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Overall analysis and design of control system

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Abstract: This article describes the temperature acquisition system designed with MCS-52 microcontroller and configuration software; DS18B20 sensor is responsible for the acquisition of temperature, the microcontroller is responsible for data reading, the host computer uses VB control to receive information and communicate with the configuration software in real time, configuration software Real-time measurement, data storage, data processing and other functions..
Keywords: Temperature acquisition, AT89C51, Electric relay System.

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1. PREFACE

With the increasing development of road transport, the heavy traffic trend has become more apparent. Because roads are load-bearing, road surface damage will inevitably be exacerbated as the carrying capacity of the road surface increases. For a long time, the thickness of the asphalt layer on road surface has become thinner, which weakens the bearing capacity of the road surface, greatly affects the structural and usability of the highway, and is likely to cause accidents.[1]
According to the analysis of relevant research personnel, temperature is the primary factor that damages the quality of the road surface. Temperature changes easily lead to deformation of the road surface. Therefore, in order to reduce the impact of temperature on the asphalt pavement, a detailed analysis of the temperature of the road subgrade needs to be performed.[2] We can place temperature sensors at different depths on the roadbed to test the temperature at different depths, then analyze the measured temperatures to find out how the roadbed and the road temperature field change.

2. OVERALL ANALYSIS AND DESIGN OF CONTROL SYSTEM

The system includes the core AT89C52 microcontroller and peripheral circuits, power modules, keyboard input module, temperature acquisition module, data storage module, serial communication module, liquid crystal display module, clock module and relay module. Among them, the power module includes a lithium battery and a power conversion circuit to convert the voltage of the lithium battery into a voltage level required by the microcontroller and other peripheral circuits.[3] The power supply uses a 7.2V, 7500 mAh lithium-polymer battery. By controlling the power consumption of the system, the power consumption of the lithium battery in the system within two months can be less than 30%.

3. SYSTEM HARDWARE DESIGN

3.1 SCM system

The system uses AT89C52 microcontroller. The MCU is a high-performance, low-power 8-bit CMOS microprocessor manufactured by Atmel Corporation and can realize serial programming in series and parallel mode. It has a full-duplex serial port, three 16-bit counters/timers, four I/O ports, 8k byte ROM, and 256-bit RAM. The program debugging is simple and convenient.[4]

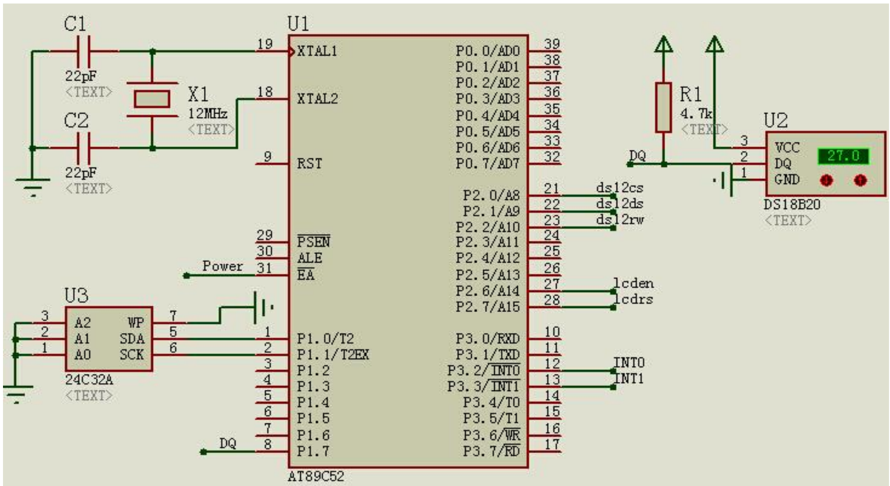

Fig 1. Microcontroller System Diagram

3.2 Temperature acquisition module

The temperature of the system is obtained using the digital temperature sensor DS18B20. The chip is a digital temperature sensor with a single bus interface. It has strong anti-interference ability, low power consumption, small size, and simple connection with the microcontroller. Temperature acquisition module schematic shown in Figure 2. The DQ pin is connected to the P1.7 port of the microcontroller.

3.3 Data saving module

The data storage module of this system uses the AT24C series EEPROM of IIC bus as the data preservation chip. Responsible for saving the data collected by the temperature acquisition module in one month, and the data can be read out by the SCM for display. The hardware connection is shown in Figure 2. The data line sda and the clock line sclk are respectively connected to the ports P1.0 and P1.1 of the single-chip microcomputer.

3.4 LCD module

The liquid crystal display module of this system is used to display temperature data. LCD1602 LCD screen, which is a dot-matrix LCD module for displaying symbols, letters, numbers, etc.

4. SYSTEM SOFTWARE DESIGN

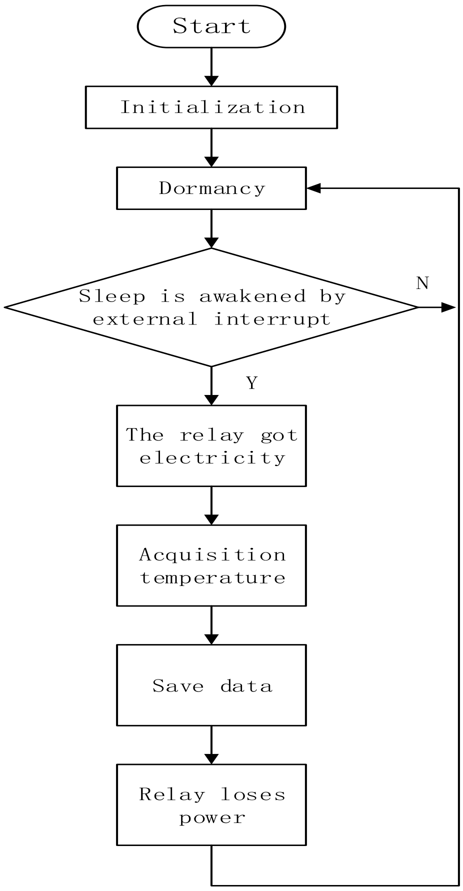

Fig 2. Work Flow Chart

The workflow of this system is shown in Figure 2. After the SCM is initialized, it enters the dormant state. After the first power-on of the SCM, the relay coil is still in the de-energized state. The peripheral device power terminal pins are not connected to the system power supply. At this time, the power supply only supplies power to the SCM and the clock chip.

If a button connected to the external interrupt of the microcontroller is pressed, the microcontroller wakes up with an interrupt signal and the peripheral devices of the relay are powered so that peripheral devices are connected to the system power supply and the device responds accordingly. After the worker finishes processing the data, the MCU reenters the sleep state.

When the timing of the daily collection temperature arrives, the clock chip generates an interrupt signal, the microcontroller wakes up through the external interrupt 0, and the relay coil is powered to allow the system power supply to the peripheral devices. Then, the temperature data is collected and the data is stored in the EEPROM.

5. CONCLUSION

This paper designed a highway temperature acquisition and storage system using single-chip computer, and introduced the specific design method of hardware and software. Because this system is used in unattended situations in the field, the power consumption requirements are relatively strict. Various methods are used in the system to reduce power consumption.

REFERENCES

[1] Cristina D. de Castilhos,Jamila Mezzalira,Mariana P.S. Goldim,Frederico G. Werlang, Janice C. Coelho. Effect of sample collection, temperature and time of storage on β-galactosidase and total hexosaminidase activities in dried blood collected on filter paper[J]. Clinical Chemistry and Laboratory Medicine,2011,49(8).

[2] Viktor Hronský. Measurement of Sample Temperatures and Temperature Gradients in Magic-Angle Spinning Nmr[J]. Acta Electrotechnica et Informatica,2013,13(1).

[3] M.A. Franzen,L.A. Roe,J.A. Buffington,D.W.G. Sears. A sample collector for robotic sample return missions I: Temperature effect on collected mass[J]. Advances in Space Research,2007,42(1).

[4] Noonan K,Kalu M E,Holownia P,Burrin J M. Effect of different storage temperatures, sample collection procedures and immunoassay methods on osteocalcin measurement.[J]. European journal of clinical chemistry and clinical biochemistry : journal of the Forum of European Clinical Chemistry Societies,1996,34(10).