Design of Intelligent Electronic Scale

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Abstract: Electronic scale is a kind of electronic weighing, is an important tool to measure quality, widely used in various fields of industry and agriculture, scientific research, transportation, electricity. It is closely related to the lives of the people, it is an indispensable measurement equipment. The design of this system is based on the full bridge weighing principle of the resistance strain type weighing sensor. The chip circuit is mainly based on MCU AT90C51 as the core of the control unit, to achieve data processing, the use of pressure sensors to collect data. Analog electronic scale 24 A/D conversion chip HX711 to collect the sensor for AD conversion, the converted data sent to the microcontroller for processing, implemented by the LCD12864 LCD data display, the system has the function of automatic calibration, can complete the goods weighing and commodity price calculation. The weighing range is from 5 to 500 grams. The whole system is simple in structure and easy to use.

Keywords: electronic scales, AT90C51 microcontroller, data acquisition, HX711, LCD display

1. INTRODUCTION

The electronic scale is the most commonly used weighing device in daily life. It usually has the function of setting, peeling, accumulating and weighing results.\cite{1} The electronic scale operation is simple, small volume, fast weighing speed and easy reading, widely used in commercial trade, hospitals, schools, enterprises and other departments.\cite{2} This system is based on single chip microcomputer AT90C51 as the core of the control unit to realize the processing of data, using pressure sensors for data acquisition, 24 bits A/D conversion chip dedicated electronic scale HX711 analog of sensors to collect the AD conversion. This electronic scale has the advantages of simple structure, high precision and good reliability.

2. SYSTEM DESIGN SCHEME

The system voltage signal through the data acquisition module, then through amplifying circuit to enlarge the signal input A/D conversion chip after A/D conversion, the converted digital quantity input control module, according to the need to control module to write programs for
data processing, and with a control module for data processing and control of the A/D conversion, again by the control module and output display signal, through the display circuit display. Its circuit block diagram is shown in Fig. 1:

![Fig. 1 schematic diagram of system design scheme](image)

2.1 Sensor module design

The design uses a resistive pressure sensor as weighing sensor which can convert mechanical signals into electrical signals. It is mainly made of resistance strain effect. The resistance strain gauge is its main component, and this resistance strain gauge can be used as a sensitive element to make mechanical sensor. Good use, high precision and good adaptability. As shown in Fig. 2, the resistive pressure sensor consists of four resistors in different directions on the same plane to form a wheatstone bridge.

![Fig. 2 diagram of complete bridge circuit](image)
When R1=R2=R3=R4, Uo=0, the bridge is in equilibrium at this time. When the pressure of the resistance type pressure sensor, the resistance will change, R1=R-ΔR, R2=R+ΔR, R3=R-ΔR, R4=R+ΔR, the output voltage is Uo:

\[
U_o = \left[ (R + \Delta R)^2 - (R - \Delta R)^2 \right] E \\
= \left[ (R + \Delta R) + (R - \Delta R) \right] \left[ (R + \Delta R) - (R - \Delta R) \right] E \\
= \frac{\Delta R}{R} E \\
= k \varepsilon E (E = 5V) \\
\]  \hspace{1cm} \text{(Formula 1)}

2.2 Analog signal processing module scheme

The system chooses to use HX711 as the main chip of signal processing module. This not only saves cost, but also improves the accuracy and reliability of the design. HX711 not only integrates the signal amplification module, but also contains a high-precision 24-bit A/D converter. Not only that, HX711 is also integrated with some peripheral circuits, such as voltage stabilizer, clock oscillator, and so on. Its advantages are high precision, low cost, excellent anti-interference ability and quick response. In addition, HX711 and MCU are mainly driven by the pipe, and the interface circuit is simple, without the need to program the register in the chip.

2.3 MCU module scheme

The system adopts AT90C51 as the control core. It is a kind of high performance CMOS 8-bit microprocessor, it contains 8 k bytes scintillation programmable read only memory can be erased, with two 16-bit timer, 32 programmable I/O lines, and the price is low, the “C” language programming is easy, easy to control.

2.4 Keyboard module scheme

The system uses 4*4 matrix thin film keyboard, as shown in Fig. 3. The 4*4 matrix thin film keyboard belongs to a kind of film switch. It consists of four parts: an upper circuit, a panel, a lower circuit and an isolating layer. The inner part is integrated with 16 small key switches and arranged in a matrix type. The utility model has the advantages of beautiful appearance, small size and strong tightness, and has the advantages of dust prevention, moisture resistance, etc.
The keyboard uses a 4 * 4 matrix keyboard. The function of the electronic scale and the number assigned by each button are shown in Table 1.

Table 1 system button configuration table

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<td>7</td>
<td>8</td>
<td>9</td>
<td>peel</td>
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<td>4</td>
<td>5</td>
<td>6</td>
<td>remove</td>
<td></td>
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<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>delete</td>
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<tr>
<td>0</td>
<td>.</td>
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<td>add up</td>
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(point)

2.5 Display module scheme

The display module in the system should be used mainly to show the weight, unit price and total price of the object, so it is very important to select the appropriate display module.

This system adopts LCD liquid crystal display, and LCD module is used in single chip microcomputer. It is rich in content and has many advantages that the digital tube does not have. LCD12864 is a liquid crystal display with no Chinese font, and we use LCD12864 for display module. The display resolution is 128 * 64, with 8192 16*16 point characters and 128 16*8 point ASCII character sets, and the flexible interface mode and simple and convenient operation instructions of the module.
3. THE DESIGN OF SYSTEM PROGRAMMING

In terms of software, the program adopts a modular structure, so that the program structure is clear, easy to program and easy to read, and easy to debug and modify.

The main program module is shown in Fig.4:

4. CONCLUSION

The design of this system is based on the full-bridge weighing principle of the resistance strain weighing sensor. Adopted the resistive pressure sensors for data acquisition, 24 bits A/D conversion chip dedicated electronic scale HX711 analog of sensor collected AD conversion, the transformed data to the single chip microcomputer for processing, according to data from LCD12864 LCD implementation, the system can can be according to the weight of the object, digital display and complete the goods weighing and commodity prices. Scale weight range of 5.00 g ~ 500.00 g; Weight less than 50g, weighing error less than 0.5 g; Weight is 50g and above, weighing error is less than 1.0 g, and it has the function of peeling. The whole system is simple, easy to analyze and easy to operate.

REFERENCES
