Journal of Computing and Electronic Information Management

ISSN: 2413-1660

The Design of Vehicle Speed Measurement System Based on Single Chip Computer

Zhaoxia Liu
Shanghai Maritime University, China

Abstract: This paper takes ATS89S51 as the core, researches and designs a vehicle speed measurement system. The working principle of the Hall sensor is introduced, and the working process of the measuring system of the Hall sensor is explained. The rotation speed measurement is realized by the pulse counting method, and the rotation speed value of the motor is displayed intuitively through LCD. The main work of the thesis includes the design of the overall scheme of the speed measurement system using Hall sensors, the design of hardware schemes, the basic principles of Hall sensor speed measurement, the design of signal preprocessing circuit modules, reset circuits, clock circuits, LED display circuits, etc. And introduced the basic hardware debugging methods.

Keywords: Speed measurement system, ATS89S51, Hall sensor, LED display.

1. Introduction

China is a large country with a relatively large population,and it is also a country with a large number of bicycles. In today's society, because the pace of people's life is getting faster and faster, all bicycles are no longer a tool-transportation and transportation. In the current society, green, energy saving, and environmental protection are the spirits represented by bicycles. Therefore, various convenient functions of bicycles have become very important to people. Nowadays, society is developing faster and faster, and with it comes people's yearning for the diversified functions of bicycles. Of course, the happiness and health it brings are also very important. Under the background that the pace of life is accelerating, the bicycle speed measurement system as an important auxiliary function of the bicycle is also developing faster and faster. While paying attention to the beauty of the appearance, it is necessary to ensure its scientific rationality. Only such a speed measurement system will not be eliminated by today's society. This speed measurement system can efficiently measure the distance traveled by the bicycle and the current speed. , Remind people to exercise reasonably within the range that the body can bear, and at the same time realize the requirements of healthy exercise and mobility, and finally achieve the ultimate goal of health and happiness.

2. Overall hardware design

The hardware composition is shown in Figure 1. It mainly consists of a sensor module, a signal preprocessing circuit, a signal processing module, and a display circuit. The sensor module uses a Hall sensor, which is responsible for converting the motor's speed into a pulse signal. Signal preprocessing includes signal amplification, waveform transformation, and waveform shaping circuits. The signal processing module is processed by the single-chip microcomputer and the processing result is fed back to the LED display[1].

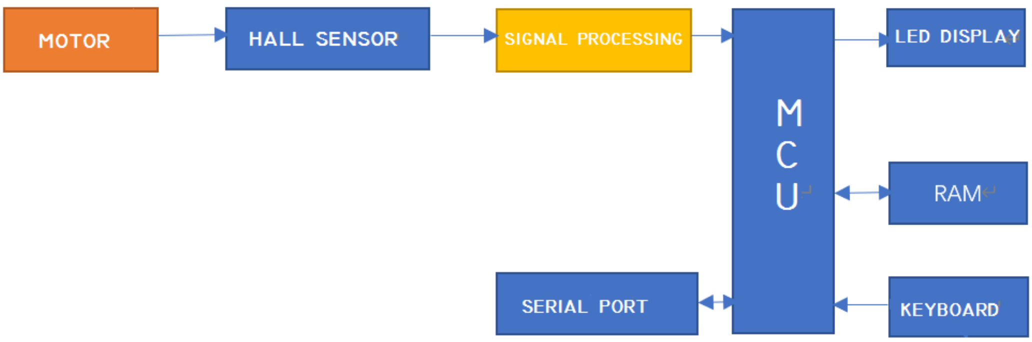

Fig. 1 Overall hardware design

3. Hardware module design

3.1 Hall sensor module

The Hall voltage changes with the strength of the magnetic field. The magnetic field is strong and the voltage is high; the magnetic field is weak and the voltage is weak. In most cases, the Hall voltage is only a few millivolts. It is conceivable that the Hall voltage signal is very weak, but the situation will be different when an integrated circuit amplifier is introduced [2]. The switch for controlling the magnetic flux can be acted by a rotating impeller. When the impeller blades are at the position of the air gap between them, the magnetic field will form a certain distance with the integrated chip, and the Hall voltage will disappear. Using such a working principle, the Hall IC chip can be used as an ignition timing sensor. The internal structure is shown in the figure below:

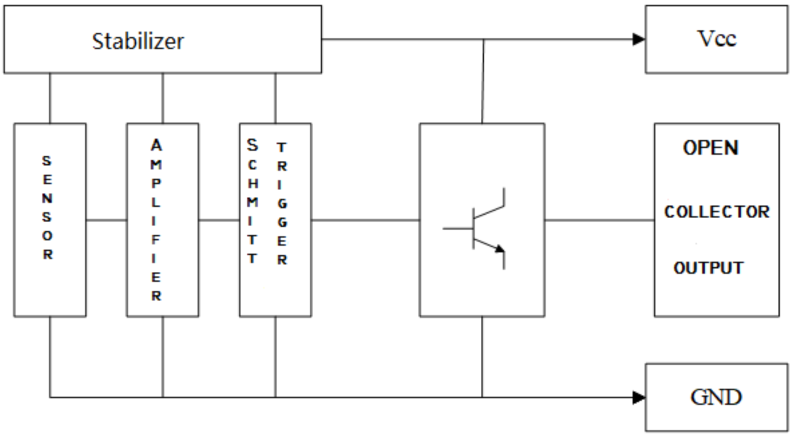

Fig. 2 The internal structure block diagram of the Hall sensor

The external signal is collected by the Hall sensor, and then the collected signal is transmitted to the single-chip microcomputer. The single-chip microcomputer has various functions, and can output mileage display, speed display, alarm part, etc. But this article is mainly about speed display. The overall structural block diagram is shown as in Fig. 3.

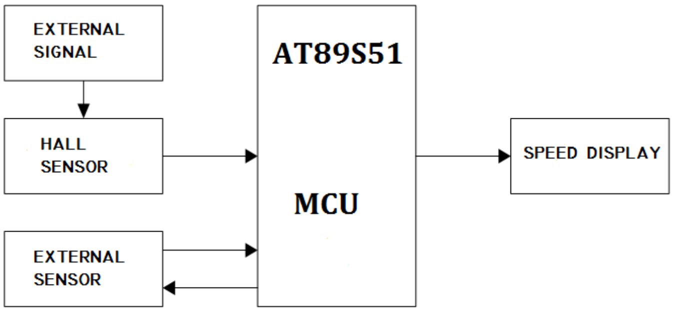

Fig. 3 The principle block diagram of the MCU and Hall sensor system

3.2 Speed measurement principle

There are many methods for measuring speed. The methods to realize speed measurement based on pulse counting mainly include M method (frequency measurement method), T method (period measurement method) and MPT method (frequency period method). The system adopts M method (frequency measurement method). Since the speed is measured by the number of revolutions per unit time, most of the changes are regular repetitive movements. According to the principle of Hall effect, a permanent magnet is fixed to the edge of the turntable on the wheel shaft. The turntable rotates with the side shaft, and the magnet will also rotate synchronously[3]. A Hall device is installed under the turntable. Under the influence of the magnetic field generated by the magnet, the Hall device outputs a pulse signal whose frequency is proportional to the speed. The period of the pulse signal has the following relationship with the wheel speed:

$$n = \frac{60}{PT}$$

Where: n is the wheel speed; P is the number of pulses when the wheel makes one revolution; T is the period of the output square wave signal. According to the formula, the speed of the trolley can be calculated. The Hall device is a kind of thin slice made of semiconductor material. The external magnetic field B is applied in the direction perpendicular to the plane, and the external electric field is applied to the two ends along the plane direction, so that the electrons move in the magnetic field, and the result is on the two sides of the device. A Hall potential is generated between. Its size is proportional to the size of the external magnetic field and current. The Hall switch sensor has been widely used in the field of measuring the rotation speed of rotating objects due to its small size, no contact, good dynamic characteristics, and long service life.

3.3 Signal preprocessing module

The signal preprocessing circuit is shown in Figure 4 below, where Hall sensors b and d are the two ends of the power supply, where b is connected to the negative pole, d is connected to the positive pole, and a and c are output terminals. When the turntable rotates, a pulse signal proportional to the rotational speed is obtained from the output terminal of the Hall sensor, and then the built-in circuit of the sensor amplifies and reshapes the signal.

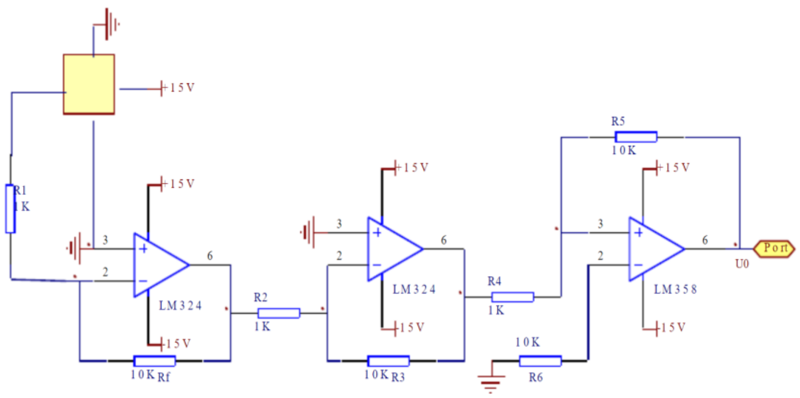

Fig. 4 Signa preprocessing circuit

The LM358 part in the picture is a zero-crossing shaping circuit to make the input alternating signal more accurately transformed into a stable rectangular pulse to facilitate the single-chip counting[4].

3.4 LED Display circuit

Static display and dynamic display are two different display types of LED. Dynamic scanning display is the type of display interface circuit selected in this paper. When we connect the ah end of the eight strokes of all displays to each other, this connection method is the connection form of the dynamic scanning display interface, but I The I/O port independently controls the common COM pole of each display. When the output channel of the field receives the font code signal from the CPU, the font code will be displayed by all the displays. However, we don't know which one of the displays will light up. At this time, COM The end will work.也Which monitor will light up depends on the COM port. At this time, we can choose the time-sharing method. The COM terminals of each display are controlled one by one, so that each display can work in sequence one by one is to make them light up. The lighting state of each display is completed in an instant, that is to say, like a meteor across the starry sky, the time of this appearance is extremely short, maybe only about 1ms, but it is also due to a physiological phenomenon of people-visual temporary The phenomenon of retention and the afterglow effect of light-emitting diodes, so the impression is that a set of very stable display numbers, and no flicker phenomenon. But in fact, each display is not lit at the same time, but as long as the scanning rate is artificially large, the process of lighting and scanning will show people a set of clear digital information.

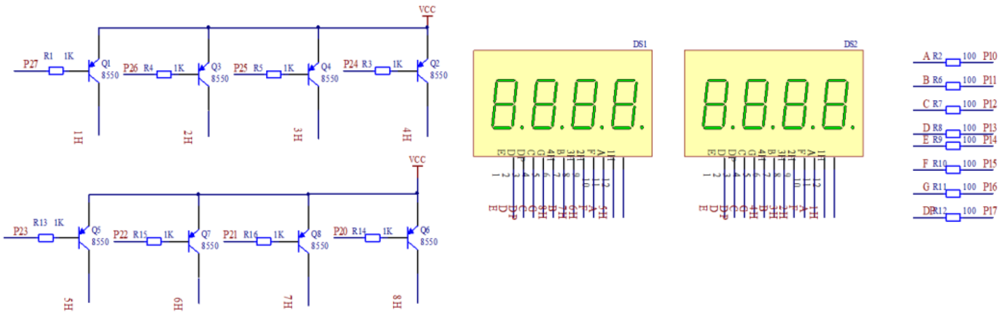

Fig. 5 Digital tube display circuit

3.5 Button circuit design

The key circuit mainly includes K0 reset, K1 display timing time, K2 display count pulse number. As shown in Figure 6 on the lower right, the button is active at low level. When no button is pressed, the four pins of the microcontroller are all at high level. You can know whether the button is pressed by reading the level of the corresponding pin status.

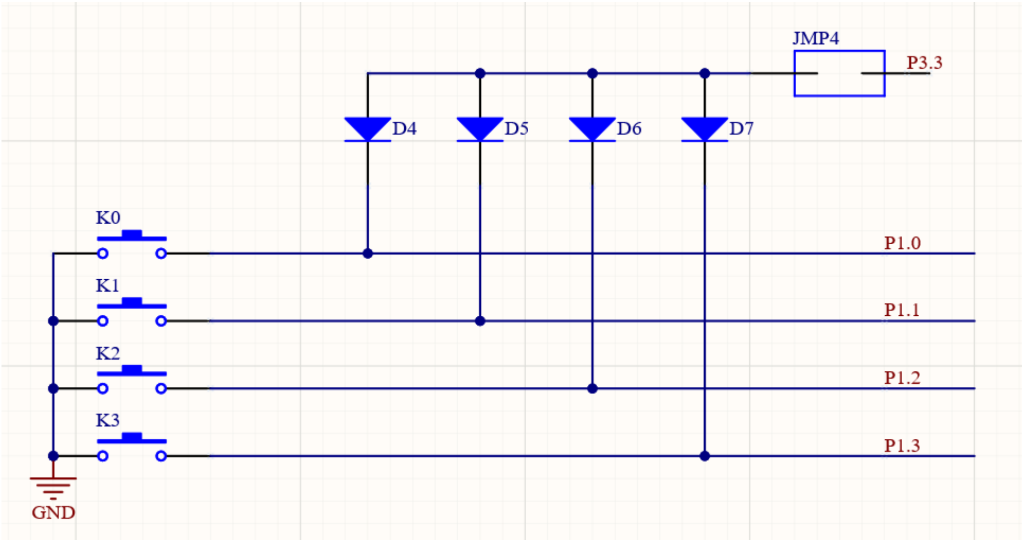

Fig. 6 Button circuit

The key circuit can be set in the software to prevent the key from jitter and false trigger function. Timer 1 is set in the software to interrupt once 50ms, and the key is scanned for each interrupt. If the key is pressed, it will be delayed by 10ms. Perform key scan again, if there are still keys pressed, the key is true.

3.6 Clock circuit

The clock can be compared to the heart of a single-chip microcomputer, just like the human heart, beating all the time and beating for the survival of human beings, providing continuous energy for human activities. The clock frequency will affect the operation of the microcontroller, and the microcontroller also takes the clock frequency as an indicator. Therefore, the speed of the microcontroller is related to the frequency of the clock. There is an oscillator inside the AT89S51 single-chip microcomputer. This oscillator is composed of an inverting amplifier, and the clock is generated by it. The internal clock mode and the external clock mode are the two most commonly used modes for clock circuits. In this design, the internal clock method is adopted.

The high gain amplifier, which is used to form an important part of the oscillator, exists in the internal structure of the microcontroller. The chip pin XTAL1 is the input terminal of the high gain inverting amplifier, and XTAL2 is the output terminal of the high gain inverting amplifier. The two pins XTAL1 and XTAL2, the quartz crystal oscillator and the capacitor are connected to each other, which are the parts of the self-excited oscillator. The circuit diagram of the internal clock mode of the one-chip computer is shown as in Fig. 6[5].

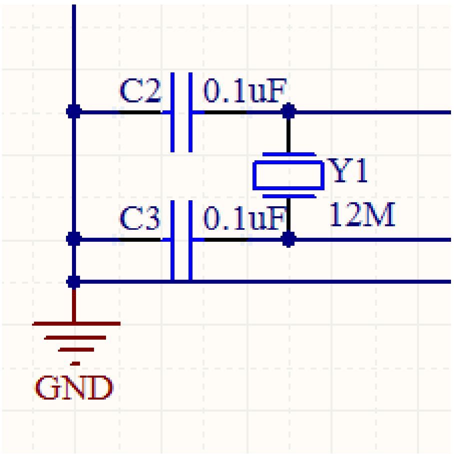

Fig. 6 Oscillation circuit inside the microcontroller

As shown in the figure, in this circuit, capacitors C1 and C2 are usually set to about 30P. Although the requirements for the value of the external capacitor are not particularly strict, the height and stability of the oscillator and the stability and sensitivity during start-up often depend on the value of the capacitor. However, the operating frequency range of the single-chip microcomputer often affects the value of the oscillation frequency of the external crystal. No matter which type of single-chip microcomputer, they have their own upper limit operating frequency. The crystal oscillation frequency of the external interface is required to be less than the upper limit of the single-chip microcomputer. Frequency. And if the microcontroller has serial communication, a crystal whose oscillation frequency/serial communication frequency can be divided should be used. In this design, the crystal oscillator is 12MHz, and the counting period is.

$$T = \frac{1}{(12 \times 10^6)Hz \times {}^{1}/_{12}} = 1\mu$$

4. Circuit test

4.1 Overall hardware troubleshooting

Through matlab simulation, the principle error is eliminated, and the completed board is carefully checked in the corresponding place to see if there is a short circuit, false welding, missing welding, etc. After turning on the power, measure whether the output of the power port and charging port meets expectations. After power-on, check whether each power chip generates heat. If it generates heat, immediately disconnect the input power for inspection.

4.2 Program test after burning

After burning the program, first start the board, check whether the functions of each module of the board are normal, observe whether the corresponding LED display screen is on, and check whether each button is valid. Use the device prepared in advance to check whether the speed measurement of the board is accurate[6].

5. Conclusion

In this paper, a hardware circuit board based on a single-chip microcomputer to realize the speed detection is designed, and a Hall sensor is used to realize the detection of the speed, and the signal can be stably amplified and shaped through the preprocessing circuit, so that the single-chip computer can accurately count. The result is displayed by LED. The hardware circuit board can be well applied to the determination of the rotation speed, has good reliability and stability, and meets the system requirements.

Acknowledgements

This paper was financially supported by Liu Zhaoxia.

References

[1] Li Quanli.Principle and Application Technology of Single Chip Microcomputer [M].Beijing: Higher Education Press,2004.
[2] Lou Ranmiao, Li Guangfei.51 series MCU design examples [M].Beijing University of Aeronautics and Astronautics Press，2006.
[3] Xu Chen, Chen Jihong and others.Principle and Application of Microcomputer [M].Beijing: Higher Education Press, 2004.
[4] Wang Furui.Design of single-chip microcomputer measurement and control system[M].Beijing University of Aeronautics and Astronautics Press,1999.
[5] Ma Xitai. Automatic detection technology [M]. Machinery Industry Press,2001.
[6] V.Yu.Teplov,A.VAnisimov.Thermostatting System Using a Single-Chip Microcomputer and Thermoelectric Modules Based on the Peltier Effect[J],2002.
[7] Yeager Brent.How to troubleshoot your electronic scale [J].Powder and Bulk Engineering.1995.