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Research on Software Programming of Intelligent DC Motor

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***Abstract*—With the continuous progress of intelligent technology, the intelligent control level of DC motor will be required to be higher and higher. Therefore, this research will take the software design of DC motor as the research object. Through the software programming design of the intelligent control system of DC motor, under the support of the hardware circuit of the system, the forward, stop, reverse and speed control of DC motor will be realized. which has the characteristics of simple circuit, space saving and low cost. It will be widely used in artificial intelligence.**

Keywords—Intelligent motor; Software programming; Research

I. INTRODUCTION

At present, with the continuous development of integrated circuit design and manufacturing technology, the function of the circuit system is more and more powerful, and the system composition is more and more simple. However, the hardware design of the system is perfect. Without the support of software, the system cannot be intelligent. The design of Intelligent DC motor control system is also the same. It consists of two parts: hardware circuit and software programming. In order to make the motor run intelligently, scientific and reasonable software programming is very important. Therefore, the software programming of Intelligent DC motor control system is discussed in this study [1].

II. DESIGN REQUIREMENTS AND SCHEME

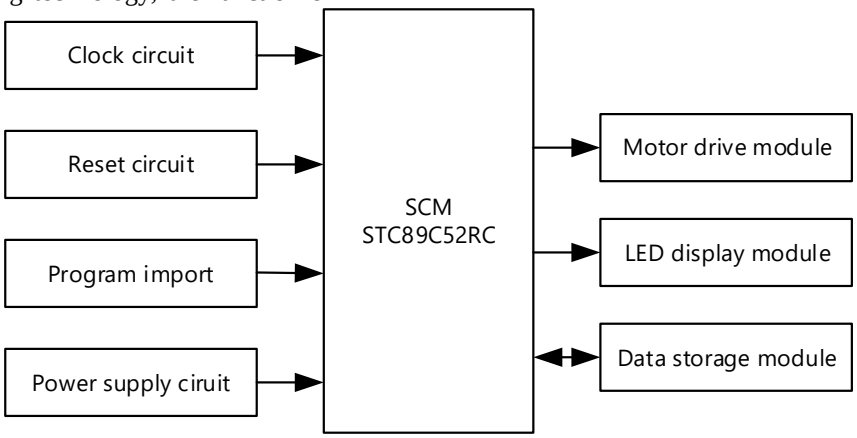

Fig. 1 Hardware design block diagram

A. Design Requirements

This research takes STC89C52 as the core, designs a digital and intelligent DC motor speed control system through motor drive module, data storage module, LCD1602 LCD display, key control, power module. The design requirements are as follows: 1. Realize the real-time storage and reading of data storage module. (2) Real-time adjustment and display of PWM values. (3). Realize the forward and reverse of LED display motor. (4) Implement keyboard input and speed adjustment[2].

B. Design Block Diagram

Based on the design requirements, the hardware control circuit of DC motor is designed by STC89C52RC, as shown in Figure 1, which includes motor drive module, key module, display module, LED module, data storage module and so on.

III. ARCHITECTURE OF SOFTWARE DESIGN

As shown in Figure 2 is the architecture diagram of the Intelligent Motor software control system, the main program in Figure 2 is the starting point of program execution, which mainly completes the initialization of each component of the DC motor control system and realizes the call of each function subroutine, and completes the coordination work of each function module in the actual measurement when there is no external interruption request. The subroutine in Figure 2 is a part of the code in a large program that consists of one or more statements. It is responsible for the completion of a particular term of service, with relative independence. It can be called by another program, but the last instruction must be to return the instruction and guarantee it to return to the main program that called it[3].

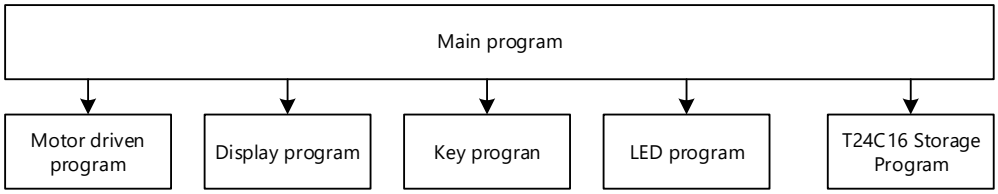

Fig. 2 Program Architecture

IV. PROGRAM DESIGN

A. Main Program Flowchart

In the design process of the program, the key input value is stored in AT24C16 through the IIC communication protocol. The value of the AT24C16 is read through the MCU, and it is displayed directly on the LCD1602. The input value controls the PWM waveform output by the single chip microcomputer, and the PWM waveform signal is sent to the H bridge to drive the electric circuit to drive the motor running[4]. When initialization, a default duty ratio is set. When the acceleration or deceleration keys are pressed, the duty ratio of the PWM signal will increase or decrease by twenty percent, and the change process and the final result of the increase and decrease on the LCD1602 will be displayed. When the duty ratio of the modulated pulse is equal to 0, the motor will stop rotating. The flowchart of the specific design is shown in Figure 3.

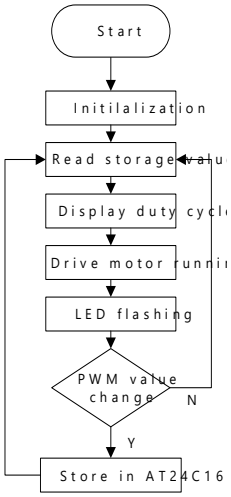

Fig. 3 Main block diagram

B. Key Program Flow Chart

In the key operation, the MCU first judges the state of the keys. If the keys are pressed, the system eliminates the interference signal generated by the keys. The purpose is to avoid the influence of the interference signal on the circuit. Then the MCU judges the state of the keys for the second time. If the keys are not pressed, the variable value sent to the MCU is the last input of the keys. The flow chart of the program design is shown in Figure 4[5].

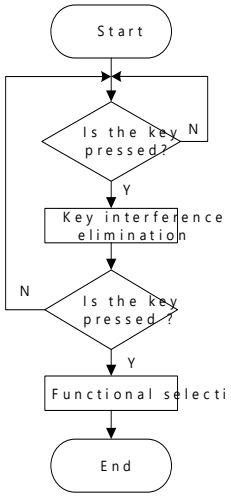

Fig. 4 Block diagram of key program design

C. LCD Display Module Program Flowchart

When LCD displays the state of DC motor, it first judges the address of busy mark BF. When BF = 1, it means that LCD is busy. LCD can not receive instructions from MCU. When BF = 0, it means that LCD can receive instructions from MCU. And LCD can display instructions or data sent by MCU. The instructions sent by MCU can be divided into read data and write instructions. LCD sets the read/write status of LCD according to the status of RS and RW terminals[6]. When the read/write status of LCD is set up, the instructions sent by MCU can be displayed in LCD under initialization conditions.

It should be noted that only characters can be displayed on the LCD, so the decimal number in the program needs to be converted to characters, the LCD can be displayed, the specific way is to add a 0x30 to the number of the program, but when the LCD in the writing character state, it can only write a decimal number to the LCD, if the decimal number number more than one bit , you need to remove the number one by one, then convert it to a character, and then write it to the LCD before it can be displayed properly. Its program flowchart is shown in Figure 5[7].

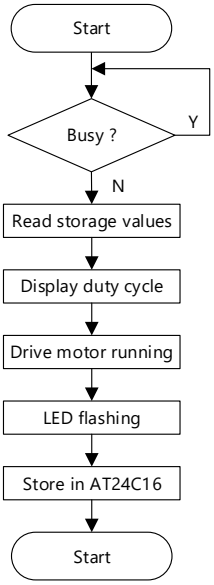

Fig. 5 LCD display flow chart

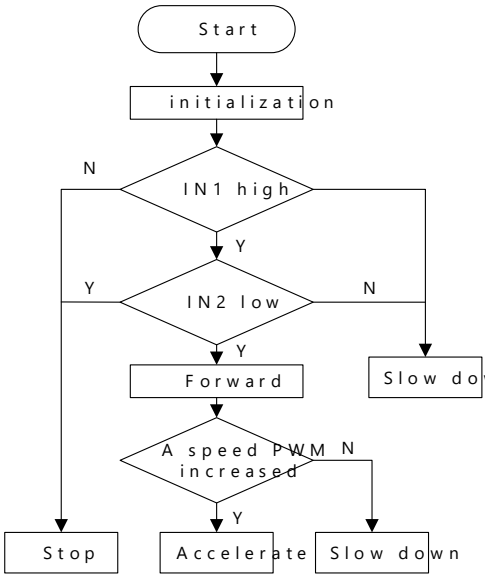

Fig. 6 Design flow chart of motor driver

D. Design of Motor Driver

From the analysis of the hardware circuit diagram, it is known that to drive the motor, signal must be input to the two pins of IN1 and IN2 for driving the L298N chip, and one pin will be placed high and the other pin will be low. When the two pins are all low, the motor will stop rotating. The output voltage level of the two pins of the L298N chip IN1 and IN2 is controlled by the PWM signal sent by the single chip microcomputer. When the duty cycle of PWM signal sent by SCM increases, the speed of the motor will speed up, otherwise it will slow down. The program diagram is shown in Figure 6.

E. Design of LED Flashing Program

In this design, two different colors of LED lights are used to distinguish the positive and negative rotation of the motor. One of the pins of the LED is grounded, and the other is connected to the MCU. Because the output current of the MCU is very small, there is no need to worry about the damage of the LED lamp. This design not only makes the circuit simple, but also greatly reduces the cost. When the function button is pressed, the LED1 goes out and the LED2 starts to blink. Press the function button again, the LED1 flickers, and the LED2 goes out. The program diagram is shown in Figure 7[8].

F. Design of AT24C16 Storage Program

In the design of the circuit system, AT24C16 is used as the chip of the storage program, while AT24C16 adopts the IIC communication protocol. The key input value is stored through a single page in AT24C16, and its design flow is shown in Figure 8.

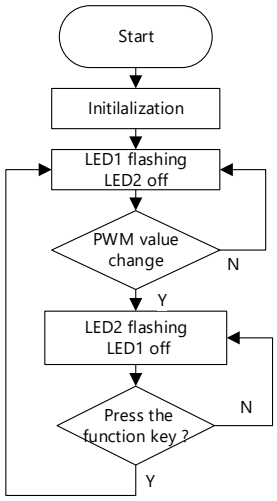

Fig. 7 LCD display flow chart

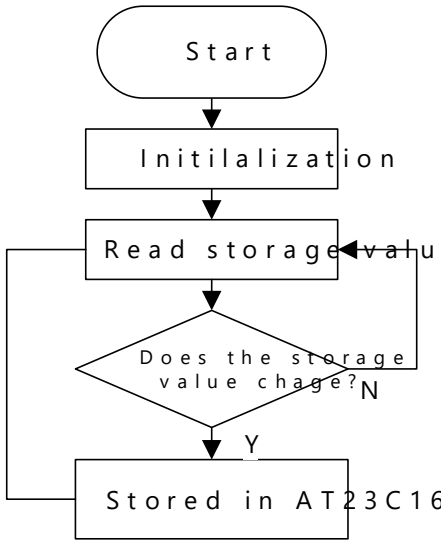

Fig. 8 Storage flowchart

V. Circuit Simulation

The LCD display module, L298N driver module, key input module, AT24C16 storage module and minimal system of single chip computer are cascaded. Keil μVision 4 is used to build the programming environment, the program is generated. Hex file, and the. Hex file is downloaded to the MCU for Proteus simulation. The conclusions drawn from the simulation are as follows: (1) When the motor turns forward and backward, LED 1 and LED 2 produce corresponding flicker phenomenon. (2) When the acceleration button is pressed, the value of PWM will increase by 20% gradient, up to 99%. When the minus button is pressed, the PWM value decreases by 20% gradient, the minimum value is 0%. At the same time, the LED does not flicker[9]. (4) When the mode button is pressed, the direction of the DC motor will change. The simulation results are shown in Fig. 9.

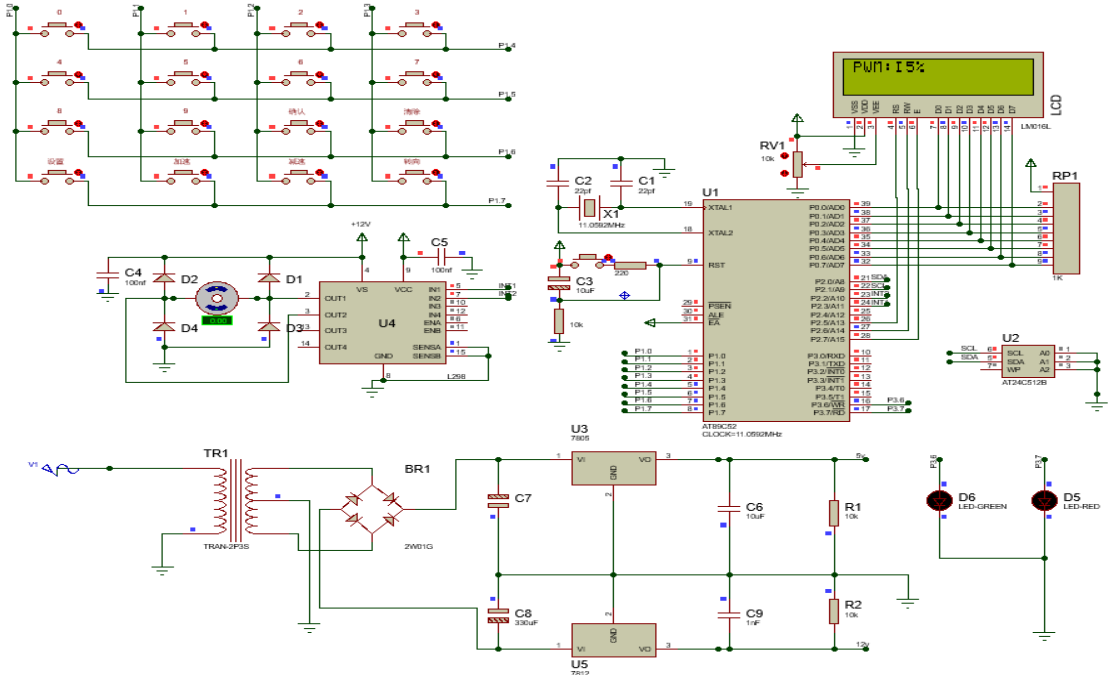

Fig. 9 Simulation diagram of DC motor speed control system

VI. Conclusion

After the design of hardware control circuit for intelligent DC motor, supported by software program, the system realizes the functions of DC motor's forward, reverse, acceleration, deceleration and LCD display through Proteus simulation, and uses IIC communication protocol to ensure AT24C16 to realize power-down protection storage function.

The follow-up work of this research is to expand the function of DC motor control system. An infrared communication module can be designed according to the demand. The remote control of DC motor is carried out by infrared remote controller, in order to make the system more "intelligent".

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