

Portable Human Physiological Parameters Detection System

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Abstract

Currently, with the accelerated aging, the number of elderly people is more and more. For the elderly, health is the largest problem need to care about, the aged cannot know real-time their physiological indicators. With age, the onset of some diseases is very fast, for some unexpected illness, inability to immediately notify the family or a doctor, which could cause serious consequences. Based on this, a portable human physiological parameters detection system is designed in this paper. This system consists of two parts: The first one is the microcontroller-based human physiological index detection system, which uses hierarchical and modular design. Data sensors collect data, then sent the collected data to the MCU for analysis and processing, finally setting the threshold of the indicators by software programming. The other one is communication using SIM900A GPRS module. The sensor detects abnormal parameters, then the MCU sends preset text message or a preset phone to notify the family or the hospital, for treatment of the patient, So as to realize the functions of detection and treatment.

Keyword: Human physiological parameters; Portable; Detection system

1. Introduction

With the social and human progress, the key point of the health service development has been transferred to prevention and treatment of some common diseases, such as non-communicable diseases and mental diseases. It is very important that real-time monitoring physiological parameters. Today, there are many kinds physiological indexes, but mainly in the ECG signal detection. Most of these devices used in hospitals, welfare and other large social institutions, and patients must be check to the hospital. These traditional physiological index detection equipment, with the advantage of higher precision, more professional, and the disadvantage of operation and detection alone difficultly, is hard to meet demands for real-time detection. For older users, this device is inconvenient, because of the unrealistic of often go to the hospital, cannot achieving real-time monitoring, will not be able to deal with an emergency. Relatively speaking, a portable, domestic physiological indexes testing instrument, has a bigger social demands. Existing signs monitoring instrument on the market are mostly imported equipment, prices are relatively high, mostly in the tens of thousands of yuan of above. So the research of a portable, can be real-time monitoring and can deal with emergency physiological indexes testing instrument has very important significance, and also has great social and economic benefits.

2. Systematic Design

The design temperature pulse detection alarm as the core, with a temperature sensor JR401 and HK-2000A temperature and pulse, the pulse sensor converts analog signals to

digital signals, then respectively for single chip microcomputer and computer for data processing and display. Finally through GPRS module communication alarm work. According to the scope of the human body normal physiological parameters set the upper limit temperature and pulse, using liquid crystal display shows the parameter, and the ability to send warning messages and calls, as long as find the measured parameters more than set value, can call the police. Because in the process of actual use, electronic devices can't be one hundred percent reliable, could be an indicator is beyond normal human body, but the sensor is not detected, or certain other physiological parameters have been excessive, the user already feel physical condition is not right, but don't know where is not normal, and it has been lose self-help ability. For this kind of situation, this paper designed an alarm button, just press the button, GPRS module immediately dial telephone number specified.

2.1. Design of Hardware Circuit

Human physiological parameters detection mainly used temperature sensor module, a pulse sensor module, micro vibration sensor module, GPRS module, liquid crystal display module, keys alarm module, power module and STM32 control chip. Temperature sensor module, a pulse sensor module, micro vibration sensor module respectively to detect the human body temperature, heart rate, steps to walk (exercise). The normal temperature of the human body is set to the maximum temperature, and the pulse of human body heart rate set the normal range as a normal range, if beyond this scope, the main control chip sends a command to the GPRS module to the preset number information or make a phone call, put an abnormal index in the form of text messages sent to the patients' families, realize real-time detection to the patient's physiological indexes. Human step gauge can set certain steps (exercise), when reach the physiological load of exercise, control chip sends a command to the GPRS module to the preset number information or make a phone call [1]. The overall design are shown in Figure1.

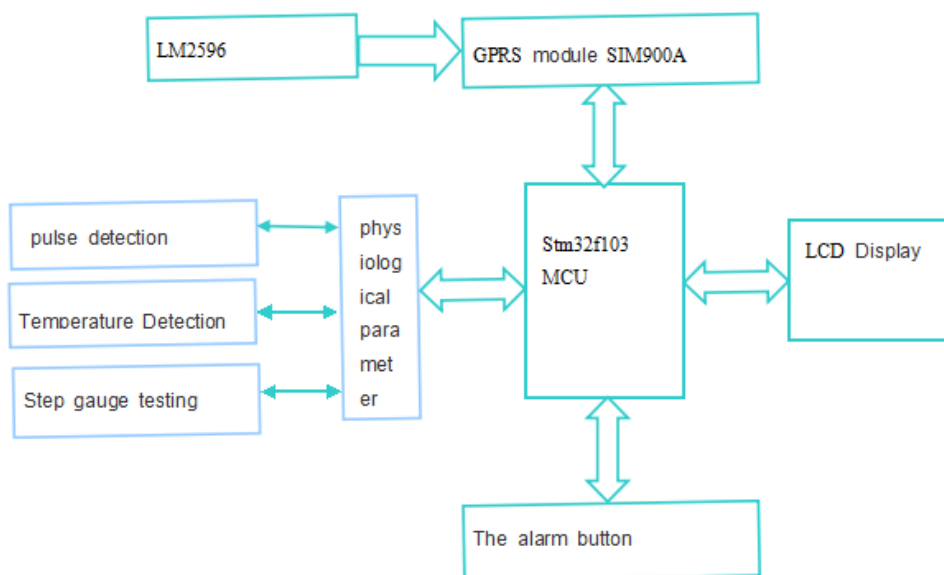


Figure 1. The Circuit Design Diagram

2.1.1. The Temperature Sensor Module

The body temperature is detected by temperature detection module, processed by stm32f103 master chip [2], displayed by 2.4-inch LCD, is determined whether beyond limit by comparing with default. If it exceed limit value, MCU will control

GPRS module call or send a text message to inform the user family. JR401 provides a quickly temperature measurements solution, body temperature measuring range can be achieved $\pm 0.2^{\circ}\text{C}$ medical-grade, the temperature resolution is reach up to $\pm 0.01^{\circ}\text{C}$ [3], with the advantages of non-contact temperature measurement, medical-grade, low-power, ultra-small size, high-speed serial communication, and digital output.

2.1.2. The Pulse Sensor Module

The pulse sensor model, using HK-2000A integrated pulse sensor, could overcome greatly the problem of piezoelectric sensors, integrating force-sensitive element, sensitivity temperature compensation element, temperature sensing element, signal conditioning circuitry, with the characteristics of high sensitivity, strong interference resistance, large overload capacity, good consistence, stable performance, long using life [4]. The detecting pressure range is from -50 to 300 mmHg, the power supply is 5-12V. The series pulse sensor has a complete signal conditioning functions, users do not need to increase coupled filtering [1]. Which reduces the interference caused by the physical link, can be sent directly to the micro-controller.

2.1.3. Step Gauge Sensor Module

Exercise testing, based on detecting the body shaking using micro-vibration sensor. When people walking, the sensor can detect the shake, and then outputs a voltage or current signal, which is processed and sent to the microcontroller, to estimate journey by multiplying the step number and the pitches. In this paper, using ND-3 micro-vibration sensor as a vibration sensor to detect the step number. According to a survey research, waist body vibration is most obvious when walking, so it is worn at the waist. ND-3 module output is a sine wave [5], whose frequency and amplitude is changes with exercise intensity.

2.2. Software Design

Human's physiology parameters detector, is detected separately human's pulse, temperature and activity using pulse sensor, temperature sensor, and vibration sensor, and displayed on the LCD screen in real-time. Three indexes are detected simultaneously and determined whether the normal human parameters while the program is running. So how to avoid conflict in carrying out the task is needed to think about in the preparation process, to prevent the implementation of a task for a long time and affect other tasks to perform. When the body parameter reaches the threshold, it will automatically trigger SIM900A module to send text messages, to achieve real-time monitoring and alarms of body parameters. The system software flow chart is shown in Figure 2.

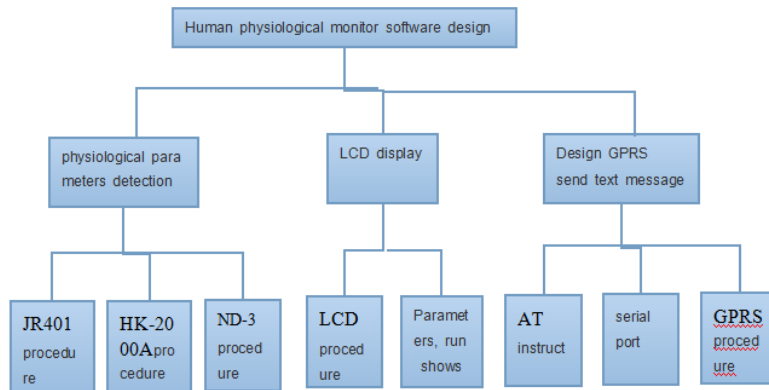


Figure 2. The Software Design Flow Chart

3. The Test Results and Analysis

3.1. The Debug for Integrated Pulse Sensor HK-2000A



Figure 3. HK-2000A Material Object

This pulse sensor, has been integrated amplifier and filter circuits into the front sensing device shown in Figure3, its connection mode is also very simple. HK-2000A does not need physical welding, when need to use, connecting the port of socket and microcontroller, the HK-2000A is connected to oscilloscope, plugged in, placed the sensor in the wrist, observed the output waveform, which is a pulse waveform as shown in Figure4.



Figure 4. Output Pulse Waveform

In traditional measurement, the sensor is tightly tied at the wrist, which will certainly affect the blood circulation. In this paper, the sensor probe is placed just to the wrist with a strap gently fixed, similar as wearing a watch. when the pulse is normal, the test results is 85 times/min shown in Figure 5, when the pulse is abnormal over a period of time, the system will automatically send an alarm instruction, and send text messages or phone calls to the designated phone.



Figure 5. Test Results Show that the Pulse

When collecting pulse, considering the acquisition of quickness and accuracy, we use the average filtering algorithm, through the test collection and a pulse interval delay to determine the number of pulse in a minute time, through the acquisition, 10 times average relatively accurate results [6], and can quickly calculate the pulse of The Times.

3.2. The Debugging for Infrared Temperature Sensor JR401

JR401 use is very convenient for non-contact temperature sensor, can accurately measuring surface temperature of the human body [7], only need MCU receive and convert the data, in order to get the temperature data. There are four pin VCC, GND, TXD, RXD shown in Figure 6.

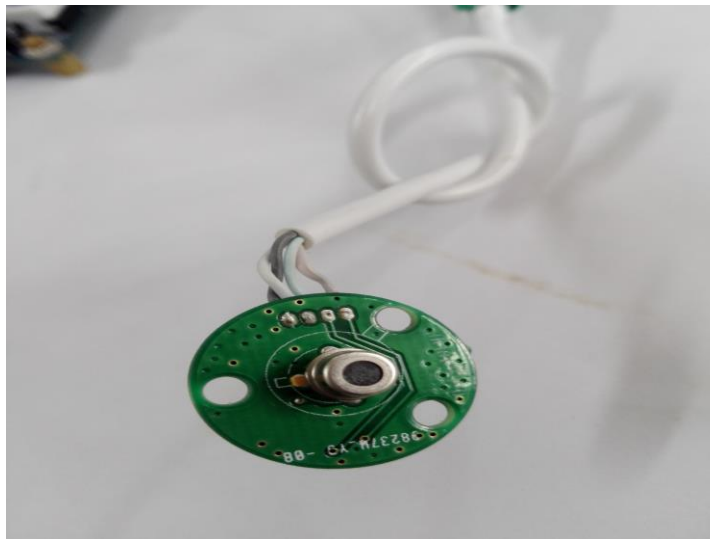


Figure 6. JR401 Physical Figure

The debugging module shows the current human body temperature is 23.19 degrees shown in Figure7.

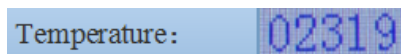


Figure 7. Temperature Display

In the temperature debugging process, because of the non-contact infrared temperature sensors, the accuracy and distance of measurements has a great relationship, with the distance increasing, the measured temperature gradually close to the air temperature, so maintaining a certain distance in measurement process is very critical. really measured temperature value and temperature values

are some errors, a compensation value is set to compensate for the accuracy of the measurement instrument, and make the measurement of the body temperature more accurately.

3.3 Wireless Communication Module SIM900A Debugging

SIM900A is a practical convenient ‘telephone’, the microcontroller via the serial port send commands to manipulate, preset phone numbers and instructions by software. When processing, just plug in the SIM card and connected to the microcontroller, if the physiological index exceeds the threshold value, the software automatically sends the appropriate command, trigger the module, make calls or send SMS messages [8]. The module is shown in Figure 8.

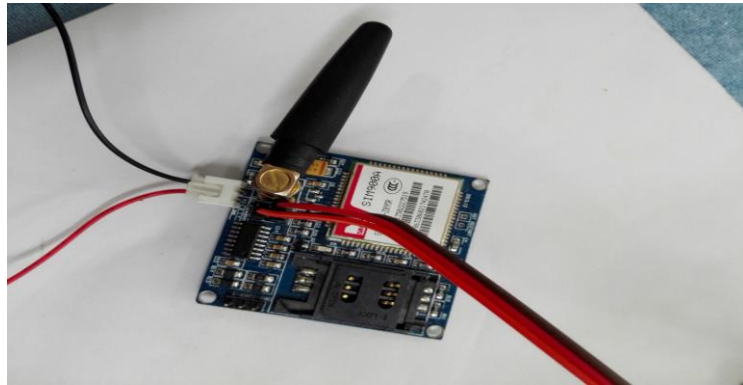


Figure 8. SIM900A Module Chart

3.5. Integration Testing

When the pulse is greater than 100 per minute (the set point is according to different ages), SIM900A module sends the ‘pulse abnormal’ SMS to the phone. When the temperature is greater than 37 degrees, SIM900A module sends the ‘temperature anomalies’ SMS to the phone. ND-3 step counting will be displayed real-time on the LCD screen, or preset a certain exercise to remind people motion. This design is successful to achieve physiological detected and an alarm function as shown in Figure 9.



Figure 9. Display Various Parameters

4. Conclusion

A portable human physiological parameters detection system is designed in this paper. This system consists of two parts: The first one is the microcontroller-based human physiological index detection system, which uses hierarchical and modular design. Data sensors collect data, then sent the collected data to the MCU for analysis and processing, finally setting the threshold of the indicators by software programming. The other one is communication using SIM900A GPRS module. The sensor detects abnormal parameters, then the MCU sends preset text message or a preset phone to notify the family or the hospital, for treatment of the patient, So as to realize the functions of detection and treatment. The test results show that this detection system could achieve precise detection, exact alarm, strong anti-jamming ability. In other words, it could meet the various requirements of a portable physiological parameters detector.

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