Design and Research of Motor Control System for New Energy Vehicle

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ABSTRACT :*In order to further optimize the power distribution of new energy vehicles, a motor control system is designed. According to the working principle of the motor, the overall design of the system is completed, and the hardware design of the controller, power supply module, signal acquisition module and power drive module is carried out. The system has reliable function, strong anti-interference ability, good application effect, and has a positive role in promoting energy saving and consumption reduction.*

KEYWORDS -*motor; control system; module; single chip microcomputer*

I. INTRODUCTION

Energy-saving and environmental protection is the strategic ideas of new energy development and the basic requirements of sustainable development. In recent years, with the strong support of the state, new energy vehicles have developed by leaps and bounds. According to statistics, in recent years, sales of new energy vehicles have increased at a rate of more than 20% annually. At present, the new energy automobile technology has entered the industrialization stage from the experimental stage, which has played a significant role in promoting the development and application of green energy in the country, but the biggest problem in the development of new energy automobile is battery technology. Under the existing battery technology conditions, the design of an effective motor control system has a good effect on the energy saving of new energy vehicles. By optimizing the design of motor control system, not only the vehicle's endurance under specific electric energy conditions can be improved, but also the battery and motor life can be improved.

II. SYSTEM CONTROL PRINCIPLE AND OVERALL DESIGN

2.1 Control principle of motor

When the motor works, the driving performance is controlled by driving requirement and vehicle condition. By adjusting the parameters of torque, speed and so on, the switching of different working modes of motors can be realized. For general new energy vehicles, permanent magnet synchronous motor (PMSM) is chosen as the driving motor. Its main working modes include pure electric mode, hybrid mode, charging mode and regenerative braking mode. How to distribute and manage electric energy reasonably according to the working state of power supply is the key of motor control system.

Permanent magnet synchronous motor (PMSM) is the main driving motor. Its key components include rotor core, shaft and permanent magnet. For this type of motor, permanent magnet material is positioned on the rotor core by attachment. This design method has been widely used because of its simple structure, easy magnetization and low cost. The driving torque of the motor mainly comes from the interaction between the current in the stator winding coil and the permanent magnet core magnetic field. When the rotor is in a static state, there will be a DC magnetic field in the axial direction. At this time, a DC magnetic field can also be generated in the stator winding according to the corresponding current control. The rotating moment will be generated during the continuous DC magnetic field. Because the stator is fixed, the rotor itself has a rotating tendency. In the motor control system, the pedal displacements signal will be converted into speed or torque control signal. In order to achieve energy-saving effect, the energy feedback module is used to distribute the torque and braking moment intelligently. During the whole process, reference should be made to vehicle

driving conditions, battery energy status and so on, so as to reduce power consumption without affecting normal driving conditions.

2.2. System overall design

For new energy vehicles, the design of controller is very critical, requiring strong controllability, stability and anti-interference ability [2]. For this reason, PIC16F72 series microprocessors are selected in this paper. This microprocessor is a typical 8-bit controller with remarkable security performance and working voltage ranging from 9 to 16V. Because of the different working conditions of the vehicle, in order to improve the adaptability of the vehicle to harsh environment, the working temperature range of the system is set to - 40 ~90 ~C. After the power supply system is closed, the leakage current of the whole controller does not exceed 1 mA. In addition, the system uses double-deck circuit board style, with waterproof performance, security protection level over IP65. The signal transmission function of the system is realized based on CAN bus. The power supply module in the control system can provide 5V and 12V voltage. The sensor can receive analog signals such as pressure and temperature in real time. When the signal is abnormal, it can be warned according to the actual situation.

In order to ensure the high efficiency of the system, the controller directly identifies the switching signal and determines the nature of the instruction according to the 16-channel signal. The system can input and output PWM signals efficiently, and has the characteristics of low power consumption. According to the working principle and design requirements of the motor, the control system can be modularized, including core processor module, signal acquisition module, power drive module, power supply module, etc. Each sub-module can work together to identify the signal and control the motor intelligently.

III. SYSTEM KEY HARDWARE DESIGN

3.1. Controller design

The CPU used in the core processor module of the system is a single chip computer. The model is PIC16F72 series. Its wiring diagram is shown in Fig.1. Under the control of the MCU, the related control algorithm and operation strategy can be effectively implemented. At the same time, the MCU has good performance and strong anti-interference ability. As the carrier of the control system, it has good application effect in vehicle control.

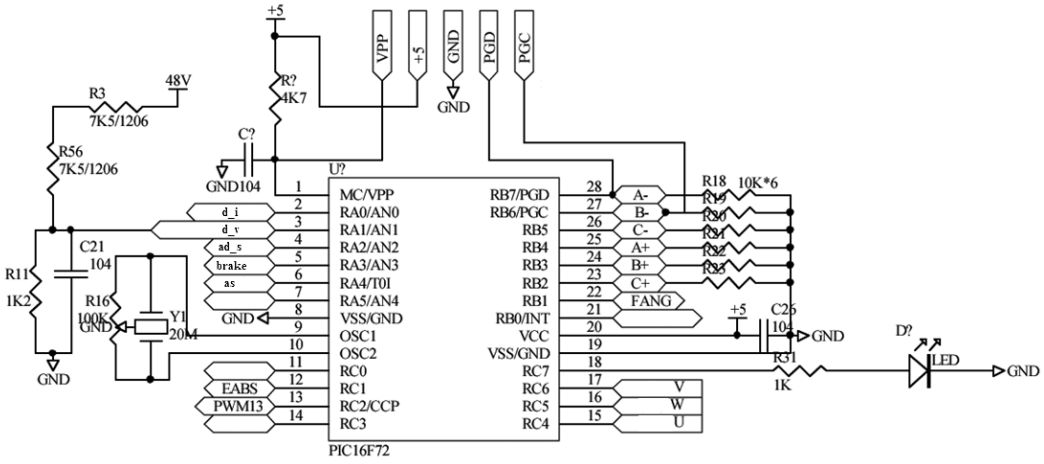

Fig.1 Wiring diagram of single chip computer

3.2. Design of power supply module

The power supply module in the motor control system is an independent unit and also a very important sub-module. The stability of the power supply module directly determines the adaptability of the control system to the environment, especially the performance under strong electrical shock conditions. The wiring diagram of the power supply module in the system is shown in Fig. 2. Under the control of the power supply module, its performance indexes are as follows: providing 9V-16V steady-voltage DC current; having back-voltage protection and power-off protection functions; realizing real-time monitoring of charge and discharge; and having temperature sensing performance. For the sensor of power supply module, TLE4250G series is selected in the system, which can realize good protection for

circuit breaking and short circuit. In the sensor, pin 3 is the input end and pin 1 is the proofreading end. Even if the input voltage fluctuates significantly, the output voltage can remain stable.

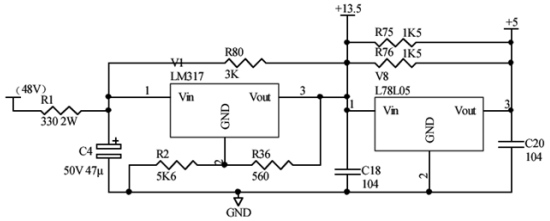

Fig.2 Connection diagram of power supply module

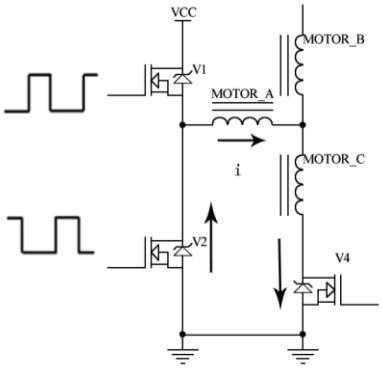

Fig.3 Synchronized continuation of acquisition module

3.3. Signal acquisition module

Signal acquisition module is the key to determine the input/output of the system. Its main interfaces include analog signal terminal, digital signal terminal and PWM signal terminal. The synchronous continuation of the acquisition module is shown in Figure 3. Signal acquisition module is at the bottom of the whole system. Without good signal acquisition capability, ideal control effect cannot be achieved. In addition, the signal acquisition module has the function of protection and diagnosis.

3.3 Power Driver Module

For the whole system, the main power-driven devices include relays, controller lights, etc. They have the basic functions of over-voltage and over-current protection and over-temperature monitoring. In order to simplify the system, the power drive wiring is designed as shown in Figure 4, which can not only ensure the stability of the whole motor control system, but also cooperate with other modules to run better.

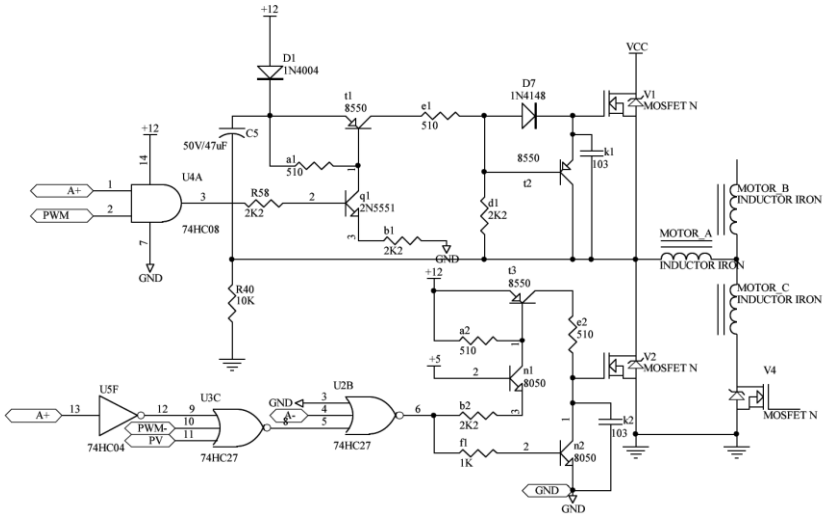

Fig.4Power Drive connection diagram

IV. KEY HARDWARE CONTROL INDICATORS

4.1. Controller function

It is very challenging to realize the control process of high-torque motor with high efficiency and low cost. MB91580 Series realizes system cost reduction, high speed feedback control by integrating key peripheral functions, and achieves the goal of improving motor operation and low energy consumption. The main features of MB91580 integration include: 12-bit A/D converter and R/D converter with high accuracy to detect current and motor position, R/D converter to detect electrical angle and synchronize with A/D converter to detect three-phase current; integrated special computing circuit, so that the sinusoidal and cosine values of electric angle detected by built-in R/D converter can be calculated automatically.

High performance motor control systems usually include core servo functions, motion

description and host communication functions, which require high processing capacity of processors. MB91580 series built-in high-performance CPU core, special floating-point operation unit integrated in 160DMIPS high-performance CPU, utilizes information processing vector conversion and PID control operation generated by built-in peripheral functions. This feature can improve motor operation and reduce energy consumption by further fast feedback control. Motor control is closely related not only to vehicle performance but also to driving safety. In the design of MCU for motor control, the security characteristics are fully considered, and six security mechanisms are adopted to ensure the safety and reliability of the system operation, including self-diagnosis of MCU, bus self-diagnosis, RAM self-diagnosis before system start-up; protection of illegal output port when program runs illegally; bus diagnosis, RAM error correction and flash memory error correction during system operation.

4.2. Display processing technology

Good display technology can make motor control more convenient. MB86R11 adopts a unique video processing algorithm. The images captured by four cameras are captured by video chip and plotted in 3D. What is presented to the driver is the panoramic image clearly displayed on the LCD, which achieves the visual effect of being in the scene, and enables the driver to accurately judge the surrounding driving conditions under the conditions of parking, driving and turning. Because the chip itself integrates high-performance graphics processing, central processing unit and memory controller, and realizes real-time four-way video information processing by hardware, it avoids the performance bottleneck of general video processing chips in processing large amounts of real-time video information.

V. CONCLUSION

The new energy vehicle motor control system designed in this paper can effectively improve the working efficiency of the drive system, and optimize the allocation of energy use through the relevant command control, which is of great significance for energy saving and consumption reduction. The whole system has high strength and anti-interference ability. Through the design of the system, the design requirements are fully realized.

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