

Design of Electronic Compass

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Abstract: With the advancement and development of science and technology, especially under the impetus of electronic technology, the society has gradually developed toward intelligence, information, and artificial intelligence. At the same time, the technology market needs to have more accurate information about azimuth angles, services to all aspects of life, industry, travel, and navigation. Due to the physical characteristics of the traditional compass, the anti-interference ability is not strong, the pointing sensitivity is insufficient, and the disadvantages of low precision are gradually eliminated by the market. This dissertation designs a set of electronic compass system based on single-chip microcomputer according to the basic principles of the compass. The system chooses STC89C52 one-chip computer as the main control chip, carries on data processing and program operation. The HMC5883L magnetic field sensor is used to collect the information of the current geomagnetic field, and then the collected magnetic field information is converted into an electric signal and transmitted to the single-chip microcomputer. Single-chip microcomputer data processing and then output to the LCD display position information, while a clock chip to facilitate real-time display time. With a button module, you can set the time and range angles. There is also an alarm module that can perform the function of exceeding the range angle alarm. The system has been tested to a point accuracy of up to 1°, which is a more accurate, anti-interference and more intelligent electronic compass system.

Keywords: Compass, Electronic compass, Magnetic field sensor

I. INTRODUCTION

With the development of society, people need to grasp the location information efficiently and accurately. Due to its own physical characteristics, the traditional mechanical pointer compass is prone to wear due to long-term use of needles and magnetic needle contact parts^{[1][2]}. Wear causes pointer pointing accuracy to be low, and magnetic needles are easily demagnetized by temperature changes. Due to mechanical congenital factors, the pointer compass has certain limitations on portability, sensitivity, accuracy, and service life usage scenarios. Due to the above shortcomings, the pointer compass is gradually eliminated from the market. The development of an efficient and reliable electronic compass detection system based on a single chip microcomputer can ensure the convenience of users, provide guidance for users, improve the original guide effect, and provide users with a better experience. This design of electronic compass can be used instead of the traditional compass for civilian navigation, Geodesy, travel navigation, vehicle-borne navigation and other practical purposes used to identify direction, which has a high application value^[3].

According to the basic principle of the compass, this paper has chosen a more portable, sensitive, accurate, long service life and strong anti-interference scheme to overcome the shortcomings of the traditional compass^{[4][5]}. The magnetic resistance sensor is used to collect the current azimuth magnetic field strength signal, and then the single chip microcomputer is used to determine the processing signal, and then output it to the current direction of the display screen. The actual test accuracy can reach 1 degree. It is equipped with clock circuit to check the time at any time, and the azimuth alarm can more intuitively remind the azimuth. In this way, the compass is more intelligent while improving the accuracy, and the operation is simple and high anti-interference.

The research on the design of electronic compass system based on single chip microcomputer mainly achieves the following important purposes: First, it can detect the current position situation in real time, and use liquid crystal LCD12864 to display; Second, it can display the time in real time and facilitate the user to view it. Third, the user can set the time by pressing the button and adjust the time; Fourth, has the alarm function, the user can carry on the azimuth angle setting, exceeds the limit, carries on the alarm processing^[6].

Based on the idea of intelligent sensor, this paper designs an electronic compass system based on single chip computer. It mainly studies the selection of detection sensors, the connection between sensors and microcontrollers and the transmission of signals, the selection of the main control chip and the design of its peripheral circuit, the power supply system design and the system's low power consumption processing. The main control uses the STC89C52 produced and developed by STC as a data processing device to perform data processing and program operations. The magnetic field information collected by the magnetic resistive sensor HMC5883L sensor is collected, and the collected magnetic field information is converted into electrical signals. Transmission to MCU. At the same time, a clock module is designed. While collecting the position, it can also

display the time in real time, making the system more convenient. In order to further increase the practicality of the system, the user can set the upper and lower limits of the azimuth angle through the keys when using the keys. When the upper and lower limits of the set angle are exceeded, the alarm processing of the buzzer is performed. Then in power supply, in order to make the system more practical, this system specially designed the circuit, using the battery power supply method to power the entire system.

II. SYSTEM PROGRAM DESIGN

The determination of the overall design scheme is the most complex part of the entire design. When determining the overall scheme, we must consider the selection of each component and the cooperation between all components. When selecting components, there are often many solutions that can meet their own design requirements. At this time, we have to consider the cost of the entire design, the complexity of the line, and even we have to consider whether the chip can be purchased. In short, there are many factors that affect our design plans. We must consider them one by one. Finally, we have determined our own plans with the help of our own efforts and teachers and classmates.

The design of the electronic compass for this topic requires the following important purposes:

- (1) Ability to detect the current position in real time and use the screen for display;
- (2) The ability to display time in real time to facilitate user viewing;
- (3) The user can set the time and adjust the time by pressing the button;
- (4) With the function of alarm, the user can set the orientation angle, exceed the limit, and carry out buzzer alarm processing.

The electronic compass system based on a single chip computer is based on an intelligent control and sensor system. That is, the system consists of a master control module and a magnetic field sensor module and an alarm module. At the same time, an LCD display module and a clock module are also added. Time information can be displayed in real time. The system also includes a key module and an alarm module. The main control module can carry out internal data processing and program operations. The sensor module is used to detect the magnetic field in real time. The clock module can calculate the time in real time, display the time, and display the information in real time. The key module uses the key as the interactive input of information, the adjustment of user time and the adjustment of the angle alarm. The power module uses the battery voltage to supply power, and then uses the voltage control module to output 5V to power the control unit and the buzzer alarm module. When the angle of the system exceeds the set angle, the alarm of the buzzer is performed.

A. Hardware options

(1) Master module

Using the STC89C52 microcontroller as the master chip, the STC89C52 is a low-power, high-performance eight-bit CMOS microprocessor with 8K online programming Flash memory. The core of the STC89C52 single-chip microcomputer uses the MCS-51 kernel. The instructions are fully compatible with the MCS-51. The STC89C52 single-chip machine has simple development, downloadable online programming, and low cost is a good choice.

(2) Sensor module

Using the HMC 5883L sensor, the HMC 5883L sensor is a weak magnetic sensor chip with a digital interface and is suitable for use in the field of low-cost compasses and magnetic field detection. The HCC 5883L includes advanced high-resolution HCC118X series reluctance sensors, and integrated circuits with Honeywell patents include amplifiers, automatic demagnetization drives, deviation calibration, which makes the sensor's accuracy controlled at 1-2 °, and its accuracy is higher. Can effectively detect equipment.

(3) Display module

Using the LCD12864 LCD display, the 128 * 64 with the Chinese text library is a 4-8 bit parallel, 2-wire or 3-wire serial multi-interface method with a display resolution of 128 * 64 and a built-in 8192 16 * 16 points. Chinese characters, And 128 16 * 8 ASCII character sets. Using the flexible interface and simple and convenient operation instructions of this module, it can constitute the interactive graphical interface of all Chinese literati.

(4) Clock module

The DS1302 clock chip is used to realize the clock. DS1302 is a high-performance, low-power, real-time clock circuit with RAM. It can be timed for years, months, days, weeks, hours, minutes, and seconds. It has a leap year compensation function. The operating voltage is 2.5 V. to 5.5 V. A three-wire interface is used to communicate with a single chip computer, and multiple bytes of clock signal or RAM data can be transmitted at one time. The DS1302 has a 31 * 8 RAM memory for temporary storage of data. The DS1302 is an upgraded product of the DS1202 and is compatible with the DS1202, but it adds a dual power pin for the main

main/backup power supply and provides the ability to charge the backup power supply. The main feature is the use of serial data transmission, which can provide programmable charging function for the power protection power supply, and can turn off charging function, using ordinary 32.768 KHZ crystal vibration as the standard clock.

B. System software design

The main core of this design is related to the control equipment is the use of STC89C52. The development of this single chip microcomputer is very simple. We use the C language for program design and development, in the selection of the development environment. What we choose is the development software Keil μ Vision 5 of the special single chip microcomputer to achieve. Keil is a single-chip computer development software designed and developed by ARM. He supports the design of a variety of single-chip computer platforms. Therefore, the 51 single-chip computer selected for this design can also carry out related support, so the efficiency of development will be greatly improved. At the same time, it is also very efficient to use Keil's internal data repository. We can call directly without the need for direct underlying program development and design, so it is very convenient and efficient. Figure 4.1 is Keil's development interface. Its interface is very simple and very conducive to the design and development of the program. Then it can directly generate a Hex file, and then download it to a microcontroller for the design and physical debugging of the program.

(1) Design of the main function

At the beginning of this function is to first perform the system initialization operation on the MCU and some related peripheral devices of the system we designed, and then we can use it properly. We design the device to initialize and re-assign some variables, and then in the subsequent program operation, the operation of the module, the reading of parameters. In the single-chip computer programming, after the initialization, we need to design a while(1) dead-loop so that the program runs into this dead-loop. If there is no dead-loop design, the program will run out once, and after the design, Add dead-loop programming structure, Will continue to cycle to achieve real-time detection and execution of the purpose of real-time data collection and display. In the design of the main program, it should be noted that it is not appropriate to put too much code in the main function. The code for the operation of specific user functions is generally used in the design of functions, and then in the main function. Call, This also makes it easy to read changes.

(2) Design of LCD 12864 Display Function

When designing the display of LCD12864, we only need to strictly program according to the timing requirements provided to us by the manufacturer to complete the display of the entire system. The 12864 LCD has a serial connection of data and a parallel connection of data. In order to better display the data, we chose a parallel data transmission method, so we need to use 11 IO ports for data transmission. P2 .4, P2 .5, P2 .6 are selected as the control end of the LCD display, and an additional 8 IO are required for data transmission. By writing the code of the five ports instructions, the initialization of the liquid crystal, the reading and writing operation of the liquid crystal, etc. can be achieved. The function definition is shown in Figure 4.2. When designing the LCD12864 LCD display program, we first need to write the corresponding address of the location that needs to be displayed, that is, the position displayed on the LCD, through the command, and then we write the data in the set order to complete the entire design.. After writing the address, the liquid crystal itself will automatically display the first content and the address will be automatically added one, without the need to use a microcontroller for other operations. The function of our designed function name LCD12864 _ play _ string(uchar X, uchar Y, uchar * s), whose parameters are defined as X, Y, * S, where X, Y represents the position coordinates that we want to display on the LCD screen. * S is the array of characters that need to be displayed. Through the program we designed, the software calculates the address based on the location coordinates that the input needs to display.

(3) Design of HMC 5883L Data Acquisition Subfunction

The HMC 5883L we use is communicated through the IIC method, so when we program, we can collect the parameters by referring to the HMC 5883L manual. It is only necessary to combine the HMC5883L internal register field in accordance with the general IIC communication protocol method and standard, and correspond to complete the collection of HMC5883L test data. First, we design a single chip chip to send the initial signal to the sensor; Then send the HMC 5883L device address and related writing signal; The program then sends relevant information for reading the register address of HMC 5883L; Complete the reading of the X, Y, Z axis geomagnetic intensity, high and low eight bits of data, and finally perform a total of six data readings; Send a stop signal to complete the entire operation.

III. SYSTEM DEBUGGING AND TESTING

In order to be able to build a stable design of a digital compass system based on a single chip computer, a series of sub-module debugging is designed before the entire machine test to be able to find out the system's problems. At the same time, this step-by-step debugging method can be used to find out the reasons for the error. Convenient data correction, easy to find loopholes in the program, improve the overall measurement accuracy and stability of the system. The debugging of the sub-module mainly includes the test of the minimum system of the single-chip microcomputer, the LCD LCD 12864 display module, the collection module of the magnetic field, and the collection module of the digital clock.

Debugging of minimal systems. The stability and reliability of the system, the most important thing is to build a stable minimum system. The method used in this system is to verify the stability of the minimum system by writing a program of running water lamp. The minimum system of single chip microcomputer is shown in Figure 1.



Figure 1 Debugging of minimum systems

When the minimum system is debugged, the joint debugging of the magnetic field sensor and the liquid crystal display is performed. The first line of the liquid crystal shows the current angle, and the second line shows a more intuitive azimuth angle. The liquid crystal can correctly display the collected angle information.

Then perform a digital clock display debugging. After the system debugging, the liquid crystal can display the current time information and display it digitally. The first line angle and the second line azimuth angle and the right hand pointer disk azimuth are all three directions. Indicate the way, In order to more intuitively reflect the direction, the time is a 12-hour system, which can be displayed in real time, and the battery can be used to achieve the effect of power outages.

The system has the function of setting the orientation alarm by the user through the key. The user enters the setting interface by pressing the key. At this time, the LCD prompt sets the compass. The user can set the upper limit of the angle and the lower limit of the angle through the key. When the set angle is exceeded, the buzzer will send an alarm signal.

IV. CONCLUSION

The circuit of this design uses a dedicated circuit drawing software, Altium Design, to draw. Recall that he has just come into contact with this software. He knows nothing about it and is now very skilled in the drawing of circuit schemas. use. In the design of the program, the design of the program is based on the current common C language. The design style is also based on the idea of modularization, which facilitates the migration of later programs and related modifications. In this graduation design, the entire design is completed through the design of the circuit and the design of the program.

Through the debugging of the entire machine and repeated modifications, the basic functions that can be achieved are as follows: The system realizes the use of the single-chip microcomputer system as the main control, and the processing of data, the system's peripheral circuit is well constructed and stable. The system can use the physical key method to carry out the user's data related input, very convenient. The magnetic field sensor HCC 5883L is specially used for orientation induction and acquisition, which meets the requirements of design accuracy. It is very convenient to use the very popular liquid crystal LCD12864 for related data display. By using low power consumption single chip microcomputer and using low power consumption circuit design, the system power consumption is very low. The power supply of the system is designed to ensure that the system is feasible.

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