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The Drunk Driving Automatic Detection System Based on Internet of Things

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Abstract

In view of the drunk driving traffic accidents caused the frequent problems, proposed drunk driving automatic detection system. The system makes use of internet of things technology, take A STC12C5A16AD single chip as the core, through four MQ-3 alcohol sensors to detection to determine whether alcohol drunk driving. When the system detects alcohol concentration which exceed the standard, the system sends out sound and light alarm and prohibited to start the car, at the same time, the GPRS module can locate the car's position, then the information can be sent to driver's relative and traffic control department through GPRS module. The experimental results show that, the system can effectively prevent drunk driving and has very good practical.

Keyword*: Internet of things; drunk driving; MQ-3; GPRS; MC55i*

1. Introduction

In recent years, with the rapid development of China economy and improvement of people's living level, the numbers of vehicle and driver are in a sharp increase. The vehicle bring people convenient life, economic profit and high quality of life, however, it also bring traffic accident at the same time. In recent years, road traffic accident happens frequently which caused server economic loss and people injury or death. Drunk driving, over speed and fatigue are three main causes of traffic accident, among which drunk driving caused traffic accident take quite high proportion. The illegal crime caused by drunk driving and drunken driving as ignorant of traffic rules have developed more and more cases .Currently in our country, drunk driving detection are mainly adopted by traffic police setting check point on the road, using breathing inspection instrument on the drives of passing vehicles[1]. But this kind of inspection can only be made on part of vehicles by sampling inspection which can not monitor the driver condition of drinking driving in real time. And it takes a lot of manpower and material resources [2]. In addition, some drunken drivers refuse to inspect which also bring traffic police problem.

In order to control drunk driving so as to reduce traffic accident, this article introduces a kind of drunken driving automatic detection system based on internet of things. The system makes use of internet of things technology, take A STC12C5A16AD single chip as the core, through MQ-3 alcohol sensors to detection to determine whether alcohol drunk driving. To install the sensor inside the wheelhouse and determine whether alcohol drunk driving by alcohol concentration inspection on four points which are positioned in front of, above and in the left side and right side of driving seat[3]. When the system detects alcohol concentration which exceed the standard, the system sends out sound and light alarm and prohibited to start the car, at the same time, the GPRS module can locate the car's position, then the information can be sent to driver's relative and traffic control department through GPRS module. Through this method, the drunken driving can be

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effectively prevented, and easy to be collectively monitored by traffic department. The traffic police don't need to set check positions for inspection so as to save human power and material resources.

2. System Integral Structure and Operation Principle

2.1 System Integral Structure Design

The system takes advantage of internet of things technology, use every vehicle as one node, then collect data from numerous nodes and send information to family and local traffic department through wireless transmission technology. The whole structure of system is as shown in Figure 1, every vehicle has two commutation objects: one is family and the other is traffic department server. Every vehicle is equipped with one vehicle-mounted drunk driving automatic inspection system which is composed of following modules: STC12C5A16AD single chip control system, MQ-3 breathing alcohol sensor, LCD display module, audible and visual alarm module, relay control module and GPRS module [4]. The integral structure design of drunk driving automatic inspection system is as shown in Figure 2.

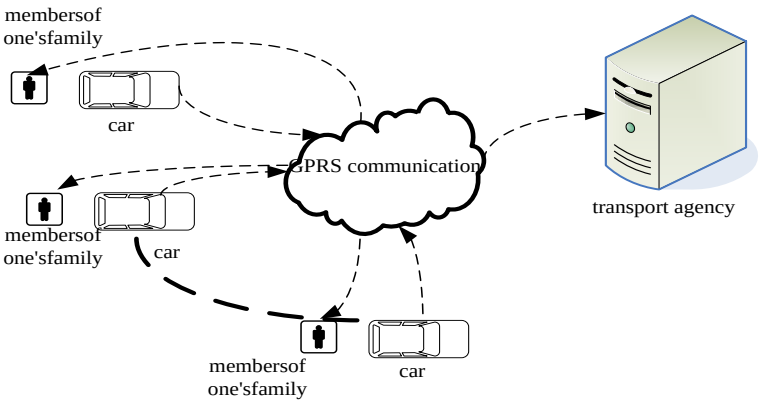

Figure 1. System Integral Structure

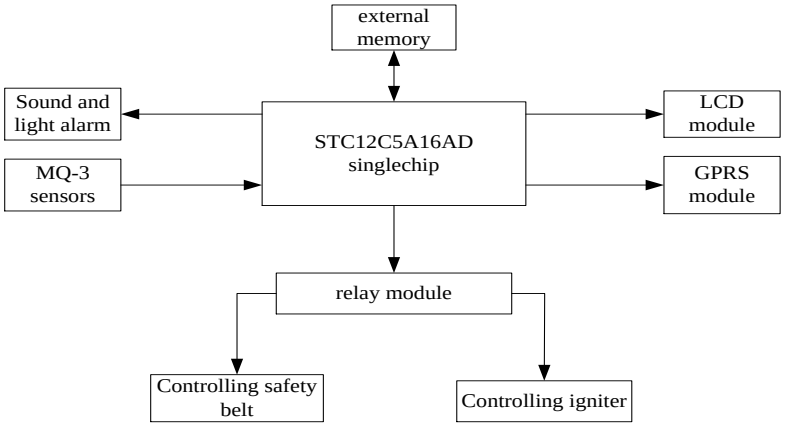

Figure 2. Drunk Driving Automatic Inspection System

2.2 Working Principle

When the driver turns the key, the detection system will be powered and activated. The drinking automatic detection system starts to operate. 4-way MQ-3 sensor will convert analog signal into digital signal through A/D. Whether being drinking driving or not will

be determined by compare this digital signal with set value, and the threshold and measured value will be displayed on LCD. STC chip will analyze the alcohol concentration signal. If the concentration is below the standard, the vehicle will operate normally. Once if the alcohol concentration detected by some sensor exceeds the safety criteria, the LED indicator starts to shine, this information will be sent to the family mobile phone, and the information will also be sent to local traffic department through GPRS module, and buzzer give out alarm sound instantly.

3. System Design

3.1 Chip System Design

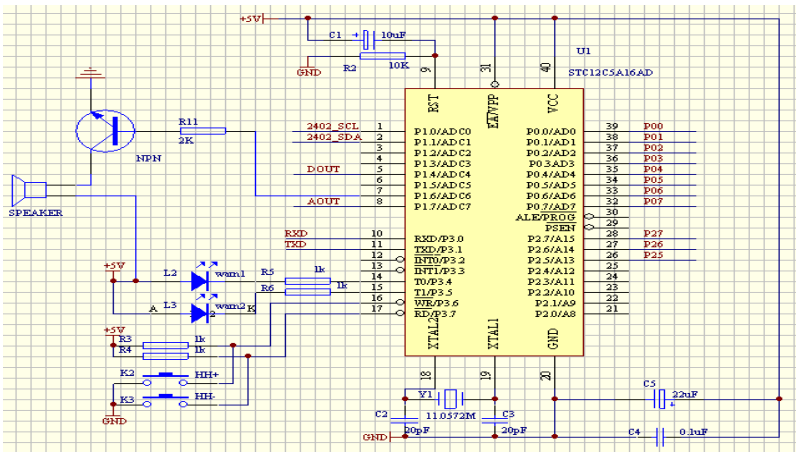

Figure 3. Single Chip System Circuit Design

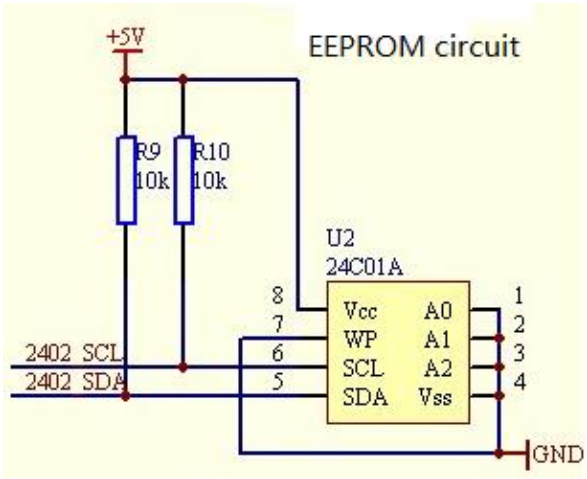

Figure 4. External Storage Circuit Design

The central control module of the system use STC12C2052AD chip made by Hong Jing Technology, STC12C2052AD is with good performance of high speed, low cost and strong anti-interference ability. Its instruction code is compatible with traditional 8051, but the speed is 8 to 12 times of traditional speed. It integrated MAX810 reset circuit, 2-way PWM, 8-way high speed 8-bit ADC. The STC12C2052AD chip is with 8-way high speed ADC so as to minimize circuit design. The chip system principle is as shown in the Figure 3, key K2 and K3 is for threshold set, K2 is “increase” and K3 is “decrease”. L2 and L3 are alarm indicators for drinking driving and drunken driving separately. Drunken

threshold is stored in EEPROM chip AT24C01, and can be adjusted and stored by using "increase" and "decrease" key. AT24C01 is EEPROM chip of IIC interface to be used to store power failure data. Its circuit is as shown in Figure 4. A0, A1 and A2 as shown in the Figure 4. are address of the chip which will work when being grounded normally. SCL and SDA are clock line and data line for the communication of AT24C04 and IIC chip. The external storage circuit is as shown in Figure 4.

3.2 Relay Control Circuit

The main function of relay control circuit is that when MQ-3 sensor finds alcohol concentration exceeding the standard, it will use control relay to control the vehicle. The relay control interface is connected with ignition and electronic injection circuit, and can control the start-up of the vehicle through chip programming. The vehicle electronic injection control circuit is as shown in Figure 5. [5, 6].

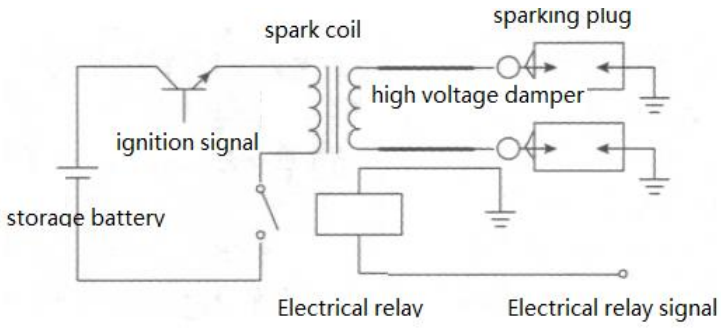

Figure 5. Electronic Injection Control Circuit

3.3 Display Circuit

It use SMC 1602 LCD for display, the working voltage of chip is 4.5-5.5v, and working current is 2.0 mA. It use 5.0v power supply in this design. The interface circuit in the LCD display and chip is as shown in Figure 6, the pin 3 of J2 is for back light, R9 and R10 is for adjusting brightness of the back light. Pin 4, 5 and 6 of J2 connects to RS, E/W and E control pin of the LCD, and pin 7 to pin 14 of J2 are data pins. The program to display some character in 1602 LCD is as shown in the following:

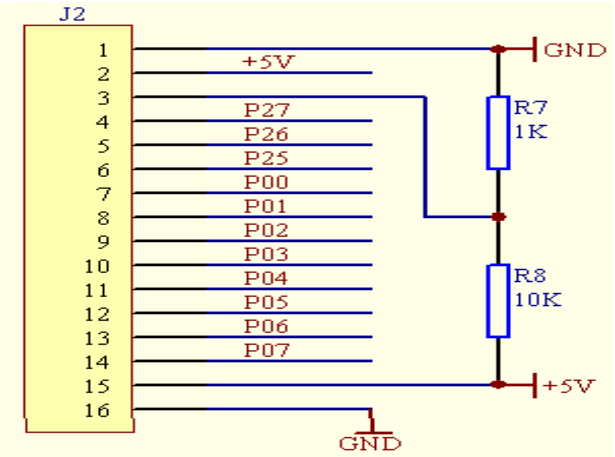

Figure 6. LCD Circuit Design

```
void L1602_char(uchar hang,uchar lie,char sign)
{
```



```
    uchar a;
    if(hang == 1) a = 0x80;
    if(hang == 2) a = 0xc0;
    a = a + lie - 1;
    enable(a);
    write(sign);
}
```

3.4 Mq-3 Sensor Circuit

There is alcohol content inside the air let out through the mouth of people after drinking. Therefore the drinking condition of the people can be determined by detecting the alcohol concentration of the air breathed by the people. In this design, MQ-3 alcohol sensor is adopted. The BAC (blood alcohol concentration) of the examinee can be determined by the odds ratio of body BAC and alcohol concentration of the air let out. In our country, the limit for drinking driving is 100-300mg/L. The vehicle engine can start up normally when the blood concentration is less than 200 mg/L, while the engine power supply will be switch off when the concentration is exceeding 200mg/L. The working principle of the alcohol sensor is in accordance with the fixed relation between BAC of the people after drinking and the alcohol concentration of the air let out through the mouth. The formula is as follows:

Blood alcohol concentration (mg/L) =2200* alcohol concentration of the air let out through the mouth

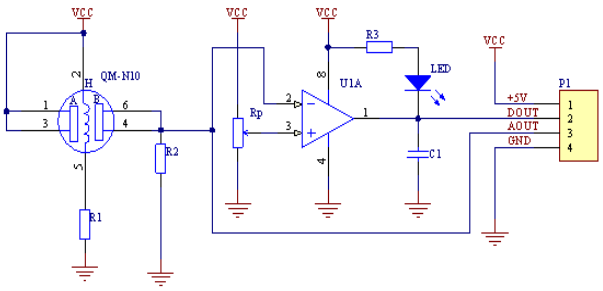

Figure 7. MQ-3 Sensor Circuit

As the output signal of MQ-3 sensor is millivolt voltage signal, therefore it is necessary to amplify the signal and be sent to control unit for analysis after A/D conversion, its working principle is as shown in Figure 7. The procedure for A/D conversion is as below:

```
uchar GetADVal()
{
    uint i;
    ADC_CONTR&=0xf7;
    for(i=250;i>0;i--);
    ADC_CONTR |= 0x08;
    while((ADC_CONTR&0x10)==0);
    ADC_CONTR&=0xe7;
    return ADC_RES;
}
```

3.5 Gsm Module Circuit

The wireless communication module adopts MC55i module. The chip sends AT command to MC55i through serial interface to make control. When the alcohol

concentration detected by the sensor exceeds safety limit, MC55i wireless module will be activated. The current location of the vehicle will be obtained through Cell-Id and then the information will be sent to family through GPRS module. The information will also be sent to traffic department through GPRS for them to take effective measures. AT+CREG command controls MC55i module to make location identification and obtain current location signal of the vehicle. The short message use Chinese Unicode. When sending the short message, the Chinese character will be selected and stored in the FLASH of the chip and change to Unicode. The short message protocol adopts PDU mode to send Chinese character. The PDU mode not only support Chinese short message, it can also send English short message. In PDU mode, three encoding method can be used to encode the sending content, they are 7-bit code, 8-bit code and UCS2 code (16-bit code). 7-bit code can be used to send normal ASCII character. It encodes a serial of 7-bit characters (highest bit is 0) into 8-bit data. Every 8 characters can be "compressed" into 7 characters. 8-bit code is normally used for sending data message including picture, ring and etc. UCS 2 code is used for sending Unicode character. PDU serial is a serial of ASCII code, and is composed of numbers like 0-9 and alphabets like A-F. They are 8-byte hexadecimal number system or BCD code decimal system. PDU serial not only include the message itself, but also contain many other information, such as SMS service center number, target number, answer number, coding method and service time.

The message to be sent is compressed into a PDU serial in accordance with AT command protocol, and then be sent to GSM module through serial interface, and finally be sent to target mobile phone through GSM module (phone number in monitor center). The transmitting should be done in connection with PDU structure, including following function: gsmEncode7bit() 、 gsmEncode8bit() 、 gsmEncodeUcs2() 、 gsmInvertNumbers(). And then function gsmEncodePdu () is given to complete the function of compressing original message into PDU serial. Above functions are included in this formula as below:

```
int gsmEncodePdu(const SM_PARAM* pSrc, char* pDst)
{
  int nLength；
  int nDstLength；
  unsigned char buf[256]；
  nLength = strlen(pSrc->SCA)；
  buf[0] = (char)((nLength & 1) == 0 ? nLength ： nLength + 1) / 2 + 1；
  buf[1] = 0x91；
  nDstLength = gsmBytes2String(buf, pDst, 2)； nDstLength +=
gsmInvertNumbers(pSrc->SCA, &pDst[nDstLength], nLength)；
  nLength = strlen(pSrc->TPA)；
  buf[0] = 0x11；
  buf[1] = 0；
  buf[2] = (char)nLength；
  buf[3] = 0x91；
  nDstLength += gsmBytes2String(buf, &pDst[nDstLength], 4)；
  nDstLength += gsmInvertNumbers(pSrc->TPA, &pDst[nDstLength], nLength)；
nLength = strlen(pSrc->TP_UD)；
  buf[0] = pSrc->TP_PID；
  buf[1] = pSrc->TP_DCS;
  buf[2] = 0；
  if(pSrc->TP_DCS == GSM_7BIT)
  {
```



```
        buf[3] = nLength;
        nLength = gsmEncode7bit(pSrc->TP_UD, &buf[4], nLength+1) + 4;
    }
    else if(pSrc->TP_DCS == GSM_UCS2)
    {
        buf[3] = gsmEncodeUcs2(pSrc->TP_UD, &buf[4], nLength);
        nLength = buf[3] + 4;
    }
    else
    {
        buf[3] = gsmEncode8bit(pSrc->TP_UD, &buf[4], nLength);
        nLength = buf[3] + 4;
    }
    nDstLength += gsmBytes2String(buf, &pDst[nDstLength], nLength);
       return nDstLength;
}
```

3.6 Power Supply Circuit

This design adopts USB power supply with 5V of power supply voltage. At the same time, USB interface writes program on the chip through converting circuit with PL2303 chip inside and communicate with GPRS module. Its electrical circuit schematic diagram is as shown in Figure 8.

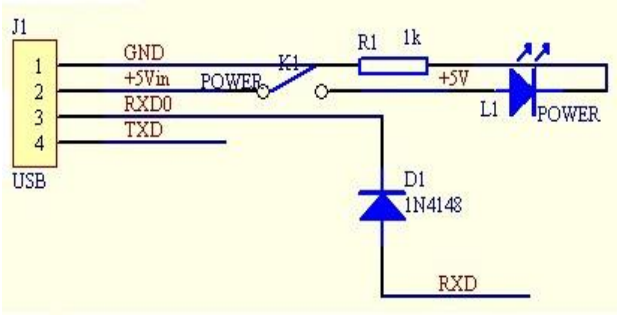

Figure 8. Power Supply Circuit

3.7 Software Design

The software use C Programming Language to program, the software design process is as shown in Figure 9. The system will initialize after being powered, then the sensor will compare this detected alcohol concentration with the threshold set in external storage to determine whether the alcohol concentration exceeding the standard or not. When the concentration exceeds set value of 200 mg/L, the system will switch off the engine power through relay. And the location message and drinking driving message will be sent the family and local traffic department.

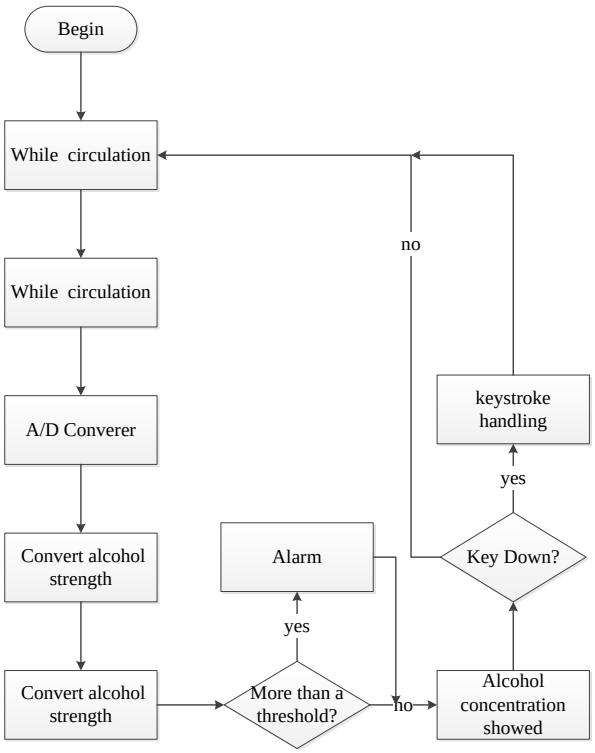

Figure 9. Process Chart

4. Conclusion

In this document, the drunk driving automatic detection system based on internet of things adopts STC12C5A16AD chip as main control system. The system automatically detects the driver's alcohol concentration and control the vehicle engine depending on the inspection result. If the alcohol concentration exceeds the standard, the system sends out sound and light alarm and send short message to traffic department and family through GPRS module. The system is small with low energy consumption and easy to be mounted on the vehicle. The test result shows that the system can realize good real-time and high-precision. It can achieve good control effect through reliable and stable operation, and strong environmental adaptability. Therefore it will play good value in the life.

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