Application and Research of Automotive Sound Control System and Body Protection System

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Abstract

In order to reduce the pressure of the driver's manual operation and reduce the safety hazard during driving, the system has designed a complete sound control system, including voice-activated windows, air conditioners and 360 panoramas. Through the body CAN and LIN bus, the purpose of voice-activated window and air conditioner is completed. The purpose of voice-controlled 360 panorama is completed by learning infrared signal and transmitting infrared signal. At the same time, the system can voice remind the user of the body state information, such as the door is not closed. Low tire pressure, etc., can also protect the personal safety inside the car, through the infrared point sensor to detect someone inside the car and the temperature inside the car is too high, and finally according to the state of the car will automatically open the window to cool down.

Keywords

Voice-Activated Electric Windows, Voice-Activated Air Conditioners, Voice-Activated 360 Panoramas, Infrared Learning, Intelligent Protection.

1. Introduction

More and more electrical appliances are added to the ranks of vehicle electrical appliances, which not only improves the performance of the car, but also increases the complexity of the car driving operation, and even brings unsafe hidden dangers to the driving process. Among them, the most important danger comes from the driver's attention shift when operating on-board electrical appliances, resulting in the occurrence of traffic accidents. The research of new generation vehicle electrical appliances is facing the problem of driving safety, and using voice control vehicle electrical appliances is an effective way to solve this problem. With the birth of a new generation of special speech system chip BH1415F and the optimization of speech recognition algorithm, the recognition rate of speech recognition has been greatly improved, and the application of speech recognition technology in automobile has been realized.

Using voice control can realize the control of on-board electrical appliances without distracting the driver, and it can operate more quickly, and relieve the pressure of the driver's manual operation, In order to improve the driving safety[1], the vehicle body status monitoring and voice warning and intelligent processing functions are completed at the same time, and through the infrared lattice sensor mlx90640, the diagnosis of the health status of the personnel in the vehicle is achieved, including stm32f105rbt6 for the control processor and ingenic x1800 for the voice processor. Taking the vehicle electrical appliances as the control object, the control of air conditioning, windows and 360 panorama of the vehicle is successfully completed. Up to now, the speech recognition rate and control response rate of the prototype system in this paper are 98% and above, which achieve the expected purpose.

The system mainly consists of three modules:Voice processing module, sensor module, data acquisition control module. The voice processing module is composed of INGENIC-X1000E, md4103s and 128M external flash chips. The sensor module is composed of a digital microphone XX and the infrared lattice camera mlx90640. The data acquisition control module is composed of stm32f105rbt6, th8056kdca, TJA1040 and md4103s. At present, the design can realize the opening and closing of the voice controlled vehicle electric window, the opening half of the window, the

window seam; the temperature adjustment, air volume adjustment, mode switching, the opening and closing of the automatic air conditioning; the switching, photographing and setting of the image of the voice controlled 360 panoramic system. At the same time, based on the control of the body electrical appliances, we analyze the data, so as to automatically remind the operator that the door is not closed, vehicle fault code and other warning information. At the same time, this design combines the infrared lattice camera to detect the personnel in the car, when someone is found locked in the car, it will automatically leave a gap for four windows, to prevent the accident of minors in the car. In the process of driving, the driver's temperature can also be monitored. When the driver's body temperature is abnormal, the voice will remind the driver.

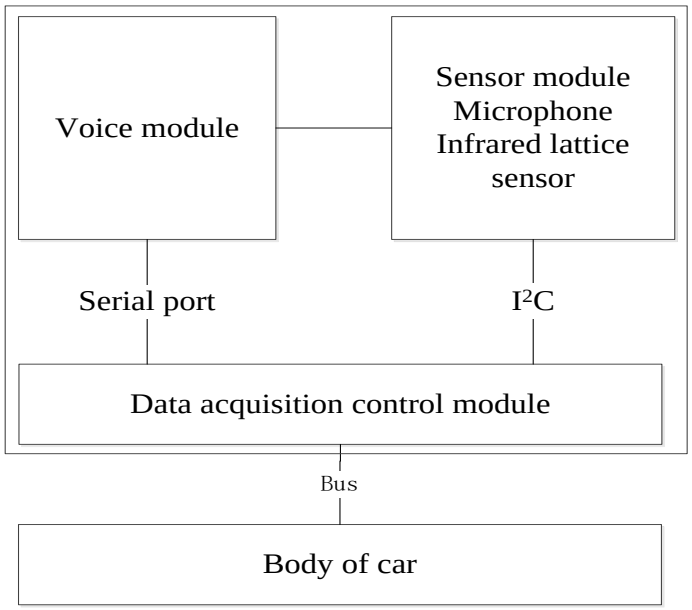

Fig.1 System overall structure diagram

In order to obtain various status information of the body, we need to read the can and LIN bus information of the body, body fault code query, tire pressure detection, engine fault detection, etc[2].

2. System hardware design

2.1 Hardware design of data acquisition control module

As shown in Figure 2, the circuit design of LIN bus is simulated through serial port. Through the s8050 triode to complete the voltage 3.3V to 5V level signal conversion, LIN bus can be mainly used to control some car windows.

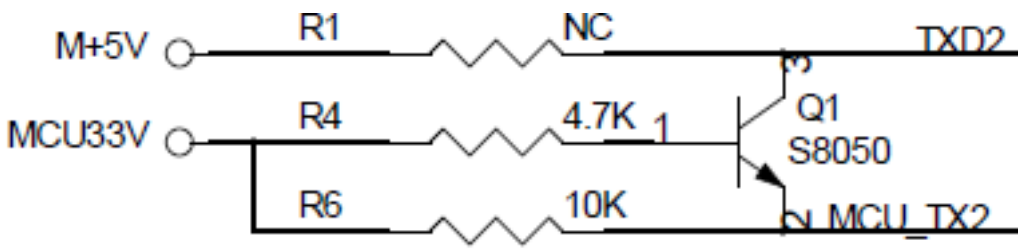

Fig.2 LIN bus transmission schematic diagram

As shown in Figure 3 and Figure 4, the circuit diagram of CAN bus acquisition is composed of two can chips th8056kdca and TJA1040. The design of single line can and double line can bus is completed respectively. Resistance and inductance filter are used in single line can to increase the

anti-interference ability of data. Figure 4 shows the differential signal two-wire can with high anti-interference ability.

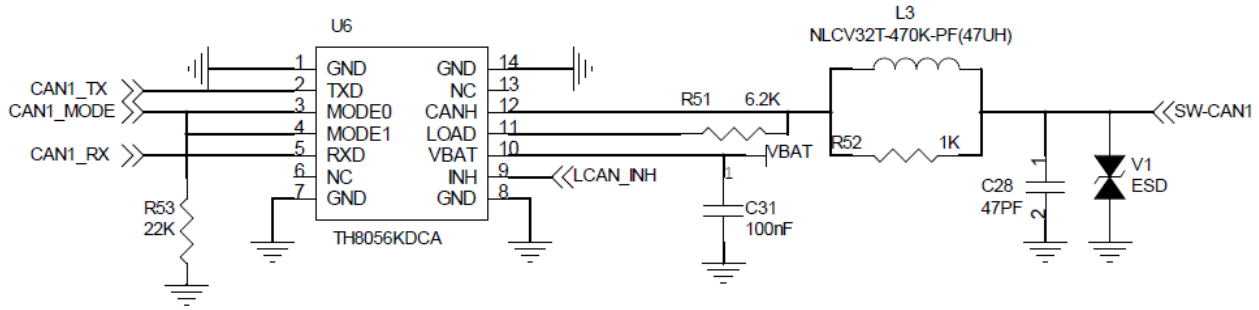

Fig.3 Single line CAN bus acquisition circuit diagram

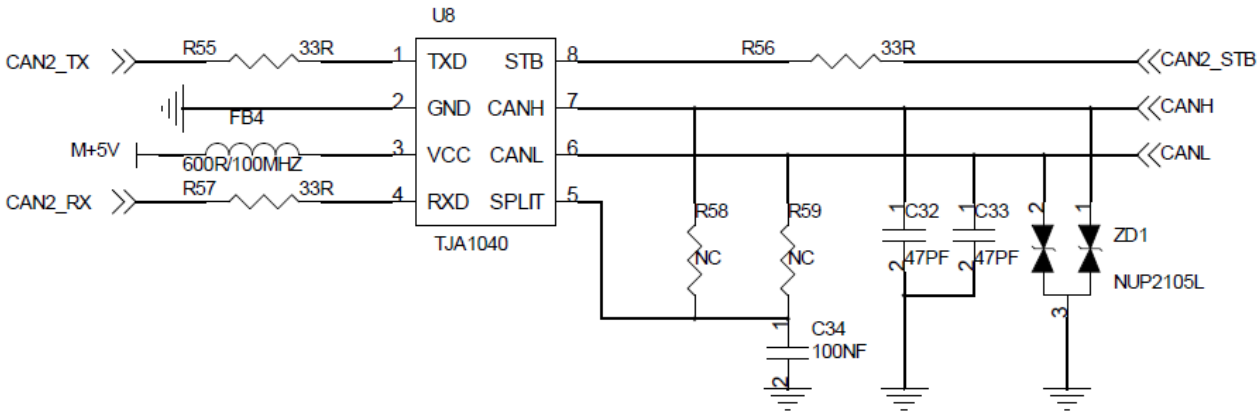

Fig.4 Dual line CAN bus acquisition circuit diagram

Figure 5 shows the audio amplifying circuit. Md4103s chip is used to amplify the audio signal. The output adopts double inductance filter, which can effectively suppress the current noise.

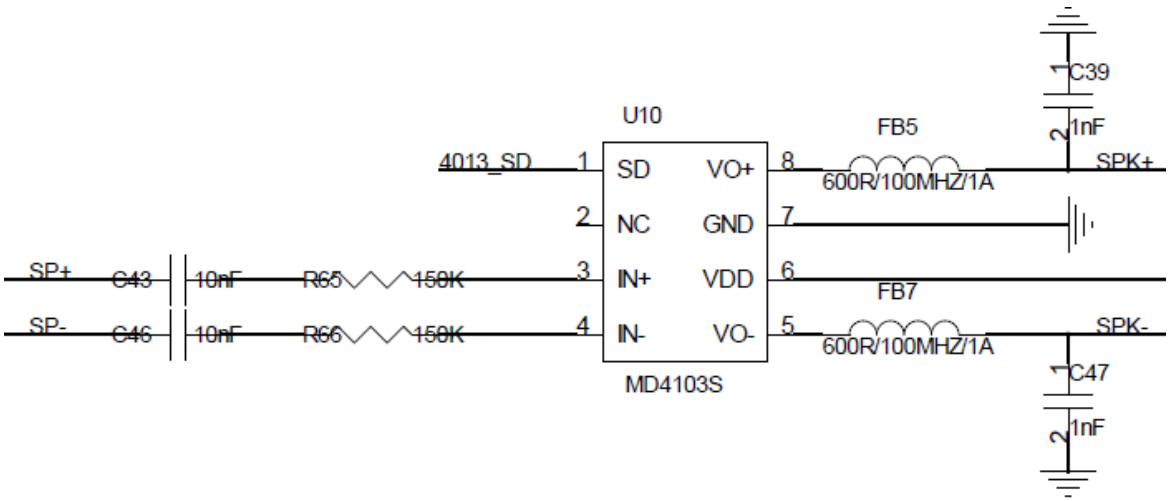

Fig.5 Schematic diagram of audio amplifier circuit

2.2 Hardware design of voice module

As shown in figure 6, pins 13 and 14 of voice module are connected with serial port 1 of stm32f105rbt6, pins 15 to 19 are connected with digital

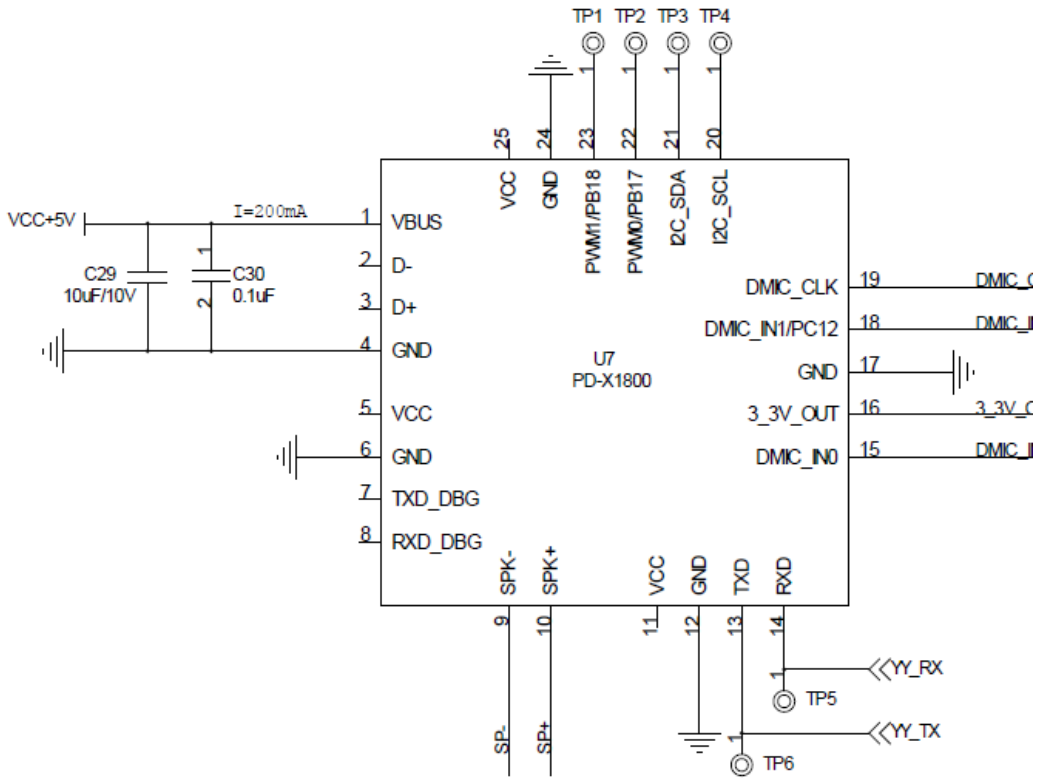

Fig.6 Schematic diagram of voice module circuit

microphone, and pins 9 and 10 are connected with audio amplifier chip.

2.3 Infrared transceiver and design of infrared lattice sensor

The infrared transmitting and receiving consists of a 200 ohm resistor connected in series with the IO port of stm32f105rbt6. The infrared lattice sensor is connected with the I2C communication interface of the single chip microcomputer to complete the data acquisition.

3. System software design

3.1 The software design of the control body electric device

As shown in Figure 7, the system group will collect data, analyze data and perform corresponding operations. The collected data include: the password entered by the user, obtained through the analysis of microphone and voice module, body status information, obtained on the vehicle can bus, body temperature measurement of personnel in the vehicle, obtained by infrared lattice camera. There are two kinds of operations to perform. One is the control of the vehicle body electric device, such as the control of windows and air conditioners. The group is completed by sending the corresponding data to the LIN bus and can bus of the vehicle body. The control of 360 panorama in the vehicle is completed by taking the analog infrared signal from the IO port of stm32f105rbt6. The infrared signal can be input for the first use, and then the corresponding wave can be analog output Shape. When the vehicle fault is detected, the MCU will control the voice module to play the corresponding reminder information.

3.2 Signal processing software design

The transmission of infrared signal is calculated by the ticking timer inside the single chip microcomputer, and the transmission of infrared signal is completed by controlling the level change of output IO port [3—4]. As shown in Figure 8, this is the waveform of the infrared signal simulated by the single chip microcomputer. The preamble consists of a low level of 8.8ms and a high level of 4.5ms, followed by four bytes of data for infrared command. After the experiment, 360 panoramic system can be controlled.

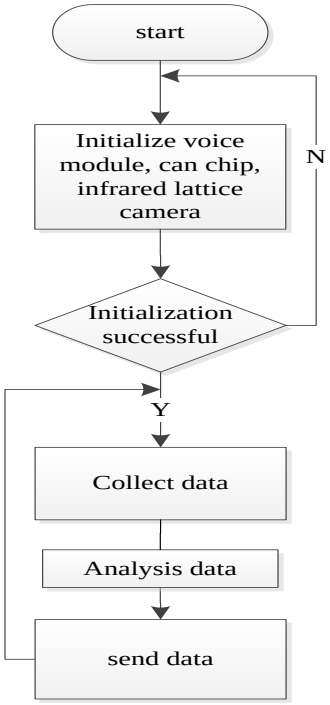

Fig.7 System framework flow chart

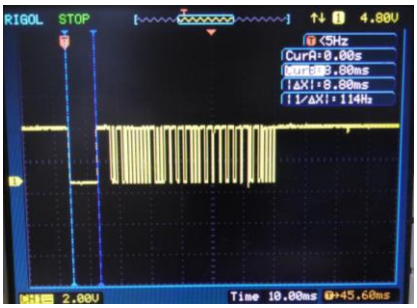

Fig.8 Infrared analog signal

For the acquisition of infrared signal, the IO port of single-chip microcomputer is set as the external middle fracture triggered by the falling edge, the timing is performed by the system tick timer, the arrival of data is judged according to the leading code, the required data is parsed, the learning of infrared signal is completed, the results are stored in the internal flash of single-chip microcomputer, and the learning is completed.

For the diagnosis of automobile fault code, the design is 5S diagnosis once, through sending data to automobile bus, and then taking analytical data through corresponding can ID, if the car body has fault, corresponding fault code can be obtained [5—6].

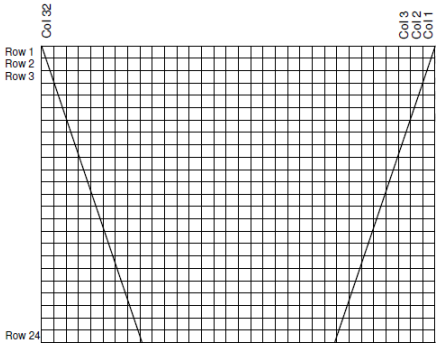

Fig.9 temperature pattern

For the detection of the body temperature of the personnel in the vehicle, the data of the group shall be collected by mlx90640 32 × 24 IR array sensor. 768 temperature points are collected, which can be obtained by reading corresponding registers through I2C interface. The power supply voltage is 3V, the refresh rate is 64Hz, the external interface is composed of power ground and I2C (SDA and SDL) interface, and the temperature distribution is shown in Figure 9.

It is found that when the temperature distribution diagram changes greatly, it can judge that the personnel in the car are active. If 10% of the temperature data changes more than 2 ℃, and someone is moving in the back of the car, the system obtains the temperature data of the personnel in the car by means of mean filtering, and sets the temperature data as XN_{ij}, Δ_{ij} is the temperature of the background in the vehicle, I and j represent the row and column respectively, the body temperature of the personnel in the vehicle is TK, and the latest temperature data collected is XT_{ij}. $\nabla=XT_{ij} - \Delta_{ij}$, When XT_{ij} is the background temperature, ∇ is close to 0, and M is the number of ∇ values close to 0, which is used to calculate the average temperature of human body. According to the continuous state of ∇ we can divide the temperature into blocks, each of which represents a person. K is the temperature of person K. Take n as 4.

$$\Delta ij = (X1ij + X2ij + \ldots + XNij)/N$$
$$Tk = (XTij - \Delta ij)/M$$

After the above detection, we get the position coordinates of the people in the car, and then we can get the average value of the corresponding position coordinates according to the temperature value, and get the human body temperature of the people in the car. In the process of vehicle driving, the driver's temperature condition should be obtained first.

When the vehicle stops driving, the body temperature in the vehicle will be detected after the vehicle is locked. If there is a large change in the temperature, it can be directly judged that there are people in the vehicle, and all windows will be seamed. If no significant change in temperature is detected, check whether there is the temperature of human body temperature, and then start to detect the temperature around this point. If more than 30 consecutive temperatures close to human body temperature are found, it is determined that there is someone in the car and all windows have seams.

4. System test

As shown in Figure 9, it is a physical display of this design, consisting of control chip stm32f105rbt6, data chip consisting of the above can chip, voice module at the back, connected with the control chip through serial port, digital microphone and voice module, audio output and voice operation amplifier md4103s.

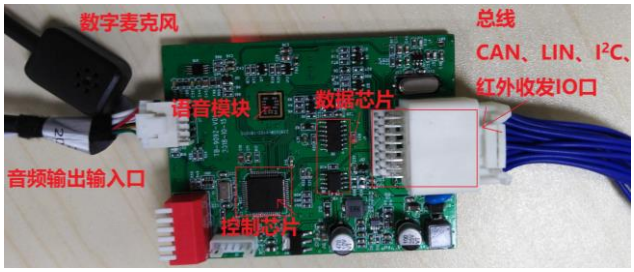

Fig.9 Design physical map

The warning message settings of this system are shown in Table 1. Reminders refer to voice reminders. Actions refer to the gap about 1cm of all windows. When some adults lock their children in the car, the temperature in the car is too high at noon, which may lead to the life risk of minors in the car. In order to prevent such incidents, the system automatically opens 1cm windows to protect the life safety of adults in the car.

Table 1. Warning reminder table

State	Warning mode
The door is loose during driving	remind
Insufficient fuel for 50km	remind
Tire pressure too high or too low	remind
Coolant temperature too high	remind
Someone inside detected after locking	action
Driver's abnormal temperature detected	remind

5. Summary

The system realizes voice controlled air conditioning, windows and 360 panoramic view of the car body, completes the analysis of the state of the car body and the protection of the people in the car, completes the subtle control of the windows (the voice can control the windows to leave cracks), can provide the driver with warning information, reduce the driver's burden, so as to better care about the road conditions in the driving process. It can detect the body temperature of the people in the car and protect the life safety of the minors in the car. Complete the effect of voice control of electronic equipment in the vehicle and protection of personal safety in the vehicle. The expected goal has been achieved.

In the future, it can join the network communication system, send the data to the server, understand the vehicle body status at all times, and realize remote monitoring.

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