International Journal of Smart Home
Vol. 10, No. 6 (2016), pp. 261-266
http://dx.doi.org/10.14257/ijsh.2016.10.6.25

Research on Speech Control Toy Car based on Single Chip Microcomputer

Guo Hongtao

North China University of Water Resources and Electric Power, Zhengzhou, Henan, 450045, China
htguo2000@163.com

Abstract

The speech recognition is a kind of technology, which makes a machine change the speech signals into homologous text or order by recognition and comprehend. The speech recognition is a cross-subject, and it is becoming to the key-technology of human-computer interface in information technology. It makes man can operate the computer through the speech order without the keyboard. Speech recognition technology has be used in fields such household electronic products and intellectual toys. The bus controlled by speech signals proposed in this paper will be more powerful than traditional toy bus. It will be structure simple, strong stability, high precise. More important, its speech control system will has especial attraction to children. This paper Introduces hardware system and software system of speech control intellectual toy bus.

Keywords*: The speech controls; Intellectualization; Single Chip Machine*

1. Introduction

The Speech Recognition is a Technology, which can change the speech signals into homologous text or order by recognition and comprehend. The speech recognition is a cross-subject, gradually becomes the key technology of human-computer interface in information technology. It make man can operate the machine through the speech order without the keyboard. Traditional remote control car make the controller give out different frequency radio waves by selecting different keys. After the radio receiver in the car receive radio waves, Drive power system,

Realize control system for the car all kinds of action. The traditional remote control car complex structure, Poor stability, precision low. The bus controlled by speech signals that we design Identify people send commands by the embedded speech recognition system, Then press command driven power system, make car "forward", "reverse", "left", "right", " speed governing". The bus controlled by speech signals has not only function that traditional bus has , but also structure simple, strong stability ,high precise. More important, its speech control system will has especial attraction to children.

2. System Composition and the Basic Principle

The intelligent car controlled by speech signals is composed by the hardware system and software system. Speech control intellectual toy bus system mainly includes the main control unit, speech recognition unit, drive control unit, motor unit, *etc*. The main control unit is the control core of the system, embedded control system that is developed by using Single chip SPCE061A with 16 bits. It is composed by Single chip SPCE061A and the main program. Speech recognition unit is composed by audio circuit, speech training program, and speech recognition program. Audio circuit includes voice signal input circuit and speech output circuit. Voice signal input circuit converted speech signal by microphone to electrical signals, then processed by speech recognition program and give

ISSN: 1975-4094 IJSH

out control signal by CPU. After digital signals command that CPU output is made D/A conversion, speech output circuit drive the speaker sound, and drive control unit drive motor work. Drive control unit is composed by drive control circuit and executive subroutine. The hardware system of speech control intellectual toy bus is composed by the core control circuit, audio circuit, drive control circuit, and motor unit. The core control circuit is embedded control system that is developed by using Single chip SPCE061A with 16 bits. The main function of drive control circuit is that drive motor forward、reverse、stop by control signal that CPU sends out through B port. Software system is composed by the main program 、voice training subsystem 、Speech recognition subsystem 、command execution subroutine.

When people send out voice commands, speech recognition control system compare the voice command obtained with entry in Word Bank that have been trained, and then control the motor movement Through the drive control unit to complete the car. The basic working principle of Voice control car is shown in Figure 1.

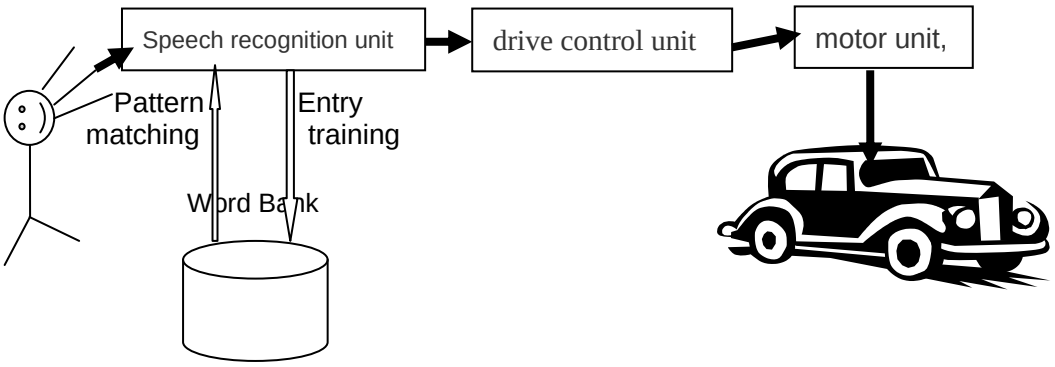

Figure 1. Voice Control Toy Car System Schematic Diagram

3. System Hardware Circuit Design

3. 1 Speech Recognition Module Circuit

The core of speech recognition system of voice control car (voice processing system) is single chip SPCE061A with 16 bits. Peripheral hardware circuit design of Speech recognition module is mainly audio circuit design.

Audio circuit is composed by the microphone circuit in Figure 2.

In Figure 2, X1 is MIC input end of the speech.

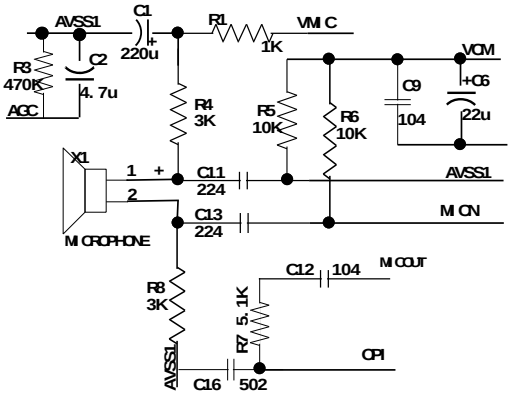

Figure 2. Sound Control Module Circuit Diagram

3. 2. Drive Control Module Circuit Design

(1)Drive Motor Control Circuit

Power drive is driven by the rear wheel, responsible for the car straight direction, including forward and backward. The rear drive circuit is a whole bridge driving circuit, as shown in Figure 3.

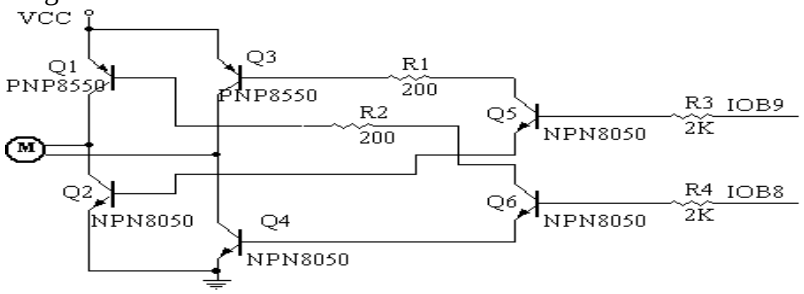

Figure 3. The Rear Wheel Motor Drive Circuit

The rear wheel motor is controlled by IOB8、IOB9 of Sunplus 16-bit microcontroller through the drive circuit. When IOB8 is high level and IOB9 is low level, Q1 and Q4 conduction, Q2 and Q3 cutoff, rear wheel motor is turned forward, the car ahead; when IOB8 is low level and IOB9 is high level, Q1 and Q4 cutoff, Q2 and Q3 conduction, the rear wheel motor reversal, the car back; when IOB8 is low level and IOB9 is low level, Q1、Q2、Q3 and Q4 cutoff, the rear wheel motor stop, and then the car stop moving.

Note: IOB8 and IOB9 can't set high level at the same time, otherwise it will cause the rear wheel drive bridge short circuit phenomenon.

(2)The direction motor drive control circuit

Direction control is driven by front-wheel (left turn or right turn). The front-wheel drive circuit is a whole bridge driving circuit as shown in Figure 3.The only difference is that the front wheel motor is controlled by IOB10、IOB11 of Sunplus 16-bit microcontroller through the drive circuit.

Comparison table of the car running status and the input is shown in the table 1.

Table 1. Comparison Table of the Car Running Status and the Input

IOB11	IOB10	IOB9	IOB8	behind motor (Driving motor)	front motor (direction motor)	Car
0	0	0	0	Stop	Stop	Stop
0	0	0	1	forward	Stop	forward
0	0	1	0	reversal	Stop	back
0	1	0	1	forward	forward	turn left front
1	0	0	1	forward	reversal	turn right front

4. Software Design

After the completion of the hardware system design, the software system of speech control intellectual toy bus system must be designed. System function is implemented by hardware and software together, neither can do without the other.

4.1 The Main Program Design

The main program mainly includes Initializes、the training、recognition and execution. The main program flow of voice control car is as follows:

(1) Initializes;
(2) If Not trained then training and save the training results else load the voice model;
(3) Voice command recognition and execute;
(4) If it is end order then clear model store area、reset and end else go (3).

4.2 The Design of the Subroutine

4.2.1 The Program Design of Training Process (TrainingSsubroutine): Work of training process is that voice model is set up, mainly by calling the subroutine TrainWord (unsigned int WordID, unsigned int SndID). Training process is as follows.

① Initializes RAM.
② Extracts the feature of the same voice command of speech signal. If the training success then store the voice commands (the voice model) else go to step ②
③ If you want to continue training then go to step ② else end.

4.2.2. Identification Process Programming: First initialize the recognizer, then voice is sampled and recognized. If not voice command (Has does not match with any word in the thesaurus) then resampling else Execute the voice command.

```
void BSR(void)
{
  int Result;                          // Store identification results
  Result = BSR_GetResult();      // To obtain recognition results
  if(Result>0)                         // Have a voice trigger
  {
    switch(Result)
    {
      case STOP_ID:                //stop command
      Stop();                          // Stop function
      break;
      case COMMAND_GO_ID:GoAhead();        // forward command
      case COMMAND_BACK_ID:BackUp();      // reverse command
      case COMMAND_LEFT_ID:TurnLeft();      // left turn command
      case COMMAND_RIGHT_ID:TurnRight();  //right turn command
      default:
    }
  }
}
```


4.2.3 Voice Command Execution Program Design: Execution of stop command, forward command, reverse command, left turn command, right turn command are realized by calling the function Stop()、GoAhead()、BackUp()、TurnLeft()、TurnRight().The body of TurnLeft()、TurnRight()、Stop()、GoAhead()、BackUp() function mainly output control command through B sport of single chip SPCE061A. The output control command as shown in table 1(comparison table of the car running status and the input).

5. Experiment

5.1 Experiment Design

Conduct an experiment on speech control intellectual toy car. We have done four experiments. For each experiment, choose a person to read the words “forward”, “reverse”, “left turn”, “right turn”, “stop” for training, said by the man A; choose another person to give voice command “forward”, “reverse”, “left turn”, “right turn”, “stop” to make the car perform, said by the man B. In every experiment, each command to do two times. We have done ten times, Record the number of the car run successfully, In the first experiment, A、B are the same person, speak Chinese; in the second experiment, A and B are not the same person, speak Chinese; In the third experiment, A and B are the same person, speak English; in the fourth experiments, A and B are not the same person, speak English.

5.2 Experimental Result and Analysis

The experiment specific result as shown in table 2. In a column of table 2, B=A means A and B are the same person.

When A and B are the same person, the success rate is very high, both speak English and Chinese. When A and B are different people and say standard voice command, the success rate is quite high. In addition, when A、B are different people and say voice command in local dialect, the success rate is very low, can’t even recognize. This situation is not in the table.

Table 2. The Experiment Specific Result

	experiment 1	experiment 2	experiment 3	experiment 4
Person A	A	A	A	A
Person B	B=A	B	B=A	B
language	Chinese	Chinese	English	English
Number of voice command	10	10	10	10
Number of successful	10	7	10	8
success rate	100%	70%	100%	80%

6. Conclusion

The experimental results on speech control intellectual toy car that we design show that the car has not only function that traditional bus has , but also structure simple, strong stability, high precise. Speech control intellectual toy car based on single chip microcomputer has strong practical value and broad market development prospects.

Innovation points of the author: Storage and processing capacity of single chip enables the Speech control intellectual toy car to have higher technological content, shorter

development cycle and lower cost. More important, its speech control system will has especial attraction to children.

Acknowledgements

This work was supported by the National Natural Science Foundation of China under grant No.U1304606, and the Science Technology Development Project of Henan Province under grant No.132102210555. It was also supported by Foundation of Henan Educational Committee under grant No 14A520010.

References

[1] T Perumal, NM Sulaiman, KY Sharif, *et al*. "Development of an Embedded Smart Home Management Scheme[J]", International Journal of Smart Home , vol. 7, no. 2, **(2013)**, pp. 15-26.
[2] T Han, Y. Seo "Development of a Service Robot System for a Remote Child Monitoring Platform [J]", International Journal of Smart Home , vol. 8, no. 5, **(2014)**, pp. 153-162.
[3] X Ri, L Jing-chen, Y,Hao *et al*. "Design and Implementation of Remote Control System for Mobile Platform Based on Interoperation of Android and Arduino[J]", International Journal of Smart Home, vol. 8, no. 4, **(2014)**, pp. 105-112.
[4] GH. Ta, "The Design and Realization of the Household Intelligent Alarm System [J]", International Journal of Smart Home, vol. 9, no. 6, **(2015)**, pp. 83-90.
[5] BJ Koo, YS,Park, SH Yang. "Microcontroller Implementation of Rule-based Inference System for Smart Home [J]", International Journal of Smart Home, vol. 8, no. 6, **(2014)**, pp. 197-204.
[6] D. Seo, Y. You, K. Lee, "Security Control Analysis of Ics [J]", International Journal of Security and Its Applications, vol. 8, no. 3, **(2014)**, pp. 137-142.
[7] S Jung, D Kim, S. Kim, "Cooperative Architecture for Secure M2m Communication in Distributed Sensor Networking [J]", International Journal of Security and Its Applications, vol. 8, no. 3, **(2014)**, pp. 175-184.
[8] L Wang, D Peng, T Zhang, "Design of Smart Home System Based on Wifi Smart Plug[J]", International Journal of Smart Home, vol. 9, no. 6, **(2015)**, pp. 173-182.
[9] Y Park, Y Choy, W. Shon, "Study on Financial-sector Information Security Level Assessment and Improvement Anticipation Model [J].", International Journal of Security and Its Applications, vol. 8, no. 6, **(2014)**, pp. 147-160.

