Design of an Introduction Robot for Exhibition

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Abstract. In order to facilitate the on-site service of large-scale Auto Show, we designed an intelligent human-computer interactive exhibition robot. The exhibition introduces robot uses STM32f767IGT and STC11l08XE micro-controllers as controllers, uses infrared proximity sensors to detect exhibitors approaching the robot, uses speech recognition chip ID3320 to recognize the voice content of exhibitors, and identify the exhibition intention, Use speech synthesis chip XSF5152CE to carry out human-computer interaction and explain the information of the corresponding booth in the exhibition hall. In addition, uses the infrared 5-way tracking sensor module to identify the driving line, and sues the OV5640 camera to identify the QR code information of the designated booth and store it in the SD card, so as to update the on-site layout and booth information of the auto show. The designed robot can complete the basic task of automobile exhibition introduction.

Keywords: Automobile exhibition robot · STM32F767IGT · Voice module · SD card

1 Introduction

With the continuous improvement of people's living standards, various commodity exhibitions emerge in endlessly. In order to improve the exhibition effect and adapt to people's pursuit of product quality, some exhibition service robots come into life. In the exhibition, the service robot can not only replace the manual to tell the corresponding product information of the exhibition and booth, but also more efficiently and accurately meet the purchase needs of exhibitors, and arouse the interest of exhibitors in a new way of guidance, so can better realize the promotion and sales of exhibition exhibits.

For the above problems, many scholars have proposed various improvements [1–4]. Luo et al. [5] proposed an development platform and an process of robot motion control system. Xiong et al. [6] designed an interactive service robot for Shanghai World Expo 2010, as an integrated design and techniques of the HAIBAO robot. The purpose of this paper is to design an introduction robot suitable for large automobile exhibition, and realize the basic functions of service robot, such as walking, speech recognition, human-computer interaction and so on.

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The exhibition introduces robot uses the infrared proximity sensor to detect the exhibitors who are close to the robot, give them voice prompts, and then provide the exhibitors with the help they need. We planned the robot tracking path on the ground in advance. The exhibition introduces that the robot uses the infrared 5-channel tracking sensor module to realize the tracking function in the above routes.

This paper is organized as follows. The overall design tasks of the system is reviewed in Sect. 2. The specific and detailed system design is presented in Sect. 3, and the conclusions are given in Sect. 4.

2 Design Tasks

This paper designs a automobile exhibition robot, which uses the ID3320 voice module to realize the recognition of voice content, extracts keywords from them, compares the keyword list, matches the most similar recognition results, then extracts its text content from the response information stored in the SD card, sends it to the voice synthesis module through serial port communication, and then broadcasts through the speaker to realize exhibition guidance and booth information introduction. In addition, the key words of speech recognition can be edited at any time. The speech synthesized by speech can be set with different reading voices, reading speed, pitch, etc.

The system structure is shown in Fig. 1. It is the overall block diagram design of the robot introduced in the exhibition hall. The robot system introduced in the exhibition hall is composed of STM32f767IGT6 main controller, infrared tracking sensor, voice recognition module (ID3320, STC11l08xe), camera module, SD card data storage module, voice synthesis module (XFS5152CE), motor drive module (DEV8833) and infrared proximity sensor. The motor drive module drives two DC motors to cooperate with the infrared tracking module to realize the automatic tracking and walking function of the robot. In addition, the camera module recognizes the booth QR code information, which together realize the function of updating the booth information in the exhibition hall. The infrared proximity sensor mainly senses whether the exhibitors are close, and then interacts with them.

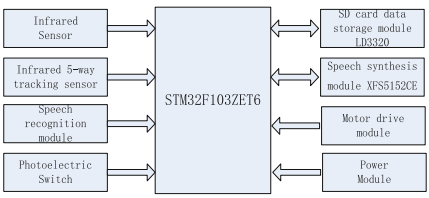

Fig. 1. Overall block diagram of exhibition introduction robot

3 System Design of Sweeping Robot

A. Control System

The STM32f767IGT6 single chip microcomputer is used as the main control single chip microcomputer in the main control circuit to realize the direct control of the camera module, SD card module, infrared proximity sensor module, tracking module and motor drive module, and realize the interface control with the speech synthesis module and speech recognition module through serial port communication. The schematic diagram of the main control circuit is shown in Fig. 2.

Specifically include:

1) Sensor module

The sensors in the whole robot system are infrared 5-way tracking sensor and infrared proximity sensor. For the robot to update the information of the booth and exhibits through tracking, the normal operation of the infrared tracking sensor is essential. The infrared proximity sensor can be used to identify exhibitors within a certain range.

The 5-way tracking sensor is composed of 5 TCRT5000 infrared reflection sensor probes. It has high infrared detection identification and strong anti-interference ability against external light. The module itself also integrates the gate circuit 74HC14 of the 6-way Schmitt trigger inverter to shape the analog signal output from the infrared diode into a digital signal.

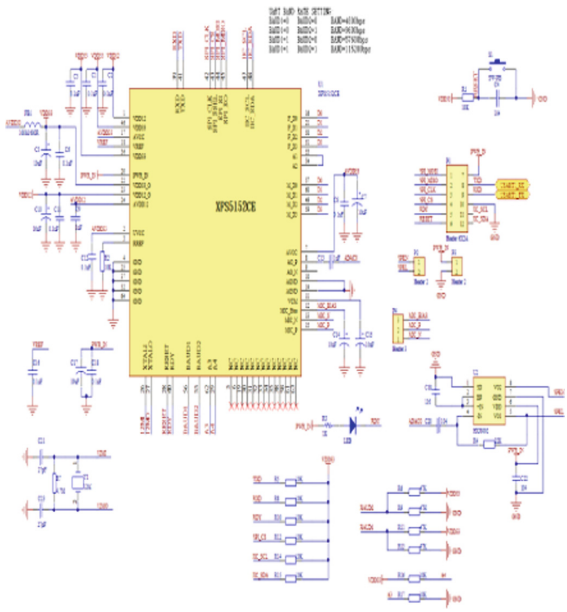

Fig. 2. Circuit diagram of minimum system of single chip microcomputer

The camera module is composed of OV5640 camera module interface and the DCMI interface provided by STM32F767IGT6 single chip microcomputer. It realizes the function of image capture, and then converts the captured pictures into gray-scale images to identify the QR code booth information contained in the images.

The robot system needs storage equipment to store and call the text information of the exhibition hall and booth. In the application examples of single chip microcomputer, the most common one is the SD card, which can store a lot of information, and the SD card has a variety of sizes according to its application occasions. In this subject, we use the 16 GB SD card, which can fully meet the needs of the subject. Its driver uses the SDMMC interface of STM32F767IGT.

The speech recognition module used in the subject is YS-LDV7 integrated speech recognition module, which is mainly composed of STC11l08XE MCU controller and LD3320 speech recognition chip. Its RECOGNIZABLE range is limited. In a single speech information recognition, only 50 keywords that have been set can be screened. The speech recognition chip LD3320 is designed by using the technology of keyword Pinyin list that can be set at any time and the technology of non-designated voice recognition. LD3320 chip contains a/d function internally, and no external A/D chip is required.

2) Core control module
STM32F103ZET6 single chip microcomputer is the core part of the system. It is responsible for receiving sensor measurement information, walking control of sweeping robot, garbage cleaning and other actions.

3) Drive module
The exhibition hall introduces that the robot is driven by a two wheel DC motor. In order to ensure the stability of tracking, a supporting wheel is added, which only follows the rotation without driving. At the same time, the high-performance small volume motor driver chip drv8833 is adopted.

4) Speech synthesis module
The speech synthesis module used in this system is designed by iFLYTEK, which includes XFS5152CE chip, 2W speech external horn and power amplifier module.

5) Power module
The robot uses an external battery to supply power. The battery is a 12 V rechargeable lithium battery composed of three 18650 cells, with a capacity of 1500 mah and a sustainable current of 3 A. The battery forms a stable 5 V voltage through the MP2359 dc/dc step-down converter through the power jack to supply power to the motor drive module, speech recognition module, tracking module and infrared proximity sensor. This 5 V voltage forms a 3.3 V voltage through AMS1117-3.3 low voltage drop regulator, which supplies power to the control core of STM32F767IGT6 and STC11l08xe, and also supplies power to SD card module, camera module and voice synthesis module.

B. Software Design of the System
The software design logic of this subject is: after the initialization of single chip microcomputer, start the camera module, voice recognition module, SD card module, infrared proximity sensor module and voice synthesis module. Under the condition that the exhibition hall information does not need to be updated, the infrared proximity sensor

recognizes whether there are exhibitors within about 1m in front of the robot. If so, it broadcasts the relevant information to guide the exhibitors through the speech synthesis module, extracts the keywords of the exhibitors' speech content through the speech recognition module, matches the relevant exhibition hall response information stored in the SD card, and broadcasts the response information through the speech synthesis module. After completing a dialogue, re recognize the voice information for subsequent human-computer interaction.

1) System Overall Operation
The overall operation flow chart of the system is shown in Fig. 3.

2) SD Card Module Program
It is the flow chart of SD card module in Fig. 4. The reading and writing of SD card information are completed by FATFS file management system. After the system runs, first mount the SD card on the FATFS file management system, then initialize the SD card, and then use the interface function provided by the FATFS module to write the function interface in the actual application. After that, the file can be opened, read (or wrote) and closed.

C. Physical Debugging of the System
Firstly, We stick black tape for tracking route planning, and place four booth information QR codes and one tracking start/end QR code at intervals next to the tracking route. After the robot receives the voice command "start exhibition hall information update", turn on the camera to recognize the QR code, and the robot starts to follow the trail. When the robot recognizes the QR code information, it broadcasts the voice information of "recognition success". During the identification process, judge whether all QR codes

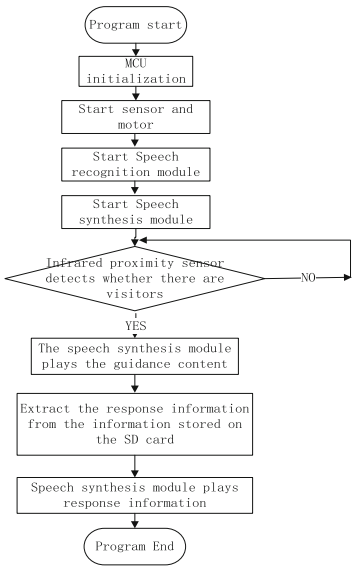

Fig. 3. The overall operation flow chart

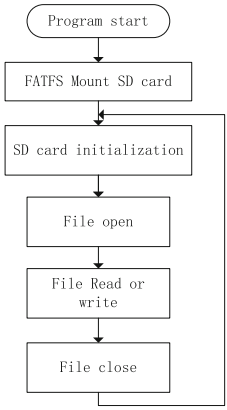

Fig. 4. Robot walking program flow chart

have been identified. If not, continue tracking. After all booth information QR codes have been identified, judge whether the QR codes at the start (or end) of tracking have been identified. After the identification is successful, the tracking ends, and the robot stops at this position to wait for the interaction of exhibitors.

When the exhibitors approach the robot, the infrared proximity sensor recognizes the exhibitors, the voice broadcast welcomes the object, and begins to interact with the exhibitors with guiding words. Match and recognize keywords according to the voice information of exhibitors, submit relevant response information by voice, and then make the next communication guidance according to the response information. When the exhibitor leaves the recognition range of the infrared proximity sensor, the voice will send the farewell greeting.

4 Conclusion

In this topic, we introduces an intelligent human-computer interactive exhibition introduction robot applied in the exhibition site of large-scale auto show. The exhibition introduction robot uses STM32F767IGTT and STC11l08XE single-chip microcomputer as the controller, uses infrared proximity sensor to detect the exhibitors close to the robot, recognizes the voice content of the exhibitors through the voice recognition chip LD3320, and identifies the exhibition intention, Use XFS5152CE speech synthesis chip to carry out human-computer interaction and explain the information of the corresponding booth in the exhibition hall; In addition, the infrared 5-way tracking sensor module is used to identify the driving line, and the OV5640 camera is used to identify the QR code information of the designated booth and store it in the SD card, so as to update the on-site layout and booth information of the auto show, and then complete the construction of the auto show introduction robot.

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