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Networked robot identification technology for multi objects based on RFID-ZigBee

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Abstract. In order to identify and monitor a large scale of indoor personnel, this paper combines network robots, RFID and ZigBee, and designs a network robot identification system. CC1110 is used to formulate RFID module, CSMA are combined with TDMA to fulfil multi-card function and overcome data collision. With the processing core S3C6410 and software technology like Linux multi-thread and H.264 decoding, the robot serves as a mobile node to identify IDs and displays guidance video according to targets priority. Gateway module is designed to collect IDs and delivery commands. PC monitoring centre based on Qt can receives IDs and displays them. Test results show that the system can identify targets accurately and provide high-priority goals with guiding service, meets the application requirement.

1. Introduction

In recent years, the aging population has become a serious social problem China and all over the world, the sixth census data show that China's population over the age of 65 reached 118 million, accounting for 8.87% of the total population, compared with the data of the fifth census, an increase of 1.19% points[1]. In the current population situation, it is necessary to study the human monitoring and service system. The radio frequency identification (Radio Frequency Identification, RFID) has higher identification accuracy, non-contact, is often used in the family, hospital, mine, production lines and other scenes, but RFID has a small range of recognition, layout of high cost, large power consumption of less than[2]. A single application RFID often fails to complete a large scale, continuous monitoring work. ZigBee is a short-range, low rate wireless network technology, the ZigBee combined with RFID, RFID can expand the recognition distance, reduce the RFID net cost, and more fully play the two key networking technology advantages. Foreign scholars and research institutions in the fusion of ZigBee and RFID were studied, some results have entered the stage of commercial application, personnel monitoring system such as dangerous working environment, automatic checkout system in the shopping center, the hospital patient identification monitoring system[3,4]. There are many research achievements in the integration of passive RFID and ZigBee in China, such as livestock information detection system applied in farm and monitoring system based on passive RFID[5]. Because the development of active RFID core chip technology in China is lagging behind abroad, its function is relatively complex, and the research on its integration with sensor network is less than that of passive

RFID. Most of the research results are still in the theoretical stage.

The network robot technology is a new, open, distributed robot control technology, which combines the traditional robot technology and the network technology. At this stage, the ability of robots is limited, and the sensors that are carried by themselves can not quickly and accurately identify and perceive the target and environment[6]. The introduction of robots into ZigBee-ID networks can not only improve the robot's ability to recognize and perceive the environment, but also increase the flexibility and robustness of sensor networks, reduce the number of sensor nodes and reduce the energy consumption of nodes[7]. This paper will combine ZigBee wireless communication technology, active RFID technology and network robot system, design an identity recognition system, complete the identification of objects in the environment, and provide video guided services for high service targets. The sweeping robot in the recognition system is shown in Fig. 1.

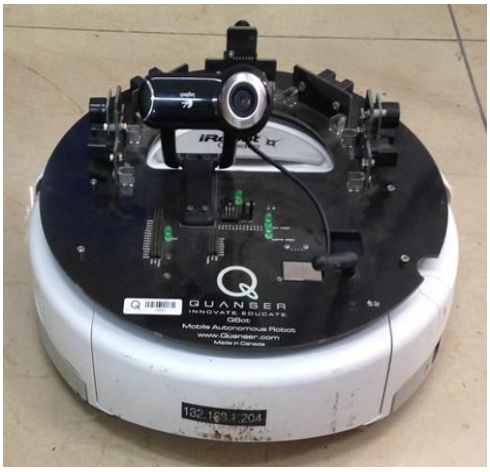

Figure 1. The robot in identification scene

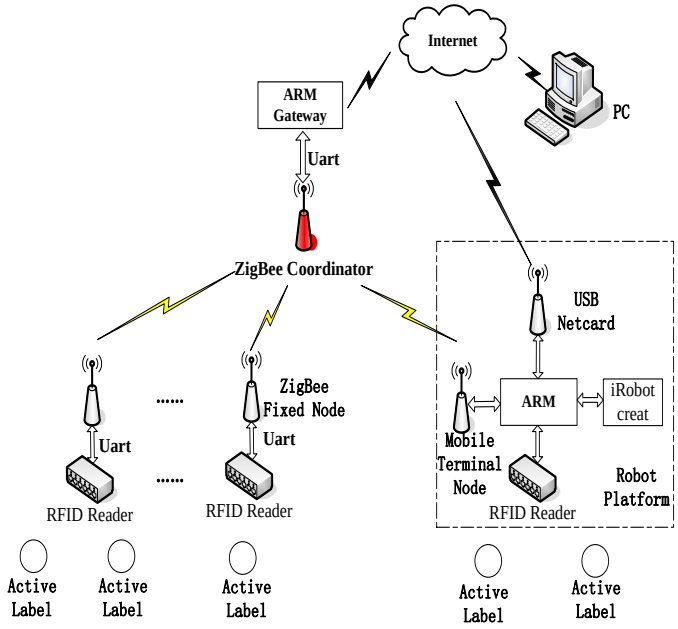

Figure 2. Overall design of system

2. System architecture and module division

The identification system is divided into four modules: ZigBee node identification module, robot node identification module, gateway module and upper computer monitoring center. The overall architecture of the system is shown in Fig. 2.

The system uses the ZigBee star type network, the RFID reader and the ZigBee terminal node as the fixed node identification module to collect the ID information. The robot takes the ARM processor as the core, carries the reader and the ZigBee terminal device, joins the identification network as the mobile node, identifies the active tag around the robot and provides video guidance service. For long distance ID, the robot uses the ZigBee network to upload information, and for the close range ID, the robot uploads ID directly through the WIFI. The gateway module and the host computer monitor center are responsible for the control of the whole system and the display of ID.

3. ZigBee node identification module

The ZigBee node identity module is responsible for collecting the ID information in the environment. After collecting the ID of the active label, the reader writes it to the serial port of the ZigBee terminal node, and then uses the ZigBee network to send the ID to the gateway.

3.1. RFID module design

In this paper, the C51RF-PS module is used to design an active RFID reading and writing module with a working band of 433MHz. The core of the module is the CC1110 of the RF chip of TI. The RFID module adopts the design mode of the reader's first request, and the tag can't send ID information without receiving the read and write card request. This mode is suitable for scenarios with complex functions and high security requirements.

To send card reader reads the tag according to the PC command, read or write a single card card reader tag according to the command, ordered to return their own ID. After receiving ID and completing the verification, the reader uploads the ID through the serial port.

3.2. Software design of ZigBee network module

The core of the networking module is the CC2430 chip of TI company. The coordinator needs to send the commands published by the host computer to the various terminal nodes in the form of broadcast and write commands to the reader through the device's serial port. The terminal node needs to send the collected ID to the coordinator in the form of uncase and upload the ID through the coordinator's serial port.

In this design, the Z-Stack protocol stack is modified in the IAR Embedded WorkBench development environment. In the Sample App project, add serial callback event, and registration of serial uartCB callback function in the SPIMgr_Init function, when the serial port after receiving the message, the system will call the UartCB function to read serial data, finally calls the SampleApp_SPI_SendData function to send information to the air.

After receiving the information from the air, the node triggers the event AF_INCOMING, and calls the information processing function SampleApp_Message. Finally, it calls to write the serial port write function HalUARTWrite, and writes the data to the device serial port. Through the modification of these two parts, the intercommunication of the serial port information of the network module is realized.

4. Robot node identification module

The robot node uses the ARM11 development board as the control module. The core of the robot is the S3C6410 produced by the Samsung Corp. A LCD screen with a resolution of 480x272 is mounted on the board. The robot carries a reader to collect ID information. The USB wireless network card and the ZigBee terminal equipment are responsible for the communication between the robot and the host computer and the gateway. The architecture design of the robot recognition module is shown in Fig. 3.

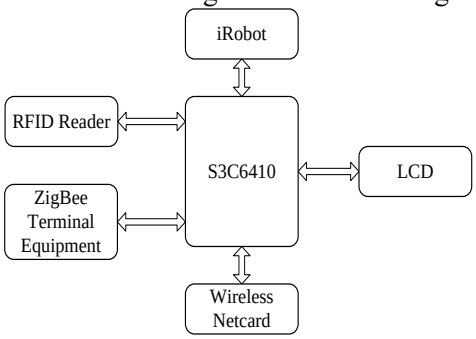

Figure 3. Design of robot identification module

In this design, Linux is selected as the ARM on board operation system. By transplantation of u-boot, operation system, file system and mpeg decoder, we can complete the building of embedded software environment.

The ARM core control program of the robot completes the transmission of the command, the uploading of the ID information and the decoding and playing of the corresponding priority - guided video. The program main thread first initializes the device and sets up the socket communication, then

creates the command sending thread, the ID collection thread, the ID upload thread and the video service thread.

Once the service thread receives the service request, the video service thread creates three threads to perform the decoding and playing of the H.264 video. The sub package thread reads and stores the compressed video frames in the stream. The compressed video frames are decoded into video data by the decoding thread. After the playback thread gets the video data, it converts it to RGB format and displays the video frame.

5. Gateway module and PC monitoring center

5.1. Design of gateway module software

The core of gateway module also adopts S3C6410. ARM boards receive ID from each identification module through ZigBee coordinator serial port, and use network card to complete communication with host computer. This section mainly introduces the software design of the ARM core. The program master thread first opens and configures the coordinator serial port, and then starts each thread. The command sending thread is responsible for sending the commands of the host computer to the serial port of the ZigBee coordinator, and then broadcast to the individual identification modules. The ID collection thread and the ID upload thread are responsible for sending the collected ID to the upper computer via WIFI.

5.2. Software design of monitoring center of upper computer

In order to realize the control of the whole identification system, this paper uses Qt to design the monitoring interface of the upper computer.

After the monitoring interface is started, clicking on the button of the connection interface of the device is connected to the gateway module and the robot recognition module. The equipment after a successful connection, through the query operation, write card scanning, three sub interface cards for issuing a read system, read or write a single card command.

6. System experiment and analysis

The system experiment is carried out in the laboratory room and the experimental environment is arranged as shown in Fig4.

Four ZigBee identity nodes and a robot identity node are set in the room. After starting the upper computer interface and connecting with the various recognition modules, the three recognition targets carry the label into the laboratory.

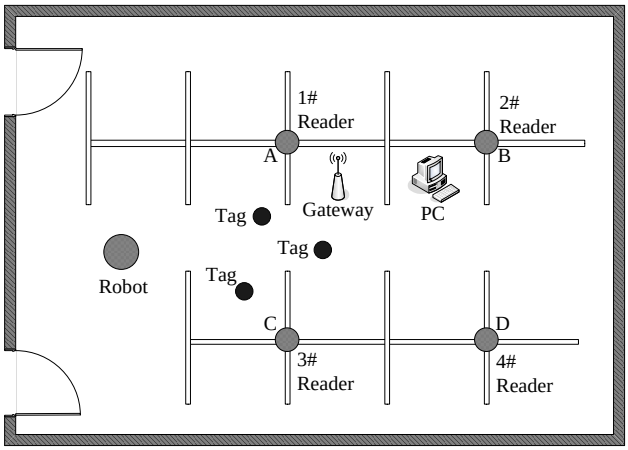

Figure.4 Robot multi-card test result

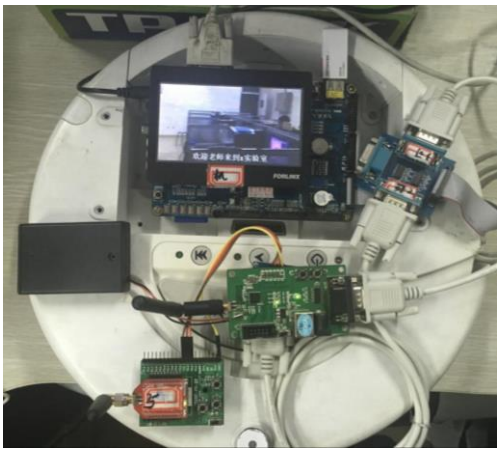

Figure.5 Robot's multi-card test result

Through the operation of the upper computer scan, query, write the card interface to complete the system function test. Figure 5 is a multi function robot node test results, the robot can read in three labels the identity information and for which the priority of service providing video guide service for the VIP target.

7. Conclusion

In this paper, the RFID, ZigBee and the three popular technology of the robot are combined to complete the design of the identity recognition system for the network robot. The use of TDMA mechanism and carrier sensing mechanism to achieve the RFID card identification function, design of the robot control program by using Linux multi thread technology and video decoding technology, which can identify the target according to the priority broadcast video guide. The monitoring interface based on QT can complete the control of the system and the display of the ID. The experiment shows that the functions of the identification nodes of the system are normal, and the robot nodes can provide the guidance service according to the identity information.

Acknowledgments

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