Research on Control Strategy and Central Control System of Intelligent Electric Vehicle

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Abstract. With the continuous improvement of world science and technology, vehicle technology has also been greatly developed. Cars bring convenience to people's travel, and occupy an increasingly high proportion in social life. Automobile plays an important role in the continuous progress of contemporary society and the change of human travel conditions. At the same time, the increasing number of cars also brings many problems: energy consumption and environmental pollution are worsening, traffic accidents are increasing year by year. According to the who survey, the number of casualties caused by traffic accidents in China is gradually increasing. High traffic accidents have caused irreversible losses to social development, people's lives and property. It has become the development goal to improve the vehicle active safety, control the vehicle to automatically identify the road, drive according to the planned route and reduce the frequency of traffic accidents. In the traditional driving environment, people occupy a dominant position. In the face of complex and changeable traffic environment and a large number of traffic information, it is easy to make mistakes in driving and cause serious traffic accidents. Therefore, it is very important to extricate the driver from the complex and changeable traffic environment and make driving safer. The intelligent vehicle collects the information about the road and the vehicle itself through the sensor, and sends it to the central controller which controls the transverse and longitudinal movement of the electric vehicle. The central controller sends out corresponding instructions to control the horizontal and longitudinal operation of the vehicle according to the control strategy, so as to realize the control of the driving behavior of the vehicle, so that the vehicle can drive safely on the desired track at the expected speed. It can avoid driver fatigue driving behavior and traffic accidents caused by driving technology. Various sensors in the intelligent vehicle can obtain more vehicle information at the same time, and control the vehicle through the controller processing.

Keywords: Smart Car, Central Control System, Control Strategy, Automatic Steering System

1. The research status of smart cars at home and abroad began in the mid-20th century

With the combination of sensor technology and automobile technology, smart cars are rapidly
emerging. All countries in the world have set off a wave of research on smart cars, and have made many outstanding achievements. In the whole research process of smart cars, safety is the primary task of researchers. Automatic steering technology is the key to the driving stability of intelligent vehicles, so the study of a mature automatic steering control system has an important impact on driving safety. The research on smart cars mainly focuses on the following three aspects: highway environment, urban road, environment and special circumstances. Smart cars, driving in highway environment, mainly complete the identification and tracking of vehicles and road signs in high-speed environment, so that smart cars can complete automatic driving on highways. In the smart car under urban road environment, the speed is slow under high-speed environment, so it has higher safety and good development prospect, but the urban traffic environment is more complex, so it is necessary to improve the accuracy of the intelligent car environment perception system and control algorithm. Only by solving these problems can we better improve the current situation of urban traffic. According to the data, Google has joined the research army of smart cars since the 21st century, and has adaptive cruise and other functions. In 2010, Google's first unmanned smart car came out. This vehicle can be controlled, recognize pedestrian obstacles and signal lights, and make judgments to control the vehicle to realize autonomous unmanned operation. The Volkswagen Electronics Research Laboratory has also developed the smart car Shelley. This skill vehicle is accurate in path planning, navigation and positioning by GPS. This vehicle uses excellent positioning system to influence the speed and acceleration of the vehicle, so that the vehicle can obtain the best driving performance. From October, 2016, all Tesla vehicles will use certain hardware to make the vehicles reach safety level 5. The hardware of Tesla vehicles with full automatic driving function includes directional radar, surround camera and ultrasonic sensor. The system runs and processes without operation processing and sends the processed data back to Tesla, so that it can be deployed through air upgrade [1].

And China's electric vehicles have also ushered in a new opportunity period of development. The government has promoted the development of electric vehicles to a national strategic level. Zero emission of environmental protection is an effective way for the automobile industry to face severe environmental pressure. Replacing oil with electric energy is conducive to reducing the country's rising dependence on oil and ensuring national energy security. Facing the dual pressures of energy and environment, it is imperative to develop electric vehicles. As far as the world is concerned, there is still a clear gap between China and foreign countries in the technology of key components of traditional fuel vehicles, while the technology of electric vehicles basically keeps up with the advanced level of the world, and has a long-term good research foundation. Under the condition that the research in the world forms a good linkage, it is possible to realize "overtaking in corners". Since 1980s, China has increased the research work on intelligent vehicles and made considerable achievements. China's major universities have developed many intelligent vehicles, such as thmr series intelligent vehicles in Tsinghua University [2].

Figure 1. THMR-5 intelligent electric vehicle designed by Tsinghua University.
2. Intelligent electric vehicle control strategy analysis

The controller is very important for the electric vehicle, even equivalent to the brain of the electric vehicle, commanding the coordinated operation of the system, and playing an important role in the control of the whole vehicle system, energy management, safety performance of the whole vehicle and signal processing. The vehicle control strategy is the software part of the vehicle controller, which is mainly responsible for the output control of vehicle power and the core content of the whole vehicle controller.

2.1. Foreign intelligent electric vehicle control system at present

There are several main intelligent vehicle control systems abroad:

2.1.1. Navlab control system of American CMU

In 1999, Navilab-V, an unmanned intelligent vehicle developed by Carnegie Mellon University (CMU), completed the test of 5000km intercontinental highway at the driving speed of 50~ 60km/h, of which 96% was driven automatically.

2.1.2. Lx control system in Germany

In 2007, a company from Hamburg, Germany, applied advanced laser sensing technology to the modification of an ordinary car. This unmanned intelligence, which integrates intelligent devices such as laser radar, GPS locator and intelligent computer, was named "Lux", and Lux can freely cope with the complex road conditions in the city [3].

2.1.3. Caravelle control system is jointly developed by German national technical department and German Volkswagen Company

The key research content is the visual navigation of autonomous driving of vehicles on expressways. Experts have developed two modules to realize visual navigation together. One is the on-board control module, which consists of two high-speed and high-resolution cameras, which are used to detect lane lines and obstacles in front; the other is the sensor module, which mainly includes speed sensors and steering angle sensors. The motor is the main control actuator: car body attitude control and image processing are completed by computer system. Caravell e system can complete the whole process from image recognition processing to vehicle control in a short time, and the maximum driving speed on the expressway can reach 120 km/h.

2.1.4. Peugeot control system in France

Peugeot is an intelligent navigation vehicle jointly developed by Citroen and Pascal University of France. The outstanding advantages of this control system are high integration of hardware structure, small size and light weight, and the whole system is integrated on a DSP chip. Through the real vehicle experiment, it is proved that the system has certain excellent performance [4].

2.2. domestic intelligent electric vehicle control system

Xiao Yanxi and others designed a braking control system for unmanned intelligent vehicles. The negative braking behavior of driving is simulated by the electromechanical structure with the motor as the core, and the control unit receives the brake master cylinder pressure signal from the brake master cylinder pressure sensor, thus completing the closed-loop control loop of the control unit to the motor. During the braking process of the vehicle, the system completes the speed control of the vehicle according to the pressure of the brake master cylinder fed back in real time. Yu Fenhua and others designed the software and hardware of the intelligent car system. The hardware circuits include: steering mechanism drive module, power voltage stabilizing module, OV7620 peripheral circuit, speed detection module, motor drive module, speed shift circuit K60, minimum system and so on. Image processing module, path planning module and fuzzy PID control module are the main components of the software. Ma Tianli studied the motion system of unmanned intelligent vehicles
from the aspects of vehicle system dynamics, vehicle stability, experimental verification of control methods and construction of simulation experiment platform. Lv Feng et al. deduced the dynamic differential equation of unmanned vehicles, deduced the position relationship of unmanned vehicles in the geodetic coordinate system, and designed the steering controller of unmanned vehicles according to the vehicle postures in different position relationships.

2.3. the whole vehicle system structure
The power of the electric vehicle comes from the power battery pack. Under the drive of the power battery pack, the power motor rotates and provides enough power for the whole vehicle. The structure of pure electric vehicle mainly includes steering system, vertical control, motor drive system, energy management system, vehicle control unit, motor and control system and instrument display system. In pure electric vehicles, the battery and its management system provide energy for the power system of the whole vehicle, and drive the motor and its control system to provide power for the whole vehicle movement. The vehicle controller (VCU) is the backbone of the pure electric vehicle control system, also known as the master controller, which can collect gear signals, throttle signals, battery capacity soC, vehicle speed information and pedal signals. Self-test the electric vehicle system, transmit data through CAN communication of the whole vehicle, control battery discharge and motor operation, play an important role in regulating the coordinated operation of the whole power system, greatly meet the driver's requirements for vehicle form, and display relevant information on the instrument display [5].

2.4. vehicle control strategy
The whole vehicle control strategy plays a vital role in the running state of electric vehicles. The whole vehicle control strategy includes four main parts: driving system, braking system, energy management and safety control. The main flow of the control system is as follows: in the initial stage, the control circuits on the whole vehicle are powered on, the program starts initialization processing, and the system quickly detects each module. If the detection fails, the system automatically switches to fault handling; if the test passes successfully, the system will automatically enter the circuit pre-charging; if the pre-charging fails, it will continue to enter the system fault state, and the system will carry out fault treatment: if the pre-charging is successfully completed, the system will enter the high-voltage power-on link, and judge and process the signals collected by the system, so as to decide the control of charging, driving and braking when the electric vehicle stops. CAN communication receives the information sent by the sensor, selects the control strategy after processing the information, and diagnoses the faults of the whole vehicle control system, and then transfers the processed information to CAN communication, circulating to collect the input signals.

3. Design of central control system-automatic steering system
Autonomous steering system plays an important role in the lateral control of electric vehicles. Therefore, in order to better control the steering system of electric vehicles, we should strive to take the existing rotation system as the basis and give control assistance, so as to achieve road identification, speed and steering control and vehicle motion stability control. The whole automatic steering control system consists of four parts: sensor system, data acquisition system, control decision system and execution system. Among them, the sensing system is used to sense the changes of the surrounding environment and internal state of the vehicle; data acquisition is responsible for collecting the sensed environment and internal information of the vehicle; as the core component of the control system and the brain of the intelligent vehicle, the controller can analyze and judge the data of the sensor and send the analyzed and processed information to the actuators such as motors as instructions.

3.1. Sensing system
3.1.1. **CCD sensor**
CCD sensor is a new photoelectric conversion device, which can convert optical signals into digital signals and transmit data to computers.

![CCD sensor display diagram.](image)

**Figure 2.** CCD sensor display diagram.

3.1.2. **GPS speedometer**
GPS speedometer can detect the change of vehicle speed, acceleration and mileage.

3.1.3. **Angular velocity sensor**
Angular velocity sensor, also called gyroscope, is mainly used in automobile navigation, attitude control and position control of moving objects, and can detect the yaw angle, roll and pitch angular velocity of vehicles.

3.1.4. **Angle sensor**
A sensor for measuring or monitoring the rotation angle of an object [6].

3.2. **Data acquisition system**
The data acquisition system of electric vehicle test is divided into two parts, namely, the upper computer and the lower computer. Through serial port, the upper computer can communicate well with the host computer and store the data in the host computer. The lower computer is connected with sensors and can collect the changes of accelerator pedal, brake pedal and motor angle.

3.3. **Control Decision System**
The control and decision system is the brain of the automatic steering system, which plays the role of command and decision, and is an important commander of intelligent vehicles. In this project, the notebook computer is used to receive and save data, and combined with VC6.0 programming software, a control decision system is formed.

4. **Conclusion**
In this paper, the whole vehicle control and central control of intelligent electric vehicles are taken as the research objectives, and the whole vehicle control strategy, the structure and function of the whole vehicle controller and the division control strategy of electric vehicles are analyzed. The automatic control system of the whole vehicle is designed. On the basis of the control system, the hardware such as sensor, MCU and serial port are designed, and the system software is designed. Because of the limited number of tests, there are still many omissions and shortcomings.

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