Study on Temperature Auto Control Based on Microcomputer

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Abstract. Research on a kind of microcomputer control system. By adopting the Dahlin arithmetic method, it can automatically control the environment temperature, collect and display the temperature signals and realize automation loop-control.

Keywords: Temperature control, Microcomputer, Dahlin arithmetic method.

1. Introduction

Temperature control is widely used in research and production, to protect the safety of production, improve the quality and the quantity of the products, and reduce the labor intensity of workers. There are a lot of traditional temperature control circuit systems, such as analog circuit and digital circuit. However, their circuits always are complex and the control effect is not accurate enough. In order to realize the automatic control in high precision, the microcomputer control system is necessary. It can realize the temperature signal automatically acquisition, display and control, and can be used computer software to achieve heating, cooling and closed loop automatic control.

2. System composition

Temperature control system structure diagram as Fig.1. The temperature is controlled by controlling the heater. The temperature signal can be acquired by the temperature sensor, then output an electric signal. This signal should be amplified by small signal amplifier, through A/D converter to microcomputer. The microcomputer is responsible for data acquisition, calculation, comparison, storage and output control. In addition, the system is also provided with keyboard input, switch control, alarm display and digital display. The circuit principle diagram is as Fig.2.

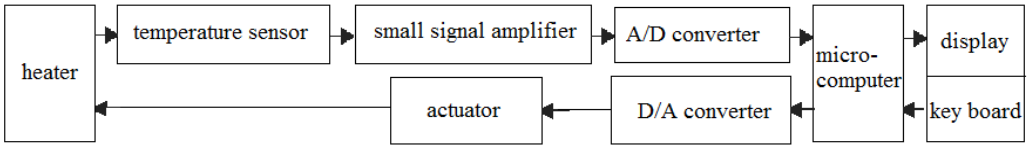

Fig.1 System structure diagram

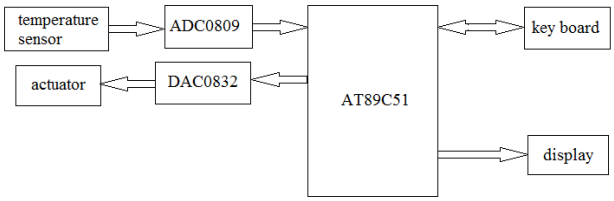

Fig.2 The circuit principle diagram

2.1 A/D and D/A converter

A/D converter adopts ADC0809, which can convert the temperature analog signal to digital signal. ADC0809 is a kind of CMOS integrated chip, it is a bitwise comparison converter. Its resolution is 8 digits, conversion time is 100μs. The data output has a three state latch; can be directly connected with the MCU data bus. It also has 8 analog switches, can connect 8 analog signals and select one to convert. Its interface with MCU is simple.

D/A converter adopt ADC0832. It has dual latch inside. It can convert four bit control signal, which comes from the microcomputer P0 port and output to controller, in order to drive the actuator, achieving the purpose of controlling the temperature.

2.2 Display and keyboard input

4 digits digital tube is adopted to display the temperature. The serial data is output from the microcomputer RXD and TXD port to 74LS164, and then be converted to parallel data. The display can also use LCD, with CD4055 driving circuit.

The keyboard adopts 4*4 digits keyboard to setup the temperature threshold or change the control mode. The 4*4 keyboard data can be read by low level scanning keyboard. Alternate input low level to the high 4 bits of P1 port, read the low 4 bits whether if there is low level. If there is low level, the key position can be judged, read the corresponding data, which should be the temperature threshold.

2.3 Temperature sensor

The temperature sensor is Nickel-Chromium/ Nickel Aluminum thermocouple, in 0-1100℃ measuring range, the thermal potential 0-45.10mV. The signal would be filtered out the high frequency signal by a resistance capacitance filter circuit, and then sent to the amplifier and A/D converter, input to the microcomputer.

2.4 Microcomputer

The microcomputer is AT89C51. It has 4k PEROM, 128 bits RAM, 32 I/O lines, two 16 bits timer, and 5 interrupt sources.

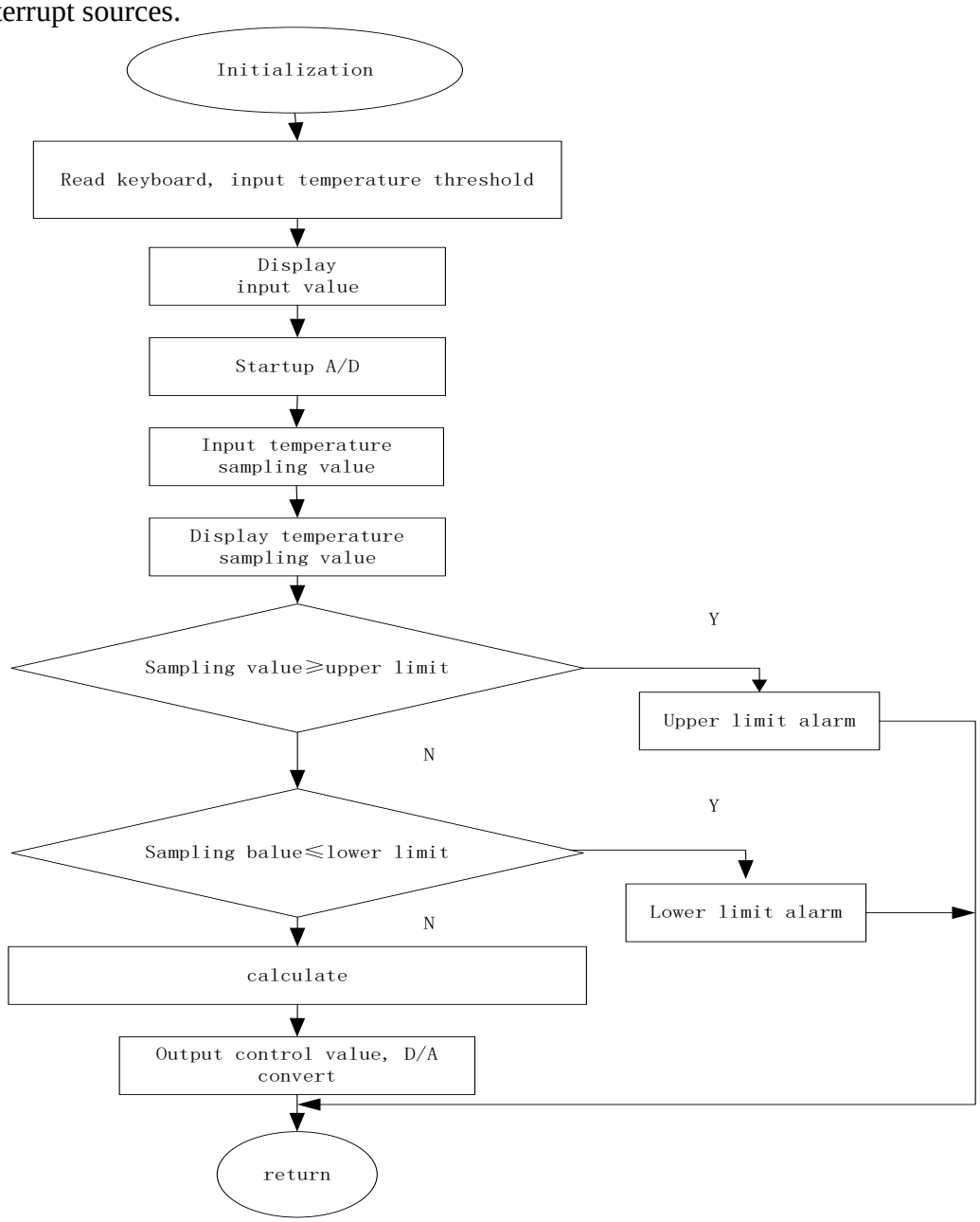

Fig.3 The main program flow chart

3. Control algorithm

The time constant of heater is very large for the sampling period. The closed-loop system can be approached with a lag of a first-order approximation. The control algorithm can adopts the regular PID algorithm, but it is not very accurate. Because the control of the pure lag object requires the use of Dahlin control algorithm, Smith estimate control, or fuzzy control, this paper select Dahlin control algorithm.

4. The design of the control system software

The program of the microcomputer mainly includes: reading keyboard data, temperature signal sampling, output display, calculate and output control. The main program flow chart is as Fig.3.

5. Conclusion

In the system above, the structure is simple, the precision is high, the algorithm is reasonable. It can realize the temperature automatically control, improve the efficiency.

References

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