Pulse Detection System Based on Photoelectric Volumetric Sensor

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Abstract: A pulse detection system based on Arduino and photoelectric volumetric sensor is designed in this paper.It can detect the pulse quickly and display it in real-time with the Bluetooth.The system has the advantages of high sensitivity, good performance, low power consumption, low cost and high performance price ratio,and it can be used for daily life and rapid medical testing.

1. Introduction

Health is more and more valued by people with the continuous development of society and the continuous improvement of people's living standards.Cardiovascular system is an important part of human body.Atherosclerosis, stroke, hypertension and other cardiovascular disease incidence increased year by year, it become a serious threat to human health.As a result,it is very urgent and important to prevent and control the occurrence of cardiovascular disease.It is necessary to design an accurate and convenient pulse detection system because we usually want to know their own real-time pulse is difficult.

2.Design principle and process

Design scheme

There are three kinds of traditional pulse measurement methods:The first is to extract from ECG signal;The second is to calculate the pulse rate from the fluctuations measured by the pressure sensor;The third is based on the photoelectric volumetric method.The first two methods of extracting signals can restrict the activity of patients,and the patient will feel uncomfortable if used for a long time.The third kind of photoelectric volume method to measure the pulse, which is also our scheme, is one of the most common methods of monitoring measurement with the advantages of simple method,convenient wearing, high reliability, etc..

The frame diagram of the pulse detection system designed in this paper is shown in Figure 1.It is mainly composed of heart rate sensor, Arduino MCU, Bluetooth module, USB-TTL module and computer display module.

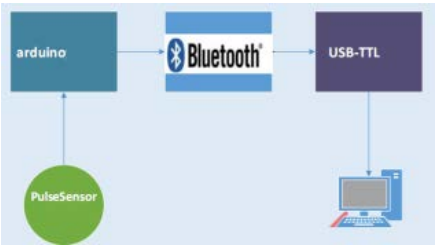

Figure 1 Schematic diagram of pulse detection system

Design proces

Pulse sensor is relatively high precision equipment and the cost is relatively high.Photoelectric volume sensor with moderate price and high accuracy is chosen in consideration of the cost.It can transmit signals through Bluetooth.It can also detect the pulse in a certain range and display the results on the screen in real-time.

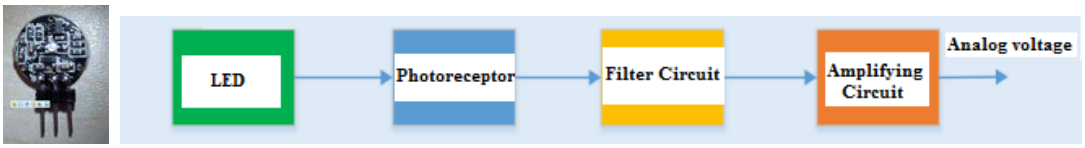

Figure 2 Photoelectric volumetric sensor and its principle diagram

The basic principle of the photoelectric volumetric method is that the pulse is measured by measuring the rate of light transmission in human tissue when the blood vessel is pulsating.The physical map and its principle are shown in Figure 2.The sensor consists of two parts: light source and photoelectric converter,with the band or the clip is fixed on the patient's finger or earlobe.The light transmittance of the light beam is changed because of the change of the volume of the arterial pulse when the beam through the human peripheral blood vessels,and the light reflected by the human tissue is received by the photoelectric converter, which is converted into an electric signal and amplified and output.The pulse is a periodic change along with the beating of the heart, so the volume of the arterial blood vessel is also a kind of periodic signal,and the electrical signal of the photoelectric converter is the pulse rate which we want to know.

The Arduino system is shown in Figure 3 below as the pin, USB interface, DuPont line slot and power interface are all welding in SCM system.

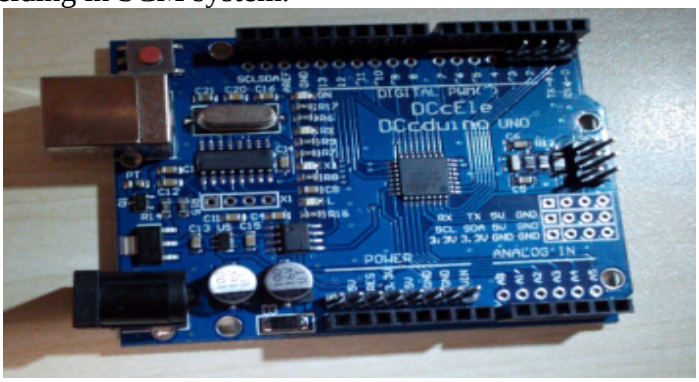

Figure 3 The physical map of the Arduino

Heart rate is collected by the heart rate sensor and send to the Arduino.Arduino then complete the following functions:collect the pulse signal,achieve AD conversion and calculate the heart rate;uploade the pulse waveform data and heart rate values to the Processing host computer through the serial port;At the same time, a LED is used to simulate the beating of the heart, in order to achieve the purpose of the detection process.

It is responsible for the MCU to collect the pulse data and sent it out.This requires the use of a USB to TTL module to configure the Bluetooth module. Connect the two modules to the ground and connect the TXD and RXD pins, as shown in figure 4.

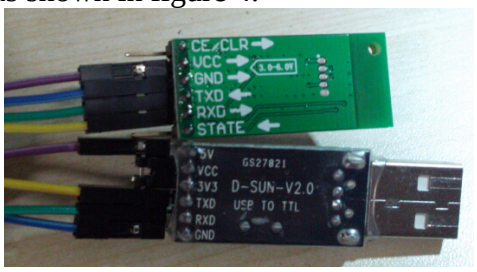

Figure 4 The connection diagram between the Bluetooth and the USB-TTL

The slave Bluetooth module is inserted into the microcontroller module when it is set up and pulled out of the TTL module.The host Bluetooth module is set up then, and the whole system is designed as shown in figure 5.

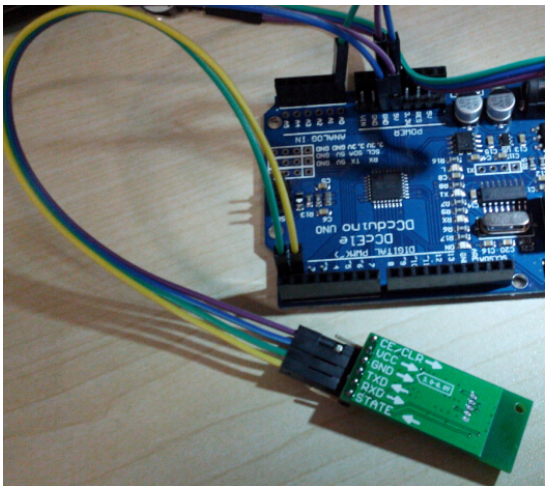

Figure 5 The physical map of the pulse detection system

Performance and analysis

The performance of the pulse detection system is tested after debugging.It show that the sensor is stable (i.e. no input signal) when the waveform tends to a straight line.Beats per minute can be read on the PC screen(Figure 6 (a)) when the finger gently on the pulse sensor (Figure 6 (b)).

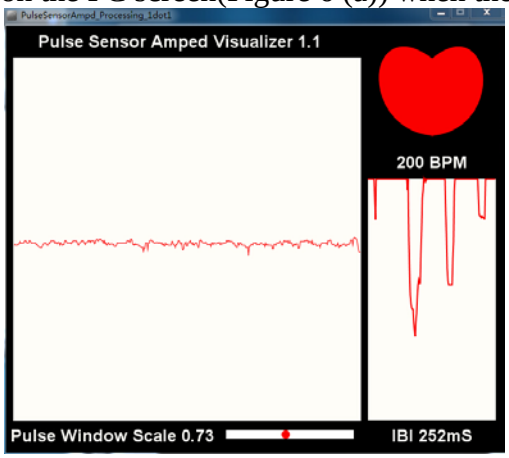

Figure 6(a) Test results on the PC

Figure 6(b) Test chart

Figure 6 The test of the Pulse detection system

In order to prove that the output of the sensor is correct, we also compare it with the simplest measurements (i.e., the measurement of the heart beat frequency with the hand pulse measurement or the chest).As a result, the precision of pulse detection system is high.

Conclusion

A pulse detection system based on Arduino and photoelectric volumetric sensor is designed in this paper.The utility model has the advantages of real-time detection and pulse display, high precision, simple structure, small volume, convenient carrying, etc.. It has high application value and good market prospect.

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