Journal of Applied Science and Engineering Innovation, Vol.2 No.10, 2015, pp.382-384
ISSN (Print): 2331-9062
ISSN (Online): 2331-9070

The Design of Analog Road Sweeper Control System Based on STC89C52

GAO Chuan[1],HAN Liu[2],YANG Xuecun[3]

[1]*State Grid Xi'an Electric Power Supply Company,710032, Xi'an, Shaanxi, China*
[2]*Xi'An Aerospace Propulsion Institute, 710100,Xi'an, Shaanxi, China*
[3]*College of Electrical and Control Engineering, Xi'an University of Science and Technology 710054, Xi'an, Shaanxi, China*

Abstract: As a symbol of urban sanitation, road sweeper is a new efficient cleaning equipment setting road sweeping, garbage collection and transportation as one. In the analog road sweeper, STC89C52 microcontroller is taken as the core of the control system. L298N driver module is used as driving the car to work by two DC motors, two-way infrared tracking and three-way infrared obstacle avoidance can control the car to complete the straight, turn left, right and back and other functions. ISD1760 voice module is used to broadcast real-time status of the current car and be displayed on the LCD12864. There are two pump motors to complete water pumping and spraying operations. At the same time, tank water situation is detected by infrared tube. In the top of the trash, exhaust fans complete cleaning function. Two lift motor is used as lifting and lowering the two disks brush motor. Control panel brush motors are used for road cleaning.

Keywords Road cleaning; STC89C52; tracking; obstacle avoidance

INTRODUCTION

Road sweeping of the city has been inseparable from sanitation cleaners' hard work every day. They rely on their own hands to beautify the face of the city, but it must be noted that the efficiency of this manual cleaning is lower, the workload is larger. This kind is not conducive to the development of urban sanitation work. As a large-scale cleaning tools, road sweeper can travel in every street of the town, and complete relational cleaning work [Tan *et al.*, 2010]. In the country, using road sweeper in place of sanitation workers to carry out conservation pavement has become a trend. It can greatly improve the level of sanitation, reduce labor intensity cleaners.

SYSTEM DESIGN

Basic principles of road sweeper control system simulation work

The designed core is STC89C52 microcontroller in the road sweeper control system, controlling some hardware device for sweeper[Yan *et al.*, 2012]. On the top of tank, when infrared tube detects insufficient water tank level, the voice module broadcasts voice prompts, while the pump motor works to pump. Once the tank filled with water is detected, the two-way lift motor start to drop two disc brushes for sweeping decentralization, After the preparation is completed, the car enter the tracking state, while sprinkler pump motor start to work, the disc brushes began to sweep, exhaust fans sweep dust into the trash [Huang *et al.*, 2011]. In this process, the car can rely on five infrared tube for tracking, obstacle avoidance operation.

Hardware design

The entire road sweeper control system use STC89C52 as main controller.The system includes a power supply module, LCD12864 module, infrared tracking / avoidance module, infrared tube detection module, motor drive module, relay control module, ultrasonic ranging module, voice module and Zigbee wireless transmission module. Among them, fans, pumps and disc brush motors are controlled by a microcontroller controlling corresponding interface of relay breaking.Voice,ultrasonic and infrared modules are controlled by the microcontroller.Power supply module is accomplished by a hardware circuit. By cooperating on these modules it constitute the entire road sweeper control system hardware system. The block diagram of overall hardware design shown in Figure 1.

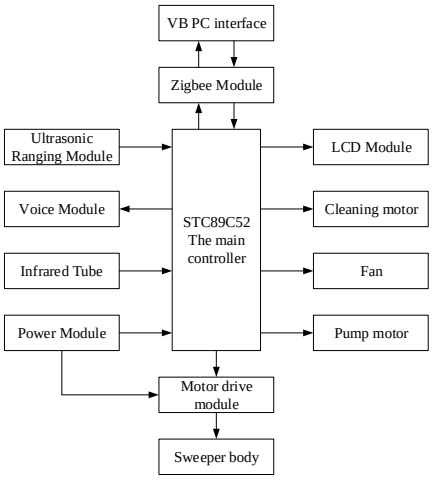

Figure 1. Block Diagram of Overall Hardware Design

Corresponding Author: GAO Chuan .State Grid Xi'an Electric Power Supply Company,710032,Xi'an, Shanxi,China

THE DESIGN OF MOTOR CONTROL CIRCUIT

In the design, the disc brush lifting descent module and the drive wheels are based on DC motors, and they need to control four. After comparing the program, Our final selection is the two comparative motor driver chip L298N, it just can control four DC motors, and have high precision and reliability. Motor-driven schematic shown in Figure 2[Jian et al., 2012].

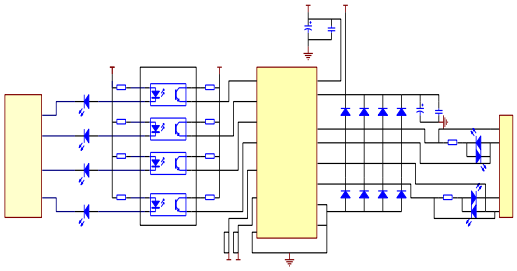

Figure 2.Motor-driven principle schematic

Among them, two DC motors connected respectively between OUT1 and OUT2, OUT3 and OUT4. INT1 and INT2, INT3 and NT4 control level input control motor reversing,stop through STC89C52 the I/O port access.The ENA, ENB enable terminal connected to select LM298N mode.

DESIGN OF TRACING OBSTACLE AVOIDANCE AND WATER LEVEL DETECTION CIRCUIT

In the entire road sweeper control system, tracking avoidance module consists of five pairs of infrared tube module, which has a pair of infrared transmitter and receiver tube. Transmitter tubes emit certain infrared frequency. When striking an obstacle in detecting direction, reflected infrared ray is received by receiver tube[Yu *et al.*, 2009].After the comparator circuit processing, the green indicator light up. While the signal output interface exports digital signal (a low-level signal), adjusting the detection distance by the knob on potentiometer. Its effective distance range of 2 ~ 30cm, the working voltage range of 3.3V-5V. Detection range of the sensor can be adjusted by way of a potentiometer, with a small interference, easy to assemble, easy to use features.

When a small car powered on, the water level detection module detects the water level. When the water is inadequate, receiving end receives a signal from transmitter[Wang *et al.*, 2009]. Low level signal is sent to the microcontroller by the signal line for impoundment operation. In the microcontroller the corresponding pin set to low trigger relay closed so that the pump works to add water. When the water level is enough, the receiver cannot receive the transmitter signal. The signal line will send a high-level signal to the microcontroller storage operation, and then, the microcontroller corresponding pin at high level will trigger the relay off so that the pump stops adding water. Circuit diagram of infrared obstacle avoidance module shown in Figure 3.

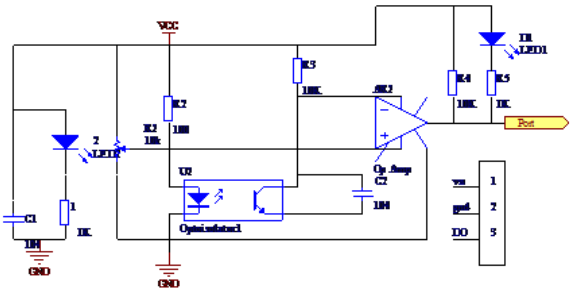

Figure 3.Circuit Diagram of Infrared Obstacle Avoidance Module

DESIGN OF VOICE BROADCAST MODULE

The voice broadcast module is achieved by using ISD1700 module. ISD1700 series recording chip can work at the independent case control mode and SPI control mode. The chip has a storage management system to manage multi-stage voice. There is a new recording prompt function. ISD1700 has two separate voice signal input channel, microphone input and analog signal input. [Lin *et al.*, 2009].In self-governed mode as a function key, after the operation is completed the chip will enter power-down mode to reduce power consumption automatically. The main microcontroller works serial communication through a four-wire (SCLK, MOSI, MISO, / SS) SPI protocol for ISD1700. As a slave, almost all the operations can be completed through the SPI protocol[Yu *et al.*, 2009]. STC89C52 microcontroller control ISD1700 module through the IO port. When ISD1700 module has been connected with our road weeper, the car can achieve "road sweeping car talk" function[Tan *et al.*, 2010]. Module circuit used in this design shown in Figure 4.

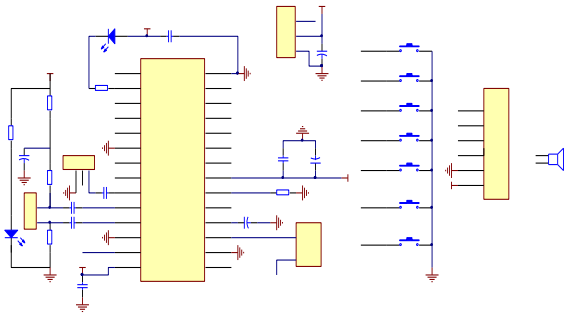

Figure 4.Circuit Diagram of Voice Module

DESIGN OF ULTRASONIC RANGING MODULE

In the module current driving conditions of car is collected by way of HC-SR04 ultrasonic distance sensor, then transmitted to the microcontroller to do appropriate treatment, and ultimately, the measured distance is displayed on the LCD. So that monitor can

know the obstacle in front of the car's current situation[Yu *et al.*, 2009].

HC-SR04 ultrasonic ranging sensor is developed by feature of ultrasonic sensors. The ultrasonic probe is mainly composed of a piezoelectric wafer, with an ultrasonic transmitting and receiving an ultrasonic apparatus.

Ultrasonic transmitter transmits the ultrasonic wave in one direction, at the same time starting the timer. The ultrasonic wave propagation in the air, and return immediately on the way encounter obstacles[Jian *et al.*, 2012]. Ultrasonic receiver received the reflected wave stop the clock immediately. The speed of ultrasonic wave propagation in air is about 340m/s. According to time recorded by the timer, you can calculate the distance between the transmitter's location and obstacles (S): S = 340t/2. HC-SR04.Ultrasonic transmitter and receiver circuit diagram shown in Figure 5 and Figure 6.

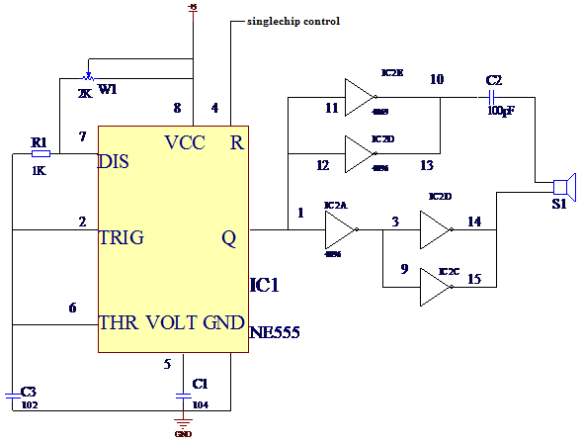

Figure 5.HC-SR04 ultrasonic transmitting device circuit diagram

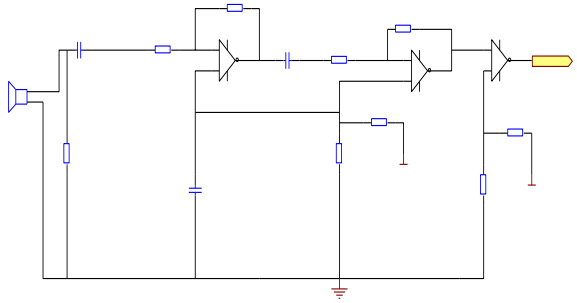

Figure 6.HC-SR04 ultrasonic receiving device circuit diagrams

SOFTWARE DESIGN

In the design STC89C52 micro-control chip is used as the main controller, to control the road sweeper various hardware. The control system is divided into multiple modules. There are subroutine modules needed to design: LCD12864 display module, motor drive module, infrared tracking / avoidance module, voice broadcast module, ultrasonic ranging module.

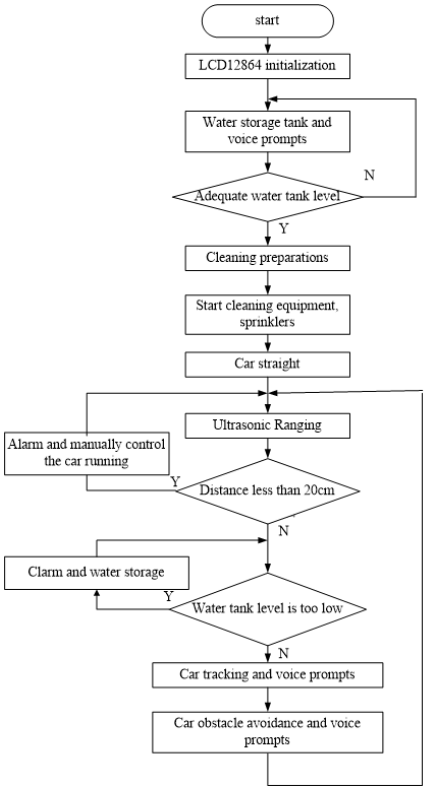

Figure 7. Main program Flow diagram

CONCLUSION

After joint commissioning of hardware and software, the results simulated road sweeper control functions are realized. We have completed the road sweeper walking, tracking, obstacle avoidance, cleaning, water testing, garbage absorption and other functions. This system has good feature of stability.

REFERENCES

Huang Weiliao. 2011, "Design and implementation of electric sweeper electrical system", [J].Journal of Shaoguan University.

Jian jie, Zhang Tieshan. 2012, "Design and Research of electric sweeper Cleaning operation device",[J]. Special Purpose Vehicle.

Linli. 2009,"Based on Proteus and KeilC'',[M]. Publishing House of Electronics Industry .

Tan Haoqiang.C 2010, "Programming (4th edition)'', [M]. Tsinghua university press .

Wang Dongfeng. 2009,"Microcontroller C language application 100 cases [M].Publishing House of Electronics Industry .

Yan Pinghua. 2012, "Electric sweeper overall design and power system study ",[D] .Nanjing: Nanjing University of Science and Technology,china.

Yu Luojian. 2009 ,"The design of automatic sweeper based on MCS-51'' [J]. Digital Technology and Application.