Vehicle Alcohol Detection System Based On Internet of Things Technology

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Abstract. In recent years, traffic accidents caused by drunk driving have occurred frequently. In order to effectively monitor and prevent drivers' drunk driving behavior, we designed this set of vehicle-based alcohol detection system based on Internet of Things technology. The system uses STC12C5A60S2 single-chip microcomputer as the main controller, uses MQ-3 alcohol sensor to collect air alcohol concentration data, and uses GU900E as GPRS module for wireless communication. When the driver enters the driving position, the system automatically performs alcohol detection. When the drunk driving standard is reached, the system uses the relay to control the vehicle to ban, triggers the sound and light alarm, and uses the GU900E to perform base station positioning, and finally sends the SMS containing the GPS information to the driver. Family. The experimental results show that the system is economical, practical, accurate and reliable.

1. Introduction

In recent years, traffic accidents caused by drunk driving have occurred frequently, and the society has been increasingly investigating the drunk driving behavior. However, drunk drivers often have a chance to get lucky enough to understand the serious consequences of drunk driving, so that they drunk in society. The accident rate is high.

This paper designs a vehicle-based alcohol detection system based on Internet of Things technology. The system uses STC12C5A60S2 single-chip microcomputer as the main controller. The MQ-3 alcohol sensor is used to collect the air alcohol concentration data. The GU900E is used as the GPRS module and detected by the LCD display. The alcohol concentration value is compared with the drunkenness threshold set by the system according to the detected data, so as to make corresponding control behaviors, such as controlling the vehicle to be prohibited by the relay, and alarming by the sound and light alarm device, and controlling the vehicle by controlling the GU900E. And locate the sending of SMS.

The system combines the Internet of Things technology with sensor detection technology to achieve the goal of low cost and high sensitivity, which can effectively prevent the occurrence of drunk driving accidents.

2. System structure design

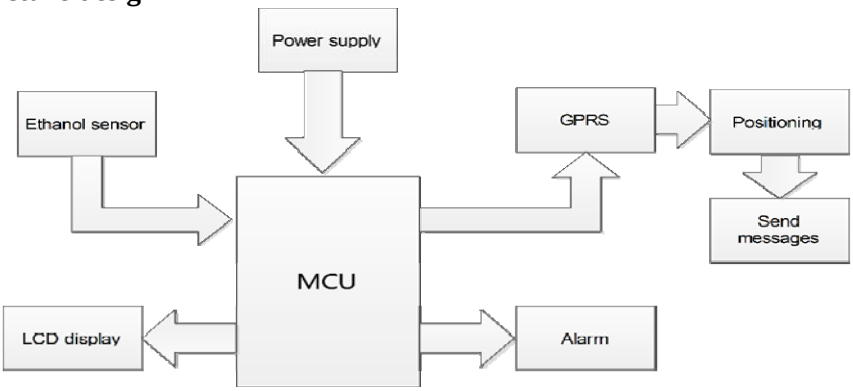

Figure 1. System structure

The system uses the high-performance low-cost single-chip STC12C5A60S2 produced by Hongjing Company to perform A/D conversion and processing on the detection signal. The MQ-3 ethanol gas sensor is used to detect the concentration of ethanol in the air, while the MCU and relay module, LCD display and The sound and light alarm device is connected, and the GU900E module is controlled by serial communication to realize base station positioning and positioning short message transmission. The system structure block diagram is shown in Figure 1.

When the driver enters the car, the car engine is locked and cannot be started. After the alcohol sensor is warmed up, it will automatically detect the alcohol concentration in the car. Since the voltage signal generated by the alcohol sensor has a specific proportional relationship with the alcohol concentration in the air, we can judge the alcohol concentration in the car according to the level of the voltage signal. The single-chip computer converts the collected analog signal into a digital signal through A/D, and then calculates the alcohol concentration value in the vehicle according to the relationship between the internal resistance of the MQ-3 and the voltage ratio of the external resistance and the alcohol concentration, and displays the numerical value on the LCD. On the display. When the alcohol concentration in the vehicle exceeds the threshold set by the system, the relay contact action disconnects the ignition circuit of the vehicle, so that the car cannot be started, the sound and light alarm is controlled to generate an alarm, and the GU900E is controlled to perform base station positioning and positioning of the short message. Conversely, the vehicle Normal start. It is worth mentioning that the system also has a drunkenness threshold setting function, which can modify the drunkenness threshold according to legal regulations or user needs.

3. System hardware design

The hardware function module of the vehicle alcohol detection system includes: STC12C5A60S2 single chip processing core, MQ-3 alcohol sensor detection module, relay control module, LCD liquid crystal display module, sound and light alarm device and GU900E wireless communication module. The design of each part will be described in detail below.

3.1. Core Controller Module

STC12C5A60S2 series MCU is a single-clock MCU produced by Hongjing Technology. It is a new generation 8051 microcontroller with high speed/low power consumption/super interference immunity. The instruction code is fully compatible with the traditional 8051, but it is 8-12 times faster. Internally integrated MAX810 dedicated reset circuit, 2 PWM, 8 high-speed 10-bit A/D conversion (250K/S), support EEPROM function. Low power consumption, high cost performance and high reliability. [1]
The minimum system circuit diagram of the single chip microcomputer is shown in Figure 2.

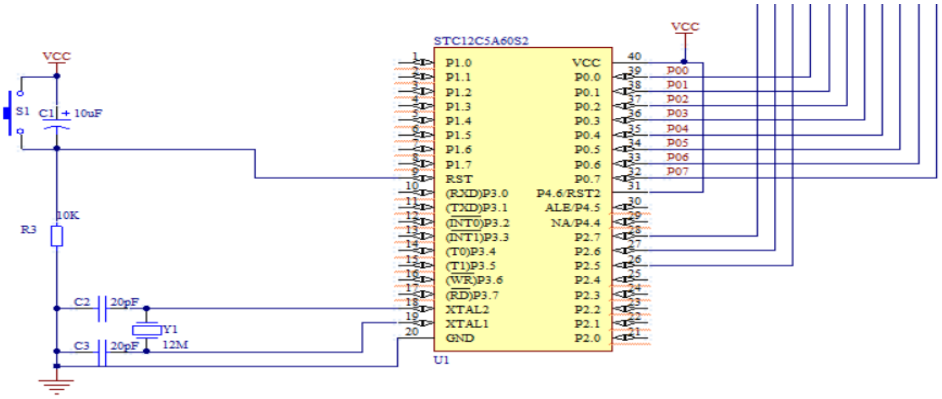

Figure 2. MCU minimum system circuit diagram

After the experiment, we decided to select the crystal frequency of the single-chip microcomputer to be 12MHZ, which is the easiest to obtain the ideal baud rate. At the same time, the reset circuit is designed to initialize the single-chip microcomputer.

3.2. Alcohol sensor module

The MQ-3 alcohol concentration sensor we selected uses tin dioxide as a gas sensing material. When the sensor is in an environment containing alcohol vapor, the conductivity of the sensor increases with the concentration of alcohol in the air. It is simple to use. The circuit converts the change in conductivity into a voltage signal corresponding to the gas concentration. MQ-3 has the advantages of high sensitivity and good selectivity to ethanol vapor, fast response recovery, long life and reliable stability, and simple drive circuit. [2]

The working principle diagram of MQ-3 sensor is shown as in Figure 3.

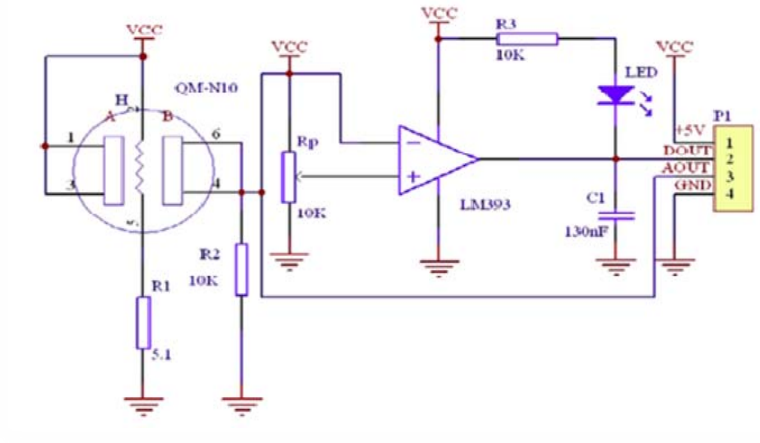

Figure 3. MQ-3 sensor circuit diagram

3.3. Wireless Communication Module

For the wireless communication module, we use the module GU900E released by the company. It supports GSM dual-band and quad-band, embedded TCP/IP protocol stack, supports large-capacity cache up to 10K, supports multi-link and rich language and data service functions. It is the best choice for high-speed wireless data transmission and mobile Internet of Things solutions. At the same time, it supports industrial DTU function, supports configurable network disconnection reconnection,

heartbeat packet configuration, SMS configuration, etc. In addition, it also supports AGPS, base station positioning, frequency point scanning, Chinese SMS and other special application functions. [3] This module is widely used in vehicle tracking, fleet management and other fields.

3.4. Relay Module

When the detected alcohol concentration is greater than the threshold, the system will control the vehicle to prohibit starting. The control circuit is shown in Figure 4. The relay control circuit is connected in series in the engine system circuit. The relay is closed with the 8550 triode drive circuit. The drive chip 74HC573 is connected to the base set of the triode. Note that a diode is added to discharge the reverse voltage generated in the relay coil for protection. [4]

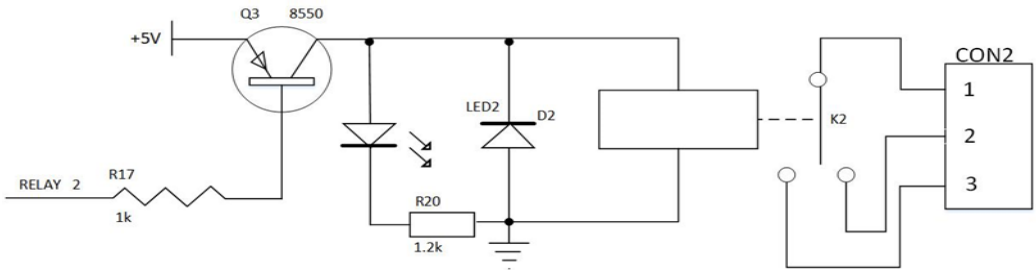

Figure 4. Relay ban circuit diagram

3.5. Alarm circuit and display circuit

Because LCD liquid crystal display has the advantages of low power consumption and strong anti-interference ability, for better user experience, the system uses LCD12864 to display the quantified value of the alcohol concentration processed by the single-chip microcomputer in real time, and when the alcohol concentration exceeds the threshold value Use the buzzer alarm and keep flashing the LED red light to remind the driver.

4. System software design

According to the target function, the system software includes the following sub-programs: alcohol concentration data acquisition and processing, LCD display program design, relay control and sound and light alarm program design, GU900E base station positioning and Chinese character text message transmission programming. The system software is written in C language. When the system is turned on, the first thing is to do the related initialization work, then enter a While loop, calculate the air alcohol concentration value and compare it with the preset threshold to judge whether to drunk and enter the corresponding Processing subroutine. The system program flow is shown in Figure 5.

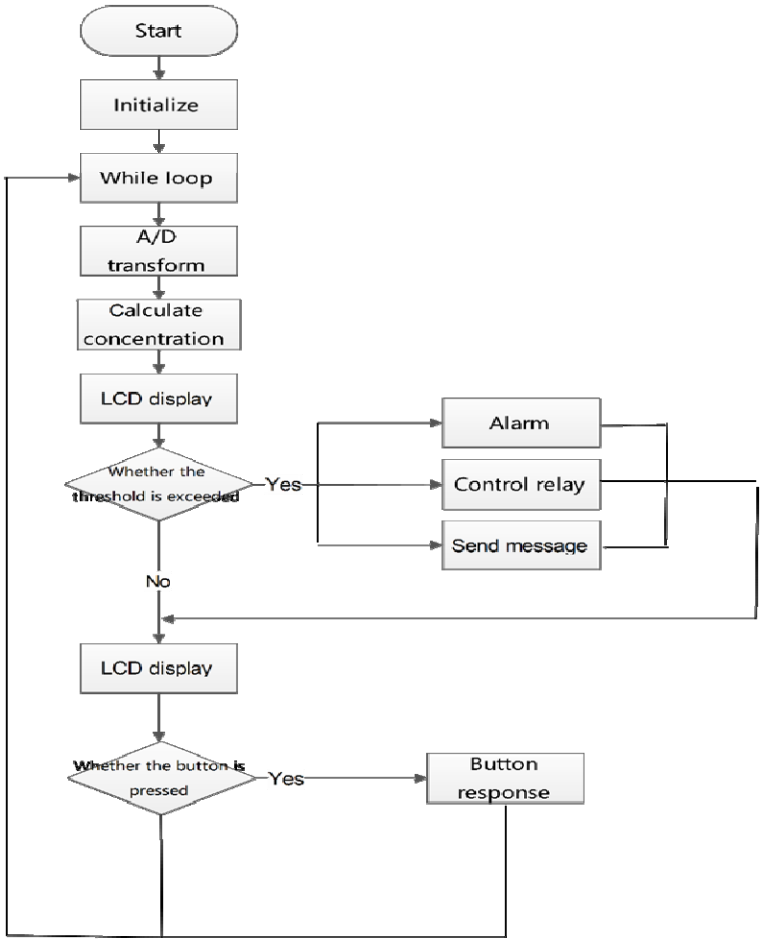

Figure 5. Program flow chart

4.1. Alcohol concentration data collection and processing

The output signal of MQ-3 sensor circuit is analog. We realize the analog-to-digital conversion by the A/D conversion function built in the STC microcontroller, and then the relationship between the voltage ratio of internal resistance and external resistance of MQ-3 and the alcohol concentration. Curve, the car's alcohol concentration value is calculated by the formula, [5] is then used to compare with the threshold to determine the program direction.

4.2. LCD display program design

First, the LCD is initialized so that it can enter the normal working state, and then the calculated alcohol concentration value is output through the output command. In the experiment, the upper and lower lines of LCD12864 display the current in-vehicle alcohol concentration value and the preset alarm threshold.

4.3. Relay and alarm program design

This part of the program controls the working state of the relay, buzzer and LED indicator. When the system enters the alarm state, the relay turns off the ignition circuit, the buzzer sounds, and the red LED of the LED flashes.

4.4. GU900E module programming

The MCU sends the AT command to the GU900E for base station positioning. The GU900 system module can obtain the information of the currently registered base station and up to 6 neighboring base

stations through the AT+ENBR command, and then use the GPRS Internet access function of the module to query the detailed latitude and longitude position information. [6] The positioning information obtained by the MCU is encoded in the PDU format, combined with the existing SMS content and sent to the target mobile phone number.

5. Conclusion

This paper designs a vehicle-based alcohol detection system based on Internet of Things technology to monitor and prevent drivers' drunk driving behavior. The system uses STC12C5A60S2 single-chip microcomputer as the control core, uses MQ-3 alcohol sensor to collect air alcohol concentration data, uses GU900E as GPRS module for wireless communication, displays the detected alcohol concentration value through LCD display, and based on the detected data and system. The set drunkenness threshold is compared to make corresponding control behaviors, such as controlling the vehicle to be prohibited by the relay, alarming by the sound and light alarm device, and performing base station positioning and positioning short message transmission by controlling the GU900E.

The experimental results show that the system has the advantages of high cost performance, strong stability, good real-time communication, etc. It can achieve good control of drunk driving effect, and has strong application value and promotion value.

References

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