

Ethanol Concentration Detection and Anti-drunk Driving Warning System Design

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Abstract

In order to solve the problems of the traditional alcohol detection system, such as poor stability, slow recovery of system reuse, inaccurate data collection and inability to connect with the online system in real time, a set of alcohol concentration monitoring system based on embedded ARM chip was designed. The system design includes the overall structure design of the alcohol concentration monitoring system, the hardware structure and circuit design of the system, and the software flow design of the system. The alcohol concentration detection system can quickly and sensitively carry out detailed detection, alarm, digital display, voice reminder and real-time data upload and other functions on the drinking status of the tested person, which has a strong practical value.

Keywords

Alcohol monitoring; Information collection; A /D interrupt; Voice warning.

1. Introduction

With the improvement of people's living conditions, more and more families use cars as a means of transportation. However, the data show that the traffic accidents caused by drunk driving of motor vehicles each year show a certain high incidence of life and property safety danger. In order to quickly improve the efficiency of relevant departments in law enforcement activities, the monitoring process of alcohol concentration can not affect the normal traffic order, so the application of rapid and accurate alcohol concentration monitoring system is a trend. Nowadays, the disadvantage of alcohol monitors is that the recovery time of the sensor after being affected by alcohol concentration is too long, which affects the normal use of the monitor.

In order to solve the above problems, this paper designed a set of alcohol monitoring system based on alcohol concentration sensor information collection technology. The slope algorithm is introduced in the system, which can realize the rapid monitoring of alcohol concentration, and shorten the interval monitoring time of the system, which greatly improves the accuracy and efficiency of the alcohol monitoring system.

2. Structure of Alcohol Concentration Monitoring System

The hardware structure design of alcohol concentration monitoring system mainly consists of five parts [3] : (1) Main control chip module: complete the functions of information collection, information fusion and information processing of each branch module; (2) Alcohol concentration detection sensor module: realize alcohol concentration information detection through the sensor, and be responsible for data storage and upload at the same time; (3)

Information frequency modulation module: frequency adjustment and digital-to-analog conversion of the information collected by the sensor; (4) Voice alarm: when the message of alcohol concentration is detected, the message of alcohol concentration is processed by information amplifier to give voice alarm; (5) LED screen display: digital display can indicate the alcohol concentration detection amount.

In this system, sensor information acquisition and information processing, voice warning, LED screen display and other functions have high requirements for data processing efficiency and data throughput. The chip STM32F103C8T6 of Samsung's low-power and high-speed industrial chip is adopted. The alcohol concentration sensor adopts MEMS952 with low power consumption, high precision and high sensitivity Gas sensor to process [4]

3. Hardware Circuit Design of Alcohol Concentration Monitoring System

3.1. Overall Hardware Design

The embedded ARM chip STM32F103C8T6 has a clock frequency of 86 MHz, 1024 KB ROM, 128KB RAM, 40 I/O ports, 16 counters, 6 SPI supply interfaces, 4 I2C channel interfaces, 2 UART conversion interfaces, 2 USB interfaces, and 2 CAN main line interfaces [5]. The power supply module adopts TD7806 chip to output 5V voltage to supply power to the external module of the system, and TMS1.6 chip to convert the top voltage to output 4V voltage to supply power to 186ETY8 main control chip to ensure voltage stability. Figure 1 shows the overall circuit connection diagram of the main control chip STM32F103C8T6.

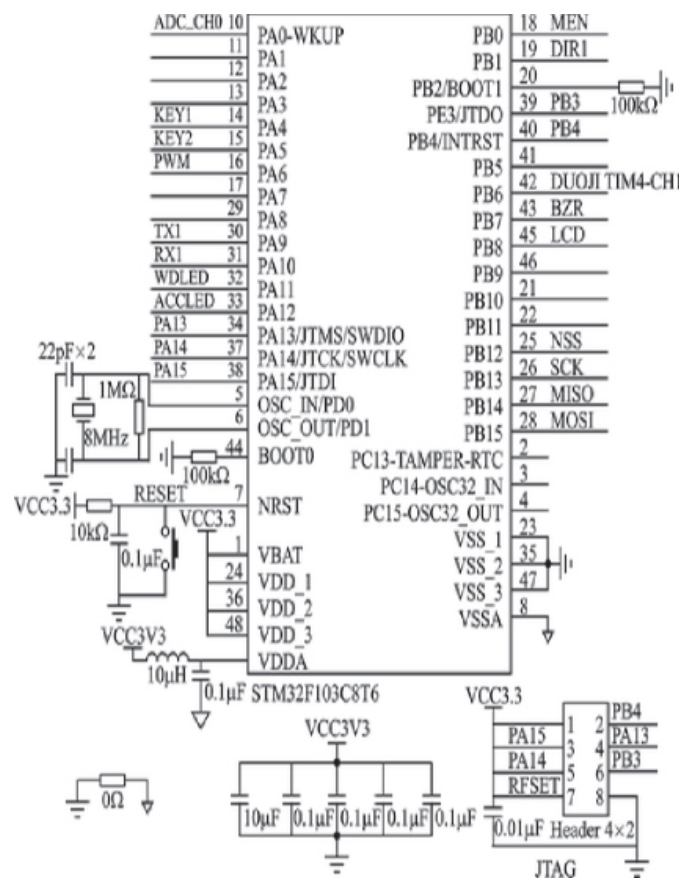


Figure 1. Overall circuit connection diagram of main control chip STM32F103C8T6

3.2. Alcohol Sensors

Alcohol sensor MEMS952 working principle is divided into three steps: (1) sensor acquisition: through the voltage acquisition amplifier to achieve sensing voltage feedback amplification, in

the feedback process through the overheating resistance to achieve constant offset temperature drift, ensure the stability of the amplification factor; (2) Sensor information processing: the voltage change signal collected by the sensor can be output at fixed frequency through the signal frequency modulation module. After digital-to-analog conversion processing, the alcohol concentration value can be processed and calculated. According to the results, whether the tested person drinks or not and the alcohol concentration value can be judged. (3) Numerical display output: make voice prompt to report the detection situation in real time according to the actual situation of the tested person, and meanwhile make digital prompt through the display module [6]. The monitoring and processing circuit of MEMS952 sensor is shown in Figure 2.

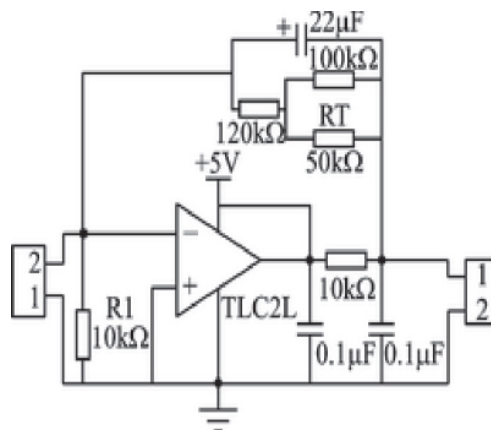


Figure 2. Signal conditioning circuit diagram of alcohol sensor

In order to verify the sensing performance of alcohol sensor MEMS952, the characteristics of the sensor were tested. The main test indexes were sensor sensitivity performance, feedback performance, stability performance, etc. The sensor in the figure is the performance test figure of MEMS952 [7]. The test results show that the sensor meets the requirements of alcohol sensing and detection system. Figure 3 shows the sensor performance test.

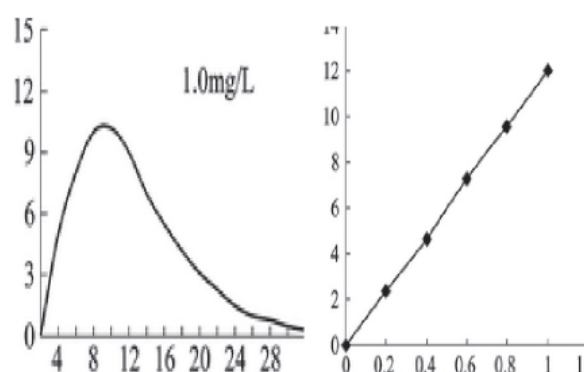


Figure 3. Sensor performance detection

3.3. Voice Alarm Module

In order to improve the accuracy of speech, the speech of professional processing chip YYF5050CN as the core of the voice conversion chip, chip through professional voice conversion URAT asynchronous interfaces and CSN bus interface to convert digital signal synthesis and string through text, directly convert voice alarm and voice remind broadcasts, including voice conversion circuit design as shown in figure 4.

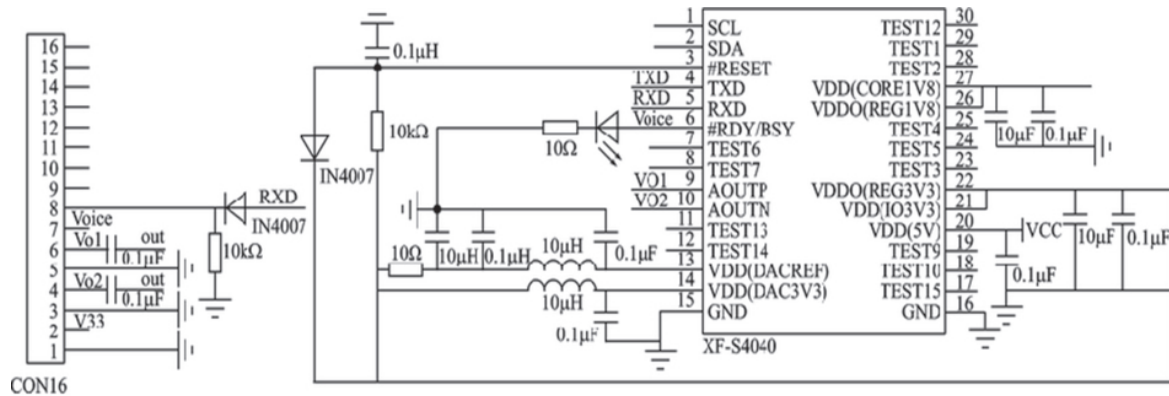


Figure 4. Circuit diagram of voice alarm module

3.4. Power Amplifier Module

Audio power amplifier using UWB1573 chip, the chip support dual output, power amplifier stereo FM work steps as follows: (1) around a track dual output signal via voice potentiometer enter UWB1573 information processing for speech signal amplifier output of two-way voice signal, through the audio voice potentiometer to adjust the size, the voice of the speaker through the external interface into the system. The chip has been tested and the voice is good after the circuit is connected [8]. The design of audio amplifier output circuit is shown in Figure. 5.

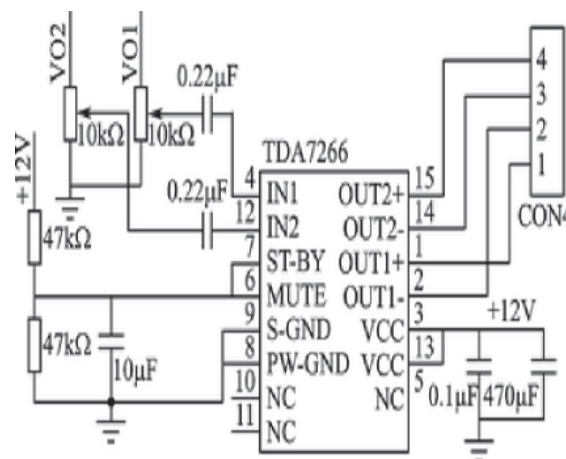


Figure 5. Power amplifier module circuit diagram

4. Software Design

4.1. Overall Software Design Scheme

After the alcohol concentration monitoring system is initialized through `do while()`, the system enters the alcohol cycle detection alcohol sensor information collection mode. When someone is blowing through changing slope curve value judgment gas through professional voice conversion URAT asynchronous interface chip and CSN bus interface to convert digital signal synthesis and string through text, directly convert voice alarm and voice remind broadcasts, including voice conversion circuit design as shown in figure 5 body containing alcohol concentration and to judge whether the tested drinking alcohol concentration. The perceived voltage value of the alcohol sensor changes as the alcohol concentration changes. The STM32F103C8T6 of the main control core passes through the eighth channel of the digital-to-analog conversion interface.

4.2. A /D Conversion System Flow Design

The interrupt program of alcohol concentration monitoring system uses the timer in the main control chip STM32F103C8T6 to complete the A /D resource conversion. Through the conversion value read/a and make voltage acquisition signal processing range, average voltage after filtering processing to calculate the voltage change slope, after comparing with various limit according to the comparison results to set corresponding labeling and according to the interrupt flag bit to make voice prompt and alarm system, lighting tips, and so on.

4.3. System Test

According to the prototype test, the measurement range of the alcohol concentration test system is 0.03-0.72 mg /L, the error is not more than 0.03 mg /L, corresponding to the human blood ethanol concentration is 60-500 mg /L, the relative standard deviation (RSD) is less than 2%, the repetition error is less than 3%FS, the resolution of gasoline and other interference gases >2. The instrument has the advantages of reasonable circuit design, small volume, sensitivity, resolution and anti-interference ability, which are suitable for the measurement of whether the driver has drunk too much or not, and can also be used for alcohol concentration monitoring.

5. Conclusion

In order to fast and efficient, real-time implementation of sensitive and accurate stable alcohol detection, design a set of use STM32F103C8T6 sensor chip and alcohol gas concentration monitoring system, the hardware circuit design mainly includes the main control chip, the alcohol concentration detection sensor performance monitoring circuit connection design, information processing, voice alarm and LED display design, etc. The system software flow mainly carries on the system control flow and the system A /D interrupt flow design. The alcohol concentration detection system can quickly and sensitively carry out detailed detection, alarm, digital display, voice reminder and real-time data upload and other functions on the drinking status of the tested person.

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