Design of Health and Safety Alarm System Based on MCU

Yuan Liu, Jiaying Chen and Haiyun Wu

College of Engineerin , Tianjin Agricultural University, Tianjin 300384, China
1417325528@qq.com,1506351098@qq.com,283699240@qq.com

Abstract: A health and safety alarm system was designed based onMCU and GSM technology to rescue and treat people immediately when they suffer from sudden illness or event.It has many functions, including real-time measurement and parameters displaying. There are two indicators: heart rate and body temperature of human health. The system takes MCU as the core, collects heart rate signals from photoelectric sensors, after AD conversion with the signals of body temperature from the temperature sensor arithmetic processing, and shown by LCD. If the heart rate or body temperature exceeds normal range and lasts for a period of time, or the wearerpress the button for help, the buzzer would be alarm.The device willsend a message for help to guardian byGSM technology to and display the guardian's name and phone number at LCD at the same time.So that passer-by can get in touch with his families to come in time.

1   INTRODUCTION

My country has a large population and aging is aggravating, but elderly people are prone to sudden illness, every year, countless people die because of sudden onset of disease without timely treatment. To reduce the occurrence of this tragedy, a health and safety alarm system was designed. At present, there are many kinds of personal safety alarm systems in the market.There are heart rate over-limit alarm systems and the systems that can make loud noises, but the former has no function of measuring temperature and GSM SMS alarm, detection index single judgment loses, the latter can voice alarm but unable to reflects the wearer's health, if nobody nearby, then alarm there would be no sense.The health and safety alarm system solves the above problems and realizes the function innovation.

2   THE COMPOSITION AND WORKING PRINCIPLE OF THE SYSTEM

Health and safety alarm system uses MCU STC89C52RC as the main controller, using the heart rate, body temperature monitoringin the integration of unitized circuit design(Chen, S.X., 2012).It can be real-time, effective monitoring and display heart rate, body temperature parameters. When the wearer's heart rate or body temperature is not in the normal range, the buzzer sounds, the LCD displays the relative number, and the GSM module sends a message to its family. The wearer can also press a button to send a distress message in case of emergency. The system composition structure is shown in figure 1.
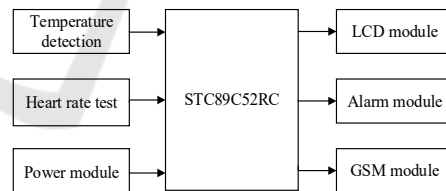

Figure 1: System block diagram

3   HARDWARE CIRCUIT DESIGN

3.1   SCM main control circuit

The main control chip in the design adopts the single chip STC89C52RC,the smallest system of the single chip is shown in figure 2, and the clock adopts the external 12 MHz oscillator circuit. Main control circuit in addition to realize detecting body temperature, heart rate, LCD display and buzzer and GSM alarm function, it can also be chromatically set

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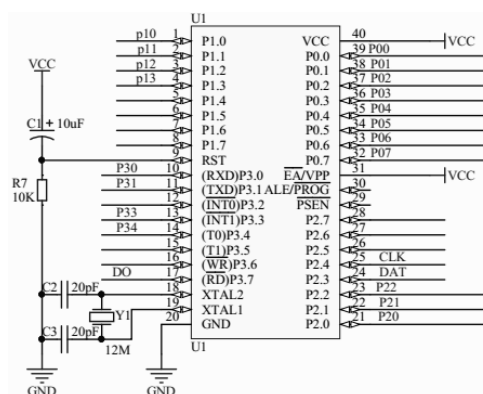heart rate and body temperature of the normal range, LCD display and GSM automatic alarm conditions.

Figure 2: MCU main control circuit

3.2 Power supply part

The system uses the linear power source, as shown in figure 3. It converts 100 ~ 240 v AC voltage to 5 v DC voltage, so as to prevent short circuit and overheating burned components, with protection circuit, filter circuit of the electrolytic capacitor and ceramics capacitor, DC power supply of pulse wave, interference and noise to the maximum to prevent and absorption.
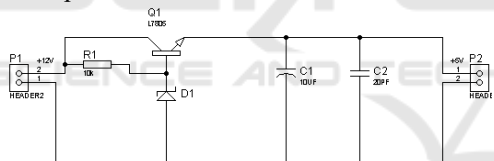

Figure 3: Power module

3.3 Temperature detection part

The temperature test selects the DS18B20 chip, which is a smart type temperature sensor, and the output is a digital signal.DS18B20 reads the measured temperature directly, and can achieve 9-12 digit reading mode by simple programming according to actual requirements. The temperature conversion power is derived from the data bus, and the single chip can supply the DS18B20 without additional power supply.MCU P3.7 is connected with the single-chip DQ.

3.4 Heart rate detection part

The heart rate test adopts Pulse Sensor photoelectric sensor, and its working voltage is 3.3V~ 5V, mainly

composed of light source and optical converter. Using photoelectric capacitance method, the pulse measurement was carried out by using human tissue to cause different transmittance during the pulsation of blood vessels (Jun, O.Y., 2004). The peak wavelength of green LED is 515nm, and the peak wavelength of the optical converter is 565nm. The peak wavelength is similar, the sensitivity is high, and the measured heart rate is high. Due to the pulse signal frequency band, generally between 0.05 ~ 200 Hz, the small amplitude of the signal are susceptible to interference, after the sensor using low-pass filter and op-amp, after making the magnified 330 times of analogy signal by A/D acquisition to easily, detection circuit as shown in figure 4.
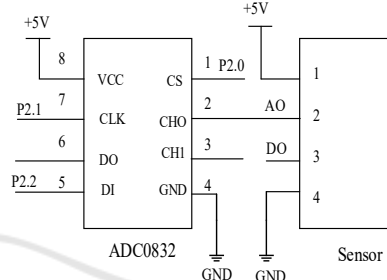

Figure4:Heart rate measurement circuit

3.5 Display circuit design

The display module adopts LCD1602A, with 16 characters per line, two lines. The communication with MCU can be used in eight or four parallel transmission modes, and the pin D0~D7 is connected with the single-chip P1.0~ P1.7, as shown in figure 5. The content displayed has current heart rate and temperature value; In a state of emergency, the guardian's name and telephone number are displayed.
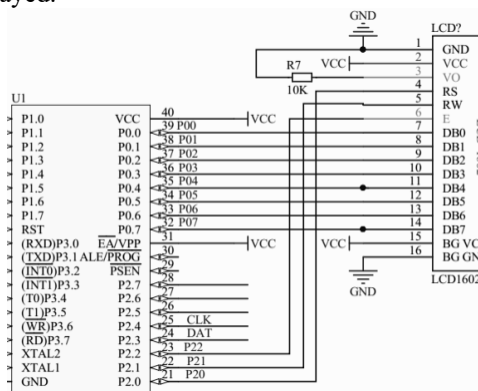

Figure 5: 1602A display circuit

3.6 Alarm part

The system uses the alarm of the buzzer and the remote alarm of GSM short message. The piezoelectric buzzer is driven by a DC voltage, which simply gives a low level to the driver and amplifies the drive current through the Trident, which can make a sound. MCU P1.6 pin by one button, when active press K1 key, or has an abnormal heart rate and temperature, maintaining measured again after 1 minute, if continued, MCU P3.2 pin output will have a low level to the buzzer, make its voice, MCU through GSM part sent SMS alarm at the same time.

4 THE SOFTWARE DESIGN

4.1 The design of the main program

System main program is mainly used for the temperature signal of collected and heart rate signal analysis and processing, and to respond to the LCD display module, a buzzer linkage control module and GSM module, initialized to the system, and other functions. This system adopts the modulus program structure, which is the core of single chip microcomputer and program in C language. The specific main program flow block diagram is shown in figure6 below.
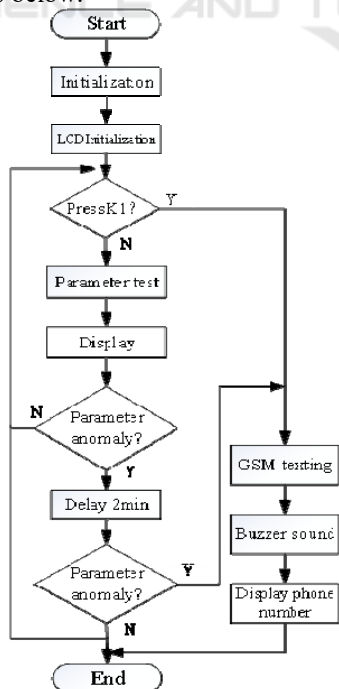

Figure6: Main program flow chart

4.2 Temperature acquisition program design

The 12 bit data stored in the DS18B20 internal 12-bit resolution is stored in two bytes of RAM. The first five in binary are the sign bits. If the temperature measured is greater than 0, the five are 0, so as long as the measured value is multiplied by 0.0625, the actual temperature can be obtained. If the temperature is less than 0, then these five are 1, and the measured values need to be reversed and then multiply by 0.625 to get the actual temperature. According to the health of human body data, the temperature setting is 36 ℃ ~ 37.5 ℃ which is storaged in sensor block of EEPROM, and still preserved after power off.Figure 7 is a flowchart of program for temperature collection.
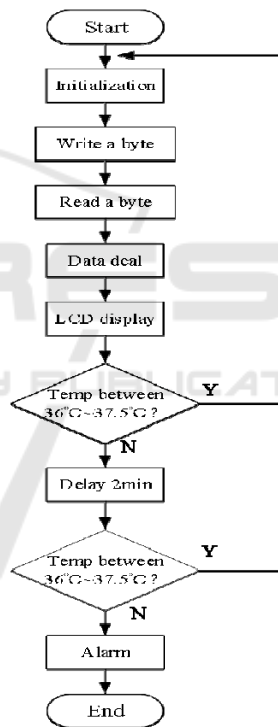

Figure 7:Temperature detection flow chart

4.3 Heart rate collection program design

When the beam of light through the human body peripheral vascular, because the pulses with blood volume changes in the light of the light transmittance change, when received by photoelectric converter by the reflection of light, human tissue into electrical signals and the amplifier

and output. The signal change period of the photoelectric converter is the pulse rate(Zhao, P.,.2013). Data were related to the health of human body, the heart rate in 60 ~ 100 / min, into the program, if measured the heart rate is beyond the scope of this delay if two minutes later also to exceed bid, trigger the alarm, the heart rate acquisition program design process is consistent with the temperature detection process.

4.4 GSM text part program design

The GSM module SIM800A uses the debug method of serial communication to control the sending of SMS via AT command (Liu. J. P., 2010). The process of sending an English TEXT message by the system is shown in Figure 8.

```
AT+CMGF=1

OK
AT+CSCA="+8613800220500"

OK
AT+CMGS="152****1923"

>HELP
+CMGS: 62

OK
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Figure 8: GSM SMS sending serial debugging process

4.5 The system test

After electrify 1602A main screen display the word "SMART HEALTH", began to register the GSM part network at the same time, the unregistered successful 1602A of the lower right corner shows "N", "N" to "Y" after registering successfully, and the second line shows the value of heart rate and body temperature value. "T" stands for body temperature, and "H" stands for heart rate. Heart rate in 60 ~ 100 / min, temperature between 36 ~ 37.5 ℃ , as the normal range; Heart rate or temperature is beyond the scope and lasts 2 minutes (or independent press K1 key) and trigger the alarm, LCD display emergency contact name and number, the GSM module automatically sent the word "HELP" information to emergency contacts, send after a successful 1602A top right corner shows the "T", normal function of system implementation and the index precision reached the standard.

5 CONCLUSION

The system uses GSM spontaneous SMS and on-site buzzer whistle, in the event of sudden illness, distress and unconscious to the guardian of the alarm, helps to solve the problem that people are difficult to get timely assistance for sudden disease. System is running well, easy to use, can be in the elderly, children and sudden illness and other populations to promote the application.

ACKNOWLEDGEMENTS

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