Design and implementation of GPRS ambulatory blood pressure monitoring system based on cloud platform

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Abstract.

This paper designs a set of GPRS ambulatory blood pressure monitoring system based on cloud computing platform. The system consists of data acquisition module, main control module, communication module, cloud platform and intelligent terminal, which selects STC12LE5A08S2 series single-chip microcomputer as controlling chip, and uses the oscillometric blood pressure measurement; the blood pressure data are sent to the internet through the communication module. The ambulatory blood pressure monitoring system can carry out real-time monitoring of the user's blood pressure in 24 hours, and uploading the measurement data package to cloud platform through the wireless transmission protocol. Users can login the network interface to query data through intelligent terminal.

Keywords: cloud platform; oscillometric; GPRS; ambulatory blood pressure.

1 Introduction

Ambulatory blood pressure monitoring is a diagnostic technique, through which we can measure the blood pressure automatically and intermittently in the normal daily life. The technology can objectively reflect actual level and fluctuation of the blood pressure, since it overcomes the limitations of less number of blood pressure measurement in clinic, observation error and the white coat effect etc. Nowadays, the equipment of ambulatory blood pressure monitoring has been used in many medical facilities and some households. However, we have large number of patients in our country, which causes the doctor-patient ratio imbalance and low efficiency of treatment, some patients starting treatment being delayed as well. [1,2]

Along with the progress of science and technology, cloud technology

develops rapidly. Using the cloud technology to design a set of dynamic blood pressure monitoring system can realize the data uploading, data storage, data analysis and other functions based on the real-time acquisition of blood pressure data. Through the treatment and analysis of the blood pressure information, calculating the historical average data and putting forward reasonable advice on health, it can greatly improve the efficiency of the treatment of patients and reduce the medical pressure. [3,4]

Based on the STC embedded chip STC12LE5A08S2, this paper complete the software and hardware design of GPRS ambulatory blood pressure monitoring system. By constructing a cloud platform, the system realizes the function of data storage and analysis of blood pressure.

2 System architecture

According to the design requirements, the system consists of data acquisition module, main control module, communication module, cloud platform and intelligent terminal.

Among them, the acquisition module adopts upper arm blood pressure acquisition terminal, using the principle of blood pressure measurement of oscillometric to realize the data acquisition of human blood pressure; the main control module uses STC12LE5A08S2 as control chip, which can collect the blood pressure data through the serial port and transfer it to the communication module; the communication module adopts A8500 wireless communication chip, which can upload the data package from main control module to cloud platform according to the wireless transmission protocol; The cloud platform analyses and store the blood pressure data by comparing it through the data processing technology , and feedbacks monitoring report and treatment recommendations. The process of the system is illustrated in Fig.1.

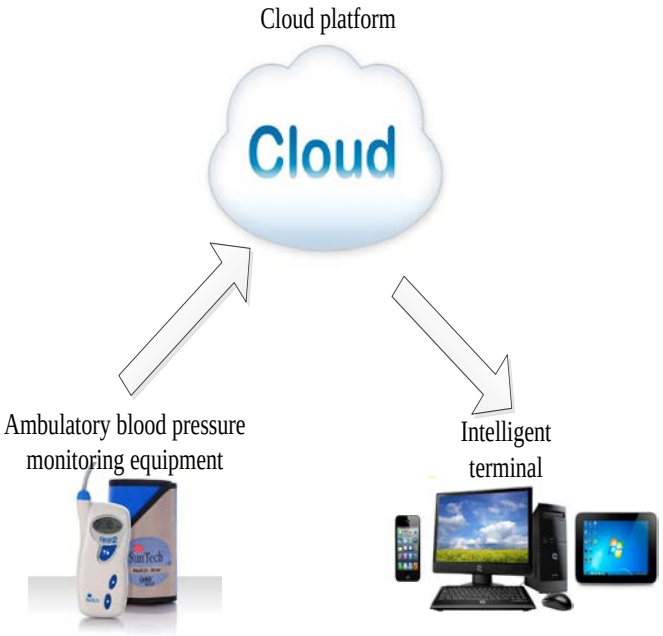

Fig.1 System Chart

3 System hardware design

3.1 Main control module

In this system, the main control module achieves blood pressure collecting by acquisition module through the serial port one, and sends data to the wireless module through the serial port two after processing the data. We choose STC12LE5A08S2 as the main control chip, considering the function of the main control module.

Compared with the traditional 8051 single chip microcomputer, STC12LE5A08S2 series has the characteristics of high speed, low power consumption, strong anti-interference and cost-effective. The chip has dual serial port, receiving and sending data synchronously, and the chip can complete all the functions of the main control module. The functional block diagram of SCM is shown in Fig.2.

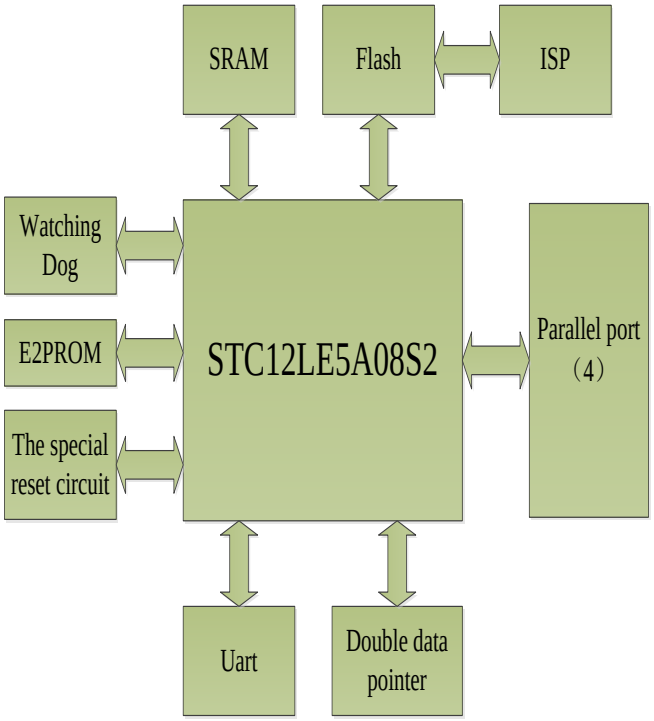

Fig.2 Function block diagram of SCM

3.2 Communication module

This module adopts A8500 wireless communication chip to receive the data packets from the main control module through the serial port, and upload the data packets to the cloud platform through the wireless protocol, using GPRS network.

A8500 is a four frequency GPRS/GSM wireless terminal product. It uses a highly integrated design scheme which is advanced in the electronic field. RF, baseband integrated in a PCB, completes the wireless receiving, wireless transmitting, baseband signal processing and audio signal processing function.

3.3 Power module

In the hardware system, the required power supply voltage for acquisition module, main control module and communication module is different, so the system needs to use voltage conversion chip which can supply different voltage corresponding to different module. It also needs a level conversion chip for serial data conversion, according to the different power supply voltage.

The system adopts the rechargeable battery power supply 3.8V, using the boost SY7208 chip provides 5.5V supply voltage for acquisition module and

selecting the XC6206 regulator chip provides the 2.8V supply voltage for single chip microcontroller. We choose NC7WZ07 as the serial level conversion chip in the design of the system.

4 System software design

4.1 Lower computer software

We use C language as the programming tool for the system software, including the main program, serial control program, GPRS network registration program and data sending program etc.

Users define the time interval by themselves to acquire the blood pressure data. The system will automatically send out a trigger signal, and then data acquisition module and communication module are triggered immediately. When get the trigger signal, these two modules will work in parallel. After the network registration have completed, the communication module will wait to receive data. After the data of blood pressure have completely acquired, acquisition module will transmit the data to the communication module through the main control module. The communication module packages the data and sends it to the specified IP and port of the cloud platform. The system control flow chart of main program is shown in Fig.3.

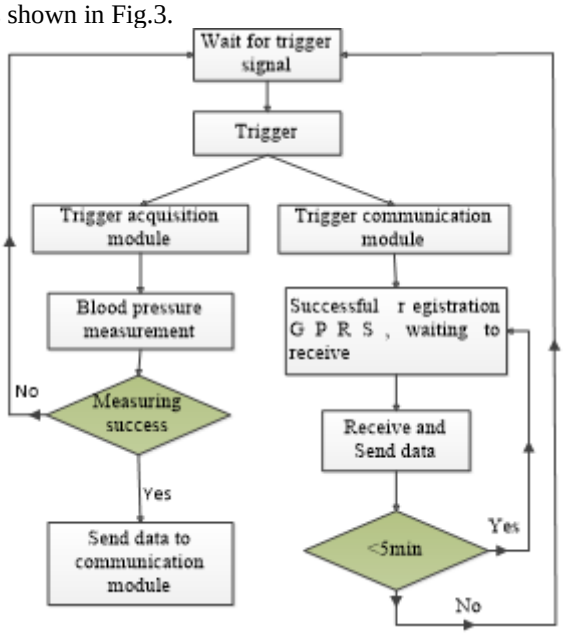

Fig.3 Flow chart of main program

4.2 Cloud platform

The system in this paper is based on the cloud platform, using cloud storage technology to save the blood pressure data of users. By using the technology of data mining, the system can process and judge the blood pressure information, and feedback the average historical data and basic health advice. When the detected data is an abnormal value, system will send SMS warning to specified user, avoiding the delay treatment.

In the cloud storage mode, the enterprises do not need to invest additional capital to build platform in addition to configuration the necessary terminal equipment which can receive storage service. They just need to provide rental service according to the number of users to avoid the risk of one-time investment and reduce the cost. In addition, the selected services can be put into used immediately, which is convenient and efficient. [5,6]

4.3 Intelligent terminal

Users can understand their own physical condition by login the user interface of cloud platform through the mobile phone, Pad, computer and other intelligent terminal. Health records can store all of the historical data of blood pressure of the users, drawing a line graph, and calculating the average value, which is more accurately reflecting the user's blood pressure condition. The user can also compare the data and have a more concrete understanding of their body. In the health analysis option, the system will determine the user's physical condition and provide basic health advice according to the blood pressure data in 24 hour.

5 Test results and analysis

We conduct a comprehensive test to the system.

Wearing the arm belt on the specified location and clicking the trigger button to measure the blood pressure. When measuring finished, we record the data, then repeating the measurements five times. We found that measurement values were identical after comparison, therefore acquisition module works normally.

We use serial port debugging tools to test the main control and communication module. At first, after the program had downloaded into the microcontroller, serial port tools display an ID code which is same with the code written in the program. Second, sending specific AT instructions of the A8500 to communication module through the serial port, then the tools display "GPRS successfully registered" and the ID number displayed in remote cloud platform anastomosis with the ID downloaded before. Above all, main control and communication module both work normally.

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