The control system of intelligent wheelchair

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***Abstract*—A control system of intelligent wheelchair based on spce061A and C8051 is introduced in this discourse. It also introduces the theory of the control system, and the design of hardware and software. The control system including the speech control system of SPCE061 and the keyboard control system of C8051.The movement including marching, countermarching, speedup, slowdown, turning left, turning right, uphill and downhill were realized. The speech control system control based on SPCE061A and C8051 is simple, a high ratio of capability to price. The system can be easily realized and enlarged.**

Keywords-Speech recognize; SPCE061A; C8051DF020

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1 Introduction

Every year, the traffic accident, natural disasters and some diseases will make many people lose some physical part. Meanwhile, the number of older person is increasing year by year, the market about assistive products which can help the old people and disable person becomes more and more prosperity

It has been a hotspot in how to enhance the assistive products among the science research. There is no reason to doubt that wheelchair is definitely to be one of the most important assistive products. Now, researchers focus on the intelligent wheelchair design in order to satisfy with people's needs.

The speech recognition wheelchair is the most current to the intelligent assistive products. The speech recognize control system make the wheelchair to communicate with people through conversation. It will convenient for people who will use it.

2 Profile

2.1 Speech recognition

Speech recognition can divide the special person speech recognition and the normal person speech recognition. The special person speech recognition was researched in this discourse. The process of speech recognition consists of the input signal, pretreatment, feature extraction, the speech training, the speech storing, the speech recognize and the output signal. Principle of speech recognition is shown in figure 1.

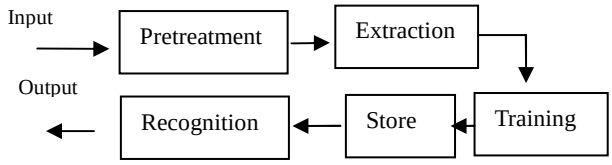

Fig.1 The principle of speech recognition

2.2 Keyboard control

The keyboard control system with stand alone structure is designed on both side of the wheelchair. A handle keyboard is also designed to help people control the wheelchair.

The keyboard control system has 9 keys. The 9 keys are connected with the C8051F020's P5.0-P5.4 Port and P7.1-P7.4 Port. The movements including marching, countermarching, speedup, slowdown, turning left, turning right, uphill and downhill were realized by the 9 keys. The control system adopts interruption model to get the key value. The port which is connected with the key will catch the 1 value when the key bounced, and catch the 0 value when the key pressed. The C8051F020 single chip will gain the value from the I/O port to realize the movements.

3 The hardware design

3.1 Overview

This control system is mainly finished with the Sunplus SPCE061 and C8051F020 single chip. The speech training and recognition are realized by the Sunplus SPCE061. The C8051 gains the speech recognize commands from RS232 serial port. When the command was recognized, the C8051 will control the motor which is assembled in the wheelchair.

The hardware design of the control system mainly including Sunplus SPCE061, C8051 single chip, FLASH store, the speech of input and output, power module, the voltage exchange module, the motor drive, stand alone keyboard, motor and wheelchair. The hardware of this control system is shown in figure 2.

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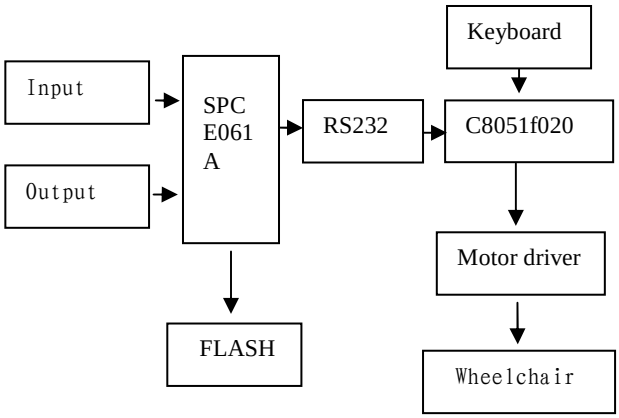

Fig,2 The hardware control system

3.2 MCU

MCU of the control system consists of the Sunplus SPCE061 and the C8051.

Sunplus SPCE061 including ICE, FLASH,I/O port ,Timer/Counter, interruption control, CPU clock, PLL, ADC+AGC and so on. The Sunplus SPCE061 has small size, high integration, reliability and excellent speech recognition

C8051F020 single chip contains the integration MCU chip, I/O port, two DAC of 12 bytes, FLASH, PGA , I2C, SPISMBUS,UART serial port and so on.

3.3 The drive motor module

This control system contains two DC servo motor and two stepping motor. The two DC servo motor is used to control the front wheel of the wheelchair, and the two stepping motor used at rear wheel.

The motor driver's voltage is 24V. The stepping motor is controlled by regulating frequency. The DC servo motor is controlled by PWM. The motor's speed and reverse are archived by the software design.

4 The software design

There are two portions about the soft ware design, one is the speech recognize of Sunplus SPCE061, the other is the control system of C8051F020.

4.1 The software design of speech recognition

The software design of speech recognize is designed in the μ'nSPIDE2.0.0. The μ'nSPIDE2.0.0 integrates the editing, the compiling, the linking and the debug together, which will make the operation more facility. Moreover, the online simulation can be made by this IDE, it also realizes system simulation. The software design mainly contains main program and interruption server program. It shows in figure 3.

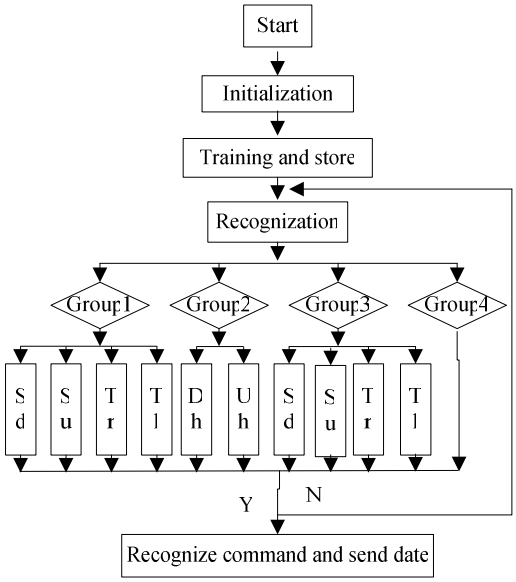

Fig3. The software design

The speech control system mainly contains the speech training, the speech store and recognition. We can train the speech through the input device. It is very important to train the speech in twice. Only in this way can we gain the exact speech information. The Sunplus SPCE061A can recognize and store many speech commands. We can divide many groups when we want to store lots of speech commands. One group can store 5 commands. The more groups, the lower speech recognize ratio. If we want to promote the speech recognition ratio, we must reduce the group. The experiment show that if we merely divides two groups when we train the speech command, we can also gain the high speech recognition ratio as like one group. Therefore, we can divide two groups when training the speech command in this control system.

The speech training progress can describe as follows: when we hear the voice which sound from the Sunplus SPCE061A is "Please input the first command", then, we input the first command is "Marching", when the first command is right, the Sunplus SPCE061A will tell you to input the same command once again. When the Sunplus SPCE061A tell you "OK", the speech command was trained. We can train others commands in this way. This control system contains five groups. The command is shown in the figure 3.

4.2 The software design of C8051

The software design of C8051F020 single chip execute in the Silicon Laboratories IDE. This IDE make the editor, compiling, linking, debug assemble together. We can see the variable in this IDE when the program is executed. This software design contains the mainly program, interruption program and the subroutine. It is shown in the figure 4.

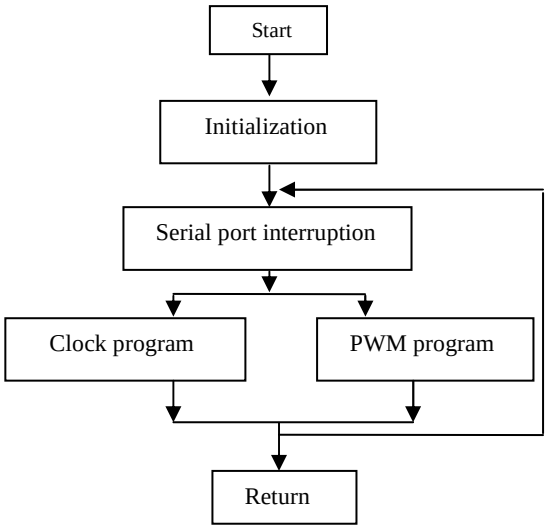

Fig4. The software design

The main program can divide three portions, which are system initialization, the serial port program, the control program of motor. We can choice the speech control or the keyboard control by DIP switch which is designed on the C8051FO20 single chip. If we choice the speech control, the main program will call the serial port program to receive the speech command which was sent from the SPCE061A. Meanwhile, the control program of motor will be executed to control the motor. If we chance the keyboard control, the process will be archived by C8051F020.

5 Results

We make an experiment about one hundred times in a quiet environment when we recognize the commands. We found it can be recognize about 96 times in an experiment, so we conclude the recognition ratio about 96%. What's more, the speech recognition results stable and exact in the testing. The movement of the wheelchair was controlled very well. With the help of the stand alone keyboard, people will operate the wheelchair convenient and fast.

From testing, the intelligent wheelchair can forward the highest speed is 4.5m/s, and the slowest is 20cm/s.

We can configure the speed is 40cm/s while considering the people's normal speed. The wheelchair has a good condition when it speed up or slow down. The biggest uphill slope gradient is 85°, the biggest downhill slope gradient is 85°. The speed is not slow when it uphill, and the speed is controlled well when it downhill.

Overall, the movements of the intelligent wheelchair are realized perfectly, it is a wonderful experiment.

6 Conclusions

The speech control has high practical value, which also has an important position in the current man-machine dialogue. It is an important tendency for intelligent products by inputting the speech command to the special mechanism in order to realize man-machine dialogue. A control system of intelligent wheelchair based on spce061A and C8051 is archived in this discourse. The SPCE061A has excellent speech recognition function, and the C8051 has excellent control function. We make the two excellent merits integrate together in this control system in order to control the wheelchair in the best way. The control system also realizes the speech control and the keyboard control, which makes the wheelchair to be a multifunction device. So it will be satisfy with custom's different requirements. This intelligent wheelchair has a high marketing value.

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