Intelligent Energy Saving Control System for Classroom

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Abstract

This paper describes a kind of intelligent energy-saving control device. The device can cut off the power and switch the light through infrared scanning and feedback processing, and make appropriate lighting measures in appropriate circumstances, which can effectively save the power energy. It has a good performance in the indoor environment where the power is wasted greatly, and it is an effective energy-saving device in the classroom of colleges and universities.

Keywords

STM32F103RCT6 microcontroller, Ultrasonic sensor, Energy saving.

1. Introduction

The classroom is common in colleges and universities and the light is opened entirely, part of the school of intelligent lighting control system is the classroom of too little population by power supply, this caused some to the students to study in the classroom, and also not conducive to energy conservation and environmental protection, electricity saving, in colleges and universities such as big power usage and difficult to unified control environment is particularly important at any time, for this reason, we developed a new type of energy-saving automatic control device to be nobody in the classroom situation power automatically turn off the lights, when someone is able to open and maintain electrical equipment operation.

2. Overall design scheme of the equipment

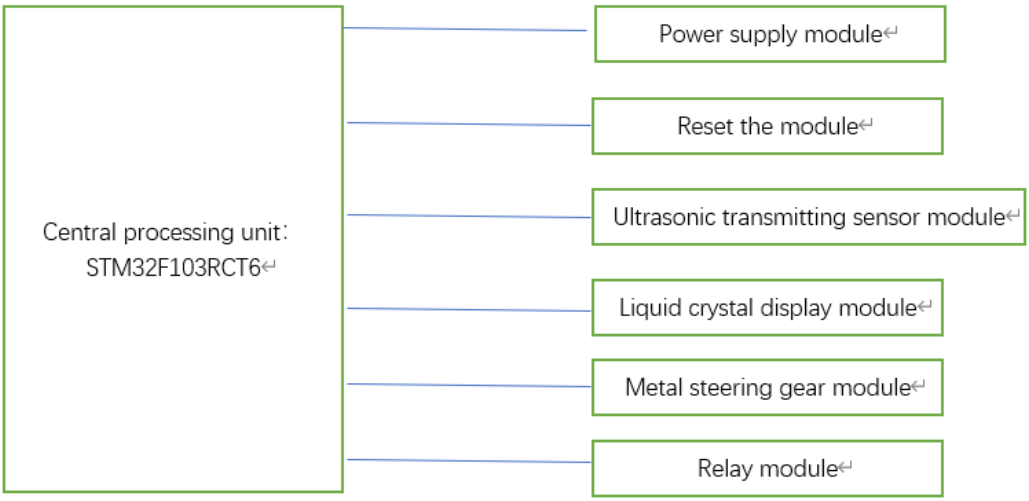

Fig. 1 General structure diagram of the system

This system adopts the STM32F103 microcontroller controller as the core control part, also equipped with ultrasonic emitter sensors to achieve the basic sampling feedback, other modules such as IGBT optical coupling isolation, PCB model, integrated circuit module, relay module, reset circuit, display circuit, ultrasonic sensors, metal gear steering gear and so on. The presence of the classroom

population is detected by the ultrasonic emission sensor. First, the ultrasonic wave corresponding to the height is emitted by the rotating ultrasonic transmitter. This height is about a little higher than the height of the classroom table, which is measured as the height near the chest of students when they sit in their seats. The ultrasound is then reflected back to the ultrasonic sensor, and the travel time is calculated to determine whether there are students in the classroom seats, which in turn determines whether the electrical system in the classroom is turned off. Among them, the metal gear steering gear is responsible for the rotation of the ultrasonic transmitter in order to transmit ultrasonic signals from multiple angles. The display circuit shows the general situation of the number of students in the classroom.

3. Advantages, disadvantages and uniqueness of the scheme

This project by ultrasonic detection method for the first time test the classroom population so as to achieve the function of the switching mode power system, compared with other same type technology is simple and effective, can greatly reduce the cost and power consumption, using ultrasonic launch conduction module receives and if someone were detected after the classroom, using the characteristics of the low frequency ultrasonic is harmless to the human body, combining economic and practical, compared with the infrared technology, image recognition scan equivalent type technology is more cost-effective, the price and show off all have good performance on energy consumption.

4. System hardware design

4.1 Microcontroller circuit

STM32F103RCT6 is the core component of the intelligent energy-saving control system in the control room. It is an integrated circuit (IC) of embedded microcontroller. The chip size is 32 bits, the speed is 72MHz, and it has online editable Flash memory. Its advantage is that there is Flash in the chip, which can be programmed for many times on the single chip, including online programming. There is 48K RAM inside the single chip, and the program memory capacity is 256KB, which is very helpful for our module design.

4.2 Reset circuit design

In order to make the system reset is the function of the system reset circuit to achieve stable work. In the process of normal operation of MCU, but can be due to the outside world all kinds of uncertain factors, so as to build into a single chip microcomputer application in the crash, wandering and collapse like now, therefore, to be good to make SCM can work normally, not the above phenomenon, now you need to design to reset to make microcontroller program to work properly, so also should reset circuit in the system design. The design USES power-on automatic reset.

4.3 Ultrasonic module

This system USES US016 ultrasonic ranging module, working voltage is 5V, has 2-300cm non-contact example sensing function as the experiment, ranging accuracy up to 0.3cm+1%, can be converted to the measurement distance of analog voltage output, output voltage value is proportional to the measurement distance. The module includes transmitter, receiver and control circuit, which can meet the general needs of the experiment. Besides, it has the advantages of low price and can purchase tests at will.

4.4 Liquid crystal display circuit design

In order to achieve a good interface for communication and interconnection between human and machine, we choose 1602 LIQUID crystal display screen, because it is very consistent with the requirements of the system. 1602 liquid crystal display screen can show the user's set rest time and the data inquired by the user. Liquid crystal display circuit USES the physical characteristics of liquid crystal, the display area of the device through the voltage control, the circuit has a current through the device will have a display, can display the graph. The device has many advantages: small size,

light weight, low power consumption and so on. It can be used to display letters, Numbers, symbols, and so on, to connect the device's display to the driver module, and to display the contents of the program directly and clearly.

4.5 Metal steering gear module

The base of the ultrasonic distance measurement device, used to cooperate with the ultrasonic ranging module multi-angle comprehensive monitoring, we adopt MG90S 9 g metal standard steering gear, can rotate 180 measurement, easy to satisfy the classroom problem of the Angle of wall to prevent the overall module, weight also meets the requirements, no pressure to carry a small amount of ultrasonic ranging module.

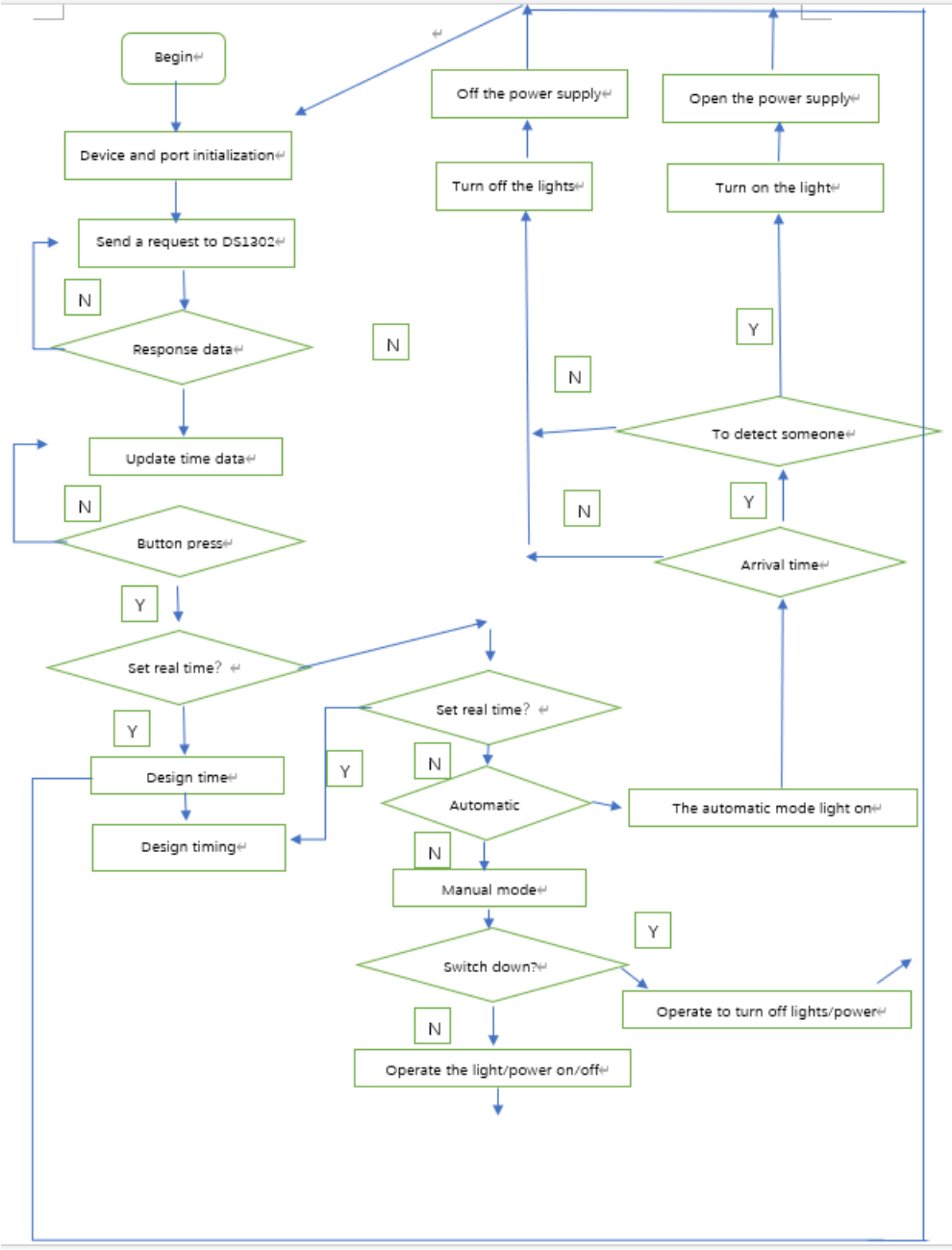

Fig. 2 Program flow chart

5. System software design

The main program of the system is designed to run in an infinite loop. Subroutine is divided into interrupt subroutine and function subroutine, subroutine can be nested and call between, such as interrupt subroutine can be called to the function subroutine. For the design process of application

software, it is necessary to write the power module of the system into the corresponding subroutine form as far as possible, and then let the main program make corresponding calls to it.

6. Analysis of results

In the process of running debugging, we need to analyze the results of debugging accordingly. Test the parts that have not been welded successfully, pay attention to the correct operation of the parts and input specifications, if there is a false welding, repair welding in time.

In the debugging, the device is powered on and begins the regular interval scanning. AD is used to check the stability of output voltage and the voltage fluctuation when there are people in the classroom. Moreover, it can calculate the approximate orientation and distance of the human body, and then determine the approximate size of the number of people in the classroom. Debug backwardness now a relatively small population, the classroom take extreme value of a person's time, distance too far result is likely to cause misjudgment, or goal to squat body bending over operation could let the machine slow response, consider late can add module development combined with scanning, such as infrared, gravity sensing devices, such as to a certain extent, can improve the success rate and efficiency of the device.

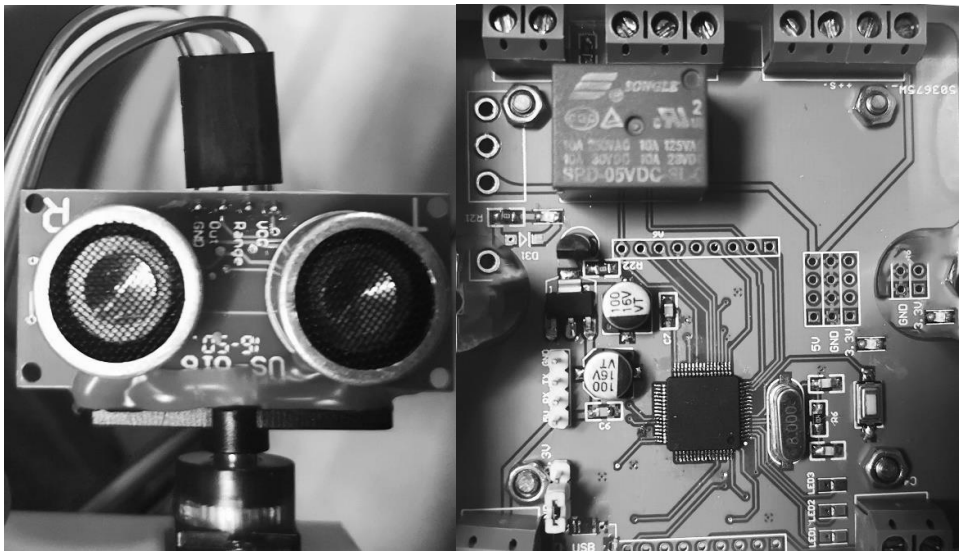

Fig. 3 The simulation diagram

References

[1] Chen Mingying, 8051 Single-chip Microcomputer Course Design Practical training textbook , Beijing: Tsinghua University publication Club (2003).

[2] Zhang Yigang, Application Design of McS-51 Microcontroller , Published by Harbin Institute of Technology Club (2004).

[3] Feng Boqin, Principle and Interface Technology of Microcomputer, Beijing: Tsinghua University Press Club (2004)

[4] Xu Xinyan, Principle, Application and Practice of Single Chip Microcomputer , Beijing: Higher Education Publishing Club (2005).

[5] Hu Honglin, XU Jing. 3GPP LTE Wireless Link Key Technology, Beijing: Electronic worker Industry technology (2008)

[6] Wang Yingmin, Td-lte Technology --HSPA Evolution and LTE, Beijing: People's Posts and Telecommunications Press (2010)

[7] Lin Hui, Details of LTE-Advanced Key Technology, Beijing: People's Posts and Telecommunications Press (2013)