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A High-precision Pressure Controller Based on Zigbee Transmission

Wang Chao[1] and Pu Han[2]

[1]Changji university, Chang Ji 831100, China
[2]Nanjing tech university ,Nanjing 211800, China

[a]Corresponding Email:wang0001chao@163.com

Abstract: Nowadays, the pressure controller is one of the most commonly used sensors in the market, it has advantages of good real-time performance, good efficiency, but also exist precision is poor, low resolution and volume weight, inconvenient to carry shortcomings. Therefore, this article designed a high accuracy pressure controller based on zigbee transmission, and gives the design diagram, hardware composition and software system, the system USES 51 single chip microcomputer, ten high precision A/D conversion chip HX711, cantilever type resistance strain sensor and zigbee wireless transmission module, system can be collected in real-time and high precision gravity through to the digital tube display; , at the same time, through the zigbee wireless transmission way of transmitting current data terminal equipment (such as: PC, mobile phone, etc.), convenient for the user in the long-distance real-time view the latest data, in improving the efficiency of using the system at the same time, also ensure the data real-time and efficiency.

1. Introduction

With the continuous improvement of people's living standard and the increasing modernization of commercial behaviors, people also put forward new requirements on the speed and precision of commodity measurement [1-3].

Currently, the pressure controller is one of the most commonly used sensors in the market, and all have one thing in common: on the scene, the pressure sensor displays the value on the current screen. However, in the field of precision control such as current industry, gravity controller has the disadvantages of low precision and difficult to view data in different places.

For using these two shortcomings, therefore, to design a set of high precision pressure controller based on zigbee transmission, this paper discusses the design idea, method and design of the system implementation process, a detailed analysis on the selection of various modules, functions and implementation method, including the system hardware structure, the selection of sensor, the flow chart of system operation, etc.

Control core unit using STC89C52 as CPU control module, sensor using A sensor with high precision, stability, good resistance bridge - 8 HL type sensor, A/D conversion module USES HX711 of high resolution and high accuracy.

2. Overall design of digital electronic scale

This digital electronic scale system can be divided into single chip computer control circuit, zigbee wireless transmission circuit, sensor sensor circuit and digital tube display circuit, etc, as shown in figure 1.

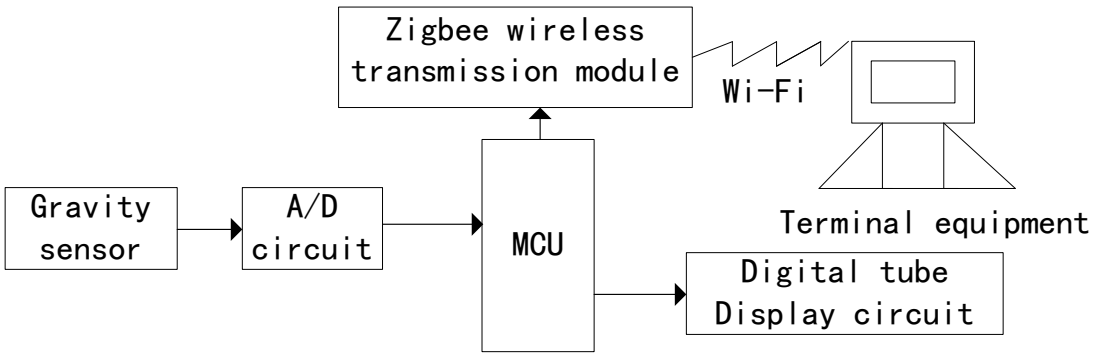

Figure 1. System block diagram

3.System hardware design

3.1. Selection of piezoelectric sensors

The strain gauge resistance sensor is a sensor that USES the strain gauge as the identification element. It has many advantages, such as: 1. High precision and wide measurement range; 2. Good frequency response; 3. Variety of strain gauge and low price; 4. High sensitivity of system contact points, high integration degree and simple structure [4-6].

The sensor used in this design is a full bridge measuring circuit. In the absence of pressure, the bridge is in equilibrium and the output voltage is 0V; When there is pressure, the bridge arm resistance of the bridge is similar to the linear change, and the bridge gradually loses its balance. In the whole bridge measuring circuit, the two strain plates with the same force nature are connected to the opposite side of the bridge. The output sensitivity of the half-bridge is approximately doubled, and the nonlinear error and temperature error [7] are also improved.

The circuit diagram of the full bridge measurement circuit is shown in figure 2.

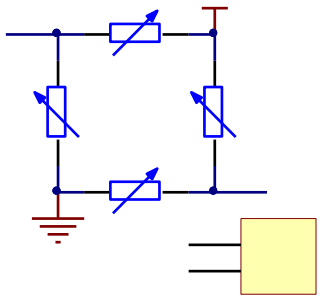

Figure 2. Full bridge measuring circuit

3.2. A/D conversion chip HX711 interface circuit design

According to the requirements of the system to use, must use reach 10 conversion precision A/D conversion equipment, however, considering the STC89C52 SCM I/O port resource factors such as tension, quantitative accuracy of final use HX711, it can reach 1/4096 < 1/1000, comply with the design requirements.

The HX711 module diagram is shown in figure 3.

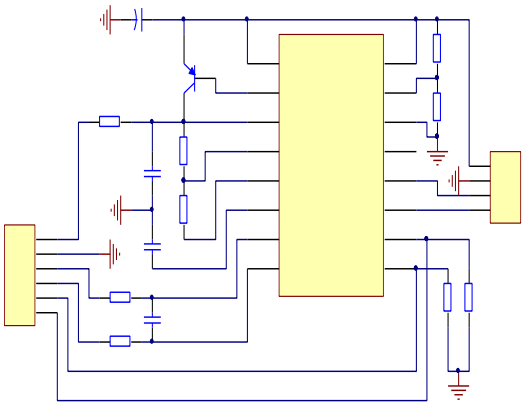

Figure 3. HX711 module chart

3.3. Digital tube display circuit design

The system USES four segments of digital tubes as peripheral typical devices. At the same time, in order to enhance the capacity of MCU para choose signal driver, the P2 port (a) in the 9012 transistors (PNP) base, 9012 triode act as the role of the switch, and at the same time, greatly improving the digital tube display brightness, for observation of the output data.

The digital tube display circuit of this design is shown in figure 4.

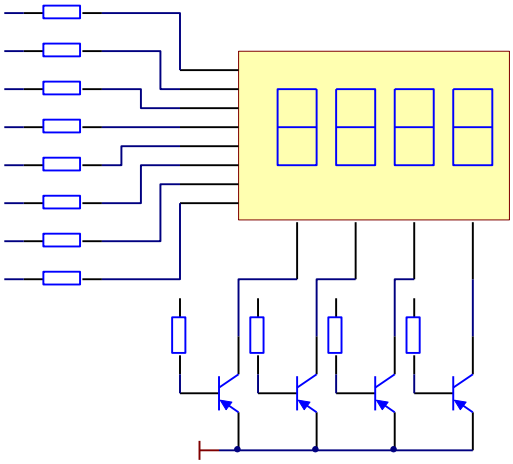

Figure 4. Digital tube display circuit diagram

3.4. Zigbee wireless transmission circuit design

Zigbee wireless transmission technology, is now one of the most popular wireless control mode, has a good real-time performance and long transmission distance, and the advantages of good stability, the system USES zigbee technology, makes the current collected gravity value can be displayed on the terminal equipment, greatly improve the utilization rate of the data and convenient for the user in real time, the accuracy and stability of different view the data.

4. System test and calibration

4.1. System hardware test

In the process of system hardware debugging, first check whether the components on the PCB welding correctly, observe carefully if there is any leakage welding phenomenon, with a multimeter test PCB whether there is the phenomenon of short circuit or open circuit. After the test, the power supply is connected. Meanwhile, the voltage value of the power part is measured with the multimeter, and the

error is obtained. First press microcontroller reset button reset the system, digital tube display subroutine call 1234, after determine the digital tube display correctly, connected to sensors and composed of 24 HX711 serial A/D converting circuit and A/D conversion circuit, the burning of all of the application to the MCU processor, observe whether digital tube display, 0000.

If it is not, the software will be adjusted to zero. After the zero is completed, the pressure will be exerted on the sensor by hand, and the display value on the digital tube will increase with the increase of pressure. When you let go, observe whether the number of digital tubes is returned to around 0000.

4.2. The determination of linearity

In the process of selection, in turn increase the quality of the weights, try to put weight on sensor test side edge, Jordan farmar's centre of gravity in the center of sensor test area, so it is concluded that the value of the more accurate. After the display value of the digital tube is stable, record the display value and use MATLAB to draw the curve.

4.2.1 Display value of digital tube when unmarked. In the software part of the design, if no clear program is added, when no weight is placed on the sensor, the digital tube displays the initial value of 70 (g). Then we put 10 (g), 20 (g), 40 (g), 50 (g)... , write down the number of digital tubes. Through the MATLAB simulation, it is concluded that the display value of the digital tube is linear with the weight value. FIG. 5 is a linear test curve when uncalibrated;

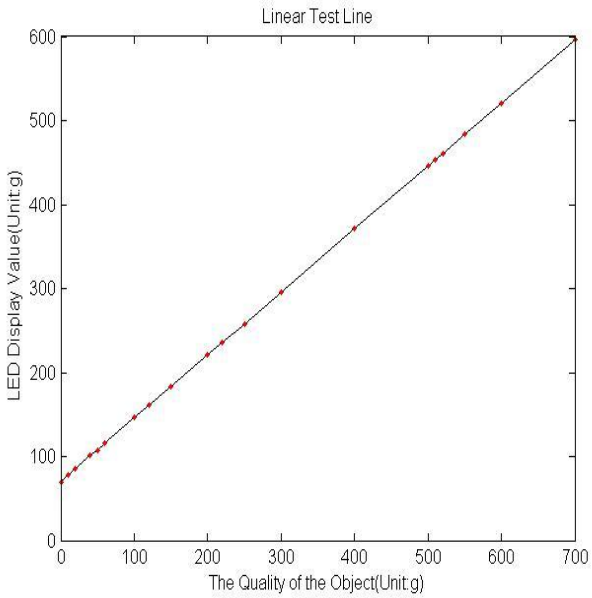

Figure 5. Linear test curve

4.2.2 Digital tube display value when unmarked. The display value of the digital tube when unmarked.

The least square method has strict mathematical basis. Although the calculation is complicated, the fitting linear precision is high, namely, the error is small. Then, in the code design, add the digital tube to display the zero - zero procedure, the calibration process is completed. The calibration curve after calibration is shown in figure 6.

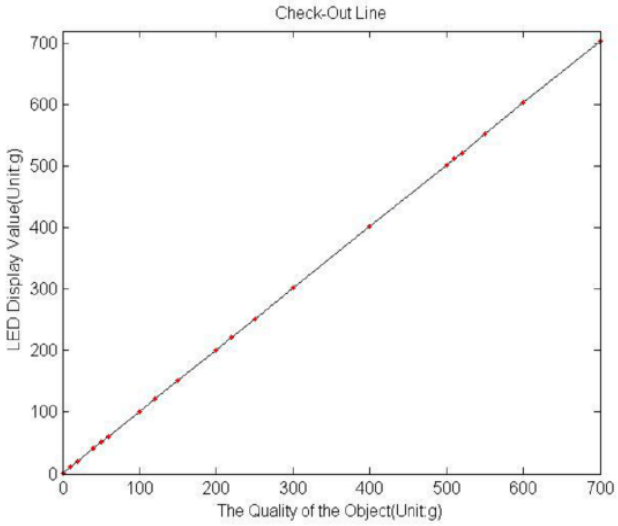

Figure 6. Linear test curve

4.2.3 The error analysis. The experimental results show that HX711 itself is highly sensitive, and if there is no fixed position of the sensor, there will be some errors in the data obtained.

In addition, the lead of HX711 is also very sensitive, even if it is slightly touched, it will produce mechanical errors.

5. The conclusion

Based on zigbee transmission, the high-precision pressure controller is characterized by high real-time performance, high accuracy, and remote viewing of real-time data, portability and high cost performance.

This system can get high accuracy in the field of gravity, also can by connecting LAN, through the terminal device to view real-time gravity, bringing great data repeated utilization ratio and improve the limited accuracy.

Especially in the process of determination of linearity, the experimental test data using MATLAB graphics, digital tube display value and weight value can be drawn from the relationship between close to a straight line, therefore, it is concluded that the linear fitting relationship between them, finally complete the calibration.

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