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Pulse heart rate measuring instrument based on STM32F

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Abstract: This subject is based on the sensor technology and single-chip technology. It is designed by ARM development environment design software. It produces a pulse heart rate measuring instrument with an easy-to-understand structure and reliable function. This pulse heart rate measuring instrument adopts STM32 single-chip microcomputer as the core of the instrument, combined with Pulse sensor pulse heart rate sensor circuit module and LCD1602 liquid crystal display circuit module. The pulse heart rate measuring instrument is connected with each pin of the STM32 microcontroller chip through the sensor and the display to realize the work. Pulse sensor pulse heart rate sensor monitors the human body. Heartbeat, pass the data to the STM32 microcontroller. STM32 single-chip microcomputer calculates and transmits to the display. The user can read the heart rate from the display at any time.

Keywords: Pulse heart rate measuring instrument; pulse heart rate sensor; STM32 microcontroller.

1. Introduction

Heart rate is the technical term for the periodic beat rate of heartbeat. The explanation for heart rate in the dictionary is "the frequency of heart beat". The number of times the heart beats per unit time. The heart rate of a normal adult is 60 to 100 beats per minute, the heart rate of people who exercise regularly will be slower, and the heart rate of people with full body will increase; the heart rate of children under three years old is often above 100 beats per minute; The heart rate will slow down as you get bigger [1]. The heart rate of people with fever in daily life will rise, the heart rate of people with typhoid fever will fall, and the heart rate of people with pneumonia and asthma will also rise. Whether the heart rate is too fast or too slow will cause coma and cause death. Pulse heart rate is equivalent to the human health password. As long as the password can be accurately deciphered, the health status of the human body can

be accurately diagnosed [2,3]. The traditional Chinese medicine in China published a "Meridian" in the third century AD, which described the impact of pulse heart rate on human health. In traditional Chinese medicine, there are five elements of pulse appearance, intensity, speed, rhythm and form. Traditional Chinese medicine regards the pulse speed in the pulse as the heart rate, and the doctor counts the measurement solely by his own feeling [4,5]. The pulse rhythm compares heart rate for a long time. Both of them are subjective and are greatly influenced by the doctors themselves. Therefore, the accuracy of pulse diagnosis has been greatly affected, which has become a constraint on the application and development of pulse diagnosis in traditional Chinese medicine. The earliest pulse heart rate recorder in history was manufactured by Vierordt in the 1960s. The earliest pulse heart rate measurement device in China was Zhu Yan. He combined the characteristics of Chinese and Western medicine to apply Vierordt's lever pulse heart rate recorder to the pulse diagnosis of traditional Chinese medicine in. Since then, with the advent of modernization, more and more medical workers have studied the pulse heart rate, and the development of more and more pulse heart rate meters has entered a peak period. There are various types of pulse probes, but the conventional pulse heart rate measuring instruments are mainly single-point strain gauge type. Due to the rapid development of the electronics industry, the current pulse heart rate measuring instrument is dominated by three multi-point types. The current pulse heart rate measuring instrument is used in many industries, but it is still the most used in the medical industry, such as non-invasive cardiovascular function testing, critical patient care, traditional Chinese medicine diagnosis, pulse rate testing, etc. In addition, pulse heart rate measuring instruments are also commercially available Continuously broaden the prospects, such as pulse heart rate measuring instruments will be added to sports, fitness equipment.

Due to the rapid changes in technology, people have higher and higher requirements for pulse heart rate measuring instruments, which in turn promotes the progressive development of pulse heart rate measuring instruments. There are more and more types of pulse heart rate measuring instruments. The classification standard of pulse heart rate measuring instruments is different from pulse heart rate sensors. (1) Contact sensor: Heart rate measuring instruments manufactured using contact sensors are divided into finger pulse type and ear pulse type formula. The advantage of finger pulse is that it is convenient and simple to measure. The disadvantage is that it is easy to sweat on the finger and there is more oil. The finger clip will be polluted repeatedly. The finger clip will be polluted. However, the ear pulse type is clamped on the ear pulse, but the ear pulse on the human ear is very weak. Especially when the temperature changes, the ear pulse is affected by the temperature change. The sensitivity of the pulse heart rate measuring instrument will also decrease. (2) Non-contact sensor:

Non-contact pulse heart rate measuring instrument is the mainstream of the current development. This type of pulse heart rate measuring instrument is characterized in that the detection device does not invade the body and does not cause discomfort. The measurement accuracy is high, and the pulse heart rate can be measured directly on the surface. The best-developed non-contact pulse heart rate measuring instrument is the photoelectric pulse heart rate sensor. The photoelectric pulse heart rate sensor is based on the photoelectric volume method. Through the detection of the degree of light transmission of the human body, the pulse heart rate is indirectly obtained.

2. Design

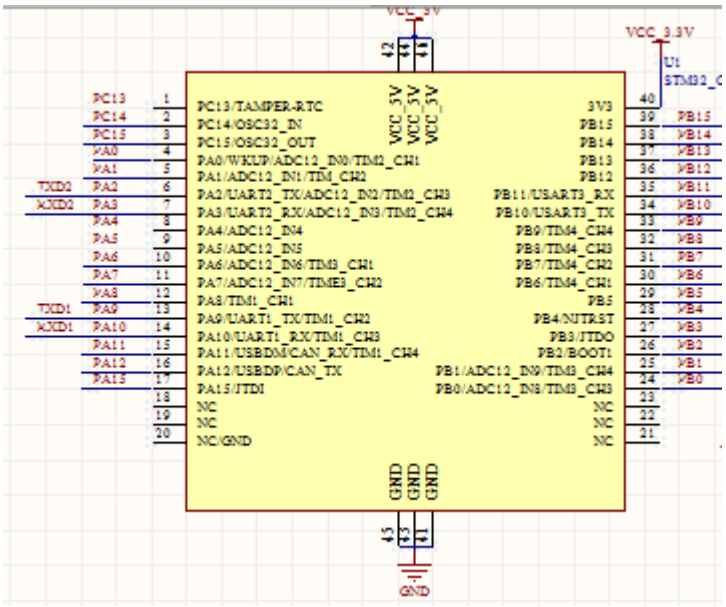

Figure 1 STM32 schematic

The pulse heart rate measuring instrument designed in this subject uses the STM32 single-chip microcomputer, which is made by the American STM company. This single-chip microcomputer has reliable performance, does not have large energy consumption in the circuit, and is relatively cheap on the market. The amount of interface required for this design can be fully provided by STM32. And most of the components can be highly compatible with STM32, which broadens the selection direction for the design of hardware circuits. STM32 does not have high requirements on the ambient temperature; it can work normally in the environment of 150 degrees Celsius to minus 40 degrees Celsius. It only needs a voltage of 2V to 3.6V, which is equivalent to the power of two batteries to support the operation of STM32. STM32 schematic diagram is shown in Figure 1.

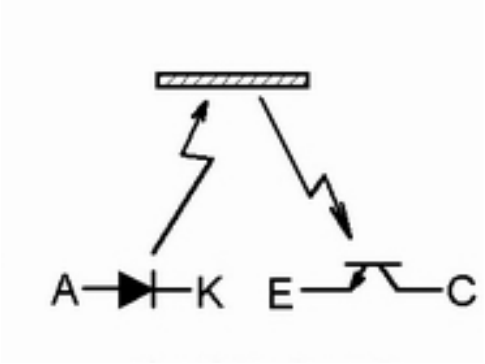

Figure 2 Photoelectric sensor working principle diagrams

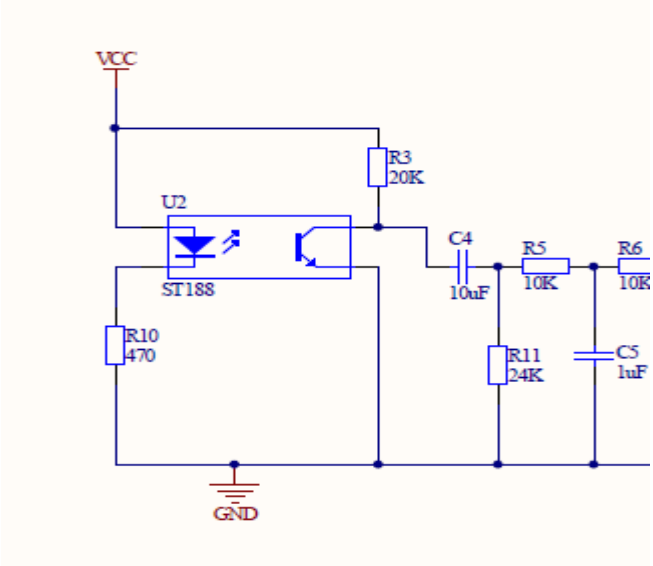

Figure 3 Signal acquisition circuit

At a fixed wavelength, the brightness of light after passing through a substance is proportional to the concentration of the substance. When the light emitted by the infrared emitting diode is irradiated onto the human tissue, the reflected light of the human tissue is received through the infrared receiving transistor, and the change in the brightness of the infrared receiving transistor at different times can reflect the structural change of the human tissue. The relaxation and contraction of the arteries in the body is the reason for the pulse heart rate. There are many blood vessels on the fingers of the "10 fingers connected heart". In addition, compared with other parts of the human body, the light transmittance is better, so the photoelectric pulse heart rate sensor Pulse heart rate is often measured at the fingertips of a person. Human tissues include skin, muscles, bones, and blood, of which skin, muscles, and bones have a constant resistance to light. Therefore, after the light emitted by the infrared emitting diode passes through the finger, the only factor affecting the difference in the brightness of the light received by the infrared receiving transistor is the change in blood volume. The change in blood volume is caused by the change in pulse heart rate, so as long as the difference in brightness of light caused by the change in blood volume

is measured, the pulse heart rate measurement can be completed indirectly. The working principle of the photoelectric sensor is shown in Figure 2.

The schematic diagram of the signal acquisition circuit is shown in Figure 3. U2 is an integrated block of infrared light-emitting diodes and infrared receiving transistors, R10 provides a reference voltage for infrared light-emitting diodes, R3 is the current limit. C4 is a coupling capacitor that separates the photoelectric sensor from the amplifier circuit behind it to prevent a large voltage from being generated during abnormal contact and damaging the LM358. R11 is the load resistance of the previous stage, and the input load of the latter stage. R5 and C5 are the first stage filter circuit.

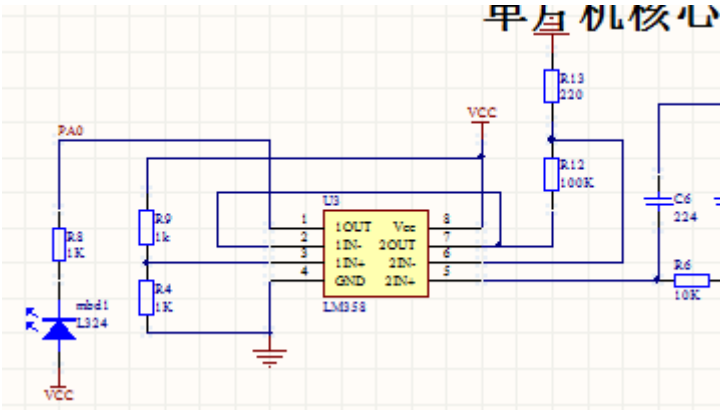

Figure 4 Amplified shaping circuit schematic

The amplifier circuit is shown in Figure 4. R6 and C6 is the second stage filter. R12 is the feedback resistor, used in combination with R13 to determine the magnification of LM358. The signal from the photoelectric sensor is filtered and passed into the 5 pins as shown in Figure 8, and then output by the PA0 after the LM358 comparison operation as shown in Figure 9, and connected to the single chip PA0 pin. The light-emitting diode will flash as the electrical signal changes, and its frequency is consistent with the pulse frequency.

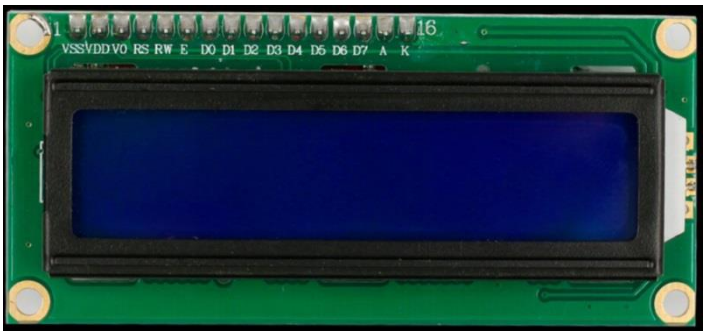

Figure 5 LCD1602 physical map

Pins 1 and 2 of LCD1602 are positive and negative power supplies. Pin 3 is connected to the adjustable resistor PR1 to eliminate the "ghosting" phenomenon. The No. 4 pin is connected with the single-chip microcomputer, and the single-chip microcomputer switches the data register and the instruction register of the LCD1602 through the No. 4 pin. The single chip computer controls reading and writing through pin 5. Pin 6 is the

enable terminal. D0 ~ D7 are the input pins of the single chip microcomputer. Pins 15 and 16 are the positive and negative power supplies for the backlight. LCD1602 physical map is shown in Figure 5.

3. Conclusion

This article combines many current pulse heart rate measurement equipment, selects STM32 microcontroller, Pulse sensor pulse heart rate sensor, LCD1602 liquid crystal display design, software uses C language, DXP software, through hardware control design a pulse heart rate measuring instrument. After actually testing the whole pulse heart rate measuring instrument, it is convenient to use it. Just place your finger on the device, you can accurately measure the pulse heart rate.

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