Research on Wireless Pulse Monitoring System Based on AVR

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Abstract: Pulse is the most important, sensitive and reliable source of information for human activities. It is an important window to reflect the health of the human body. The extraction speed of the pulse is fast. Therefore, it is also an effective method to quickly find the cause by using the pulse signal. This topic adopts embedded and wireless communication technology, and proposes a new scheme for processing pulse signals, namely acquisition and processing and wireless transmission part (front end system) + wireless reception and PC display part (back-end system). The front-end system is mainly responsible for the acquisition and initial processing of the pulse signal and can be sent separately. It can be connected to the PC through the wireless receiving and serial port interface. The back-end system is mainly responsible for tracking and displaying the signal transmitted by the front-end system. It is the role of the wireless receiver module that enables the system to have remote monitoring capabilities.

1. Introduction
Research on pulse information has important clinical diagnostic value and practical significance in both Chinese medicine and Western medicine[1]. In the medical field, the testing of biomedical parameters is an emerging discipline that is of great interest to both the medical and engineering fields[2]. The use of modern sensor testing technology to solve the clinical diagnosis and laboratory research of a variety of parameters of the measurement, whether for clinical diagnosis and monitoring or for medical basic research, is of great value and significance. The use of sensor[3-5] testing technology to quantitatively analyze pulse information is one of the topics of general concern to medical experts at home and abroad.

Because pulse detection is a biosignal detection technology with Chinese characteristics and unique characteristics, the development of such a monitoring instrument[2, 5-10] can meet both medical and patient needs. If the self-analysis ability is added, it has very obvious social and economic benefits, mainly reflected in the following aspects: clinical diagnosis, early diagnosis, simultaneous monitoring, guiding medication, and research on the pulse principle of Chinese medicine.

Based on theoretical research and practical practice, this thesis makes some meaningful research and discussion on the hardware, algorithms and algorithms of embedded pulse detection system, and proposes a new system scheme for pulse detection and analysis. The entire monitoring system uses a wireless transceiver module and a minimum system, so that the transmission speed is fast and the system structure is simple. The data collected by the monitored points in real time is transmitted to the PC of the upper computer in time through wireless network communication, and dynamically reflects the situation of the monitored points in real time.

2. System overall design
This topic uses the photoelectric sensor to extract the pulse signal, uses the embedded processing pulse
signal, transmits it remotely through the wireless transceiver module (CC1100), and displays it on the PC. This can reduce the trauma to the human body while also being remotely monitored. It can be monitored on a PC to form a system that can remotely monitor the body's pulse, providing an effective data foundation for doctors' research. The system block diagram is shown in Figure 1.

Figure 1. The system block diagram

### 3. Lower Computer Hardware Design

The pulse signal acquisition circuit is shown in Figure 2. The UA of the LM393 is connected to a unity gain buffer to generate a reference voltage of 2.5V.

Since the infrared receiving diode can generate electric energy under the irradiation of infrared light, a single diode can generate an O.4 V voltage and a 0.5 mA current. In Figure 4-1, D2 is an infrared receiving diode (type BPW83) and D1 is an infrared emitting diode (IR333 type). Their working wavelengths are all 940 nm. In the finger clip, the infrared receiving diode and the infrared emitting diode are placed opposite each other. Get the best pointing characteristics. The larger the current in the infrared emitting diode, the smaller the emission angle, and the greater the intensity of the emission. In Figure 4.1, R5 selects 100 Ω based on the sensitivity of the infrared receiving diode to the infrared light. If R5 is too large, the current through the infrared emitting diode is too small, and the BPW83 infrared receiving diode cannot distinguish between the pulse and the pulseless signal. On the contrary, if R0 is too small, the current passing through is too large, and the infrared receiving diode cannot accurately distinguish the signal with and without pulse. When the infrared light emitted by the infrared emitting diode is directly irradiated onto the infrared receiving diode, the potential of the inverting input terminal of the UB is greater than the potential of the non-inverting input terminal, and Vi is “O”. When the finger is in the measurement position, two situations will occur: one is the pulse-free period. Although the finger blocks the infrared light emitted by the infrared emitting diode, due to the dark current in the infrared receiving diode, a dark current of 1 μA causes the Vi potential to be slightly lower than 2.5 V. The second is the pulse period. When there is a beating pulse, the blood pulse makes the finger translucency worse, the dark current in the infrared receiving diode decreases, and the Vi potential rises. Because the infrared light is invisible, it is not intuitive to know if it is turned on when the power is connected. Therefore, an indicator light is placed on the back of the R5 to determine whether it is working properly.
The low-pass amplifier is designed according to the calculation of the maximum pulse rate of the human body pulse after exercise for 240 times/minute. The low pass filter is a circuit for transmitting a low frequency band signal and suppressing a high frequency band signal. When the frequency of the signal is higher than a certain cutoff frequency $f_h$, the signal passing through the circuit is attenuated, and the frequency is lower than $f_h$ the signal can pass through the filter unimpeded. The range of signal frequencies that can pass is defined as the passband: the range that blocks the passage of the signal is defined as the stopband, and the cutoff point between the passband and the stopband is the cutoff frequency $f_h$. $A_0$ is the voltage amplification factor in the passband and is called the passband voltage gain. When the frequency of the input signal is increased from small to large so that the amplification factor of the filter is equal to $0.707A_0$, the corresponding frequency is the cutoff frequency $f_h$.

When the PCB is routed, try to widen the power supply and ground line width to improve the anti-interference ability of the device. Static interference is a hazard to the system and may even break down the device. In order to avoid static interference to the system. The following measures are taken in the design: PCB wiring keeps the loop area to the minimum; make the wire length as short as possible; strengthen the capacitance between the power line and the ground line; each power supply pin of the integrated circuit is placed near a bypass capacitor. Ground, a 104 (0.μF) capacitor is used to filter out noise and smooth power supply fluctuations. In the PCB layout, we separate the signal ground from the digital ground, and then connect the power and ground at a single point after independent wiring to avoid mutual interference.

4. Wireless receiving design
The upper computer part includes a wireless receiving module part, a digital display part (the principle of the digital display part is the same as that of the lower computer), a receiving data processing part, and a serial port part. The main function of this part of the whole is to receive the data sent by the lower computer, and display it with the digital tube to see if the received data is matched with the transmitted data. The serial port communicates with the PC through the serial port, because the CC1100 wireless module cannot Direct communication with a PC. The function of each part and the corresponding schematic are separately explained below.

The receiving data processing part consists of a single-chip microcomputer, and the reset circuit has a crystal oscillator circuit. After the signal is received by CC1100, it is transmitted to it for processing. He is mainly responsible for reprocessing the incoming signal: the received signal is displayed on the digital tube. Whether the artificial observation is the same as the data of the lower computer, and resend if it is different. In one case, he communicated with the PC through the MAX232 chip and the
serial port interface and serial port program. Thereby achieving a complete line of the entire monitoring system.

5. **Software design**

The lower machine flow chart is shown in Figure 3.

It is not enough to take anti-interference measures only on the hardware. It is necessary to take measures on the software to make the system more resistant to interference. In the software part, I mainly use software traps, program passwords and software filtering. Use "software trap + program password" to deal with the pointer running away. When the system is disturbed by the outside world, the pointer will fly to another program or jump to a blank segment. If the pointer flies to the blank segment, it is better to handle.

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Begin

Port initialization

Determine if there is any signal input

Digital tube display 8888

Start counting and timing

When the timer is full for 1 minute, the digital tube stops displaying and keeps the number recorded

Determine if there is a high level change

No counting operation

Figure 3 software flow chart
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6. **System debugging and verification**

The acquisition part is a key part of the whole circuit. Due to the high requirements of the instrument, it can only be roughly debugged. Place your finger between the completed photoelectric sensors, and then use the oscilloscope to receive the signal output from the acquisition section to see if there is a signal with a frequency of around 1 Hz. Since the absorption of the infrared light causes the absorption of the receiving tube to be weakened a lot, the output voltage value is small, so it is difficult to distinguish whether the signal is a pulse signal, and only after the processing of the filtering amplification portion can he know whether it is a pulse signal or not. Therefore, the debugging of the filter amplification section is also important.

The debugging part of the filtering part mainly depends on whether he can meet the low-pass requirements of the design. First, the function signal generator is used to generate the 50Hz signal, let him pass the filtering part, observe the output end with the oscilloscope, and whether there is a 50Hz signal. If there is a description that the filter is unqualified, it needs to be changed. If not, slowly reduce the original output frequency of the signal until it is observed that the output waveform is not distorted. Record the frequency corresponding to the signal at this time. If it is close to the theoretical value we set, then there is no problem in the filtering part. If the frequency below 40Hz can pass normally, this filtering circuit can still be used, because it can effectively reduce the interference signal of 50Hz power supply. After EWB simulation, as shown in Figure 4: When the frequency is close to 33Hz, he almost decays to zero. So the filtering part is no problem.
7. Conclusion
The human body pulse is an important part of the cardiovascular system. It is an important way for the human body to transport nutrients, transmit energy and spread various physiological and pathological information. The pulse contains abundant information on human health status. Research on pulse information has important clinical diagnostic value and practical significance in both Chinese medicine and Western medicine.

Based on the combination of theoretical research and specific practice, this paper makes some meaningful research, discussion and design on the hardware and software of embedded pulse detection and analysis system. The system adopts the structure of the lower part of the lower part and the upper part of the upper part. The lower part of the machine is responsible for the acquisition and preliminary processing of the pulse signal, and the upper part of the upper part performs the serial communication and the display of the PC. The lower computer part and the upper computer part communicate through the CC1100 wireless module. The entire monitoring system uses a wireless transceiver module and a minimum system, so that the transmission speed is fast and the system structure is simple. The data collected by the monitored points in real time is transmitted to the PC of the upper computer in time through wireless network communication, and dynamically reflects the situation of the monitored points in real time.

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