Design of Embedded Intelligent Car Control System Based on Android

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Abstract. With the rapid development of artificial intelligence technology, Unmanned intelligent vehicle technology, more and more people pay attention to it, it will change the way people live and travel, it can be applied to all aspects of urban construction and social development. Aiming at the instability of the intelligent car in the process of automatic driving, an embedded intelligent car control system based on Android is designed. Cortex-A9 is the core of the main control platform of the system, connect seven function modules, and through the data receiving module of the controller, it is connected with the Android application control system of the host computer, each function module can work independently and cooperate with each other, realize the automatic control of intelligent car, the intelligent car can move forward by itself, identify the path, grab the goods, patrol the line, avoid obstacles, and can run smoothly and quickly, at the same time, it can accept the manual control of Android interface.

1. Introduction
With the rapid development of human science and technology, artificial intelligence and internet plus technology have been applied in various fields, the research of driverless technology and intelligent car is in full swing in various countries[1]. At the International Auto Show, mainstream automobile enterprises at home and abroad, all of them are trying their best to show their strength in the field of intelligent vehicles and their plans for the future[2]. Intelligent vehicle is a comprehensive system which integrates environmental perception, planning and decision-making, automatic driving and other functions[3], it is an important part of Intelligent Transportation System, it has a wide application prospect not only in civil, but also in military, space development and other fields[4].

The intelligent car is different from the automatic driving, it refers to the use of a variety of sensors and intelligent road technology to achieve the car's automatic driving[5].

The main control platform of the intelligent car control system based on Android uses cortex-A9 core board, the host computer uses open source Android application control system, the incremental PID control algorithm is adopted[6], realize the dynamic control of speed, use camera to collect images and process information, to achieve efficient environmental video transmission in an effective range. The intelligent car has the functions of path identification, autonomous line inspection and obstacle avoidance, it can also interact with intelligent car through mobile app, it is a intelligent car technology with broad application prospects[7].
2. Overall design of the system
The embedded intelligent car control system based on Android is composed of controller data receiving module, obstacle avoidance module, manipulator control module, WSN wireless sensor network module, main control platform, camera module, WiFi communication module, communication interface and upper computer intelligent car control system. This system takes the Android terminal control system of intelligent car as the upper computer, it is connected with the main control platform mounted on the main body of the intelligent car. The main control platform adopts cortex-A9 core board, supported by seven functional modules. Each function module can work independently and cooperate with each other, complete the whole function of intelligent car[8]. The system structure diagram is shown in Figure 1.

![Fig.1 System Structure Diagram](image)

3. The design of system hardware
The hardware design of the system and the functions of each module are as follows.

3.1. The main control platform
The main control platform of the intelligent car adopts cortex-A9 core board, it hands the collected data to the upper computer Android terminal control system, the Android terminal control system receives the data sent by the main control platform, and save and process the data, at the same time, the generated control instructions can be sent to the main control platform, after receiving the command from the main control platform, control function unit realizes specific function, realize the control of intelligent car and other peripheral equipment.

3.2. Camera module
The video acquisition port of the main control platform is connected with the camera module, the main control platform receives the video information collected by the camera module. The camera module is located in front of the main body of the intelligent car, collect the front image of the main body of the intelligent car, the main control platform transmits the above images to the upper computer Android application control system, judging whether the road ahead can pass by upper computer, if it is judged that it is not passable, then through the main control platform to the car body traveling mechanism to stop or turn instructions. The main control platform circuit communicates with the camera module through CSI camera serial interface[9], capture camera images. The camera module adopts ov5640 camera module, its circuit connection diagram is shown in Figure 2.
3.3. \textit{WSN wireless sensor network module}

The information acquisition port of the main control platform is connected with WSN wireless sensor network module, responsible for collecting environment status information and intelligent car status information. For example, the state of the car body is collected through a six axis accelerometer, collect the car speed through the motor speed, collect whether there are obstacles in front of the vehicle by ultrasonic wave, the electric quantity information is collected by Hall sensor. The main control platform sends the above environmental status information and intelligent car status information to the upper computer, the upper computer saves and extracts the specific environment state information and driving state information of the intelligent car, according to the above information, judge whether it is suitable for the intelligent car to continue moving. UART asynchronous serial communication is used between the main control platform circuit and WSN wireless sensor network module. WSN wireless sensor network module circuit connection diagram is shown in Figure 3, CC2530 sensor module is used to realize the above functions.

3.4. \textit{Manipulator control module}

The executive port of the main control platform is connected with the manipulator, it is used to execute the instructions sent by the upper computer, grab, in order to realize the functions of road clearing and sample collection. USB interface is used to communicate between the main control platform and the manipulator, the main control platform acts as the calling party, low speed mode and manipulator module are used for command transmission. The circuit connection diagram of manipulator control module is shown in Figure 4, Cy68013 is used as the control module of the manipulator.
3.5. Data receiving module
The upper computer is connected with the main control platform through the controller data receiving module, the controller data receiving module is used to establish Bluetooth communication link and realize communication connection. At the same time, the wireless connection port of the main control platform is connected with the Wi-Fi module to establish the Wi-Fi network link. The Wi-Fi module uses HTTP protocol and 5g transmission to realize network communication. UART asynchronous serial communication is used between the main control platform and Wi-Fi module, Esp8266 module is used to realize the above functions of Wi-Fi module. The circuit connection diagram of Wi-Fi module is shown in Figure 5.

3.6. Obstacle avoidance module
The detection port of the main control platform is connected with the obstacle avoidance module, the obstacle avoidance module is an infrared detection device, its function is to detect the obstacles ahead and send the detection results to the main control platform. The main control platform sends the received infrared detection data to the upper computer, according to the signal and the video data collected by the video module, the upper computer can judge whether the intelligent car can pass in front of it, and send further action instructions to the main control platform.

In addition, the main control platform also has a number of communication interfaces, it can be used to realize data exchange with peripheral devices (such as worm gear dc motor, three axis electronic compass, etc).

4. The design of system software
The upper computer of the embedded intelligent car control system based on Android is the Android terminal control system, it is a smart phone app based on Android operating system. The main control platform is responsible for the image processing of the intelligent car, if the processing result is fuzzy, it will be sent to Android application for secondary processing. Communication between Android
application control system and intelligent car main control platform, realize the control and status display of intelligent car, and can carry out UI interactive control.

Software control is the core of intelligent car control, through the software can realize image processing, control the intelligent car stable high-speed automatic line inspection. According to the business function analysis, the system function is mainly divided into four modules: connection module, operation module, waveform sensing module and parameter setting module. The system function module diagram is shown in Figure 6.

![Fig.6 System function module diagram](image)

5. Conclusion
The embedded intelligent car control system based on Android is designed based on cortex-A9, the main control platform is connected with controller data receiving module, obstacle avoidance module, manipulator control module, WSN wireless sensor network module, camera module, communication module, communication interface module, and through the controller data receiving module and upper computer Android application control system connection. Each function module can work independently and cooperate with each other, realize the automatic control of intelligent car, the intelligent car can move forward by itself, identify the path, grab the goods, patrol the line, avoid obstacles, and can run smoothly and quickly, at the same time, it can accept the manual control of Android interface. The intelligent car control system covers computer engineering, the knowledge of artificial intelligence, automatic control, automotive electronics and other fields[10]. This study will promote the development of automatic driving and intelligent transportation system, it can be applied to all aspects of urban construction.

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