Design of Vehicle Intelligent Anti-collision Warning System

Qiguo Yao [1, a *], Yuliang Liu [2,b]

[1] School of Naval Architecture & Ocean Engineering, Zhejiang Ocean University, Zhoushan, Zhejiang, 316022, China.

[2] School of Naval Architecture & Ocean Engineering, Zhejiang Ocean University, Zhoushan, Zhejiang, 316022, China.

[a]yaoqiguo@163.com, [b]lyl_zjou@126.com, [*]corresponding author

Keywords: Single Chip Microcomputer AT89C51; Distance Measurement of Ultrasonic; Anti-collision Alarm; Astern Radar

Abstract. This paper designs a vehicle intelligent anti-collision warning system based on the single chip microcomputer AT89C51, which has such characteristics as low cost, high-accuracy, micro-miniaturization, digital display and acousto-optic alarm function. The system includes forward anti-collision warning system, auto parking system, as well as astern anti-collision radar system. It is mainly developed on the basis of ultrasonic distance measurement, and the performance of system is reliable. Thus, the safety of driving is greatly improved, and the efficiency of parking and astern will be enhanced enormously.

Introduction

This paper designs a vehicle intelligent anti-collision warning system based on the single chip microcomputer AT89C51, which has such characteristics as low cost, high-accuracy, micro-miniaturization, digital display and acousto-optic alarm function. The system includes forward anti-collision warning system, auto parking system, as well as astern anti-collision radar system. It is mainly developed on the basis of ultrasonic distance measurement, and the performance of system is reliable. Thus, the safety of driving is greatly improved, and the efficiency of parking and astern will be enhanced enormously.

Hardware structure design of the system

AT89C51 is an 8-bit single chip microcomputer which has low voltage, high performance CMOS, and it contains 4k bytes of flash read-only memory and 128 bytes of data random access memory. This single chip microcomputer is produced by ATMEL company and compatible with the standard MCS-51 instruction system. In the case of less peripheral circuit constitute, it can be built a functional ultrasonic ranging system.

Design of the button control circuit. This design uses the independent button control, its function mainly includes the start and stop of the control system, as well as the selection of working mode. Among them, the function of key 1 is to control the forward anti-collision warning system, and the function of key 2 is to control automatic parking system, the function of key 3 is to start up the astern radar system, and the function of key 4 is to stop each work mode of controlling.

Design of the digital tube display circuit. We use four bit digital tube to display the distance of the obstacles which is measured by ultrasonic. Because of the I/O ports are very little in the system, so we use digital tubes to scan and display dynamically, and adopt two 74HC573AN latches to latch bit code and segment code separately, so achieve the dynamic display of digital tube 1-8 bit with the least amount of I/O interfaces.

Design of the alarm circuit. This design has alarm function of warning distance. When the distance is less than the safe distance, the voice alarm begins to start up, reminds driver to take corresponding measures. There, the control signal of buzzer is provided by the pin 2.3 of AT89C51.

Design of the steering light circuit. The running state of itself also has a great influence to other drivers when the car runs. This design has both front directional lights and back turning lights to reflect the running state of the vehicle. There, LED1 and LED2 are on behalf of the front turn signal of the car, LED3 and LED4 are on behalf of the left and right turn signal, slowing warning lights are at the end of the car.

Design of the software structure

Design of the system program. The key point is how to accurately measure the distance by ultrasonic. From the DYP-ME007 working principle of ultrasonic module and sequence diagram, it is found that the detection of echo signal and the duration of the echo signal measurement are very important.

The measurement period of DYP-ME007 ultrasonic module is recommended for more than 60 ms. The display part of the system uses digital tubes to display dynamically, in order to ensure the display brightness is even, the digital tube scan time needs to be set accurately.

We use PWM modulation mode to control the DC motor speed. The PWM control signal is provided by AT89C51. The system function module chart is shown in figure 1.

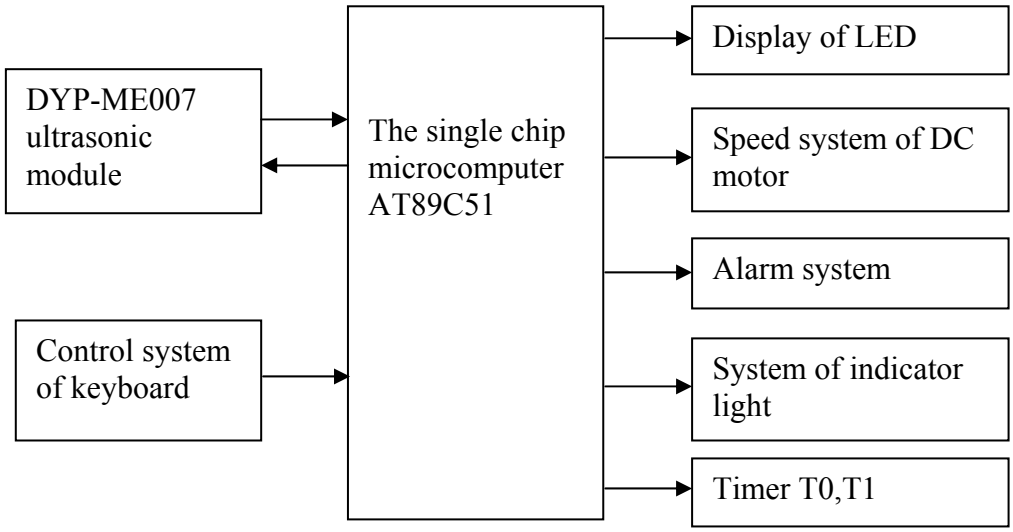

Fig.1 Function module chart of the system

Design of the main program. The software of the system mainly includes two parts, the main program and interrupt service program. The main program completes the initialization of timer and scanning of other buttons, as well to control the start and stop of each work manner. The timer/counter T0 and T1 need to be initialized in the main program, and through the key scanning system to select the working mode of the system, and control the start and stop of work patterns. The main program flow chart is omitted.

Design of the interrupt service program.1)Design of interrupt service program of the timer T0. The interrupt service program is mainly to start DYP-ME007 ultrasonic module, read the time value, control the DC motor speed, scanning display the result, etc. The timer T0 is to determine whether overflow. If overflow, it shows that the car does not run into obstacles or measure ranging error, at this point, to deal with according to not measured results.

The interrupt service program is as follows,

```
void zd0( )  interrupt 1
{
  flag=1;
}
```

2) Design of interrupt service program of the timer T1. The Main function of the interrupt service program of the timer T1 is to start DYP-ME007 ultrasonic module, read the time value, control the DC motor speed, dynamically scan and display the results, as well reload the initial value, etc.
The interrupt service program is as follows,

```
void  zd2( )  interrupt 2
  {
 TH1=0xf8;
 TL1=0x30;
 Display(0,4);
 PWM( );
Module(  ) ;
}
```

3) Design of display subprogram. In the design, we use two 74HC573AN latches to latch bit code and segment code separately, so as to dynamically scan and display the value of digital tube [2]. The subprogram is as follows.

```
void Display(unsigned char FirstBit, unsigned char Num)
      {
       unsigned char i;
    {
    DataPort=0;
       LATCH1=1;
       LATCH1=0;
       DataPort=dofly_WeiMa[i+FirstBit];
       LATCH2=1;
       LATCH2=0;
       DataPort=TempData[i];
       LATCH1=1;
       LATCH1=0;
       }
    i++;
    if(i==Num)
 i=0;
     }
```

4) Design of PWM regulating speed subprogram of DC motor. Here, we adopt the macro definition Speed to define speed level, namely the PWM pulse number. We control the DC motor speed by adjusting the pulse open time (PWM_ON) [3]. The program is as follows.

```
void PWM( )
 {
  if (t1==PWM_ON)
    ENA = 0;
    t1++;
  if(t1==Speed)
    {
   t1=0;
if(PWM_ON!=0)
ENA = 1;
   }
 }
```

5) Design of the ultrasonic module startup program. The ultrasonic module startup condition is that the control end of the module (Trig) should be input a high level voltage of more than 10 us. Considering the maximum measuring range of ultrasonic module related to the measurement periodic,

the longer the measurement periodic, the farther the distance of measuring, but the more slow the system responses[4].
Comprehensive the above consideration, this plan set 100 ms as the measurement periodic. The program is as follows.

```
void Module( )
  {
    timer++;
  if(timer>=50)
  {
  timer=0;
  TX=1;
  _nop_(); _nop_(); _nop_(); _nop_(); _nop_();_nop_(); _nop_();_nop_(); _nop_(); _nop_(); _nop_();
_nop_();_nop_(); _nop_();_nop_(); _nop_(); _nop_();_nop_(); _nop_(); _nop_(); _nop_();
  TX=0;
  }
  }
```

Design of the positive intelligent anti-collision warning system. The function of positive intelligent anti-collision warning system is to measure the distance from the car to the front obstacle and display[5]. There, we use the DYP-ME007 ultrasonic module, only read the receive output PWM high level signal (Echo), the echo signal is a distance object with the pulse width, the calculation of distance is through counting the time from transmitting to received the echo signal[6].

The flow chart of ultrasonic measuring is shown in figure 2.

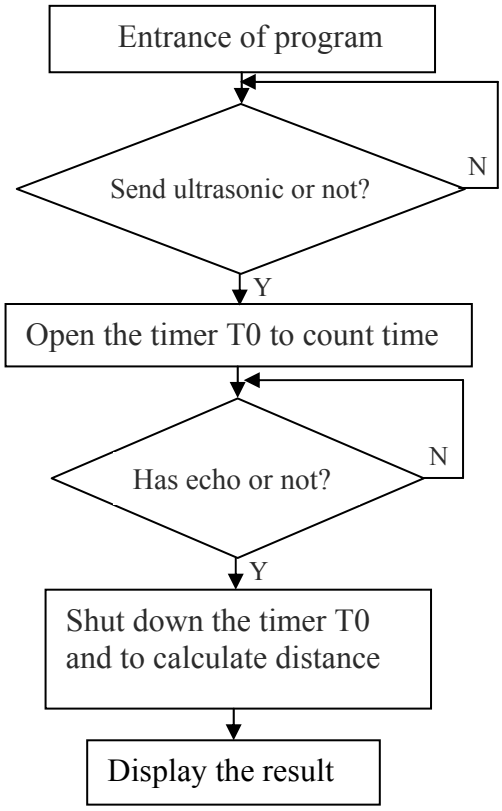

Fig.2 The flow chart of ultrasonic measuring

Design of the automatic parking system. The principle of automatic parking system is that, when the driver to park his car in the parking place, he starts the automatic parking system, the system will monitor and display the obstacle distance behind it real-timely, and automatically drive the car into the parking space accordance with the set path [7].

According to the suitable parking steps, the flow chart of parking car is shown in figure 3.

Design of astern program of the radar system. This system can display the around obstacles in manner of sound, remove drivers' trouble such as parking, astern and starting car, and help drivers eliminate the blind spot and blurred vision defects, improve the safety of driving[8]. The system adopts the voice to warn, and have two level alarm functions. The flow chart of the system is shown in figure 4.

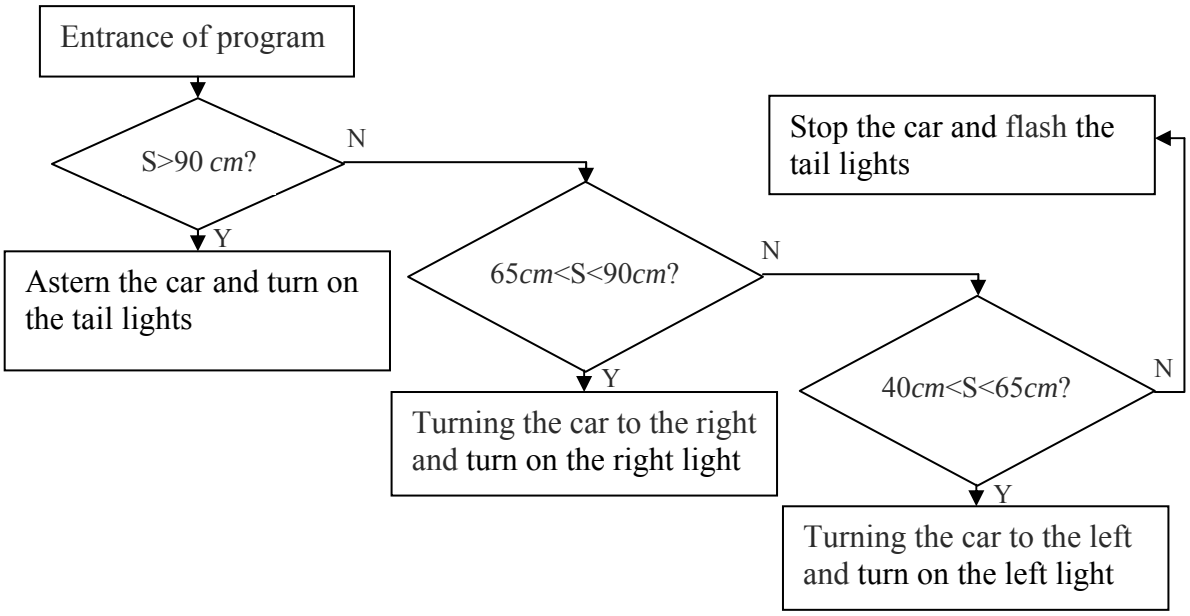

Fig.3 The flow chart of automatic parking car

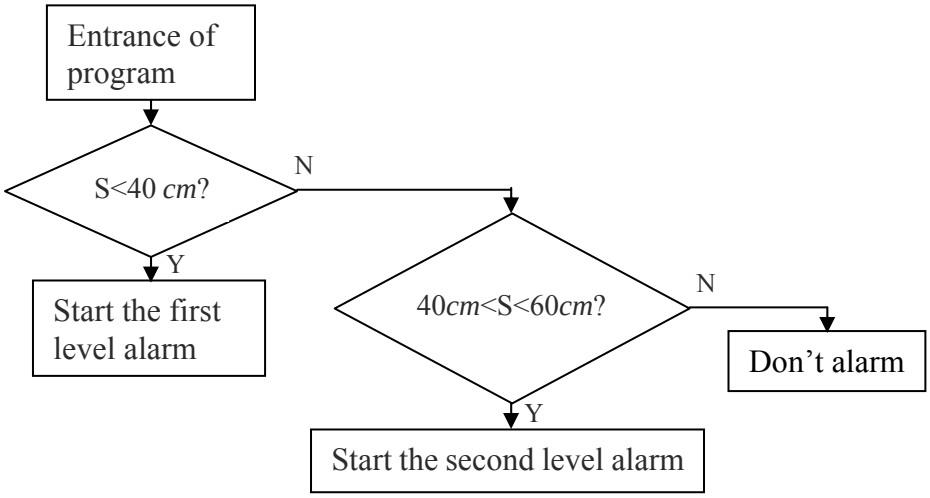

Fig.4 The flow chart of the astern radar system

Conclusion

This paper designs a vehicle intelligent anti-collision warning system based on the single chip microcomputer AT89C51, it adopts the DYP-ME007 ultrasonic ranging module to realize the non-contact distance measurement. Experiment results show that the system improves the measurement range and measurement accuracy, as well achieves expected effect of anti-collision

alarm. The design of this system is reasonable, we believe it will have good market application value in the near future.

Acknowledgments

This study is supported by the project of public welfare of Zhejiang province (Grant No. 2015C31072), and supported by the project of Zhejiang Ocean University (Grant No. 21185011010), as well as supported by the Natural Science Foundation of Zhejiang Province of China (Grant No. LY13E090004).

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