Design and Simulation of Temperature Data Acquisition System based on Proteus

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Abstract. The design and simulation implementation methods of temperature data acquisition system are introduced in this paper, which takes a greenhouse as the research object .At the same time, the temperature measurement circuit, periphery circuit of single chip computer and software flow are described in detail in the paper. In addition, the virtual simulation debugging process is realized successfully by integrating the hardware and software in the Proteus and the Keil uVision2 environments. This method is proved to be an effective means which raised the development efficiency and saved costs. Results verify that it is possible to realize many functions of the system, such as temperature data acquisition, data processing, displaying on real time, optic alarm, and the keyboard operation and so on. The temperature control accuracy can be controlled in 0.1℃; it verifies that the system has met the requirements.

Keywords: AT89S52; temperature; Proteus.

1. Design of general system plan

The intelligent temperature measurement system is made up with AT89S52 as its control kernel and digital temperature sensor DS18B20 as its measuring element. The system design plan is as that shown in Fig 1.

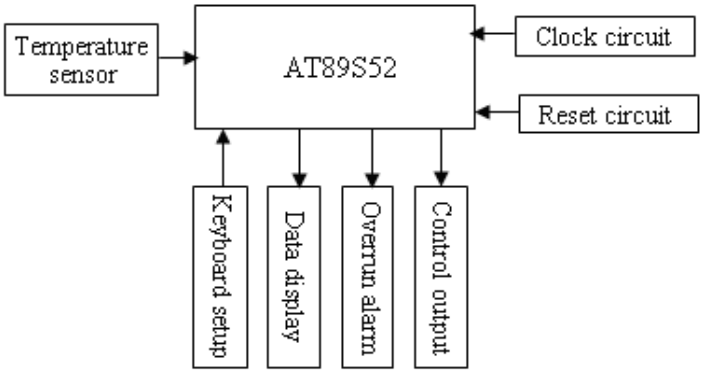

Fig. 1 Design plan based on SCM temperature data acquisition system

2. System hardware design

The System hardware design includes mainly temperature sensing test and SCM peripheral circuit design, among which the latter includes clock circuit, reset circuit, power supply circuit, keyboard entry circuit, display circuit and light alarm circuit etc.

2.1 Design of temperature sensing test circuit

DS18B20 is a high precision digital temperature sensor in 1-Wire series designed and manufactured by Dallas Company. It could be connected directly with SCM. For the measuring circuit thereof, see that shown in Fig. 2. The pin No.2 is for signal wire, the AT89S52 exercises control over DS18B20 via the port P2.7, reads the temperature measured thereby, and then display temperature value through 4-in-one LED.

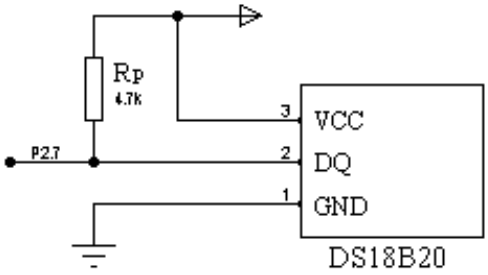

Fig. 2 Temperature measurement circuit diagram

2.2 Design of SCM peripheral circuit

By reason of that all of the clock circuit, reset circuit and power supply circuit are the circuits that are comparatively mature, so the designs of the keyboard entry circuit, display circuit and light alarm circuit are to be introduced principally here.

Keyboard entry circuit. Independent-type keyboard is adopted for this system (See Fig. 3); for the various key functions, it's as that shown in Table 1.

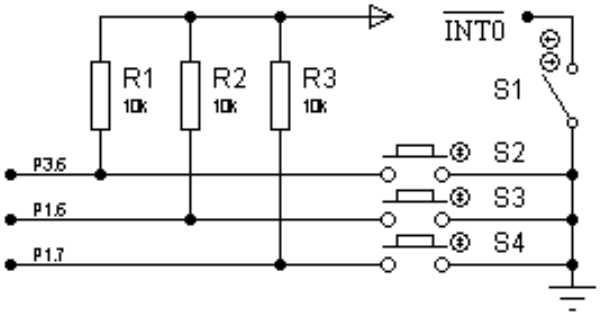

Fig. 3 Independent-type circuit

Table 1 Key functions for system keyboard setup

Key	Function
S1	Give a low level to external interrupt 0 to make it enter key interrupt subroutine. The system keyboard setup function is started up when S1 key is pressed.
S2	Selection of set value channel number
S3	Set value plus 1 operation
S4	Set value minus 1 operation

Design of display circuit. Two 4-in-one LED display nixie tubes in anode connection are adopted for the display circuit. The first nixie tube is used to display the temperature sampling value with decimal place; the second nixie tube is for displaying the set value within temperature upper and lower limits without decimal place, among which the first place is for displaying the channel value of the set value (1- upper temperature limit, 2- lower temperature limit), and the following two places are for displaying the set value. Dynamic scan mode is adopted for display, and P0 port is used for section control line to provide section input (font code); P2.0~P2.6 are used for position control line to realize the position control of display unit, among which the P2.0~P2.3 are used for driving the nixie tube that is for displaying the temperature sampling value, and the P2.4~P2.6 are used for driving the nixie tube that is for displaying temperature set value (as that shown in Fig. 4).

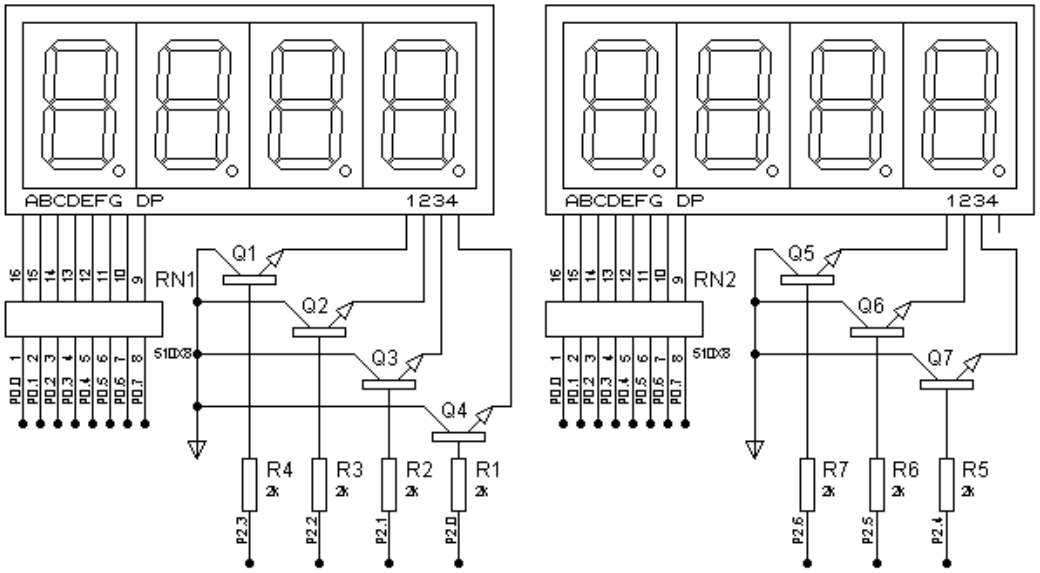

Fig. 4 Display circuit

Design of light alarm circuit. Light alarm circuit consists of three LAMPS (See Fig. 5); for the execution actions of the light alarm circuit, refer to Table 2.

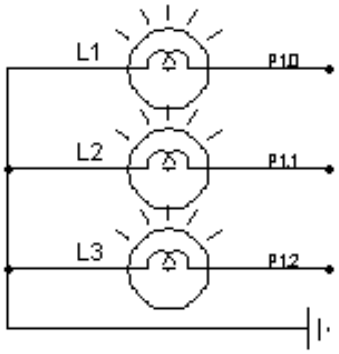

Fig. 5 Light alarm output circuit

Table 2 Light alarm circuit executing action table

Execution condition	Execution action
Measured temperature value ＞ Upper limit of set temperature	L1 light is up and refrigerator is started up
Measured temperature value ＜ lower limit of set temperature	L2 light is up and heater is started up
Temperature upper limit ＜ Temperature lower limit	L3 light is up

3. Design of system software

Modular structure design is adopted for the system, including mainly Main program modular and subroutine that is possessed of specific function modular. For the system software structure, see the block diagram shown in Fig. 6.

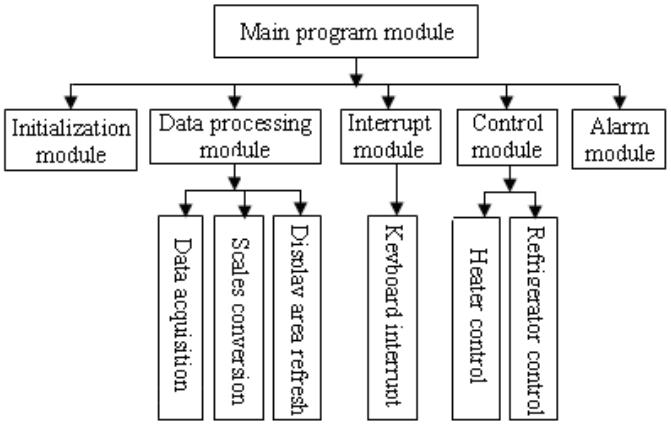

Fig. 6 Block diagram of system software structure

3.1 Main program flow

The primary function of the Main program is to precede with initialization setup for the system, including interrupt entry setup, stack area setup, setup for interrupt initialization and timer initialization etc. Temperature measurement is to be conducted once a second, and then it'll fulfill conversion processing, sending and display of temperature, as well as control output of switching value. For the flow diagram of the Main program, refer to Fig. 7.

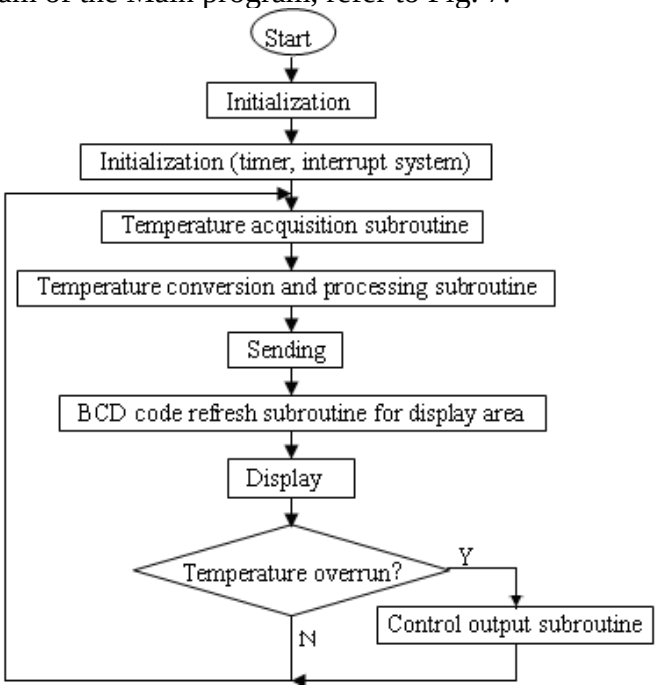

Fig. 7 Main program flow diagram

3.2 Temperature acquisition subroutine flow

The following operations should be noticed during temperature acquisition: (1) Initialize DS18B20 (send out a low pulse signal that is no less than 480us); (2) Execute ROM command for positioning mainly; (3) Execute storage control command of DS18B20 for converting and reading data; (4) Conduct data processing. Only the value in binary system read out from DS18B20 is converted into that in decimal system, could it be used for display of characters. In order to improve conversion accuracy, 12 digits is adopted for this system, and the value in temperature register is stepping with 0.0625, i.e. the actual temperature value of decimal system is the value of binary system in temperature register multiplied by 0.0625.

For the flow diagram of temperature acquisition subroutine, see Fig. 8.

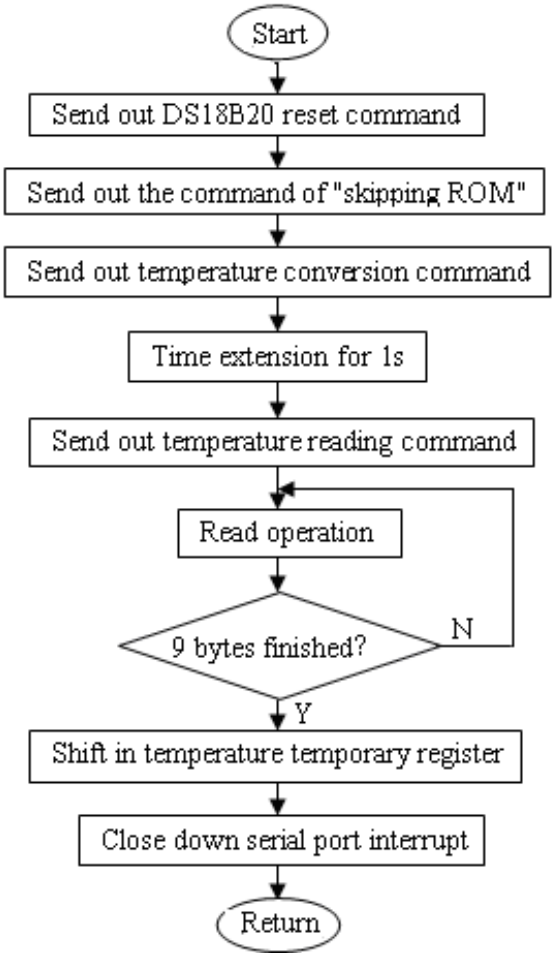

Fig. 8 Flow diagram of temperature acquisition subroutine

3.3 Keyboard interrupts subroutine

For the keyboard interrupt subroutine flow, see Fig. 9.

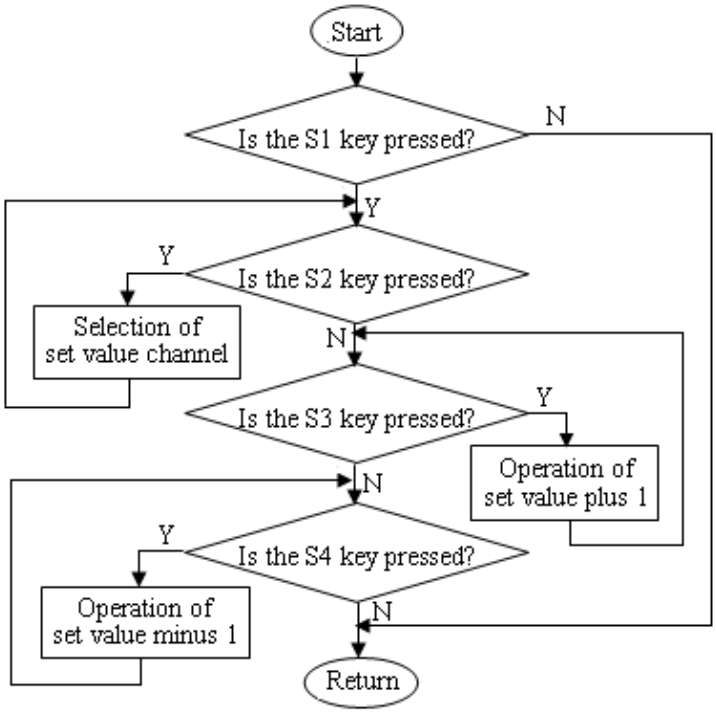

Fig. 9 Keyboard interrupts subroutine

4. System debugging and emulation

The system debugging should give priority to program debugging. The Proteus that is the EDA utility software developed by Labcenter Electronics Company, U.K. is to be adopted to realize emulation debugging. This software is designed with analog circuit digital circuit and A/D mixed circuits with emulation platform, as well as an advanced design of SCM and embedded system with an emulation platform. It's possessed of abundant library resources, such as manifold SCMs like ARM7, 805x, PIC, AVR and HC11 etc. more than 8,000 component and part models, more than 10 kinds of virtual instruments, like oscillograph, logic analyzer etc. different kinds of signal sources, and visualized ASF high class chart emulation that can be used for sophisticated analysis; meanwhile, it has provided the Keil combined emulation environment for editing source program, generating object code, combined real-time debugging and integrated development of environment with third party. The system hardware debugging is comparatively simple. Proteus software is adopted for inspecting electrics. The electrics could pass inspection smoothly when various junction points are correct and each pin of various components is free from error. For the system software debugging, display routine ought to be redacted in advance and hardware validity verification ought to proceed, and then conduct programming and debugging for each subroutine. Finally, load the compiled program on AT89S52 after Hex file is generated, and then real-time simulation outcome would be in view after clicking the "Operation" button.

5. Conclusion

On the bases of that the temperature data acquisition system of SCM is a sort of comparatively intelligent, economic plan, and due to the fact that its installation is simple and convenient, its system is stable and reliable, and it's good at maintainability and anti-interference ability, it's in a position to satisfy the design requirements for greenhouse environment, and possessed of very strong practicability. In addition, this system can be popularized to the application in some other environmental temperature test systems or similar parameter test systems. The system is provided with favorable value for popularization and application.

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