

Design of Image Recognition Car Based on Baidu Cloud

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Abstract—In order to save the use of computing power, reduce the difficulty of development and reduce the development cost, this paper proposes a design of gesture recognition control car based on Baidu Intelligent cloud. The design is realized by the combination of cloud system, edge system and embedded control system, which is similar to the design of an extension frame in other systems. The gesture recognition control can be completed without the overburdened image recognition algorithm of MCU. The cloud system is supported by Baidu Intelligent cloud development platform. The edge system is composed of camera module, gateway module and lower communication module based on Bluetooth. The embedded control system designed a storage car by modularization and attached it with a communication module based on Bluetooth. Through continuous physical debugging, the car can realize the decision of sudden events such as yaw, classification error, and artificial error through gestures. To meet the gesture as an example of image recognition design requirements.

Keywords—Gesture recognition; Baidu intelligent cloud; stm32; microcontroller robot

I. INTRODUCTION

A. Development background and significance

At present, with the rapid development of high-speed network communication and computer computing power, artificial intelligence and cloud computing technology have been widely used in various fields. The extended intelligent control car based on image recognition has been widely used in daily life and production neighborhood. Because the image recognition algorithm needs to process and calculate the image frame returned by the camera in real time, it puts forward certain requirements for the computing power of the computer. These types of chips often lack computing power for computer vision; For embedded systems, the computing power of this chip is excessive, which causes a waste of computing power and funds. In response to this situation, this paper tries to propose a design that uses cloud computing to release the computing power required by computer vision algorithms, and completes the task by an embedded system under the direct control of a small computing power chip.

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B. Domestic research status

Liu Xuewen's team from Guangzhou Huaxia Vocational College wrote an article in 2019 describing a design idea based on stm32 car system, including mechanical hardware selection and design of various functional modules, and put forward selection suggestions for some components. Fu Lin's team from the School of sensor was combined with the robotic arm to realize object retrieval and classification. The design of Fu Lin's team puts more emphasis on the actual use of objects, and proposes a good design template. Haocheng Ye's team from the School of Mechanical and Electrical Engineering of Henan University of Science and Technology proposed an intelligent storage car design that combines STM32F103RCT6 with Arduino Nano as the MCU core in 2021. In this design, ArduinoNano is mainly responsible for the manipulator control and color sensor control, and STM32 is used for each module to feedback information and make decisions. These designs provide some design help for this paper. This paper further designs on this basis. Due to the use of cloud control, STM32F103C8T6 is used as MCU to control the car, and Bluetooth can be used to combine with the control side camera to realize the gesture recognition in the cloud and send the identification code to the MCU, and the MCU makes further decisions to realize remote human-computer interaction and participate in the control process. This paper mainly focuses on implementing such a design, so a simpler control system is adopted, but the same control effect can be achieved.

II. METHODS

The image recognition car system based on Baidu Cloud is composed of three subsystems: cloud system, edge system and embedded control system.

Cloud system is cloud computing, which is a system with strong computing power formed by computer network (mostly referring to Internet). It can store, gather related resources and configure them according to needs to provide personalized services to users. Around 2021, cloud computing has developed rapidly in China. Our cloud system is designed based on Baidu's Baidu Intelligent Cloud. The edge system is the computer

Information Engineering of Shaoyang University proposed the design of intelligent storage car using Arduino microcontroller as the core MCU in 2020, and realized the obstacle avoidance function through ultrasonic and infrared sensors. The line inspection is carried out by the black label sensor. The color control side of the periphery. In this paper, it also serves as the port for the interaction between the local system and the cloud system. It includes the call of the camera system, the information frame is packaged and uploaded to the cloud, and the execution command is coded back to the embedded control system. The embedded system is a car motion system based on stm32f107c8t6 chip. In addition to the services provided by stm32f107 chip, tb is used for motor control, and HC-06 Bluetooth communication chip is used to communicate with the edge control system.

In this design, the embedded system only needs to execute control according to the received communication, and does not need to directly settle the picture information, which not only releases the computing power, but also makes the small chip can be used for complex function development. And it can be compatible with many mature algorithms and functions in the computer field. Systems with existing development experience, such as embedded mapping and gesture interaction, are often designed based on higher computing power chips. Such a system has good performance, but it also has the problems of high price, difficult maintenance and large learning cost. The design proposed in this paper greatly reduces the hardware requirements of the embedded system by using the cloud algorithm based on Baidu Cloud, and uses python to develop upstream and downstream communication ports, which improves the compatibility, closure and readability of the program, and facilitates further design and horizontal development.

III. DESIGN CONTENT

A. Hardware Design

1) Microcontroller: In this design, STM32C8T6 is selected as the microcontroller. STM32C8T6 is a 32-bit microcontroller based on ARM Cortex-M3 core, which has high performance, low power consumption and rich peripheral resources. The chip provides rich interfaces, such as GPIO, UART, I2C, SPI, etc., to facilitate connection and communication with other hardware modules. In addition, STM32C8T6 also has strong computing power and stability, which is suitable for real-time control and processing tasks.

2) Motion control module: TB6612FNG is selected as the motor drive for the motion control of the car. The TB6612FNG can realize independent control of two DC motors, including forward and reverse rotation, speed regulation and braking. At the same time, it has high output current capacity and low power consumption, which is suitable for applications such as small robots and smart cars.

3) Camera module: In order to realize the image acquisition and recognition function, this paper uses the camera of the peripheral computer or other peripheral cameras. opencv based on python has the advantages of simple and easy to write, and can capture image information. Through the network port of the computer, the image information is packaged and sent to the cloud, which can realize real-time image acquisition and transmission.

In addition, in the car system, we further design a vision system based on K210 vision module, which makes the car have stronger autonomy in object grasping and classification transportation.

4) Communication module: In order to realize data interaction with Baidu cloud, this design uses the network port of the peripheral computer and the API of Baidu cloud to realize the process of sending image information to the cloud. HC-06 is used as the carrier for the instruction communication between the computer and the car. HC-06 is a Bluetooth communication module, which has high transmission rate and low price, and can realize stable and efficient wireless communication.

(5) Circuit design: In this design, the circuit of the car uses PCB (printed circuit board) design technology, and

the above hardware modules are integrated and laid out, so as to realize the stability and reliability of the circuit, reduce the failure rate and maintenance cost.

B. Software design and implementation

In the embedded system, we use C language to write programs, and use KeilMDK to realize program compilation, debugging and burning. Through the Bluetooth serial communication interface with the peripheral computer, the remote command signal can be received and sent.

On the peripheral computer side, we develop a library based on python language and opencv to drive the camera and capture the real-time image frames of the camera. In this design, the peripheral computer terminal only acts as an independent camera module and does not perform too many image processing algorithms. Python was used to write programs to realize the interaction with Baidu Cloud image recognition API and transmit image frames to cloud computing.

In the cloud, we trained a model that can recognize common gestures. By calling Baidu Cloud image recognition API, the image data is uploaded to Baidu cloud server for image recognition processing. After the processing of Baidu cloud image recognition API is completed, the image frame with the logo and the identification information are returned to the peripheral computer end.

We need to write a Python program in the cloud to parse the returned results. The parsing process includes extracting key information (such as object category, location, etc.) and judging the confidence of the recognition result. After parsing, the results are transmitted back to the embedded system through the Wi-Fi communication module.

C. Car control strategy

In the embedded system, we use C language to write the program, according to the parsed recognition results, to realize the automatic control of the car. The control strategy includes the tracking of the target object, obstacle avoidance, navigation and other functions. Through the interface with the motor drive module, the direction and speed of the car are controlled to realize the recognition

and response to the target object.

In summary, this design implements embedded functions through C language, such as image acquisition, preprocessing and car control strategy, and cloud functions through Python, such as Baidu cloud image recognition API call and result analysis. Through reasonable software design and implementation, the efficient and accurate image recognition and automatic control functions of the image recognition car based on Baidu Cloud are realized. In the subsequent testing and evaluation process, we will further optimize and debug the software system to improve the performance and stability of the system.

IV. INSPECTION AND EVALUATION

After the completion of hardware construction and program design, we first test each module driver, and write a test program. After running the corresponding program, you can test whether the module can work properly.

In order to test the application in the actual application scenario. We design a warehouse robot working in a simulated warehouse and improve the gesture control on it. In this simulated warehouse, there is a guide line for pointing and viewing, and the entry ports are designed on the east, west and south sides of the site. In the north of the site, is the stacking area of classified placement. The car is required to cruise the site automatically, and carry and classify according to the pre-designed decision. When the goods are put into storage, the car will call the host computer operator to confirm the decision. At this time, the operator can control by gesture. In addition, the alarm mechanism will also be triggered when the car is out of

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line and falls, and the operator can help the car out through gesture control.

After testing, our design can achieve the above design expectations. However, the cloud control brings the convenience of computing, but also brings the instability and delay of information processing. Through further design, we can avoid these problems. Complete the design function.

V. CONCLUSION

In the design and implementation process of the image recognition car based on Baidu Cloud, we have realized a series of functions, including image acquisition, preprocessing, cloud recognition, result analysis and automatic control of the car. Through experiments and evaluation, we verify the functional integrity, reliability, good performance and adaptability of the system. Although some achievements have been achieved in the experiments, there are some challenges and problems. In terms of image recognition, although Baidu cloud image recognition technology shows high accuracy and real-time performance in the test, in complex environments, the recognition results are affected by illumination, occlusion, background interference and other factors, resulting in recognition errors or failures, which cause interference to the car control. However, in this design, the car can realize the corresponding movement, interaction and function according to the operator's gesture. It can also be used for exception handling and remote control. In addition, we use a relatively simple MCU and design structure to achieve the functions that used to require complex computer vision algorithms + high -performance MCU implementation. This further reduces design costs, optimizes performance, and improves design integrity, reliability, good performance, and adaptability.