

Design of Intelligent Street Lamp Control System

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Abstract

Night road lighting, as an important engineering project in urban architecture, should attract people's attention. Unreasonable planning of night city lighting will to some extent waste power resources. Therefore, in the process of increasing the construction of urban lighting projects, emphasis should be placed on energy conservation and environmental protection, reducing urban electricity expenses, reducing post maintenance of urban lighting projects, and achieving intelligent street lights on the basis of energy conservation and environmental protection. According to the concept of energy conservation and environmental protection, an intelligent street lamp with AT89C52 single chip microcomputer as the core component is designed. Intelligent components (Photoresistor, etc.) are used to realize the acousto-optic control of street lamp lighting. In the daytime, the light of the strong light signal identified by the photosensitive resistor is extinguished. When the light is dark at night, the street lamp lighting is controlled by the voice control recognition system. The light is dim when there are no people and vehicles. When people and vehicles are identified, the light brightness is improved to realize the automatic control of light, Maximize the conservation of electricity resources.

Keywords

Intelligent Street Lights; Energy Saving; AT89C52 Microcontroller.

1. Introduction

With the rapid development of science and technology, as an important part of urban beautification, the decoration of street lights is becoming increasingly important. At present, the control of street lights is mainly manual. When the light is dim, workers turn on the street lights and need to turn them off in a timely manner when it gets bright the next day. There are differences in the timing of turning on the lights due to weather factors and personal judgment. Turning on street lights all night can cause a great waste of electricity resources. After people fall asleep, they use less electricity and have a high voltage. The street lights are brighter than before and consume more electricity. The use of intelligent street lights can greatly save power resources and ensure that the street lights are illuminated at the appropriate time, avoiding the time difference caused by manual switching and reducing the cost of urban road lighting. Intelligent street lights use modules such as sound and light control to achieve timely start and stop of street lights, maximizing the reduction of resource loss. Intelligent street lights make people's lives more convenient. They can be intelligently turned on or off based on the sound and light conditions on site, avoiding the situation of street lights not turning on due to rainy weather. This greatly saves electricity and achieves intelligent control of street lights.

2. Basic Situation of Urban Street Lights

With the renovation and upgrading of urban roads and green spaces, increasing the construction of urban lighting projects has caused lighting waste to a certain extent. Some cities

experience situations where there are roads with no lights or lights with no lights on, which to some extent affects people's travel and poses significant safety hazards. As a basic urban lighting project, road lighting projects continue to increase investment, and their proportion in urban construction continues to increase. Based on the concept of "energy conservation, emission reduction, green, and environmental protection", a set of street light control system is developed and designed, which utilizes software and hardware coordination control to achieve intelligent opening and closing of street lights. The brightness of street lights can be adjusted according to personnel or vehicle conditions, saving urban electricity. Implement relevant national policies and guidelines as much as possible, implement energy conservation and emission reduction in place, achieve intelligent control of street lights, maximize the operational efficiency of the system, and reduce maintenance costs.

3. Development Prospects of Intelligent Street Lights

The era of intelligent street light control has arrived, and the artificial era is coming to an end. Intelligent street light control can effectively save electricity. At present, there are many problems with street light monitoring: 1) the function is single, only providing simple switch functions, daily fault checks, data reports, etc. require manual operation, and the scalability is poor; 2) Adopting relatively outdated manual control methods, the lighting time is not uniform due to factors such as season, environment, and human factors; 3) The maintenance is difficult, the manual troubleshooting cycle is long, the workload is heavy, and there is a lack of a sound fault warning mechanism. The intelligent control system can effectively control according to the on-site situation, such as setting single mode or sunrise and sunset mode, and can also achieve single, one piece, and one line control of street lights, and achieve real-time monitoring, intelligent management, effectively improving the scalability of street light control, improving system reliability, and facilitating management and operation.

4. Intelligent Street Light Control Circuit

4.1. The Basic Principle of Intelligent Control of Street Lights

Intelligent street lights have many advantages, especially in terms of energy conservation and environmental protection. At the same time, they can achieve automatic control of street lights. PWM dimming technology is used to achieve interval adjustment of street light brightness (set between 40% and 100%). Once the system detects that the ambient brightness is lower than the set brightness threshold at night or in abnormal lighting weather (such as rainy weather), the relay acts to control the brightness of the street lights. The street lights are powered by solar cells, and the solar panels rotate at any time to maintain a vertical relationship with the sunlight, improving the utilization of sunlight. When the light intensity is weak, the system detects that the light intensity is below the set threshold, and the street light module turns on the solar system to stop running.

After the street lights are turned on, they will maintain high brightness during peak hours at night. When infrared thermoluminescence, ultrasonic detection, and voice control modules detect abnormal movements (such as people or cars passing by), the street lights will slowly turn on for a certain period of time. After people and cars pass by, the street lights will gradually turn dark (which can be set according to the specific situation). If no movable objects are detected, the street lights will operate at the set brightness until the next day. Before dawn, when the system detects that the brightness threshold is higher than the set brightness threshold, the street lights will automatically turn off. According to this operating process, the control of street lights is achieved, maximizing energy savings, reducing light pollution and operating costs.

4.2. Hardware Design of Intelligent Control Circuit

4.2.1. Intelligent Control Circuit

The hardware design adopts a modular control method, mainly including a brightness acquisition module, a solar power supply module, and a street lamp adjustment module, as shown in Figure 1. The control sequence is: when the system detects that the ambient brightness is higher than the system threshold, the power module starts working, and the street light module does not work at this time; When the brightness at night falls below the threshold, the street light module operates and the power module stops working. The solar module provides power for the street lamp regulation module, and the environmental collection module, as an important intermediate link, plays an important role in the intelligent system and is the main switch of the dimming circuit.

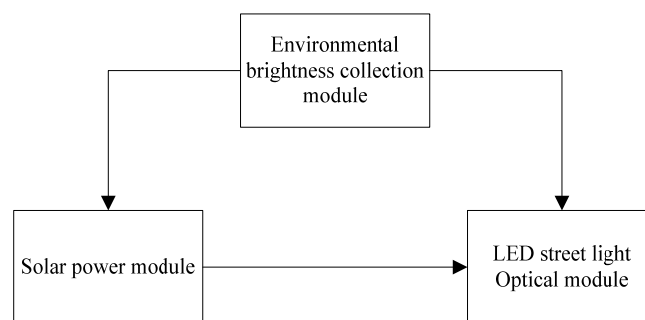


Figure 1. Structure diagram

4.2.2. LED Street Light Optical Module

In the LED street light Optical module, AT89C52, as an important core component, receives the signal sent by the sensor, and outputs the modulated PWM signal through a series of operation links. The human body infrared thermoluminescence sensor is mainly used to receive ultrasonic signals within a certain range. For the convenience of debugging, within 0.3m, the sound sensor is used to repeatedly measure and obtain the corresponding experimental data results.

4.2.3. Solar Power Module

In order to effectively improve the working efficiency of the system, the designed solar power module can maximize the conversion of solar energy into electric energy, effectively store it for system power supply, and can also supply power to the other two modules. The design module is shown in Figure 2, which uses the Photoresistor to collect the light intensity of the current environment, uses the signal processing of the single-chip microcomputer to achieve the forward and reverse rotation of the motor, and maximizes the adjustment of the angle between the solar panel and the sun to achieve timely correction, When the solar panel is perpendicular to the sunlight, the motor stops operating.

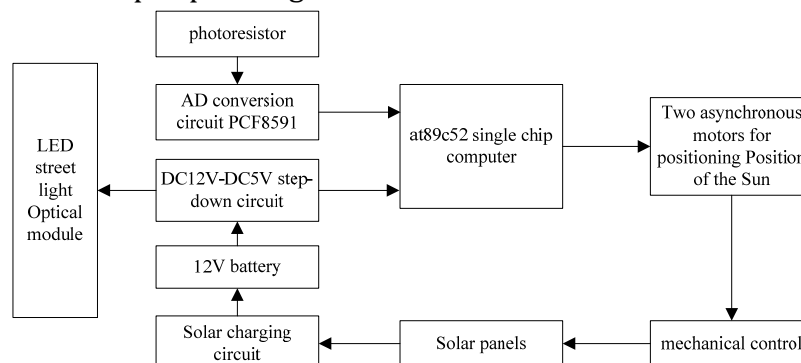


Figure 2. Solar power module

4.2.4. Environmental Brightness Collection Module

The module mainly uses LM393 chip and Photoresistor to adjust the output voltage, compare the output value with the threshold voltage set by the system, so as to judge whether the system sends instructions to the relay and whether the pull in action is carried out. As a switch module, it determines the status of the solar module and the Optical module. At the same time, the AT89C52 single chip can also be used as a replacement core component to realize the smooth operation of each module of the system.

4.3. Software Design of Intelligent Control Circuit

4.3.1. Design of Circuit Optical Module

As the core program, the circuit Optical module mainly uses PWM regulating signal to adjust the brightness of street lights, as shown in Figure 3. After the system is initialized, the PWM signal output by the system is used to adjust the brightness of the street lights. In the daytime, the light of the strong light signal identified by the photosensitive resistor goes out. At night, the light signal is dark (40% of the rated brightness) when no one and vehicles pass by through the voice control recognition system. Once the voice control recognizes that people and vehicles pass by, the light brightness increases.

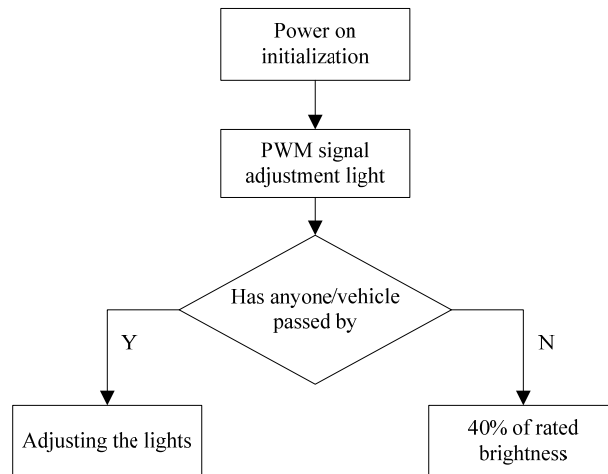


Figure 3. Design of circuit Optical module

4.3.2. Circuit Power Module Design

After the system startup program is initialized, ensure that the system is in solar panel charging mode, and at this time, the battery panel tracks the sunlight. In the digital to analog conversion module, the PCF8591 chip is used to effectively collect photosensitive acquisition signals, which are transmitted to the microcontroller using the digital to analog conversion module. Process and compare the received signals to achieve steering control of the stepper motor. When the sun light is perpendicular to the solar panel, the motor stops. With this module, accurate judgment of the Position of the Sun can be realized, and the solar panel can track the sun.

5. Conclusion

With the progress of science and technology, as well as the development of economy and society, urban lighting and lighting engineering have become increasingly important. However, urban lighting engineering has to some extent wasted power resources, affected urban environmental protection, increased urban electricity bills, and increased the cost of later maintenance. Therefore, it is very important to achieve intelligent street lighting on the basis of energy conservation and environmental protection. According to the concept of energy conservation and environmental protection, an intelligent street light with AT89C52 microcontroller as the core component is designed to effectively control the lighting of the street light. The sound

recognition system is used to recognize the environment. When the environment is unmanned or vehicles pass by, the light signal is dim, and the brightness of the light increases when people and vehicles pass by, achieving the adjustment of the light brightness.

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