

Design of PH sensor signal acquisition and display system

Huifa Qian, Quanzhu Zhang and Yonghong Deng

Information and Control Technology Research Institute North China Institute of Science and Technology, Beijing 101601, China

Abstract. With the continuous development of sensor manufacturing technology, how to better deal with the signal is particularly important. PH value of the sensor voltage generated by the signal as a signal, through the MCU acquisition A / D conversion, and ultimately through the digital display of its PH value. The system uses hardware and software to achieve the results obtained with the high-precision PH meter to strive to improve the accuracy and reduce error.

1. Introduction

With the development of sensor technology, especially the wide range of single-chip applications. There is wider use of single-chip and digital control of the small sensor measurement and control system. Because they are well combined with the low price of the microcontroller, strong function, good anti-interference ability, temperature limit and control and other advantages. In this system, the microcontroller collects the signal and processes it, and sends the data to the digital tube through the serial port, and the digital tube displays the data.

This paper uses the PH value sensor as the front section of the data acquisition, and then under the control of the microcontroller AD conversion, and the signal through the serial port to the digital tube for display.

1.1 System introduction

The system can be divided into three parts. The first part is the signal source, the PH value sensor to generate the voltage signal, the signal through the differential amplification, filter to get a clearer signal; the second part of the signal into the AD conversion into the microcontroller processing, and then through the I/O port into the digital tube; The third part is the data display, is the digital tube to complete. The overall flow chart of the system is shown in Figure 1.

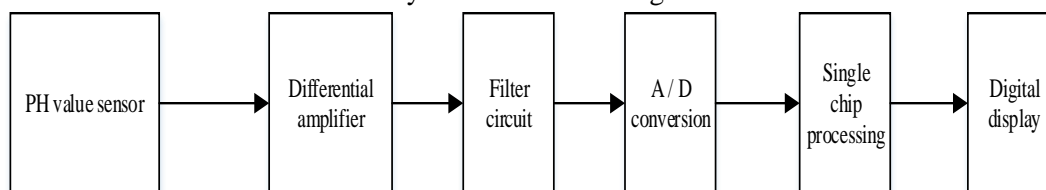


Figure 1. system total flow chart

1.2 PH value sensor

PH value sensor principle, according to the chemical definition: pH is defined as $\text{pH} = -\lg n(\text{H}^+)$ measured PH value is the concentration of H^+ . Must be converted into electrical quantities of electricity, this paper uses a calomel electrode and glass electrode. In the measured solution, the potential of the calomel electrode does not change as a reference electrode. The potential potential on

the glass electrode increases with increasing H^+ concentration. That is, the potential difference between the glass electrode and the calomel electrode can represent $n(H^+)$.

That is, $V = Kn(H^+)$, K is a positive correlation coefficient.

The initial signal to be processed by the system is provided by the PH sensor, as shown in Figure 2.

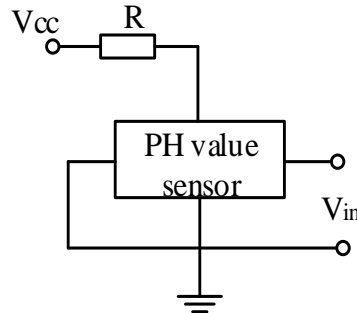


Figure 2. PH value sensor

2. Hardware circuit design

2.1. Amplification circuit

The voltage signal provided by the PH value sensor is too small. The microcontroller can't be processed and the PH value sensor has a large input impedance. So the hardware circuit pre-stage input using a high impedance differential amplifier circuit, the hardware system by the differential amplifier circuit, low-pass filter, reverse proportional operation amplifier circuit. OP07 chip can be used to achieve, the hardware system shown in Figure 3.

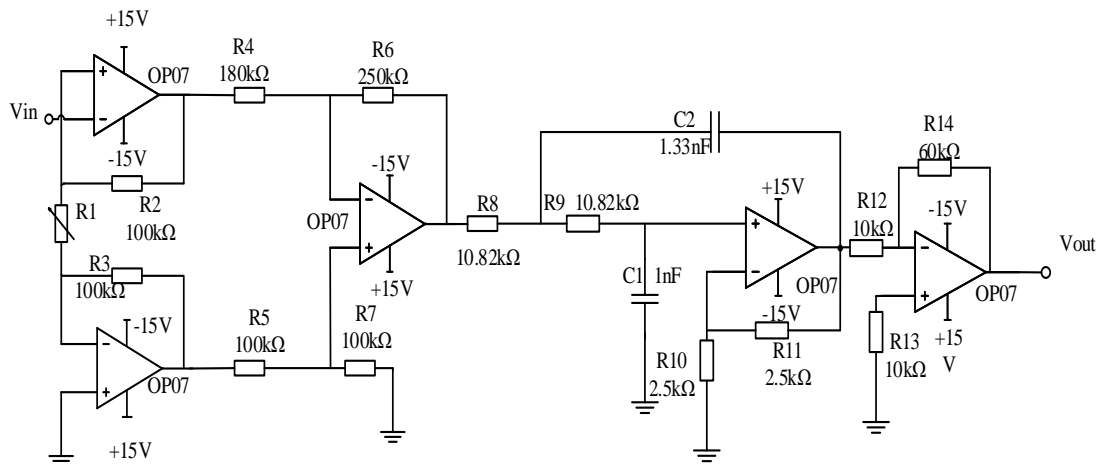


Figure 3. hardware circuit

2.2. A / D converter

The system uses Atmel's AT89C52 micro-controller, compatible with MCS-51 single-chip products, with 4KB flicker programmable erasable read-only memory, 1000 erase cycles, 32 programming I / O lines, 2 16-bit timer / counter, 5 interrupt sources, UART serial communication and so on. In the design of the main use of it to control the sensor signal generator output analog signal into a digital signal for data acquisition and display.

A converter converted to a discrete signal expressed as a binary value, referred to as an A / D converter, is converted into analog converters after comparison with standard quantities. The input of the converter is typically a DC current or voltage, and the output is a digital quantity of binary digital. The design uses the ADC0808 chip, the process is as follows First of all, the chip has IN0 ~ IN7 eight analog input port. By ADDA, ADDB, ADDC control which port to use analog port into the converter,

you can scan the analog input port through the microcontroller, you can achieve multi-signal analog conversion. After one pulse is applied to the START and ALE pins, the channel select code is immediately locked and the ADC converter is started. After the start of the conversion OE pin plus a positive pulse, the output buffer of the three-state door open, so that the converted digital quantity can be transmitted to the microcontroller, the above process driven by the microcontroller.

The data display circuit is displayed by the digital tube circuit. Digital display for single-chip, single-chip control section of the code and bit code output. So that the PH value in the digital display process is as follows, a single chip port will be a one-time code into the 74HC573 latch LE pin is low so that the data is not read, and then the bit code into the 74HC573 latch Device, so that the LE pin is low so that the data is not read, and then drive the digital tube off or light.

3. The software part

Through the preparation of the program to drive ADC0808 analog to digital conversion, and that is read the data processing needs to show the PH value and the sensor generated by the device provided by the voltage value was negatively correlated. There is a simpler way to get a functional relationship between its voltage and PH. A high-precision acidity meter was used to measure the pH of a dozen groups of different acid-base solutions. In addition, the PH value sensor is used to measure the voltage of the ten groups. Data Analysis The SPSS software was used for regression analysis to determine the pH values measured by these different acid-base solutions as a function of the voltage values provided by the sensor generating device. According to the function of the relationship between the data processing, this design has several advantages Through the source program can be amended due to the hardware circuit and analog conversion to bring measurement error, you can detect the hardware circuit measurements, if the deviation from the normal range of warning hardware system Fault, easy maintenance.

4. Concluding remarks

The design is based on the PH value of the microcontroller display. The key part of this paper is how to handle the voltage signal provided by the PH sensor. Firstly considering the supply of the signal is too small and there is a large input impedance, so the use of high-impedance differential amplifier circuit, differential amplifier circuit designed adjustable resistance, through the adjustable resistor can reduce some noise; The filter circuit can remove the high frequency noise, the circuit has the amplification function; Finally, the reverse operation amplifier circuit, part of the circuit is mainly used to adjust the signal magnification, because the voltage signal to meet the A / D converter analog 0 ~ 5V Of the input range. And then A / D conversion, digit input into the microcontroller for data processing, the design also has the advantage of using the source code to correct the hardware circuit caused by the measurement error. The system is safe, efficient and reliable.

Acknowledgements

This work was financially Supported by Hebei Science and Technology Department Project (16274603,16214408), China Coal Industry Association (MTKJ2016-35, MTKJ2016-329).

References

- [1] Kang Huaguang, the basis of electronic technology (analog part) [M]. Beijing: Higher Education Press, 1999.
- [2] Li Quanli, single-chip principle and application (C51 programming) Beijing: Higher Education Press, 2012.
- [3] He Xicai, Xue Yongyi. Sensors and their application examples [M]. Beijing: Mechanical Industry Press, 2004.
- [4] Fu Fenglin editor. Analog electronic circuit foundation [M]. Xi'an University of Electronic Science and Technology Press, 2001.
- [5] Meng Li Fan, Zheng Bin editor. Sensor principle and technology [M]. Defense Industry Press,

2005.

- [6] Hu Hancui. Single-chip principle and its interface technology. Beijing: Tsinghua University Press .1996.
- [7] Tan Haoqiang. C program design (second edition). Beijing: Tsinghua University Press, 1999.
- [8] YANG Ting-ge. Study and application of computer numerical control of pH value in neutralization pond [J]. Journal of Applied Science, 2001, 28 (12): 49-50.