

## Design of ECG Acquisition System

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### Abstract

This paper designs a kind of ECG signal acquisition system based on STM32 microcontroller and Bluetooth module, and demonstrates the design scheme of hardware and software in detail. The hardware circuit mainly has the signal conditioning circuit, the single chip microcomputer control circuit, the liquid crystal display module and the Bluetooth module. Software program achieves the acquisition of analog digital conversion, LCD display ECG waveform, Bluetooth module data communication. The system has the function of plug and play, and can realize the data communication and transmission between the ECG signal and the Android mobile phone. The experimental results verify the validity and feasibility of the system.

### Keywords

STM32 single chip microcomputer, ECG signal, Android phone.

### 1. Introduction

ECG signal is one of the most important signal in human body, which can reflect the physiological changes of human heart and blood circulation system, which plays a very important role in clinical observation and diagnosis of disease. With the progress of modern science and technology, using computer based signal detection system of the equipment to obtain the information of ECG, assist doctors to diagnose diseases has become a development trend. Therefore, it is needed to design a kind of ECG detection system which can communicate with the mobile phone. This paper designs an ECG signal acquisition system based on STM32, which can not only realize the collection of human ECG signal, but also transmit the ECG signal to the mobile phone through the Bluetooth module to facilitate the analysis and processing of the follow-up data.

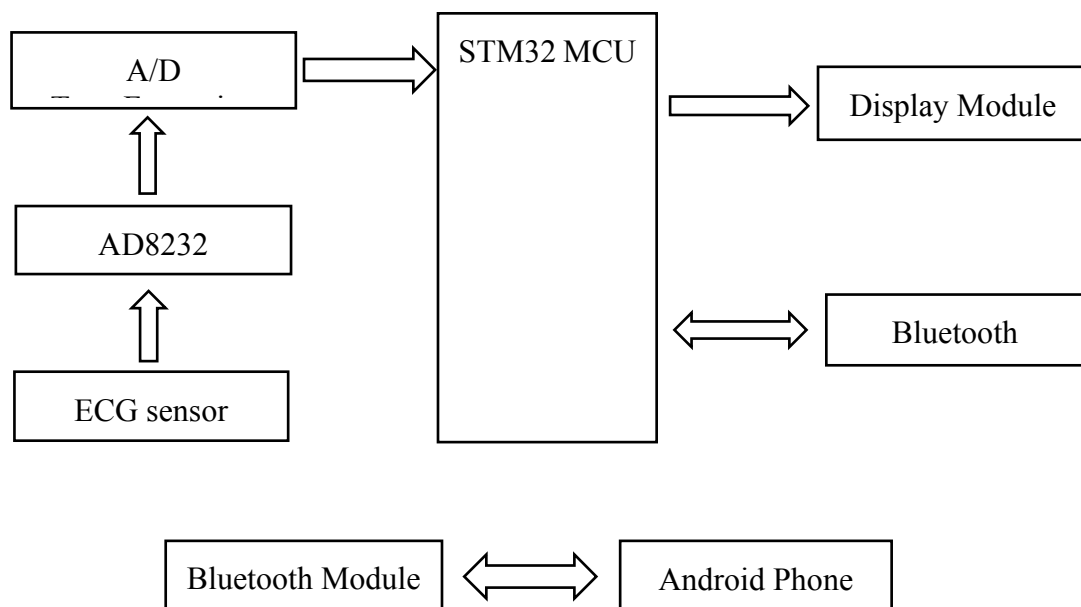


Fig.1 System to achieve the overall block diagram

## 2. System Design

ECG signal is a weak signal in the strong noise, in order to achieve the system requirements, the signal conditioning circuit is first used to enlarge to the appropriate amplitude, and then the A/D conversion and data transmission of ECG signal by the microcontroller. The hardware circuit of the whole system mainly consists of signal conditioning circuit, STM32 microcontroller control circuit and Bluetooth module. System to achieve the overall block diagram is shown in Fig.1.

Working principle: The ECG signal obtained from the surface of the body is filtered by the lead. The high frequency interference is further suppressed by a 50Hz notch filter. Then the A/D conversion of the single chip computer is converted to digital ECG signal.

## 3. System Hardware Circuit Design

### 3.1 Signal processing circuit

Pre amplifier circuit is the key to the design of signal conditioning circuit module, which directly related to the quality of the signal. ECG signal is a weak signal in the strong noise background, generally only 0.05~5mV, the spectrum range is: 0.05-100HZ, ECG signal output is about 1mV, and the input level of A/D converter is about 1000 times, that is, the output of the ECG is about times. AD8232 is used as the preamplifier, which has the characteristics of low noise, low drift, high common mode rejection ratio, high input impedance, etc.. The circuit can be realized in the background of strong noise, and the signal is detected by the ECG electrode without distortion. The Circuit of ECG Signal processing as shown in Fig.2.

### 3.2 Control system based on STM32 MCU

The system controls the core of the 32 bit Cortex-M ARM core microcontroller STM32 series, power consumption is low, the 72MHz 36mA (all peripherals are in the working state), standby down to 2μA. . and has a dual 12 bit ADC 1 s, 4 Mbit / sec

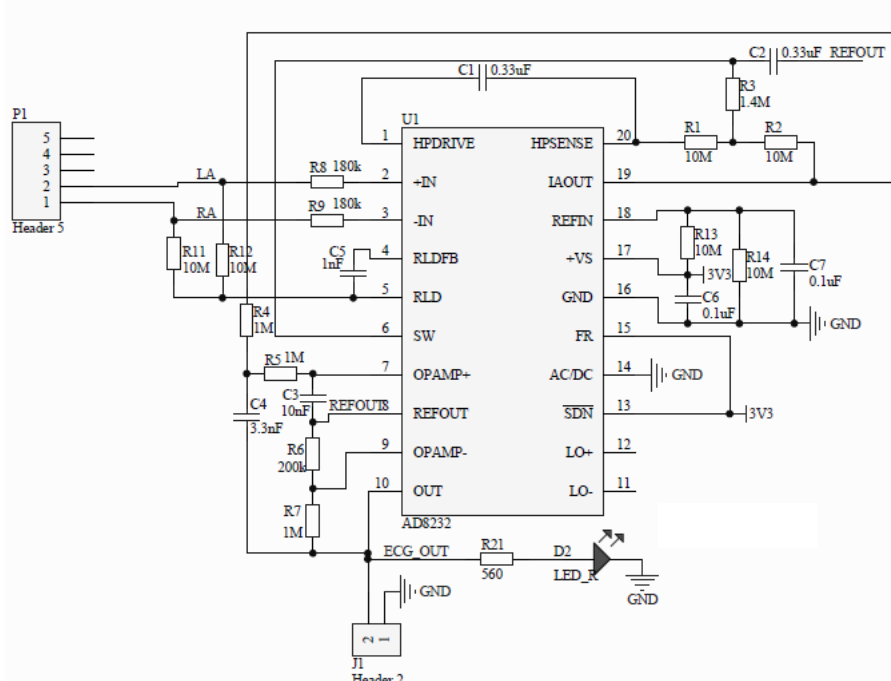


Fig.2 The Circuit of ECG Signal processing

UART, 18 Mbit / s SPI, I/O turning speed 18MHz The chip for the acquisition of the amplified signal AD processing accuracy, and can be stored by the SD card, contrast processing, liquid crystal display, alarm and other functions, through WIFI, Bluetooth and other wireless communication mode and PC, Android phones and other interactive, to achieve dynamic testing.

**3.3 Bluetooth module**

Bluetooth module is used for data communication between single chip microcomputer and mobile phone, the ECG signal is sent to the mobile phone by Bluetooth module, and the ECG waveform can be observed on the mobile phone.

**3.4 Display module**

This system uses OLED as the monitor, through the single-chip microcomputer to deal with the signal count (heart rate), and then through the OLED to dynamically the measured heart rate and ECG waveform display, and simultaneously its heart rate is stored in the microcontroller EEPROM.

**4. System software programming**

Single chip microcomputer application program mainly includes the main program, data acquisition subroutine, data communication subroutine. Using C language programming, the software design program block diagram is shown in Fig.3.

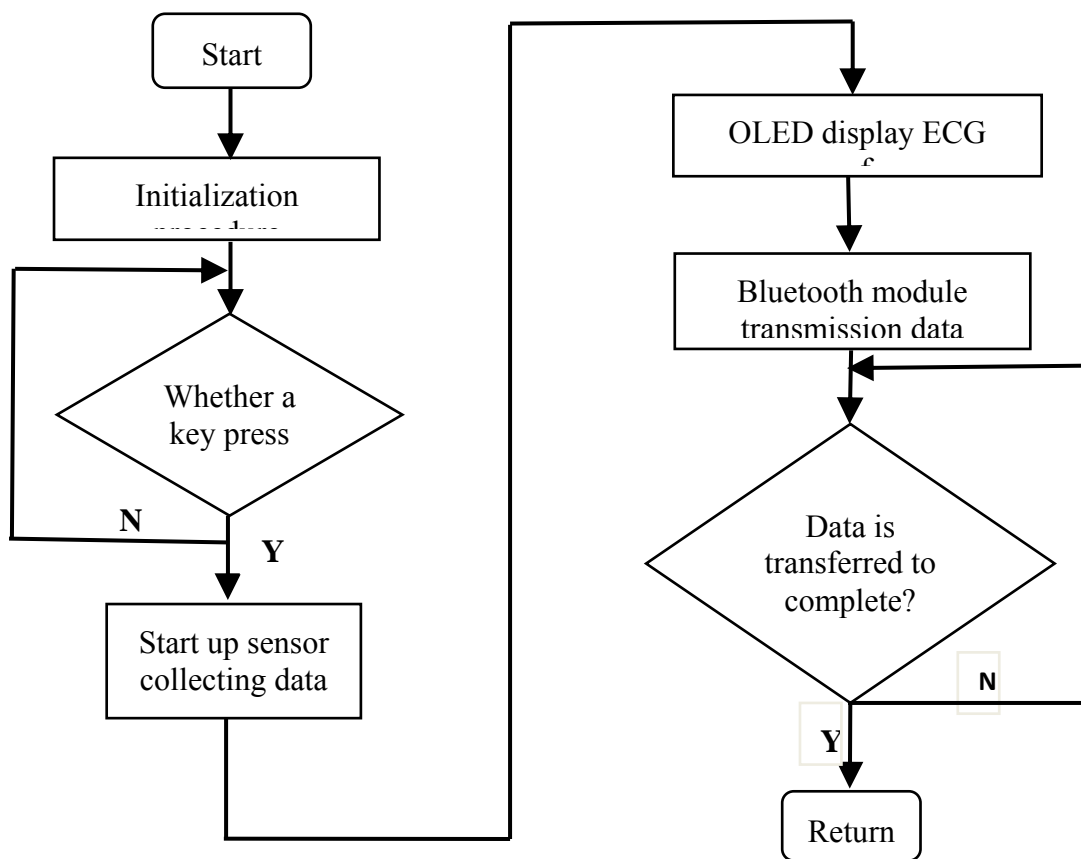


Fig.3 Software design program

**5. Conclusion**

At present, there are many kinds of ECG signal system, and most of the price is expensive. In this paper, the design of ECG signal acquisition system based on STM32 has low cost, high performance price ratio, simple operation, easy to operate, and has a certain reference value and use value.

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