Research on Communication Design of Electronic Control System of New Energy Vehicle Based on Cloud Platform

Yanjie Zhao, Jiang Ye

City College of Huizhou, Huizhou, 516025, China

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Abstract: In order to ensure the safety of new energy vehicles, wireless communication and network facilities should be added to the old electronic control system of new energy vehicles based on cloud platform, so that vehicles can be controlled at any time, and vehicle faults can be analyzed and calibrated remotely, thus improving driving safety. Based on the cloud platform, this paper briefly introduces the SAEJ1939 communication protocol standard, and implements the SAEJ1939 communication protocol in the form of protocol stack. The protocol stack includes hardware abstraction layer, data link layer, transport layer, network management layer, application layer and diagnosis. Among them, the hardware abstraction layer directly calls the CAN module driver of the hardware system, which facilitates the transplantation of SAEJ939 communication protocol stack in different hardware systems. In this way, we can fully understand the actual situation of the vehicle.

1. Introduction

With the rapid development of modern industrial technology, new energy vehicles are becoming increasingly intelligent, networked and automated. It also integrates advanced modern technologies such as machinery, computers and electronics. Moreover, new energy vehicles need to obtain various status information and control information of the vehicle body, so the number of sensors and electronic control units on vehicles is increasing [1]. As one of the most widely used and hottest bus technologies, CAN bus network has been widely used in distributed control systems, modern industrial control systems, automobile communication networks and other control fields.

In order to ensure the safe and efficient operation of new energy vehicles, the electronic control system of new energy vehicles based on cloud platform adds wireless communication and Internet service functions to the traditional electronic control system, so as to realize many functions such as real-time monitoring of vehicles, fault diagnosis and analysis, parameter optimization, remote calibration and so on.

2. Electronic control system technology of new energy vehicles

2.1. Battery management system

The battery management system is the key to solve the battery consistency, which is an important link between the vehicle power battery and the electric vehicle, and forms a battery system together with the automobile power battery pack to provide power for the automobile. Its working principle is to coordinate each battery cell, and monitor the sensor signals of battery voltage, current and temperature, so as to prevent overcharge and discharge, overtemperature and overpressure from harming the battery [2].

The vehicle battery under the battery management system is particularly important as the only power. At present, it has been developed and applied in lead-acid battery, nickel chromium battery, nickel hydrogen battery and Keng ion battery. Keng ion battery has become an ideal power source for new energy vehicles because of its high energy density and high voltage platform, However, the safety and long life of Keng ion battery is still an urgent problem to be solved. Therefore, battery technology research and development is still the bottleneck of new energy vehicle electronic control

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technology.

2.2. Motor drive control system

The motor drive control system determines whether the new energy vehicle can run safely and reliably, and is the core of the drive system, which can be divided into electrical and mechanical systems [3]. The key of the motor drive system is the electrical system, which consists of three key parts: motor, power converter and controller. The speed and starting speed of electric vehicles depend on the power and performance of the drive motor.

2.3. Energy feedback system

Compared with the traditional automobile braking energy which is converted into heat and radiated to the surrounding environment, the braking energy feedback system can convert the traction motor into an engine during the automobile braking process, and rely on the wheels to drag the motor to generate electric energy and wheel braking torque, thereby converting the braking energy into electric energy and storing it, thus achieving the purpose of improving the automobile cruising range. Energy feedback system plays an indispensable role in the development of new energy vehicles, and its application field in the future is also very considerable.

2.4. Electric power steering system EPS

Power-assisted steering system has gone through three development stages: conventional hydraulic power steering system, electronically controlled hydraulic power steering system and electric power steering system, and has a tendency to continue to develop towards electronic and intelligent [4]. The working principle of electric power steering system is to add motor as power source on the basis of mechanical steering system, and replace hydraulic power with electric power; It has the characteristics of energy saving, environmental protection, high performance, high controllability, light weight, good working reliability and low manufacturing cost [5-6].

3. Communication design of electric control system

3.1. System composition

According to the modern automobile standards, the biggest difference between the new energy automobile system and the traditional automobile system lies in the introduction of battery management system, electric drive system, battery detection, balance between single battery packs, data analysis, SoC value estimation, battery information instrument display, voice alarm and other functions, all of which improve the performance requirements of communication bus for data transmission. Figure 1 shows the system architecture.

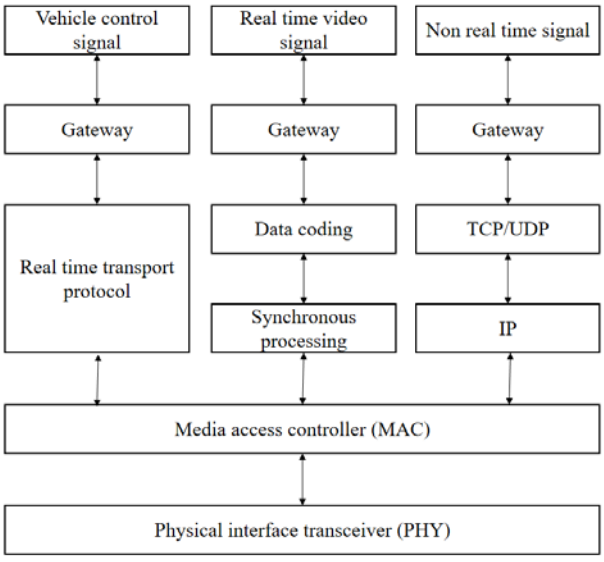

Figure 1 System architecture

3.2. Hardware design of communication system

3.2.1. Can communication node controller

MC9S08DZ series provides debugging, simulation, embedded MSCAN controller, FLASH memory and EPROM memory as a whole. MC9S08DZ60 series products feature 8-bit HCS08 CPU, on-chip memory, power saving mode, clock source option, system protection, development support, comprehensive peripheral equipment, digital-to-analog conversion and temperature sensor, input and output pins and package. Online simulation is supported during development, and bus dynamics are monitored in real time [7]. In the sleep, wake-up, and working states, the interrupt with ultra-low power consumption can be performed in real time, and the Flash memory can also be programmed and deleted. It has 60K Flash memory for reading, deleting and programming, 2K EEPROM online programmable memory and 4K random memory. It has high-strength system protection, supports monitoring watchdog reset, illegal operation code reset, Flash block protection, clock signal loss protection, and supports the development of single-line background debugging interface.

3.2.2. Administration of networks

The main function of network management layer is address management. In J1939 network, most cas have a predefined address when they are powered on for the first time, which is generally set by the manufacturer [8]. If the pre-defined address of CA has been used by other CAs on the network, it is necessary to declare other available source addresses or send a message that cannot declare the address. After successfully declaring the address, the nodes on the network can enter the normal communication mode.

The attributes and requirements of address management message of network management layer are the same as those of J1939 message, so the design of related data structure is the same as that of J1939 message. Because the network management layer needs to manage the address and arbitrate the name of CA, it is necessary to design the data structure of CA. The specific data structure design is as follows.

```
public  struct  CA {
     public  volatile  U08[]  Name; //The name of the 8-byte CA
    public  volatile  U08   pre_addr; //Predefined address
    public  volatile  U08   status;  /Status of /CA, whether it is communicating normally
    public  volatile  U08   source_addr; //Actual assigned source address
      }
```

The main functions of the network management layer include sending and responding to request address statement messages, sending and responding to address statement messages, address arbitration mechanism, and sending and responding to command address messages. Initialization function NML_init is mainly used to initialize the name and predefined address of this node CA.

The parameter of the address claim request message sending function is 60928. This function is used by CA to send an address claim request message to a specified specific address or global address. The main flow is to configure the content of the sending message and call the sending function of the transport layer. The specific flow chart is shown in Figure 2.

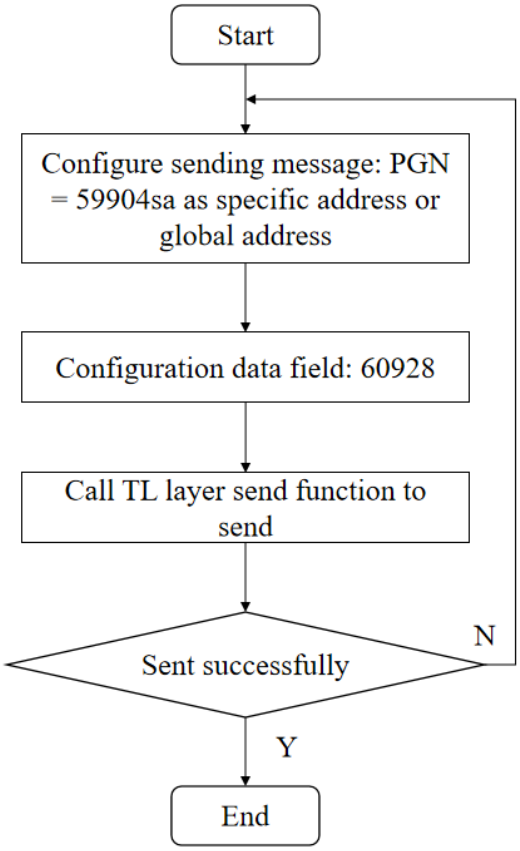

Figure 2 Logic flow chart of address claim request message sending function

3.3. Software system design

3.3.1. Create database

You need to create an Access database file as a data source, and then use ADO class to access the database. Create data table: create PGN and SPN data table according to PGN, SPN, resolution, offset and other related information defined in SAE J1939-71 application technology document.

Before connecting to the database, the System.Data.OleDb library file needs to be introduced, so that the compiler can compile correctly. The process of database connection mainly includes the following aspects: First, create a database object Constr and connect it to the created J1939Data.accdb Secondly, create a command object, and connect and set the command object with SQL execution statement. At last, DataSet DataSet and DataAdapter dataadapter are defined, and data set dataset is filled.

3.3.2. Design of communication protocol for battery management system

Two frame formats, standard frame and extended frame, are defined in CAN2. 0B protocol. The identifier ID of the standard frame is 11 bits, and the identifier ID of the extension frame is 29 bits. Because there are many nodes involved in CAN communication in this system, the extended frame is selected as the communication data frame. Table 1 is the 29-bit ID identifier of extension frame.

Table 1 29-bit ID identifier of extension frame

Field	P	R	DP	PF	PS	SA	DATA
Digit capacity	3	1	1	8	8	8	0-64

P indicates that the priority occupies 3 bits, which are only used to optimize the message delay in bus transmission. The receiver must be aligned as a global mask (i.e. ignored), and the message priority can be set from the highest 0 to the lowest 7. R means to reserve 1 bit for future development and use. Generally, it is fixed at 0.DP means that the data page occupies 1 bit, and the data page bit selects the auxiliary page described by the parameter group. After the assignment of

all parameter group numbers available on page 0 is completed, the assignment on page 1 will be made. PF indicates that the command occupies 8 bits, which is used to determine an 8-bit field of PDU format, and is also one of the fields for determining the parameter group number corresponding to the data field. PS indicates that the destination address occupies 8 bits, and a specific PDU is an 8-bit field, and its definition depends on the PDU format. SA means that the source address occupies 8 bits, and the source address is an 8-bit domain. A source address in a network can only match one device. DATA means that the data field occupies 64 bits (that is, 8 bytes), and the CAN data frame contains 0-64 bits of data defined by the application layer.

3.3.3. Signal design of battery management system

The arbitration field of CAN Dataton includes identifier and remote sending request. In the standard format based on 2.0B, the length of identifier is 29 bits. On the can bus, when multiple electronic control units send signal messages to the bus at the same time, the bus will judge according to the id identifier of the arbitration field. after the result is obtained, the one with higher id bit, i.e. lower priority, will automatically quit sending and continue waiting, while the one with the lowest id bit, i.e. higher priority, will send. In the design process, the functions of system management and monitoring should be fully considered, and some vacancies should be reserved, which can also meet the needs of system renewal and reuse in the future.

The battery management system includes a battery balance and charging control system, which provides power support for other ECU, reflects humidity, current and voltage information to drivers and passengers in real time, and displays status signals, which is conducive to judging whether the battery is in a fault state of sufficient power and excessive current as early as possible, preventing high temperature and improving the safety of the whole system, so it is ranked as a higher priority in the battery management system. In the overall numerical signal, the smaller transmission cycle time is ranked in the lower priority.

4. System test

After the bus controller is successfully designed, it is necessary to establish a test environment topology diagram for the whole system to test whether the technical standards are met. The established topology structure is shown in Figure 3.

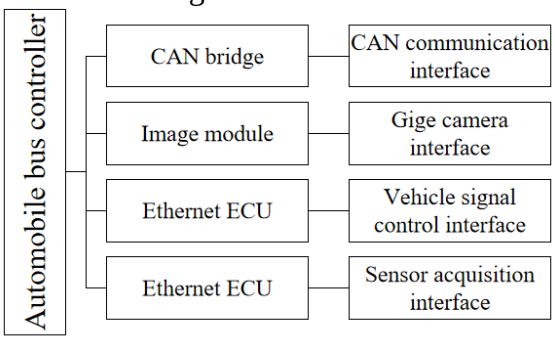

Figure 3 Test environment topology diagram

After the connection needed for testing is established, the transmission rate and synchronization error of the system are tested in this study, and the test method uses Fiddler software. After testing, the requirements of system composite design, specific test items and indicators are shown in Table 2.

Table 2 Test items and indicators

	Functional test		Result
Serial number	Test item	Test specification	Pass
1	Live transmission	Real-time transmission of automobile motor control signal	Pass
2	Live transmission	Real-time transmission of information collected by	Pass

		sensors	
3	Live transmission	Real-time transmission of automobile steering control signal	Pass
4	Real-time image transmission	In the process of assisting driving, the video data of intelligent sensors such as high-speed cameras can be processed in time to realize the real-time transmission of video data	Pass
5	CAN bus bridge	CAN communicate with CAN bus module	Pass
	Performance test		Pass
1	Data synchronization	Data transmission is synchronous and jitter is within 1 μ s.	Pass
2	Transmission speed	The maximum transmission speed can reach 1000Mbps	Pass

5. Conclusions

With the increasing number of traditional cars, the problems such as energy consumption and exhaust pollution have become increasingly prominent. It is particularly important to develop new energy vehicles. In recent years, many achievements have been made in the electronic control technology of new energy vehicles in the world, but on the whole, it is still in the trial stage, and battery technology is still the focus of research and development. This requires relevant researchers to master the hardware design of communication system in new energy vehicles based on cloud platform. In this paper, SAEJ1939 communication protocol stack is implemented hierarchically in the form of protocol stack based on CAN bus. It mainly includes hardware abstraction layer, data link layer, transport layer, network management layer and application layer. Therefore, SAEJ1939 protocol stack can be transplanted to different electronic control systems in the form of software middleware. The application layer is user-oriented, and users can design and expand applications according to their own needs.

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