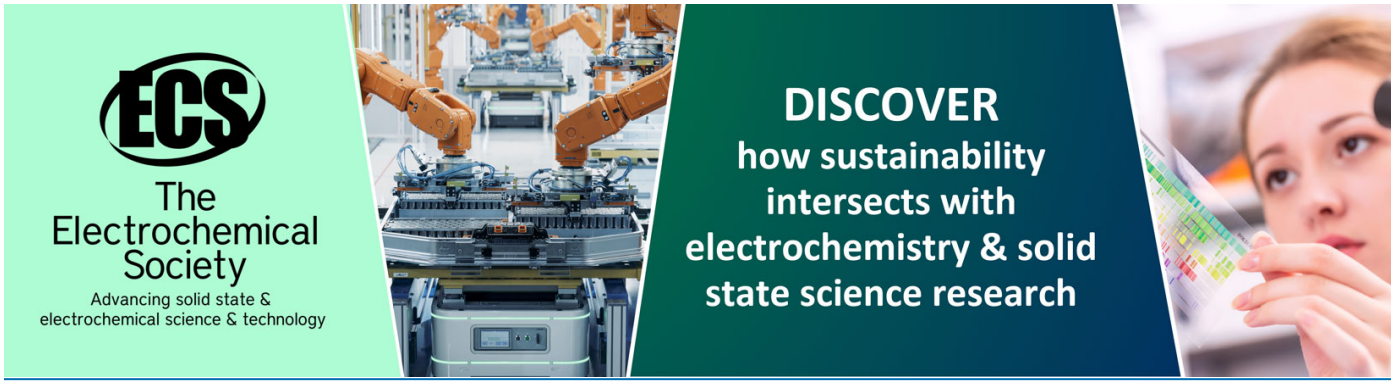
Design and Research of Infrared Light Intensity Tester Based on STM32



Design and Research of Infrared Light Intensity Tester Based on STM32

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Abstract: With the progress of the times, more and more scientists begin to pay attention to the inherent scientific principles of TCM treatment. As a part of traditional Chinese medicine, moxibustion has been widely concerned. Recent studies have shown that moxa sticks can emit a near-infrared light with obvious therapeutic effect when burning. This near-infrared light needs a light intensity tester to measure the light intensity. Starting from the design idea and operation flow of the near infrared intensity tester, this paper describes the overall design method of the hardware of the tester system, and makes a concrete analysis of the software and hardware system of its photodetector. It is hoped that it can provide relevant equipment and theoretical support for the near infrared intensity research of Moxibustion in the future.

1. Hardware Analysis of Light Intensity Tester System

1.1 General idea of hardware design

In the design of STM32 infrared intensity tester, the main idea is to take the microcontroller as the core of the whole system and add some peripheral circuits, so as to realize the omni-directional signal monitoring and main data measurement, and centralize the measured data on the host computer. In this infrared intensity tester system, there is also a certain speech recognition and playback capability. Power. In this design, photodetectors are the core part of electronic technology. It is necessary to establish the correlation between optical information and electrical signals. Generally speaking, photodetectors can be roughly divided into two parts: thermoelectric detectors and photonic detectors[1]. The working principle of thermoelectric testing device is to detect the intensity of the signal expressed by the optical signal through the related thermal effect of the thermal sensor, while the photonic detecting device uses the correlation effect of the photoelectric element to realize the detection of light. In this design, the photoelectric tester is mainly used to measure the near infrared light in 780nm ~ 1100nm band, and the photon detection process is carried out through the type of relevant detectors. The overall framework is shown in Figure 1 below[2].

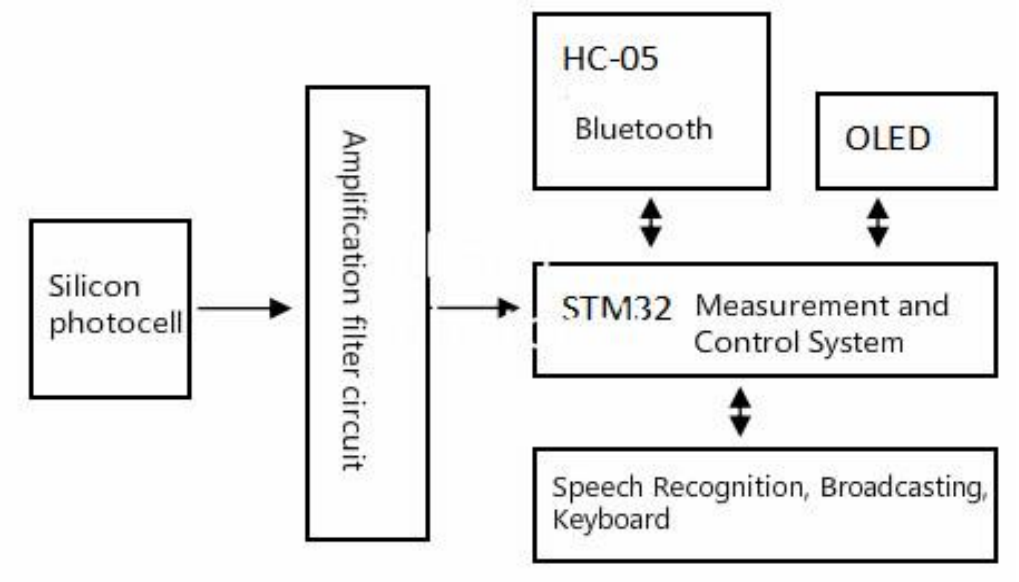

Fig. 1 - Hardware frame diagram of light intensity tester system

1.2 The Use of Silicon Photovoltaic Cells

The infrared intensity tester of STM32 uses silicon photovoltaic cell, which is essentially a PN junction. Its working principle is very similar to the principle of photoelectric effect. It contacts each other through P-type semiconductor and N-type semiconductor, because the charged characteristics of these two semiconductors are different, and there will be mutual cancellation in the process of charge collision. A complete depletion layer is formed and a current is finally formed. Figure 2 is a diagram of a silicon photocell[3].

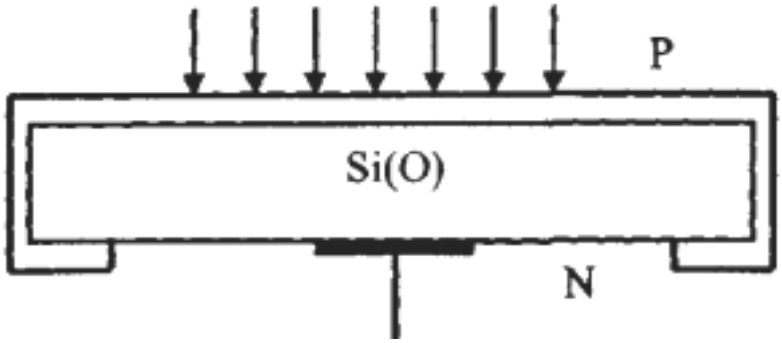

Figure 2 - Structural schematic diagram of silicon photovoltaic cells

In the actual working process, silicon photovoltaic cells can be used as photon detectors for centralized use. Generally speaking, silicon photovoltaic cells can also be used as current sources. From the output characteristics, it is a combination of short-circuit current and light intensity interaction. This system is designed to take short-circuit current as a small current signal displayed by measurement[4]. The silicon photovoltaic cell in this design also uses optical filter BPW34FS, whose function is to filter out the visible band, which is used in remote control, radio, recorder and other places[5].

1.3 Modular Circuit and Speech Recognition

In the design of STM32 infrared light intensity tester, the light intensity tester adopts a variety of modular circuits to combine with each other. Because this design involves multiple power supply directions, it is necessary to ensure the stability of power supply between each module when supplying power to the system, reduce the ripple voltage as much as possible, and use the form of dual power supply for centralized power supply. The design of power supply plays an important role in the

operation of the whole system. In this design, in addition to the above functions, in order to facilitate the use of speech recognition and broadcasting circuit also need to be designed. YS-LDV7 module is used in speech recognition. In the voice broadcasting circuit, the chip NY3P035 is used to program voice broadcasting. The circuit diagram of the speech recognition module is shown in Figure 3[6].

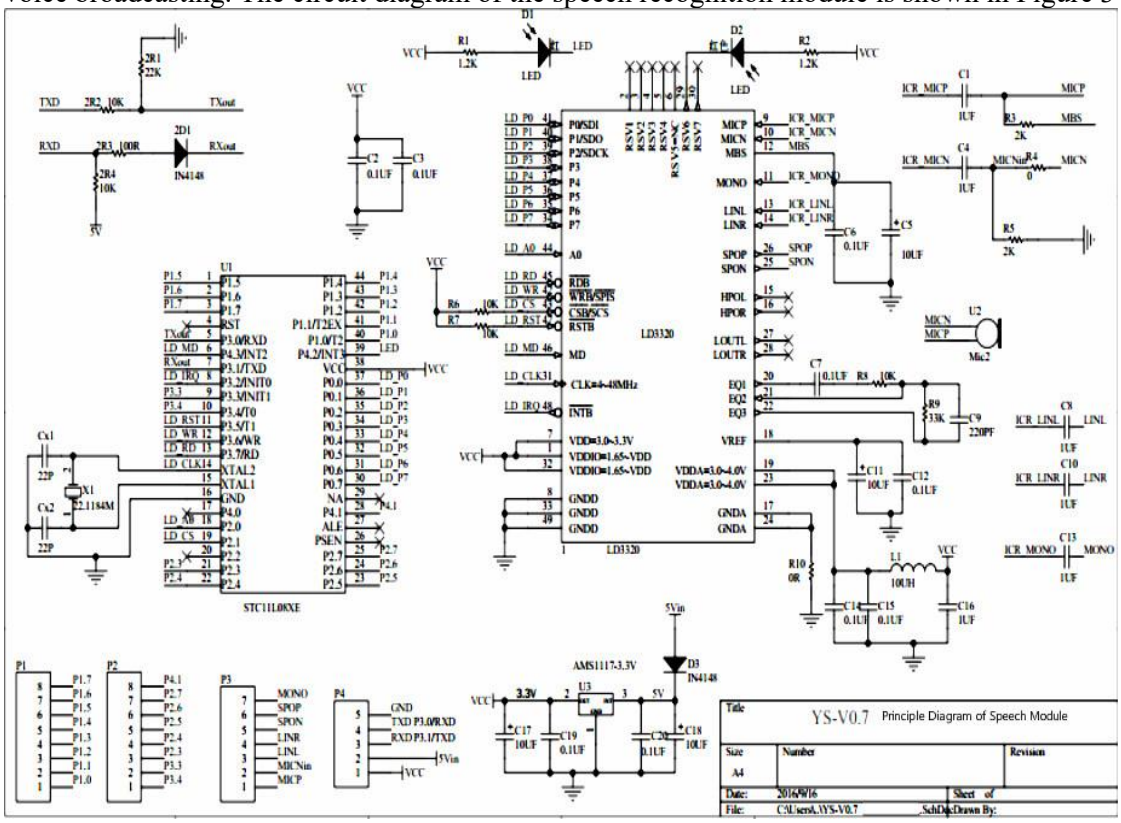

Figure 3 - Circuit diagram of speech recognition module

This kind of chip is a one-time programming chip, in which the voice content can only be edited once, and can not be erased and modified after input. The price of this chip is low, and the installation circuit is relatively simple, which can meet the basic requirements of the system design. In this design, the key circuit and Bluetooth interface circuit are also adopted. HC-05 is chosen according to Bluetooth module, which can better realize wireless data transmission between MCU and computer[7].

2. Software Analysis of Light Intensity Tester System

In addition to the hardware design of the light intensity tester system, the software design is also a very important part. Hardware design has basically laid the foundation of the light intensity tester, and the combination of software and hardware can make the system play the greatest role.

2.1 A/D Conversion Software Design

Because the STM32 system is designed and used, in order to facilitate the period, no special AA/D conversion chip is needed. Instead, the A/D embedded in the system is adopted. The light intensity and voltage are converted through a specific structure, and transmitted through DMA. Finally, the relevant data of light intensity are obtained. In library function programming, the first step is to turn on the clock. There are three corresponding ADCs in STM32 system. They are OA and OB according to the corresponding IO of the system. Therefore, they can select the clock of GPIO1 according to their own needs and convert data according to STM32 data manual. On the basis of data conversion, frequency division is used to adjust the data. This adjustment mode needs to be determined by sampling time. It needs to ensure that there is enough conversion time to initialize the settings. The configuration of DMA is required after full setup. DMA here refers to the access time of memory. The data

transmission mode of DMA does not need to pass through CPU, but directly transmits data to each other through the controller of DMA. This kind of transmission speed is very fast[8].

2.2 Design of LCD Software

In the infrared intensity tester system, the OLED lamp module of 0.96 inch is needed for patients. The programming method adopted by this module is the writing method of four-line SPI, as shown in Figure 4. The OLED module leads to seven pins (OLED can be described in Chapter 2). They are:

D0: OLED's D0 foot is the clock pin in SPI and IIC communication.
D1: The D1 foot of OLED is the data pin in SPI and IIC communication.
RES: The RES foot of OLED, used for reset (low level reset);
GND: Power source;
VCC: Positive power supply (3-5.5V);
DC: OLED D/C pin, data and command control pin;
CS: The CS foot of OLED, that is, the chip selection foot.

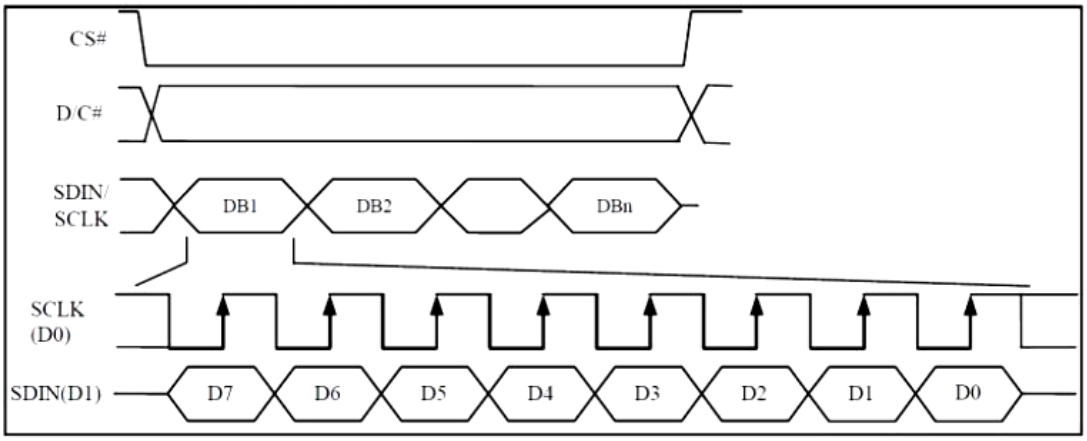

Figure 4 - Four-Line SPI Writing Operation Sequence Diagram

In this case, OLED shows the data of light intensity, RTC time and related date limits. The RTC here refers to the RTC device of STM32, which does not have a separate RTC chip. The clock used to store the clock signal is only a 32-bit register, which can be stored for more than 100 years. It can be placed in the register to supply power separately, even if the power supply of the whole system fails later, it will not lose data[9].

3. Test and Analysis of Light Intensity Tester System

After defining the light intensity tester system, the welding operation of the circuit is needed. It is necessary to be familiar with the corresponding models of various drawings and components, especially the size of some resistors and capacitors. The reason is that there are many kinds of components of this kind, which need to be carefully identified and centralized identified with the relevant models on the circuit diagram. In the welding process of the system, the main arrangement sequence is STM32 system, light emitting diode, crystal chip, various seats, sliding rheostat and BPW34FS[10]. Finally, the determined program is input into the system, and the test results are as follows:

OLED LCD displays four light intensity values and RTC date and time, in which V number displays four light intensity data values instead. Four buttons can adjust the date and time. As shown in Figure 5 below.

Figure 5 - OLED Display Results

4. Summary

Based on the concept of Moxibustion in traditional Chinese medicine, through the study of near infrared light intensity in the combustion process of moxibustion at this stage, the hardware and software design of the light intensity tester system are analyzed. According to the design of software and hardware, the whole light intensity system is tested centrally. Its function meets the anticipation. Based on the principle of photon detection as a whole, and according to the hardware circuit of the light intensity tester, the corresponding scheme of voice broadcast and recognition circuit is designed, hoping to provide corresponding suggestions for the future design of the light intensity tester system.

Reference

[1] Zhao Fang, Li Guilei, Zhang Meng, Tong Yanrong. Development of Intelligent Single Slit Diffraction Intensity Tester [J]. Science and Technology, 2016 (20): 87.
[2] Hulin. Design of software system for atmospheric visibility tester [D]. University of Electronic Science and Technology, 2012.
[3] Duan Jiangfeng, Wang Xiaokun, Liu Zhuqin. Measuring the Field Constant with the Light Intensity Distribution Tester [J]. Informatics, 2012, 36 (06): 48-49.
[4] Liu Zhuqin. Optical rotation and concentration of sucrose solution were measured by light intensity distribution tester [J].University Physics, 2010,29(02): 37-39+42.
[5] Ouyang's Hua, Pan Gongbi, Guanhua, Du Xuefeng, Lu Huiping, Liu Guosheng. Application of Transient Light Intensity Tester in Pyrotechnic Pulse Combustion [J]. Modern Instruments, 2009, 15 (02): 22-23.
[6] Zhang Feigang, Cai Jianle, Hu Shuji. Experimental study on validation of Marius law by light intensity distribution tester [J]. Laboratory research and exploration, 2008 (01): 29-31.
[7] Su Lijun, Li Yulin, Ding Xibo, Ma Teng, Wang Faxiu. Design of Light Intensity Detection Module of Milk Composition Tester [J]. Sensor World, 2006 (06): 41-43.
[8]Jayant Kumar,Preeti Gupta,Asma Naseem,Shalie Malik. Light spectrum and intensity, and the timekeeping in birds[J]. Biological Rhythm Research,2017,48(5).
[9]Green,Cohen-Zion,Haim,Dagan. Evening light exposure to computer screens disrupts human sleep, biological rhythms, and attention abilities[J]. Chronobiology International,2017,34(7).
[10]Inger K Holmström,Elenor Kaminsky,Anna T Höglund,Marianne Carlsson. Nursing students' awareness of inequity in healthcare — An intersectional perspective[J]. Nurse Education Today,2017,48.