jin (2011)). Two keys are designed “+” and “-” to control temperature. The circuit is shown in figure 4.

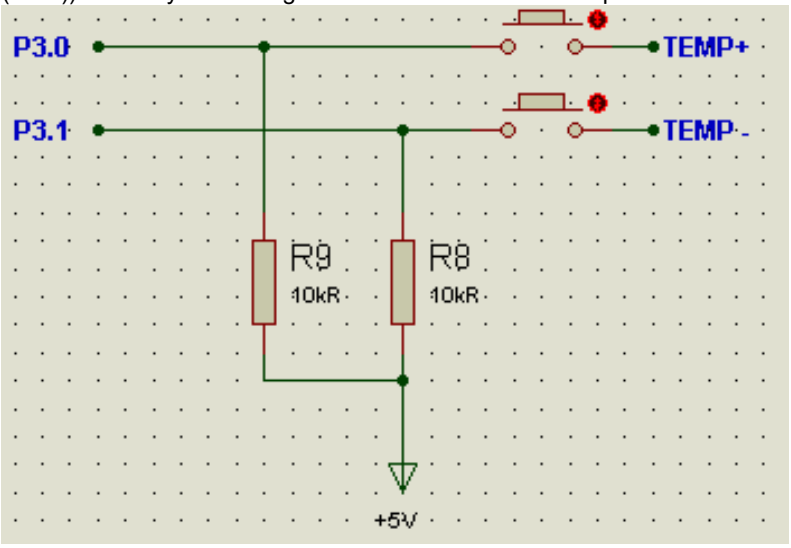

Figure 4: Keystroke circuit

3.4 Automatic start fan circuit

P1.0 of the microcomputer outputs high and low electric levels to control the on and off of the luminous diode in the photoelectric coupler. When the temperature received by the microcomputer is higher than the temperature set by the keystroke circuit, the coupler is on; and then the triode Q1 is on; Coil RL1 turns on the switch with magnetic force. The Fan is then connected to a power supply of 220 V and starts to work. According to how much the temperature limit is exceeded, the fan speed is controlled, which can save the most electricity (Zhang Hai-feng et al (2011)). The circuit is shown in figure 5.

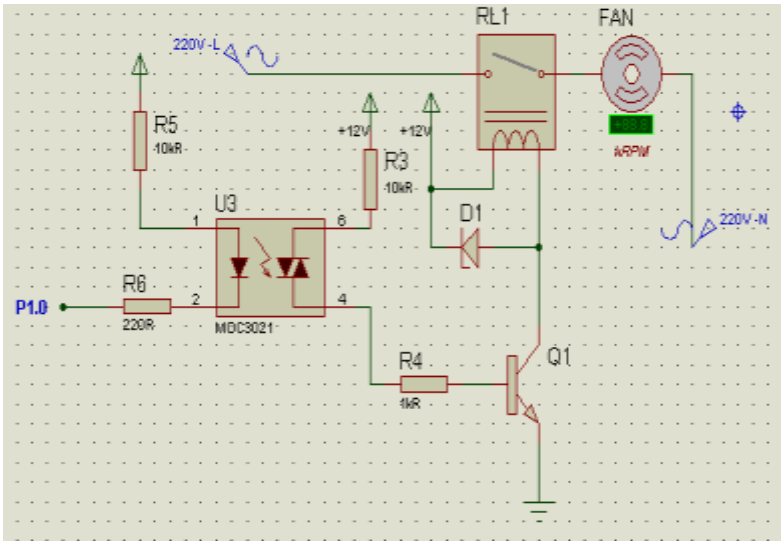

Figure 5: Automatic start fan circuit

3.5 Display circuit

The display circuit uses LCD1602 screen, connects to the superordinate resistance through P0.0-P0.7 of the microcomputer, and then connects to the pins D0-D7 of the screen. The screen shows the current temperature and set temperature (Lakhoon Hwang et al (2014)). The circuit is shown in figure 6.

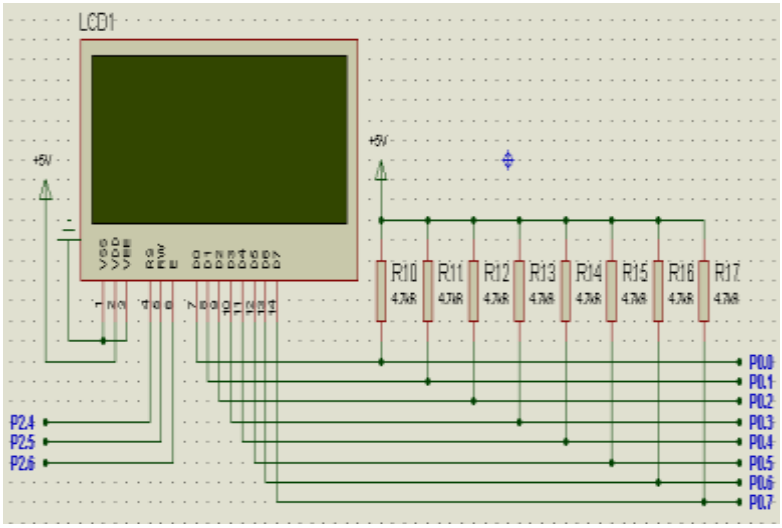

Figure 6: Display Circuit

4. Software design

After the microcomputer is connected to the power supply, firstly the system is initialized; DS18B20 and LCD1602 are turned on. CLS is conducted. Then major cycle is carried out. After that, temperature measurement, keystroke processing, temperature screening, warning and automatic start fan operation are conducted (Wei Lijun (2013), R. B. Gusev (2010)). The main procedure code is the following:

Main program main code: void main (void)

```
 {
        LcdInitiate();
        delaynms(5);
            display_cent2();
            display_cent3();
            delayns(50);
            LcdInitiate();
```

```
        if(Init_DS18B20()==1)
        display_error();
        display_explain();
        display_symbol();
                display_dot();
                hum1=3;
         hum2=35;
                while(1)
        {
                        ReadyReadTemp();
                    TL=ReadOneChar();
                    TH=ReadOneChar();
                    Send(0x55);
                    Send(TL);
                    Send(0x33);
                    Send(TH);
                                TN=TH*16+TL/16;
TD=(TL%16)*10/16;
                                        display_tempSZ3(bj);
                                 display_tempSZ1(hum1);
                                  display_temp1(TN);
                                display_temp2(TD);
                                       humd1=key1_Detection();
                                 humd2=key2_Detection();
                                        display_tempSZ2(hum2);
                                        humd1=key1_Detection();
                                        humd2=key2_Detection();
                                        bj_Detection();
                                        baowen();
                  }
}
Temperature setting subroutine main code:
unsigned char key2_Detection()
{
                if(key_3==0)
               {
                            //delaynms(2); s
                            delay1ms();
                            while(!key_3);
                            //delaynms(2);
                               delay1ms();
                             if(hum2>100)
                             {
                                          hum2=1;
                                        return hum2;
                              }
                              else
                             {
                                          hum2=hum2+1;
                                          return hum2;
                             }
                }
                if(key_4==0)
                {
                               delay1ms();
                             while(!key_4);
                             delay1ms();
                             if(hum2<1)
                              {
                                            hum2=1;
                                            return hum2;
```

```
                    }
                else
                {
                        hum2=hum2-1;;
                        return hum2;
                    }
            }
}
```

5. Conclusions

Using AT89C51 microcomputer for control, this system can monitor and show real-time temperature, and intelligently control the off and on of the electric fan through temperature. The stable and low-cost system is suitable for school computer rooms and has certain applicable values. Modification of the circuits and procedures of the system can further realize other functions such as greenhouse temperature control, kindergarten classroom temperature control, household application automatic control, etc., which indicates strong portability.

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