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Design Of Intelligent Energy-Saving Management System For Classroom

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Abstract

Based on the current situation of energy saving and management shortage in the teaching building, an intelligent saving management system has controlled by STM32F103RCT6 micro_controller with perfect function is designed. Current students' number is obtained through detecting the state of two laser beams, when the number is lower than preset value, launch voice broadcast to hint students in order to transfer from current place and close the appliance. Students' number and state of appliance sending by Bluetooth HC05 are stored in database and displayed constantly through independently developed management platform so that the usage of energy in classrooms and appliance can be checked constantly by administrator, which is convenient to manage and easy to save energy as well. It's meaningful for campus to cut down the energy usage.

Keywords:*STM32,energy-saving,classroom,intelligence control, management.*

1. Introduction

With the rapid development of industrialization, energy issues have become the focus of attention. In order to strengthen energy conservation management, advocate environmental protection low-carbon lifestyle in colleges and universities, especially some classrooms are empty but the lights are on during the self-study period, only a few people but the fluorescent lamps of the classroom are all open, causing huge waste. Although the school has taken measures, such as only open few teaching buildings, but there is still a phenomenon of the waste exists. In summary, if taking a series of actions in the university to realize the effective conservation of electricity, the implementation of the action can well play an exemplary role model on improving the energy-saving awareness of students and society, to achieve the purpose of saving energy and protecting the environment.

This is a system that can automatic control lights and air-conditioners, the system detects of the current number of students in the classroom by laser tube, and if the current number of students in the classroom is lower than the defaults, then the broadcast voice reminds students transfer to the specified classroom for self-study, and the system automatically turns off lights, air conditioners and other appliances after a period of time. The number of students in the classroom and the status of air conditioners are sent to the PC, so that the administrator can view real-time classroom state, achieved the purpose of energy saving and humanized management.

2. General Design Scheme

The number of sensors on the tube and out of the classroom to detect cheap laser used in the system, and through the wireless transmission to the current classroom study the number sent to the backstage management platform, and stored in the database, the data in the database is updated. SCM automatically read the current number of classrooms, if the current classroom is lower than the preset value, then based on the principle of STM32 micro_controller broadcast voice to remind the classroom to transfer to another classroom. And then use the micro_controller equipped with peripheral control relay circuit to close the classroom lights, fans and air conditioning and other electrical equipment used to achieve the purpose of energy saving and emission reduction.

The whole system structure diagram is shown in figure 1. The system comprises a power supply module, a sensor module, a MCU control module, a peripheral relay switch control module and a voice broadcast module data transmission and storage module.

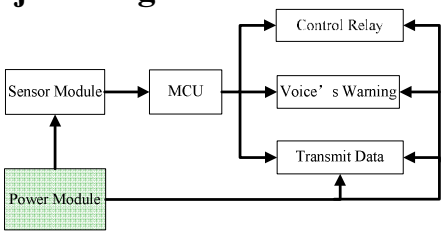

Fig. 1 The whole system construction

3. Block-Based Design

The hardware circuits of this project with the STM32 micro_controller minimum system, TFT_LCD module, the people-counter module and relay circuit will be introduced following.

3.1 Design The STM32F103RCT6 Micro_controller Minimum System

The minimum system is essential circuit board for micro_controller to work normally. This project monitors the voltage of integrate receive head via micro_controller, and according to the voltage level, it can be judged that there is person across the door or isn’t. The STM32 micro_controller transmits datum that include current number of people and the state of Air-conditioning to Personal Computer and then Personal Computer saves the datum in database. At the moment, as well as TFT_LCD display the datum.
The STM32F103RCT6 micro_controller minimum system includes of STM32F103RCT6 chip, clock circuit consists of oscillators and HF filtering capacitor, reset circuit and power supply circuit.

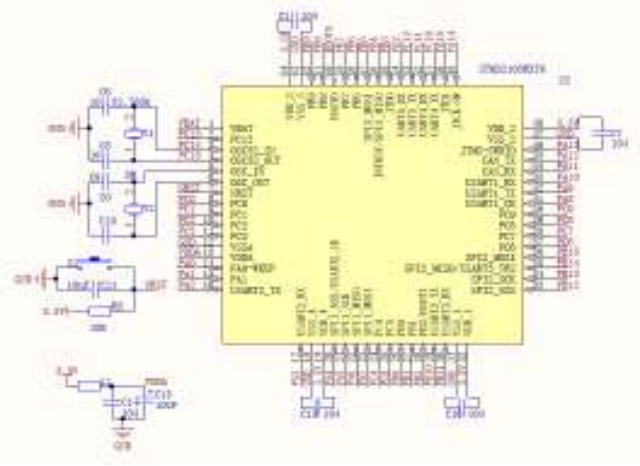

Fig. 2 The minimum system for STM32 micro_controller

3.2 Design TFT_LCD Module

TFT_LCD is not only used for displaying current state of electrical appliances and number of people in classroom but also displaying the value of intermediate variable when design and test system. It is very convenient to communicate with micro_controller. Figure 2 presents how does TFT_LCD connect its pins to the STM32 micro_controller via wires.

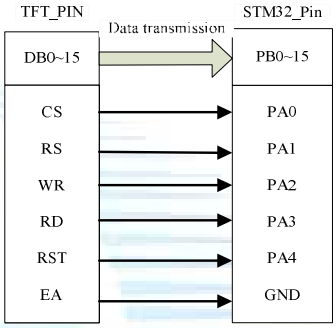

Fig. 3 TFT_LCD connect to the STM32 micro_controller diagram

3.3 Design People-Counter Module

The realization of this project bases on people-counter module, therefore, if only the algorithm combined the circuits to obtain accurate number of people is designed, following progresses will work on efficiently. Figure 3 presents a diagram of monitor equipment. As following, the operating principle of the monitor is described. If the infrared ray at A-site be shaded lead to trigger interruption in micro_controller, then, the same thing happens at B-site. At the moment, it is regarded that there is one person entering classroom. Of course, after the infrared ray be shaded at A-site but B-site doesn’t, that will be regarded as interference. Similarly, the infrared ray is shaded at B-site firstly, then the same thing happens at A-site, it is regarded that there are one person leaving classroom. Therefore, current number of people in classroom is obtained.

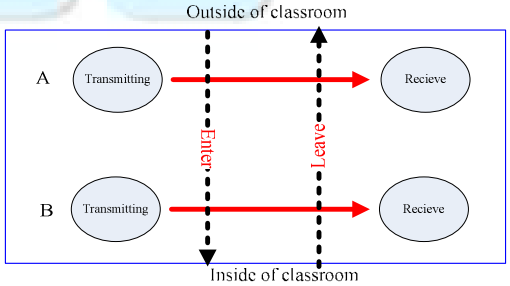

Fig. 4 The diagram of monitor equipment

3.4 Design Relay Circuit

To achieve low-current digital circuit control electrical appliance, relay circuit need. In this project, micro_controller gives a switch-off signal relay circuit after playing voice, and electrical appliances, just like light and Air-conditioning, will be turned off.

4. Design of Software

Software design tool of the system uses base on C language programming Keil5MDK-ARM, which can straight express programmer ideas and achieve it.

The system software flow is show in Fig.5. System initialization at first when power supply for the single chip. Interrupt of trailing edge will be trigger if someone pass the door, meanwhile judge in or out the classroom, then renew the person number and display the number for the classroom actual time by TFT_LCD. At the same time, single-chip send the number to the backstage management system by wireless module. Relay switch turn off the electrical equipment and remind students transfer to other arrange classroom when the number lower than the preset number. The hardware circuits of this project with the STM32 micro_controller minimum system, TFT_LCD module, the people-counter module and relay circuit will be introduced following.

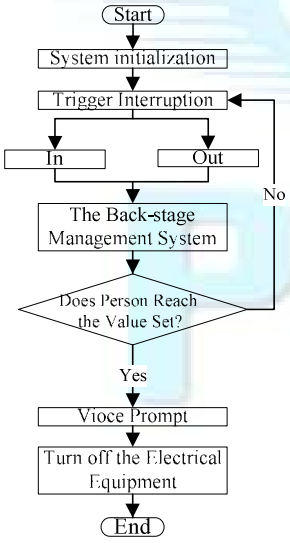

Fig. 5 Software flow diagram

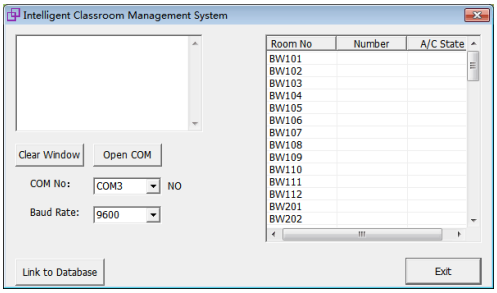

Fig. 6 Backstage management interface

System software has four subsystems includes detection people-counter, TFT_LCD display, voice prompt and the backstage management system. the backstage management system is show in Fig.6.

5. Conclusions

The paper uses single-chip as the main controller. Current students' number is obtained through detecting the state of two laser beams. And then use the micro_controller equipped with peripheral control relay circuit to close the electrical equipment. The system combine high voltage with low voltage. According the number of classroom decide whether turn on the switch to achieve intelligent control and save energy. The system can save 20KWH power one hour with 64 classrooms. By experiment, the device can automatic control the electrical equipment switch to achieve the purpose of energy saving and emission reduction, which convenience the supervisor check and manage classroom.

Acknowledgments

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