

Design of multifunctional intelligent LED table lamp

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Abstract

In this paper, a multifunctional intelligent LED table lamp is designed by applying pyroelectric infrared induction principle, and adopting AT89C52 SCM as the control core, pyroelectric infrared sensor RE200B and BISS0001 integrated chip. This table lamp owns intelligent switch and automatic light adjustment functions and is free from tedious process of manual control. Besides, when one is close to the table lamp, the table lamp will give an alarm to remind him (she) of correcting the sitting posture and protecting eyesight. This reflects intelligent and humanized design philosophy of modern household appliances.

Keywords

SCM, Auto-control, Protect eyesight, Smart switch.

1. Introduction

People cannot live without table lamp in daily life, and most table lamps are common incandescent light bulb and incandescent light bulb. Such table lamps cannot adjust light automatically and continuously, and adopt manual control. It is very inconvenient when people turn the light on at night. Some often forget to turn the light off, which leads to huge energy waste.

LED is cold light source and free from radiation, with high lighting effect, low energy consumption and good controllability [1]. Under the same luminance, energy consumption of LED is 10% of incandescent light bulb and 50% of fluorescent lamp. In addition, the service life of LED is as high as 100000h, which is 10 times of fluorescent lamp and 100 times of incandescent light bulb. With energy shortage, continuous rise in electricity price, high environmental requirements and enhancement of LED lighting effect, it is imperative to replace incandescent light bulb or fluorescent lamp with environmentally-friendly and pollution-free LED [2]. Besides, since light source of traditional table lamps adopts alternating current and 100-120 times of stroboflash will be generated per second, students' eyesight will be influenced if they use the lamp for a long time. LED lamp is driven by direct current, and flickering phenomenon will not be generated. Thus, LED is considered as the lighting source in the 21st century.

2. Hardware design for multifunctional intelligent LED table lamp

2.1 Design scheme.

Multifunctional intelligent LED table lamp owns the following functions:

Intelligent switch control function: when one approaches the lamp within certain range, the lamp will light up automatically. When he (she) leaves, the lamp will delay to go out for some time. When the light is sufficient, the lamp will not give out light no matter whether someone approaches it.

Intelligent luminance adjustment function: the lamp luminance can be adjusted automatically with the changes in ambient light. In other words, the lamp luminance will decrease automatically when ambient light is intense; the lamp luminance will intensify automatically when ambient light is insufficient. In this way, the total ambient light can always make eyes comfortable.

(3) Eyesight protection function: when one is close the lamp, the lamp will give an audible alarm to remind users of correcting sitting posture and keeping away from the lamp.

The design scheme is shown in Fig.1.

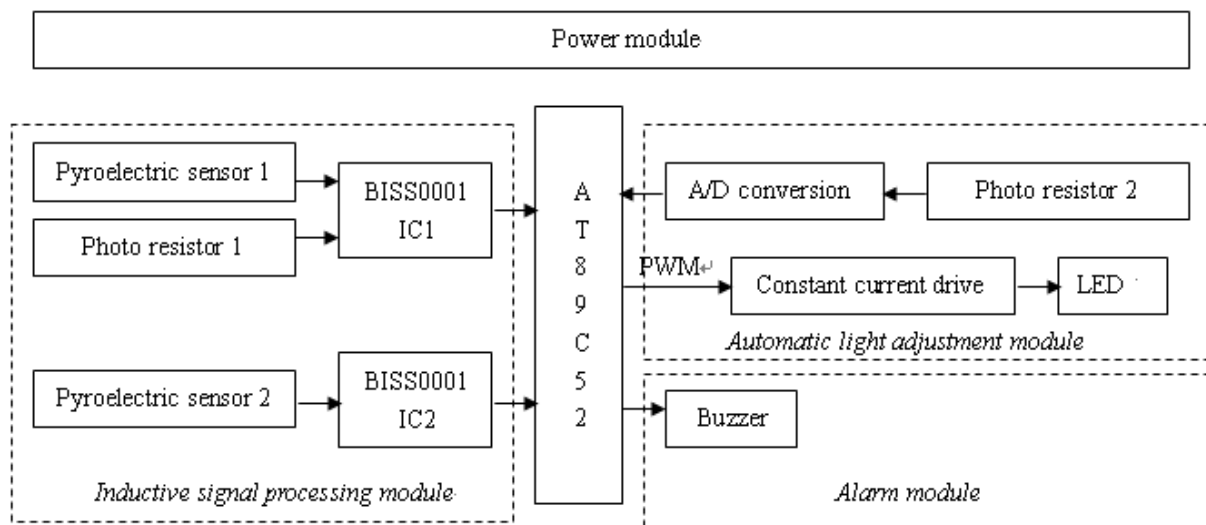


Fig.1 Functional block diagram of multifunctional intelligent LED table lamp

2.2 Working principle.

The system of this intelligent table lamp is composed of SCM control module, power module, inductive signal processing module, automatic light adjustment module and alarm module.

In inductive signal processing module, pyroelectric infrared sensor 1, photoresistor 1 and BISS0001 chip 1 form intelligent switch control module. Automatic lighting up needs to meet the following conditions: the person is within the scope of the lamp, and ambient light is weak. The sensor 1 is installed at the top of the lamp and facing towards the door. The induction distance is 0.3-4m, which is controlled by angle. When the above conditions are met, the SCM receives interruption 1 signal and the table lamp is lighted up under the control of SCM P1.2 port. The timer T0 delays for 1min. If human body triggering signal of sensor 1 is received again within 1min, the timer T0 will start up again to delay for 1min. In this way, when the person is near the lamp, the lamp is always on, and the lamp will be off automatically when the person leaves for 1 min.

Sensor 2 and BISS0001 chip 2 constitute sitting posture inductive signal processing circuit which controls alarm circuit switch. The angle controls induction distance within 0.1-2m. If sitting posture is wrong and the person enters the induction range, the signal will be triggered. To prevent wrong judgment, if this state still continues after 10s, the sitting posture is considered to be wrong. Then, interruption 0 signal is generated, and SCM P1.3 port controls control to remind the user of correcting sitting posture.

Automatic light adjustment module utilizes PWM technology and gathers the intensity of background light according to the photoresistor. ADC0804 analog-digital conversion chip is used to continuously detect voltage of photoresistor and indirectly measure induction luminosity. PWM duty ratio is adjusted through comparing voltage and present threshold value. P1.2 port of SCM transmits different pulse-width signal to adjust drive current. Output current of LED can change from 0% to 100%. In other words, LED luminance depends on duty ratio of PWM signal [3]. The basic thought of PWM method is to adjust PWM duty ratio through software under the precondition where the period of PWM square wave remains unchanged so as to control current of LED table lamp and automatically adjust luminosity. Compared with analogue light adjustment, the advantages of PWM light adjustment include unchanged LED chroma, high efficiency and energy conservation.

Alarm module unit mainly gives warning signal according to the order of AT89C52 so that people can correct sitting posture in time and protect eyesight.

3. Software design for multifunctional intelligent LED table lamp

3.1 Design philosophy.

Modular design philosophy is adopted. Sub-program of each functional module is designed by taking main program as the core, which simplifies design structure. Sub-program of each functional module is called by main program to achieve each relevant function. Sub-programs of main modules include: signal input module, A/D conversion module, PWM signal generation module, and automatic light adjustment module etc. Working software of this system mainly completes the following functions: signal input module achieves that corresponding sensor signal is inputted in SCM data channel. In control system software, the output signal after pyroelectric infrared sensor and light intensity detection signal are processed by BISS0001 serves as external interruption signal of SCM. Thus, control signal which decides the table lamp is on or off is generated. In addition, A/D conversion is carried out for ambient light intensity data. The data as control signal of luminance adjustment are coded and outputted to PWM automatic light adjustment module of system to reach the purpose of automatic luminance adjustment of LED table lamp.

3.2 Overall process design.

Power-on reset of SCM is initialized. The corresponding interruption is conducted. The initial value of the timer is set. When someone enters the triggering range of sensor 1 and ambient light is weak, external interruption 1 signal is generated to make the table lamp on automatically. Meanwhile, 1min timing is launched. External interruption 0 monitors sitting posture signal of sensor 2 to launch automatic light adjustment module. If the signal of pyroelectric sensor 1 is not received within 1min timing, it is considered that the person has left and the SCM controls the table lamp to be off. This achieves automatic light off function after 1min delays. Otherwise, 1min timing will restart. Automatic light adjustment module will continuously defect voltage of photoresistor 2 through ADC0804 analog-digital conversion chip to indirectly measure inductive luminosity. PWM duty ratio is adjusted through comparing voltage and present threshold value so as to achieve automatic adjustment of lamp luminosity. When there is external interruption 0 signal, interruption 1 is shielded. 10s delays to prevent wrong judgment of sitting posture signal, If sitting posture triggering signal is still received after 10s delays, SCM will control P1.3 port to generate alarm signal for reminding. Flow diagram of the system is shown in Fig.2.

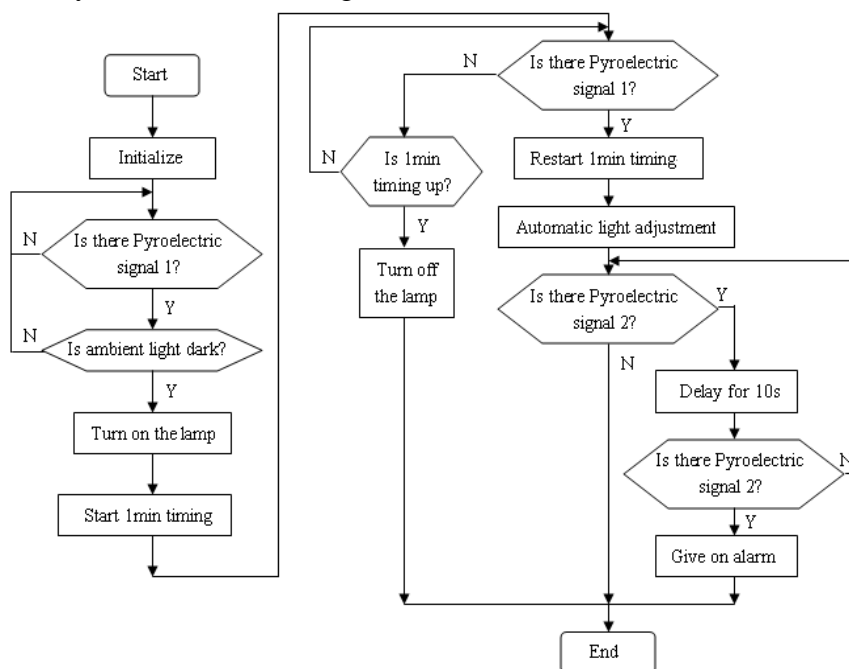


Fig.2 Flow diagram of the system

4. Conclusion

Although the multifunctional intelligent LED table lamp reaches the purpose of bringing convenience in life, and improves greatly in energy conservation, environment protection and eyesight protection, the circuit is not simple enough. When there are multiple pyroelectric infrared sensors, corresponding signal detection circuit is needed. An improvement is that a signal processing circuit controls multiple sensors at the same time [4]. A shortcoming is that when the lamp is on, light intensity may easily disturb the photo resistor to judge ambient light intensity, which will trigger wrong judgment. Thus, this design remains further improving.

References

- [1] Petriu E M, Geoganas N D, Petriu D C, etc.: Sensor-based information appliance, IEEE Instrumentation and Measurement Magazine, (2000) No.10, p.31-25.
- [2] Allan R. Hambley: *Electronics 2nd ed* (Prentice Hall Inc., New Jersey 2000).
- [3] Adel S. Sedra, Keneth C. Smith: *Microelectronic Circuits 4nd ed* (Oxford University Press, New York 1998).
- [4] Y.H. Wei, S.Y. Chen: BISS0001-based intelligent table lamp design, Management & Technology of SME, (2010) No.10, p.293-294.