

The Design of Intelligent Wheelchair Based on MSP430

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Abstract. With the continuous development of the information society, R & D new intelligent wheelchair products, not only can better meet the needs of the elderly, but also can help the elders to improve the degree of freedom of action, to enable them better integrated into society. This design takes the MSP430 single chip microcomputer as the core control unit, through processing the data collected by the sensor to adjust the movement state of the intelligent wheelchair.

Introduction

With the deepening of the degree of aging society, elderly care become focus of social attention, improve the convenience of the elderly action intelligent elderly care product demand is growing^[1-2].

As an important means of transport of wheelchair disabled elderly people's daily life, plays an increasingly important role^[3]. However, the current electric wheelchair products only to replace the power of human power, the elderly in the use of the process is very difficult^[4]. With the continuous development of the information society, R & D new intelligent wheelchair products, not only can better meet the needs of the elderly, also can help older people to improve the degree of freedom of action, to enable them to better integrate into society^[5]. This design takes the MSP430 single chip microcomputer as the core control unit, through processing the data collected by the sensor to adjust the movement state of the intelligent wheelchair.

Scheme Design

Overall design overview

This design uses the MSP430 single chip microcomputer as the core of each module control; ultrasonic sensor and infrared sensor is used for detecting wheelchair operating situation of, smoke sensor mq-2 detection of harmful gases, and real-time transmits the signal to the microcontroller; power module with 12V electric car powered by lithium battery, voltage regulator module output need 5V, 3V voltage.

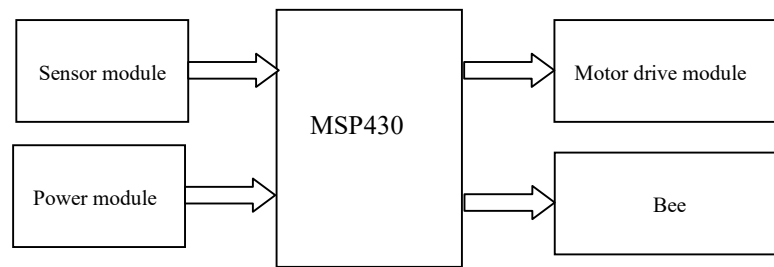


Fig.1 Overall design overview

Control system

Research focus of this design is to achieve the intelligent wheelchair's safe driving and intelligent obstacle avoidance, using multiple sensors to collect wheelchair around traffic information, the main control system need to have sufficient I / O pins, to accept both multiple sensor signals, the selection of MSP430g2553 device can meet the requirements.

Sensor module

This design uses three infrared module, two placed on the smart wheelchair central front, a placed on the smart wheelchair rear centre and on the front part of the intelligent wheelchair installation a ultrasonic module, with the ultrasonic module through the infrared module at the same time with the obstacle avoidance, which can comprehensively detect the presence of obstacles can also monitor whether there is danger of falling, the most comprehensive safe obstacle avoidance design reach the.

Motor drive module

H based on the PWM bridge circuit speed, can achieve continuously variable speed, the speed change is smooth, the speed regulation span is big, the overload ability is strong, can reliably complete the motor repeatedly start, brake and reverse and so on. Output control DC motor using power transistor as power amplifier. The design for the three intelligent wheelchair, two front wheels were by a DC motor drive control, by controlling the DC motor to two wheeled differential to complete steering, rear wheel Vientiane, the supporting role. The infrared module were placed in the intelligent wheelchair before and after the central, when the front part of the intelligent wheelchair cliff, the main control system will control wheel turn right, ultrasonic module is placed on the intelligent wheelchair front tilt steering gear for obstacle detection for intelligent wheelchair on both sides of the front and, when an obstacle is detected, the intelligent wheelchair will turn right, around obstacles.

Power module

Because there are lots of hardware used in this design is the need to achieve the function, so greater consumption in order to solve this problem and does not affect the performance, the design by 12V electric cars powered by lithium batteries, and the voltage regulator module step-down can greatly reduce the space occupied, was able to lose, very high utilization rate of batteries.

System hardware circuit design

Sensor module

The sensor module mainly uses the infrared sensor, the ultrasonic sensor and the gas sensor. The principle diagram of each sensor is shown in figure 2-4.

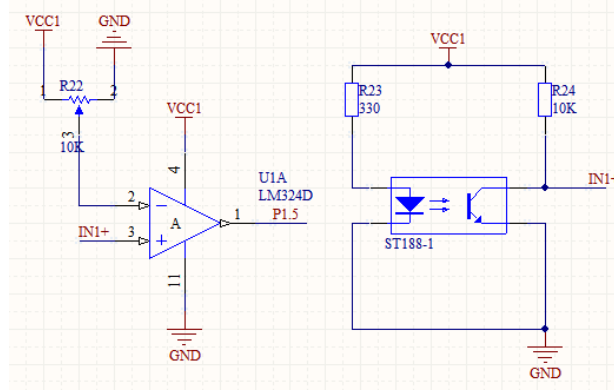


Fig.2 Infrared module circuit

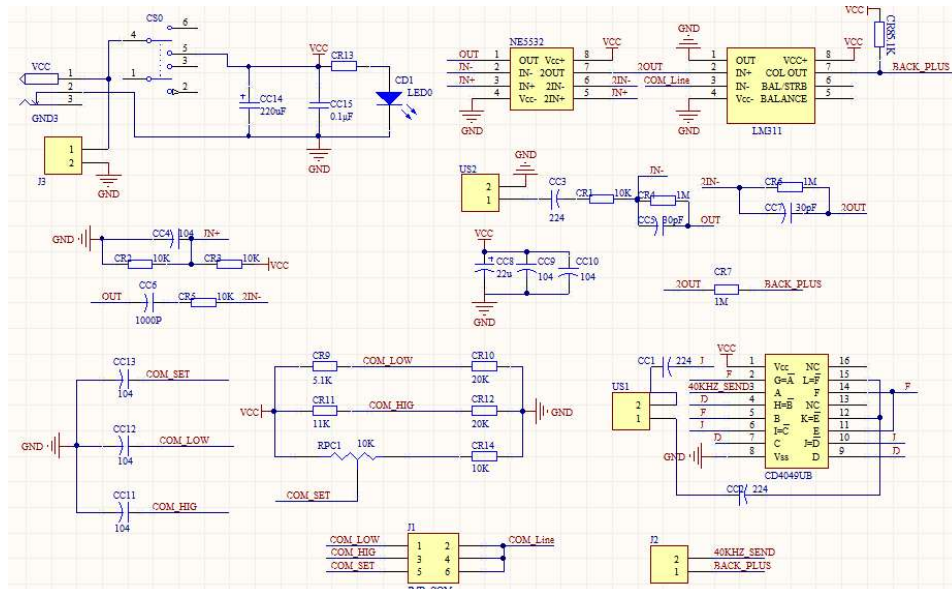


Fig.3 Ultrasonic module circuit

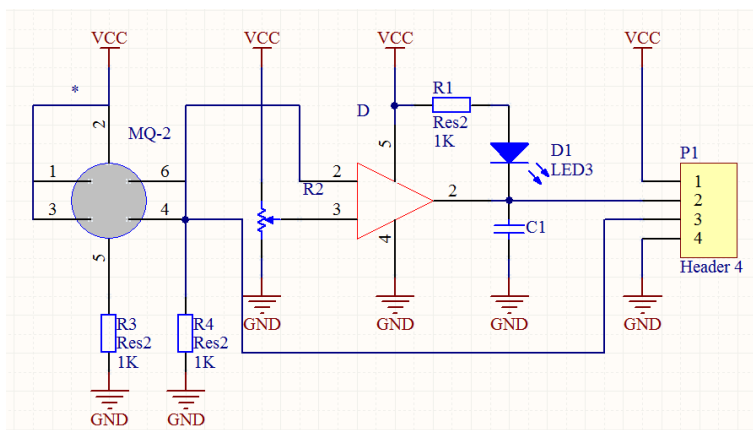


Fig.4 MQ-2 module circuit

Driving circuit

Motor drive using H bridge drive circuit, through the microcontroller to give the driver circuit PWM to control the motor of the intelligent wheelchair is reversing and start and stop. Drive schematic figure5.

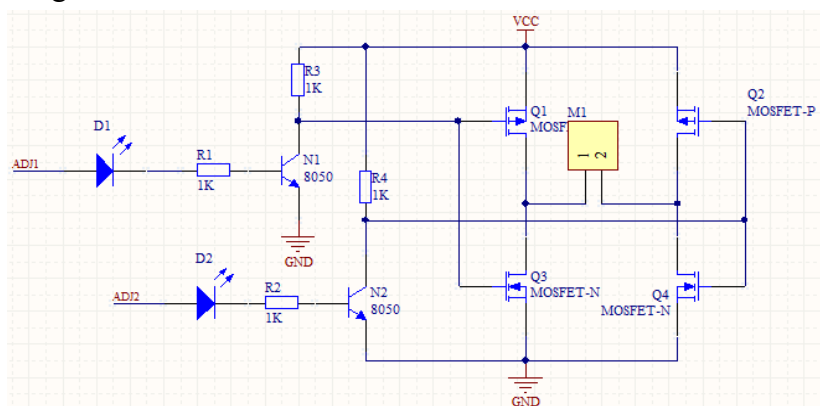


Fig.5 H bridge drive circuit

System power supply circuit

Each module of the requirements of the voltage is different, the need for a single chip voltage of 3V, and the voltage required for the motor is 5V. This design is used in the 12V lithium battery power supply, through the 5V to get the LM7805 voltage, through the LM7111 to get the 3.3V voltage.

Main control circuit

We use the PWM (Pulse Width Modulation) to carry on the electric motor's speed control, the PWM signal is produced by the single chip microcomputer software, uses the PWM method to be able to realize the speed regulation very easily.

Software design

This design uses the MSP430 microcontroller, select IAR as the programming software. A total of 16 I / O port using p1.0-p1.7 and P2.0-P2.7, which P1.0-P1.4 used to control DC motor, P1.0, P1.5 and P1.6 for receiving infrared signal module, P1.7 control rotary platform, P2.0-P2.3 for receiving the key signal, P2.4 and p2.5 for receiving and controlling ultrasonic module, p2.6 and p2.7 respectively receive mq-2 signal and control buzzer (see Fig.6-7).

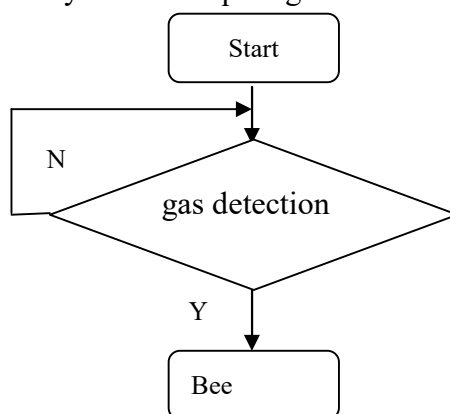


Fig.6 Gas detection

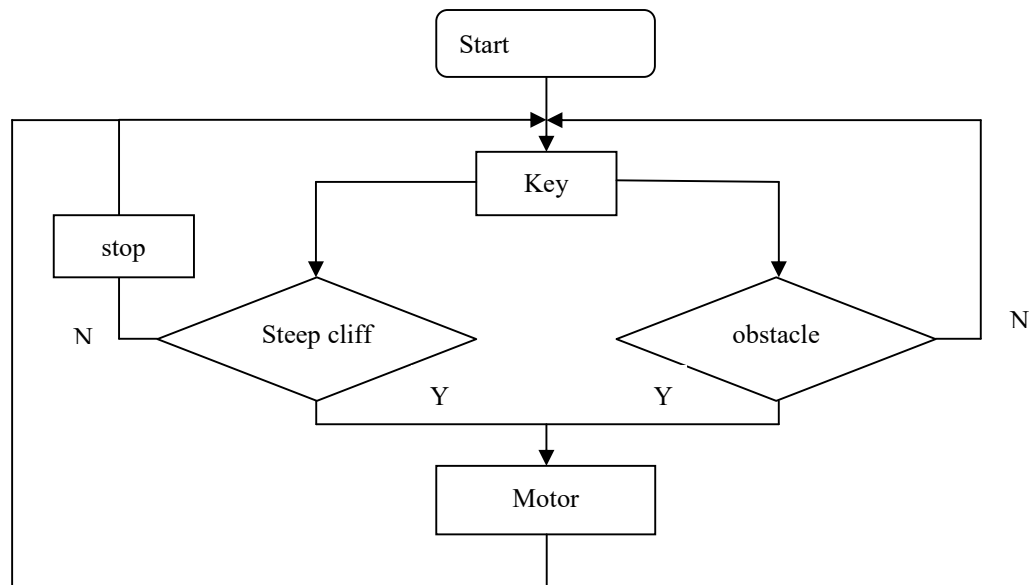


Fig.7 Procedure flow chart for obstacle avoidance

Conclusions

After testing, the intelligent wheelchair can realize the anti fall and the detection function of toxic gas, the basic realization of obstacle avoidance function, and can achieve a simple route planning. For complex line, due to the route algorithm, in which a large number of operations, the MSP430 microcontroller is bloated, with embedded module to optimize the design, it will be the future research contents.

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