Design of Multi-point Intelligent Temperature Monitoring System for Transformer Equipment

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Abstract. With the development and progress of industrial technology, the temperature range of factory substations is required strictly, and most of the temperature measuring devices widely used in the market at present are single-point measurements, with the disadvantages of slow transmission speed and imprecision, etc., it is disadvantageous for the controller of the substation equipment to make a decision in time according to its temperature change. This subject is based on single-chip microcomputer as the core of the control components, the acquisition temperature through the acquisition channel multiplexing technology, to achieve multi-point temperature monitoring and recording. A temperature measurement and control system is composed of a / D conversion photosensitive triode, a temperature sensor and a light intensity acquisition, detection and display. The temperature sensor is controlled by a single-chip microcomputer to collect the temperature, and the temperature is fed back to the single-chip microcomputer to make corresponding analysis and processing, it has powerful data processing function, intuitive display, friendly interface and high cost performance, and can be widely used in industrial and agricultural control, mechatronics engineering, smart home and many other fields.

1. Introduction
After entering the 21st century, in modern life, temperature intensity has a close relationship with human production. It is also the most common, basic and important parameter in industrial and agricultural production. The traditional temperature detection method is to use a thermometer, but this manual test method has many disadvantages, such as time-consuming, labor-intensive, large test error and large randomness. After entering the 21st century, with the rapid development of science and technology, the system includes measuring instruments such as microcomputers and microprocessors. It has functions such as data storage, calculation of logical functions, and automatic control. It will replace manual operations in many fields. Currently, most of the environmental detection instruments on the market are single-point measurements, and the temperature information is not timely and accurate. If it fails to meet the ideal requirements, it is not conducive for the controller to make a timely decision based on changes in temperature and light intensity.

At present, the temperature monitoring technology of those developed countries in the West has reached a relatively complete level, and a series of standards have been formed, which can not only monitor conventional environmental information such as temperature, humidity, and light, but also monitor and report factors such as carbon dioxide. And reports. In their monitoring, all kinds of sensors have developed to a relatively complete level, and the combination of sensors and controllers is very high. In addition, some countries are even more modernized on the basis of modernization. Further, it is moving towards unmanned and intelligent.
2. Overall design of multi-point temperature monitoring system
This subject uses a single-chip microcomputer as the core control component, and the acquisition temperature is monitored and recorded at multiple points through the acquisition channel multiplexing technology. The phototransistor is used for a / d conversion to collect, detect, and display the light intensity. The temperature sensor is used as a measuring element to form a temperature measurement and control system. The microcontroller is used to control the temperature sensor to collect the temperature and feed it back to the microcontroller for corresponding analysis and processing, and the microcontroller displays the processing result on the LCD.

3. System hardware design

3.1 Control circuit design
The minimum system of a single-chip microcomputer refers to the simplest circuit system that enables the single-chip microcomputer to run programs and work normally. It is a necessary circuit to ensure the normal startup and start of a single chip.

The clock circuit represents the heart of the single-chip microcomputer, and it controls the working rhythm of the single-chip microcomputer. The clock frequency of the single-chip microcomputer varies with the model, and the general definition value is 12MHZ. STC12C5A16S2 has a reverse-phase oscillator amplifier inside, XTAL1 and XTAL2 are the input and output of the reverse-phase oscillator amplifier respectively. The inverting amplifier can be configured as an on-chip oscillator. Both stone crystal and ceramic oscillations can be used. The crystal frequency used in this design is 12MHZ. 51 series mcu can also use external clock, when using external clock, external clock must be input from XTAL1, and XTAL2 hanging. When the RST reset pin of the microcontroller generates a high level of 5ms and above, the microcontroller completes the reset operation. If the RST has been continuously high level, the microcontroller will always be in the reset state, so the microcontroller needs to be able to leave the reset state after the reset is completed. The reset operation usually includes power-on and switch reset. In the SCM operation period, if the occurrence of a crash, with the key switch to complete the reset.
3.2 Temperature sensor design

In the multi-point temperature measurement system, the traditional temperature measurement method is to remotely sample the analog signal and perform ad conversion. In order to obtain higher temperature measurement accuracy, measures must be adopted to solve the problem of multi-point measurement switching due to long-line transmission. The error compensation caused by factors such as the zero drift of the amplifier circuit. The ds18b20 uses an external power supply method. In theory, 256 ds18b20 can be hung on a data bus. However, it is found in time applications that if more than 25 ds18b20 are connected, there may still be power consumption problems. In addition, the length of a single bus should not exceed 80m, otherwise it will affect the data transmission. In this case, we can use a grouping method to drive multiple channels with multiple 1/Os of the microcontroller. ds18b20, as shown in Figure 3.

Figure 2. Minimal system block diagram

Figure 3. Temperature sensor circuit diagram
3.3 LCD Display Circuit Design

LCD12864 LCD screen with font library LCD display module can display Chinese characters and graphics, built-in 8192 Chinese characters (16 × 16 dot matrix), 128 characters (8 × 16 dot matrix). LCD12864 is a kind of low power and low voltage display device. The current requires only a few microamperes during operation, which is unmatched by any display. At the same time, it can display a large amount of information. In addition to numbers, it can display curves, text. Compared with the traditional digital LED display, the curve and text display interface has been greatly improved. It has been widely used in meters and low power consumption application systems. The specific advantages are as follows.

1) The quality of the display is high, and since each point in the liquid crystal display keeps that color and brightness constant after receiving the signal, the picture quality of the Liquid Crystal Display is very high and there is no flicker.

2) Digital interface design, LCD displays are all digital design, easy to operate when connected to a single-chip microcomputer, and very convenient.

3) Low power consumption. Compared with the main power consumption of liquid crystal displays, the power consumption of internal electrodes and driving ICs is much smaller than that of other devices with the same function.

Today, most digital data are displayed by leds, but leds can only display numbers, not Chinese characters. To achieve a better human-machine interface, using a liquid crystal display to display data is the best choice.

4. System software design

4.1 Main program flow chart

After the system program is initialized, it enters the working mode. The microcontroller will cause the corresponding DS18B20 to start collecting temperature data and complete conversion according to the currently specified channel. The light sensor will collect light and perform ad conversion, and then send the collected data to the microcontroller. After the internal processing, the microcontroller sends the data to the LCD12864 LCD screen for data display. The flowchart of the main program is shown in Figure 4 below.
5. Conclusion
This design aims at multi-point temperature monitoring design, with stc12c5a16s2 single-chip microcomputer as the core, which is mainly composed of LCD liquid crystal display circuit, digital temperature acquisition module, and illumination acquisition system. The system collects the temperature of the environment through six digital temperature sensors and uses phototransistors as After the sensor detects the light intensity after ad conversion, the collected data is sent to the single-chip microcomputer. In the STC12C5A16S2 single-chip microcomputer, the data sent by the sensor are processed and analyzed, and the data are displayed by the LCD display circuit, thus the multi-point temperature and illumination are collected and monitored.

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