Design of Indoor Lighting Circuit with Automatic Brightness Adjustment is Analyzed

Dong Zhai1*, HongWei Li2
1 Cangzhou Technical College, China Hebei 061000
2 Cangzhou Normal University, China Hebei 061000

*Corresponding author e-mail: zhaidong8331@163.com

Abstract. With the continuous progress of science and technology, People's Daily life is also toward the direction of intelligent development, intelligent technology embodies in every aspect of people's lives. As an important part of people's life and production, indoor lighting also gradually reflects the intelligent factors. Indoor lighting has gradually realized automatic brightness adjustment, that is, with the help of natural light brightness changes to adjust the brightness of indoor lighting. The purpose of this paper is to realize the automatic adjustment of indoor lighting through the design of indoor lighting circuit for automatic brightness adjustment. This article first to automatically adjust the brightness has carried on the summary of the basic circuit, secondly from circuit control principle, material selection and use of all aspects, such as the design of main circuit to automatically adjust the indoor light circuit design are discussed in detail, finally by means of indoor lighting brightness calculation method to automatically adjust the brightness of the reliability of the circuit design for testing. The experiments in this paper show that the design of indoor lighting circuit with automatic brightness adjustment is reliable and can realize the automatic adjustment of indoor lighting according to the ambient light.

Keywords: Brightness Automatic Adjustment, Indoor Lighting, Circuit Design, Brightness Calculation

1. Introduction
With the continuous progress of science and technology and people's pursuit of quality of life, various automatic intelligent technologies gradually enter People's Daily life and have a profound impact on People's Daily life. At present, as an important part of automatic intelligent technology, the luminance automatic regulation lamp has been widely used in indoor lighting. Luminance automatic adjustment is the use of photosensitive resistance, the use of natural light intensity change to achieve the automatic adjustment of indoor lighting. This kind of lamp brightness automatic adjustment does not need manual control, effectively reduces the power consumption. The key to realize the automatic adjustment of the brightness of electric lamp is to realize the scientific design of the automatic adjustment circuit of indoor light. Therefore, it is particularly important to study the design of indoor lighting circuit for automatic brightness adjustment.
Current automatically adjust the brightness of the design of the indoor lighting circuit has made significant progress, but at the same time the circuit design, there is a series of problems, such as the stability of the problems in the circuit, photosensitive resistance, vulnerable to the outside world changes suddenly light interference problems, these problems in the current brightness has not been solved effectively in the design of automatic regulating circuit, circuit of the whole work caused adverse effect [1-2]. At present, domestic and foreign scholars have also conducted a series of researches on the indoor lighting circuit of automatic brightness adjustment. Through consulting a large number of research materials, it is found that these researches mainly focus on the environmental analysis of circuit design, the application of automatic adjustment technology in circuit design, the working principle of circuit and other aspects [3]. By summarizing the data, we find that these studies are all about a specific aspect of automatic brightness adjustment, not about the overall operation of circuit design; After the circuit design is completed, relevant tests are not carried out, so the stability of the circuit operation cannot be understood [4-5]. Therefore, from this point of view, the design of indoor lighting circuit for automatic brightness adjustment needs to be further studied.

To make up for the blank related theory, deepening the research theory, to better guide the practice of circuit design, this article first to automatically adjust the brightness has carried on the summary of the basic circuit, secondly from circuit control principle, material choice and application, the design of main circuit, and so on each aspect to automatically adjust the indoor light circuit design are discussed in detail, finally by means of indoor lighting brightness calculation method to automatically adjust the brightness of the reliability of the circuit design for testing [6-7]. This paper aims to realize the scientific design of the circuit through the comprehensive analysis of the automatic regulation circuit and to promote the wide application of the automatic regulation lamp in People's Daily life. The research in this paper not only promotes the scientific design and practical application of automatic regulation circuit, but also lays a certain theoretical foundation for future related researches [8-9].

2. Method

2.1 Basic Overview of Automatic Brightness Adjustment Circuit
Automatic brightness adjustment is the automatic adjustment of light brightness with the help of natural light brightness. Generally speaking, the brightness of light in the surrounding natural environment is inversely proportional to the brightness of light. The weaker the light in the surrounding environment is, the stronger the brightness of light is; the stronger the light in the surrounding environment is, the weaker the brightness of light is [10-11]. The automatic brightness adjustment lamp is composed of a lamp tube or bulb, a switch, a power supply, a photosensitive resistor, etc. The power supply voltage is 220V, and the alternating current is changed into a direct current by means of the rectifier diode. The essence of the rectifier diode is a semiconductor current conversion in the form of a conversion current, and one-way conductivity is its main characteristic [12-13]. In general, the rectifier diode has positive and negative poles, including a PN junction, the positive pole is the current inflow, negative current outflow. The photosensitive sensor is installed at the bottom of the lamp tube, which can adjust the internal current according to the changes of the surrounding light. When the ambient light reaches a certain intensity, the indoor light will automatically turn off. When the ambient light is low enough, the room lights will turn on automatically. On the basis of consulting a large number of relevant materials, I found that the transistor is a necessary component in the design of automatic brightness adjustment circuit. Triode is mainly used for current control, is a kind of semiconductor element, through the triode to achieve weak signal amplification, and turned into electrical signal, the amplitude of the electrical signal is larger; Moreover, the transistor is usually used as a contactless switch [14-15]. In the triode, the transistor can realize the function of amplifying current, which is the essential core device of electronic circuit.
2.2 Brightness Calculation Algorithm

The luminance calculation algorithm can effectively calculate the luminance of the light, and realize the comprehensive comparison between the luminance of the light and the luminance of the surrounding environment, so as to realize the reasonable adjustment of the luminance of the light in this technology. This algorithm is widely used in interior design and circuit design of automatic regulation. Generally, the calculation of indoor lighting brightness involves two fixed parameters, namely the utilization coefficient and the maintenance coefficient. Generally, the utilization coefficient is 0.4 and the maintenance coefficient is 0.7-0.8. To realize the scientific adjustment of indoor lighting, the average brightness of indoor lighting should be calculated firstly. The specific calculation formula is as follows:

$$E_{av} = N \times CU \times \frac{MF}{S}$$

(1)

Where, $E_{av}$ represents the average illuminance, $N$ represents the total light flux of the light source, $CU$ represents the utilization coefficient, $CU=0.4$, $MF$ represents the maintenance coefficient, here $MF=0.78$, $S$ represents the total indoor area. After calculating the average brightness of the light, it is necessary to calculate the brightness of the total indoor lighting. The specific calculation formula of the brightness is as follows:

$$q = \frac{\lambda}{n} \left(1 - k \right)$$

(2)

Where, $q$ represents the total amount of indoor lighting, represents the ideal lighting coefficient of indoor lighting, $n$ and $m$ represent the actual number of lights needed and the number of lights available, and $k$ represents a fixed parameter value, $k=0.3$.

3. Test Experiment of Circuit Design

In order to ensure that the interior circuit design can realize automatic brightness adjustment, it is necessary to test the reliability and stability of the circuit design. In this paper, the design of indoor lighting circuit is tested with the help of Multisim7 tool. The application of this tool can reduce the time required for testing experiments and reduce the difficulty of experiments. The detection experiment involves the recording of indoor light brightness under different natural light brightness,
the change of circuit current, and the proportion of natural light brightness and actual indoor light brightness. First, draw the indoor lighting circuit diagram in accordance with the standard circuit diagram requirements, to ensure the mastery of each part of the circuit, the analysis of different electric sections; Secondly, with the help of Multisim7 tool, the changes of circuit current under different natural light and the changes of light brightness are realized, and the accurate calculation of indoor light brightness is realized with the help of brightness calculation algorithm. Then, the actual running data of the circuit is analyzed to find out the actual problems in the running process of the circuit, and relevant problems are recorded. Finally, Excel is used to analyze the data and draw the data table, so as to realize the visual reflection of the circuit design test results.

4. Discuss

4.1 Specific Description of Indoor Lighting Circuit Design

(1) Selection of circuit materials for automatic adjustment of indoor lighting brightness

After consulting relevant materials, it was found that the materials needed in the design of the automatic adjustment circuit for indoor lighting brightness were shown in table 1 below, and the author consulted and sorted out the results of the data in the table.

| Name  | Model  | Number | Note   |
|-------|--------|--------|--------|
| VD1~VD4 | 2CZ13  | 4      | 1A/400V |
| VD5   | 2CZ14  | 1      |        |
| VT    | 3DD15  | 1      |        |
| C     | 2000μF/25V | 1 |        |
| R1    | 4.7 kΩ | 1      |        |
| R2    | 220 Ω  | 1      |        |
| RP    | 200 Ω  | 1      |        |
| RG    | 470 Ω  | 1      |        |
| S1    | Switch | 1      |        |
| S2    | Switch | 1      |        |
| EL    | Indicator light | 1 |        |

*Data came from the in-depth analysis of financial data in the experiment

(2) Instructions for the automatic adjustment circuit of indoor lighting brightness

Indoor lighting according to natural light brightness changes to achieve constant adjustment. The brightness of this kind of indoor light adjusts automatically not only makes the stimulation to the eye of high intensity light when just changing the lamp is minimized, but also prolongs the life of the bulb, reducing the power consumption to some extent. In this circuit design, C9014 is used as A circuit triode. The electric exile is about 200-600 times. The allowable limit current is 0.3a. The adjustable resistance is RP.

As shown in the circuit design drawing in figure 1, the indoor lighting circuit is generally a SCR voltage regulating circuit. In the circuit design diagram, S1 represents the main switch. When the main switch is connected, this is the S2 switch connected to the position of 1, which is an ordinary dimmer. When S2 is connected to the location of 2, the connection between capacitor C and RG is realized. Under the action of rectifying diode VD1~VD4, indoor ac is changed to dc, and since the thyristor voltage is unidirectional, it can be remembered that the capacitor realizes the power connection of the lamp, and the thyristor is connected when the capacitance value reaches a certain level. When the natural light is dark, the RG becomes a high-resistance lamp and the voltage at both ends of the lamp increases continuously, and the brightness of the lamp increases continuously, and vice versa.

(3) Main features of the automatic brightness adjustment circuit for indoor lighting

Compared with traditional indoor lighting circuit, found that indoor lighting brightness automatically adjust circuit has a great advantage, the advantage is mainly due to the characteristics of the circuit itself determine, indoor lighting brightness automatically adjust has many characteristics,
including main characteristics are as follows: first, light cure poison to adjust without manual operation, automatic intelligent processing; Second, the power consumption is greatly reduced. The circuit is designed to consume almost no electricity when the light is strong. Thirdly, the hysteresis voltage comparator is used in the circuit design, so it has strong anti-interference ability. Fourth, the circuit has a strong service life, and the circuit design occupies a small area; Fifth, the circuit voltage is relatively stable, to ensure the stability of indoor lighting.

4.2 Testing of Indoor Lighting Circuit Design
In the design of the circuit, the sensitivity of the photosensitive resistor will be affected by the temperature and change, resulting in certain circuit error, affecting the normal operation of the circuit. In order to ensure that the interior circuit design can realize automatic brightness adjustment, it is necessary to test the reliability and stability of the circuit design. The specific experimental data are shown in figure 2, which is the result of the author's experimental arrangement.

![Figure 2. Comparison between traditional circuit design and automatic regulation circuit design](image)

According to the data in figure 2, it can be found that compared with the traditional lighting circuit design, the automatic adjustment circuit design occupies an advantage in all aspects. Therefore, the following conclusions can be drawn: the automatic adjustment circuit design of indoor lighting brightness in this paper can run normally and has relatively complete functions.

5. Conclusion
The indoor lighting circuit with automatic brightness adjustment has great advantages, which not only reduces the energy consumption of indoor lighting, but also plays a role of environmental protection. And through the brightness of the automatic adjustment to reduce the damage to the eyes. The experiment shows that the design of the automatic adjustment circuit of indoor lighting brightness in this paper can run normally and its function is relatively perfect. With the continuous development of technology, the luminance automatic adjustment lamp will be more improved, the application prospect is also very wide.
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