LED infrared sensor light

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***Abstract**:*

Compared to traditional lighting, LED is small, low power consumption, long life, easy to design, small heat radiation and environmental protection. Therefore, LEDs are more and more widely used. In the near future, it will be able to replace traditional lighting as mainstream lighting equipment. Infrared sensing is also a widely used technology. For example, electrical appliances, automatic doors and even faucet switches in the home, the sensor can not only save the trouble of manual control but also take energy conservation.

The purpose of this paper is to combine LED lamps and infrared sensors to understand the principle and operation of the actual operation. In this paper, a pyroelectric infrared sensor is used as an automatic switch. When the pyroelectric infrared sensor senses a change in temperature, it will be turned on and turned off by the IC.

Keywords

LED, infrared sensing, pyroelectric infrared sensor

1. Introduction

In terms of R&D concepts and technologies, LED has been developed since the 1950s.

Just a few years later, LED lighting can really replace the traditional lighting due to LED blue light wafer invented. LED blue light wafers were not invented by Japan Nichia Chemical until 1993. At this point, LED can enter the era of high brightness. Infrared sensors are another widely used technology. Due to its convenience, infrared sensors are used in electrical and daily life in many products. By using an infrared sensor to control the LED luminaire, it also has applications for infrared sensors and LEDs [1-4].

2. The Basic Principles

2.1. The Principle of LED Infrared Induction Lighting

The whole LED infrared induction lighting is composed of three components, namely infrared sensing module, control module and LED module. The three modules are combined into a complete LED infrared sensing lighting as shown in Figure 1.

Therefore, the sensitivity, sensing distance and effective operation of the infrared sensor are the focus of this paper. The circuit diagram of the infrared sensor illumination lamp is shown in Figure 2. The circuit diagram of the control module and the LED module is shown in Figure 3. When the object moves around the sensor and the heat source changes, the sensor detects the change of the heat source and transmits the signal. After the OP amplifier amplifies the signal, the white LED turn up. When the heat source leaves, the sensor turns off and the white LED also turns off. The entire LED infrared sensor can achieve this process is the goal of this paper.

2.2. White LED Principle

The white light is a mixture of multiple colors. At least two kinds of light must be mixed in the form of

Figure 1. LED infrared sensor lighting.

white light visible by human eyes, such as two-wavelength light (blue light + yellow light) or three-wavelength light (blue light + green light + red light). The currently commercialized products are only two-wavelength blue single-chip and YAG yellow phosphor.

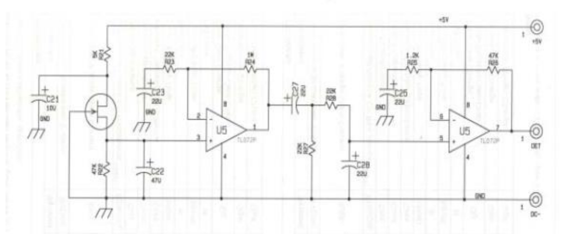

Figure 2. **Infrared sensor module circuit diagram.**

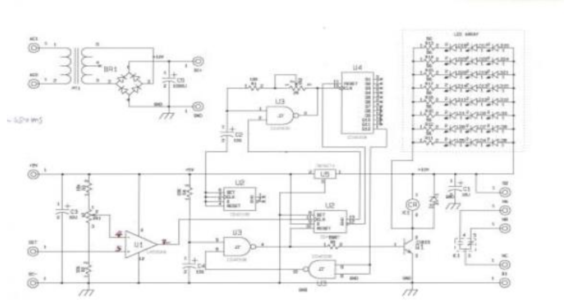

Figure 3. **Control module and LED module circuit diagram .**

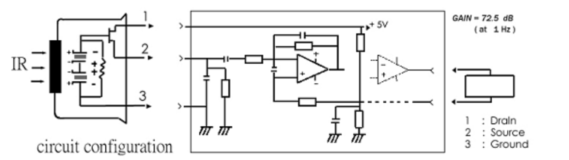

Figure 4 PRI325 human body infrared sensor pin and internal schematic.

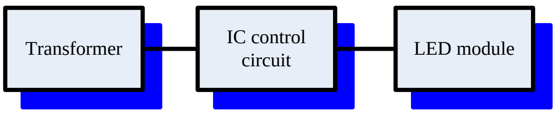

Figure · 5. Basic structure of the control circuit.

In the future, it is more favored about three-wavelength light. Inorganic ultraviolet light wafers are added with RGB three-color phosphor powder. Layer three-wavelength white LEDs also have the advantages of low cost and ease of fabrication. Three-wavelength white LEDs have been commercialized. In the future, White LEDs will replace the fluorescent lamps, U-type energy-saving bulbs and LCD backlights. It is of great help to the market growth of white LEDs.

2.3. Principle of Pyroelectric Infrared Sensor

PIR325 human body infrared sensor is mainly used to generate charge phenomenon by temperature change. Therefore, it is also known as the "focus type" human body infrared sensor. The human body infrared sensor is a photosensor made of a strong medium such as TGG (triglycine sulfate) or PZT (acid-based piezoelectric material). The power supply voltage is 3~15VDC. Its operating temperature range is -10 °C ~+50°C. The output signal of the source is extremely small, only a few mV to tens of mV. Thus, it can receive infrared rays (including human body) radiated by all the hot bodies.

PIR325 human body infrared sensor pin diagram and internal block diagram is shown in Figure 4. Where, Pin1 (Drain) is the output, Pin2 (Source) is the voltage input, up to 15V, and Pin3 (Ground) is connected to the negative pole of the power supply.

This article uses PIR325 as an infrared sensor. The human body or other animals emit an infrared ray, and the pyroelectric type infrared sensor can sense such changes in infrared ray. When the human body passes through the sensor, the sensor generates a slight signal change through the OP amplifier. After amplification, combined with the use of the HA17555 timing chip, the relay can be controlled to be turned on or off, thereby achieving the purpose of using infrared sensing as a switch.

2.4. Control Circuit Basic Architecture

The basic structure of the control circuit is shown in Figure 5. The device is combined with the IC control circuit, transformer, and connected to the LED module.

3. The Production Results Analysis

3.1. Experimental Procedures and Steps

The operation flowchart of LED infrared sensor lighting is shown in Figure 6. LED infrared sensor lighting is divided into two major parts, circuit production part, and experimental part. Part of the circuit production is to make the control module, the infrared sensor module and the LED module separately. After test actions are correctly, these modules are combined. The experimental part is to measure the sensing distance of the infrared thermal sensor. The control circuit operates correctly when the sensor senses a temperature change. The LED will turn on when sensor senses the change. The LED turns off when the sensing object leaves.

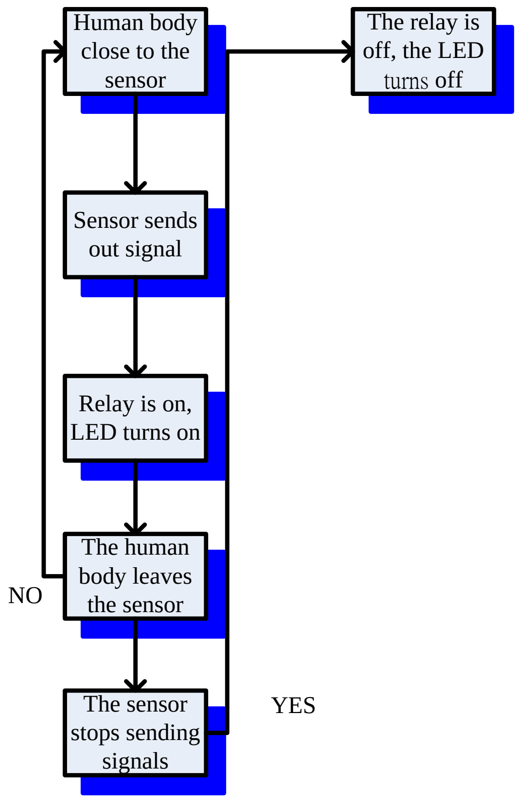

Figure 6. The operation flowchart of LED infrared sensor lighting.

3.1.1. Infrared Sensor Module. In this paper, the PIR325 is used as an infrared sensor. According to the flowchart of Figure 6, The experiment steps are shown as follows:
Step 1 The circuit will be fabricated as shown in Figure 7.
Step 2 Test the circuit and determine that the infrared sensor module can operate correctly.

3.1.2. Control Module Production. In this experiment, the circuit of the control module is composed of the transformer and the IC circuit. After combination, the control module is shown in Figure 8.

3.1.3. LED Module Production. In this experiment, the circuit of the control module is composed of the transformer and the IC circuit. After combination, the control module is shown in Figure 8. In this experiment, the LED module was installed on the housing kit by connecting 24 white LEDs, 3 in series and 8 in parallel. After combination, the LED desk lamp is shown in Figure 9. In addition to the LEDs controlled by infrared sensing, a switch installed on the LED module is shown in Figure 10.

Therefore, the LED can be controlled not only by infrared sensing but also by the operator manual control. After the control module has been tested and operated correctly, the LED infrared sensor illumination lamp is combined with the infrared sensor module and the LED module in Figure 1.

Figure 8. Control module circuit.

3.2. Experimental Results

In this paper, the effective infrared sensing range is 1 meter. When the person is close to the sensor within 1 meter, the infrared sensor senses the temperature change, and the sensor input signal sends to the OP amplifier. OP amplifier amplifies the AC signal source. The relay turns on, and the voltage input to the white LED. The white LED turns on. When the human body leaves, the sensor does not sense the heat source for 10 seconds. the sensor turns off. After the sensor is turned off, the signal stops input, the relay is turned off, the voltage cannot be input to the white LED, and the white LED is turned off.

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Figure 9. LED module.

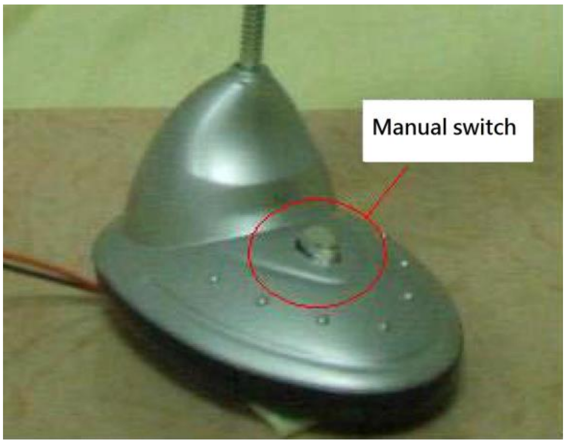

Figure 20. The manual switch of LED module.

3.3. Discussion of Results

From the operation flow of LED infrared heat sensing, several features can be seen. These characteristics can be a reference for similar experiments in the future.

1. Inductive distance of infrared sensor: In this experiment, the effective sensing range measured is 1 meter. The farther the distance sensor is, the lower the sensitivity is.

2. Sensitivity of the pyroelectric infrared sensor: From the experimental results, it was found that the pyroelectric infrared sensor requires a response time of 1 to 2 seconds during sensing a change in the heat source.

3. Increase in brightness of white LEDs: It has been found that increasing the brightness of LEDs does not simply increase the number of LEDs in experiments. When the number of LEDs increases, the design of the circuit becomes more complicated.

4. Conclusion

In the experiment, the pyroelectric infrared sensor has many problems. In this paper, the sensing distance is the key point of the implementation, but the sensing distance of 1 meter is still not ideal. When focusing on the sensing distance of the pyroelectric infrared sensor, it is found that the sensitivity of the sensor is another problem. When the sensing distance is farther, the sensitivity of the sensor is lower. When the human body passes the sensor, it still takes 1~2 seconds of reaction time. There is no way to achieve the ideal state of immediate response to changes of induction.

5. References

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