Design of vehicle management reader based on STM32

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Abstract. This paper mainly studies the parking lot counting system, which is a modern and new system integrating detection and conversion technology, computer technology, information processing, digital technology and other technologies. This work uses STM32F103 single-chip microcomputer as the MCU processor, and uses 2 infrared modules to detect vehicle access. Through the single-chip microcomputer, information is collected to detect vehicle access. LCD12864 is used to display vehicle parking information for drivers to watch.

1. Introduction and literature review

As a result of the rapid development of computer technology and electronic technology, the performance of the single-chip microcomputer is constantly improved, more and more considerable cost performance, at the same time, the technology is becoming more and more perfect. Single-chip microcomputer has the characteristics of small size, light weight, simple structure, low price, high reliability, fast operation speed and strong control ability. It can be widely used in military, household appliances and national economic construction. Data acquisition and control algorithm are realized by using single chip microcomputer and additional electronic components to complete vehicle management. Therefore, it is necessary to understand the system design process of single chip microcomputer, as well as the actual production and debugging ability of circuit boards. At the same time, students' ability to design and grasp the overall circuit is also tested [1]. Among them also strengthened to the digital circuit, the single-chip microcomputer and the microcomputer principle curriculum knowledge practical application ability, for the further development of similar products to lay a theoretical and practical foundation.

2. System scheme design

2.1. Design tasks and requirements

This design in the overall design framework, chose the 32-bit microprocessor chip as the main control chip, and for the system performance requirements of the hardware circuit design, including the RFID module circuit, data display circuit, buzzer circuit, power circuit, USB to TTL circuit, communication circuit and so on. STM32 microcontroller processes the IC card information read and written by the RFID module, and displays the temperature and humidity value through the liquid crystal display LCD12864 with Chinese character base. Finally, it realizes the remote real-time display through serial communication. The system can also carry out balance inquiry and payment functions.
This design combines sensor technology, automatic control technology and communication technology to design a high-performance vehicle management system, aiming to achieve efficient vehicle management and recharge, to provide people with a more convenient and efficient way of operation [2].

The system design scheme is based on the control device and the acquisition device through the STM32 microcontroller as the control core of the system program design. The design contents included in the system include the driver programming of RC522 RF chip, vehicle management billing and recharge, vehicle access information collection, and vehicle access and billing control functions [3]. As show in Figure 1, it is the system design scheme.

![System design scheme](image)

**Figure 1.** System design scheme.

2.2. Introduction to STM32 microcontroller

STM32F103C8T6 is the central processing unit (CPU) at the core. The CPU will compare the collected rf data with the billing information to realize the deduction. After the deduction is successful, the vehicle management system will count the number of vehicles and display it on the LCD12864 screen. STM32F103C8T6, as the central processing unit (CPU) of the core, independently implements a recharge function. When the balance of the IC card is insufficient, we need to recharge the card first when the next deduction is made, and the data will be displayed on the LCD12864 and PC terminals at the same time.

SCM is not a single logic chip, it is the use of large integrated circuit technology will be integrated with a variety of functional chips, forming a complete computer system, in essence, a microcomputer [4]. Single chip microcomputer has a wealth of extended functions, which is very convenient for beginners to learn computer knowledge, and there are a lot of applications in the industry, can complete a lot of automation functions, to improve productivity plays a great role. A complete single-chip system consists of a Central Processing Unit (CPU), timing/counters, Random Access Memory (RAM), and Read-Only Memory (ROM). The STM32 series is a cost-effective embedded application with a specially designed ARM cortex-m3 kernel with a main frequency of 72 MHZ, convenient for future functional expansion, and operating voltage of 3.3 volts. STM32 MCU processor provides clock pulse of 8 MHZ frequency as crystal oscillator circuit. In order to ensure that the circuit can provide continuous and stable frequency pulse, two 10PF capacitors are connected in series. PLL is set as 9, and the working frequency of the MCU is 72MHZ. As show in Figure 2, single-chip microcomputer minimum system.

The minimum system of a single chip microcomputer refers to a single chip microcomputer composed of a minimum of components and can work normally. The minimum system module is composed of single chip microcomputer, reset part, power circuit, clock and other components, which can keep the single chip microcomputer in the normal running state.
Figure 2. Single-chip microcomputer minimum system.

Reset circuit is a kind of circuit equipment to restore the circuit to the original state. When the RST pin of STM32103C8T6 chip flows into the high level and maintains two machine cycles, the internal reset operation will be run. If the pin is always in the high level, the MCU will be in the cyclic reset state. The reset part of the circuit is used to determine the initial state of the microcontroller when the microcontroller begins to work. After the reset signal power supply appears in the MCU, the working conditions of the MCU chip microcontroller are determined to determine the initial state. When the operation of the MCU system is out of control due to external environment interference, the reset button in the program will be automatically restarted. The reset circuit is an essential part of the infrared remote control code lock. When the code lock is locked, press the reset key to restart the program. The existence of the reset key greatly improves the security and confidentiality of the code lock. As show in Figure 3, reset circuit.
The function of crystal oscillator is mainly to provide a basic clock signal for the system. Generally, a crystal oscillator is shared by a system, which is convenient for maintaining synchronization of all parts. In some communication systems, different crystal oscillators are used for rf and fundamental frequency. Crystal oscillator is usually used in conjunction with the PLL circuit. If different subsystems require different clock frequencies, different PLL connected to the same crystal oscillator can be used to provide [5]. As show in Figure 4, internal clock circuit.

This design uses the electromagnetic buzzer, buzzer is the audio signal into sound signal pronunciation components, using a integrated circuit, stable performance, long service life, sound and high temperature resistance wave soldering, using DC voltage power supply. As show in Figure 5, buzzer circuit.
LCD display function rich, count, Chinese characters, graphics and other complex information can also be displayed [6]. Information rich and easy to read, easy to use, without complex control circuit, programmable. When connected with the MCU, the display effect can be directly controlled by the MCU, so this design uses the LCD12864 display. As shown in Figure 6, LCD module circuit.

2.3. USB to TTL circuit design
The computer USB terminal is USB level, the signal of the single chip microcomputer is TTL level, the level of the two different is unable to communicate, need to achieve mutual communication through conversion. CH340C USB to TTL module is the realization of USB level and TTL level conversion module [7]. When debugging the single-chip microcomputer program, want to know the execution of the program or related information, the general simple way is to use the serial port to send the information to the computer, the computer received by the host computer (serial debugging assistant) display. But the microcontroller serial port sends the signal is TTL level, the computer can receive the signal is USB level, the two can’t communicate directly. USB to TTL module can convert the TTL signal sent by the serial port into USB signal and send it to the computer, the computer can receive the signal sent by the single-chip microcomputer and display it on the upper computer (serial debugging assistant). As shown in Figure 7, USB to TTL circuit design.

3. System software design and testing
The software part is the key part of the control system. On the one hand, the overall design of the software can give full play to the powerful advantages of CPU (central processing unit) in data processing; On the other hand, it can complete the system function more comprehensively and improve the reliability and stability of the system. The Software part of the control system is based on the Keil

![Figure 6. LCD module circuit.](image)

![Figure 7. USB to TTL circuit design.](image)
C32 platform developed by Keil Software. The external 8MHz crystal pulsation used by the system is the external clock source, which makes the PLL multiplier inside STM32 reach 72MHz. The two peripheral clock buses of STM32 are APB1 and APB2 respectively, and the highest clock frequency is 36MHz and 72MHz respectively. The entire initialization step is as follows: the first step is to set the software peripheral clock to the highest frequency and turn on the clock source for ADC, timer, DMA, serial port, and GPIO. The function of the timer is to produce PWM signal to control the motor. Set the frequency of PWM signal in the program to 20kHz and 3600 duty cycle output. The interval timer generates 8kHz signals for ADC and Kalman sampling frequencies. The interval timer is a 24-bit decrementing timer with only three registers and only one statement to complete the configuration of the firmware library [8].

After completing the software and hardware design of the vehicle management system design system, in order to ensure the normal work of the system, it is necessary to carry out tests to verify whether the software and hardware functions are normal. After completing the software and hardware design of the system, check and test the power on the system. As show in Figure 8, it is the principle prototype. All communication is normal, and all functions of system design are realized.

![System physical drawing](image.png)

**Figure 8.** System physical drawing.

4. Conclusion
The research work of this topic has basically reached the expected requirements, with low design cost and controllable function modularization. This design is based on modular design, which not only reduces the difficulty of development, but also improves the reliability and accuracy of the system. Passed the final hardware and software simulation debugging.
Acknowledgments
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