Volume 7, Issue 5, May 2017 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Automatic Brightness Adjustment of Streetlights based on the Presence of Vehicles

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DOI: 10.23956/ijarcsse/SV7I5/0124

Abstract- Controlling of street light is of utmost importance in developing country like India to reduce the power consumption. This paper presents a street light control system which combines various technologies: a Light Dependent Resistors (LDR), photodiodes, Light Emitting Diodes (LED), Arduino board. IR Sensors used on one side of the road send logic commands for the LEDs at the output to get glowing for a patch ahead. Intensity control is also possible by pulse width modulation based on sensing the movement and density of vehicles. Thus this way of dynamically changing intensity or off to on helps in saving a lot of energy. A programmable Arduino is engaged to provide different duty cycle for different intensities at different density conditions.

Keywords — Streetlight, Energy efficient, Light intensity, Power saving, Automatic.

I. INTRODUCTION

Street lights are the major requirement in today's life of transportation for safety purposes and avoiding accidents during night. Despite that in today's busy life no one bothers to switch it off/on when not required. The project introduced here gives solution to this by eliminating manpower and reducing power consumption.

Fig. 1 Automatic streetlight system

This requires three basic components i.e. LDR, Sensors and microcontroller. During daytime there is no requirement of street lights so the LDR keeps the street light off until the light level is low or the frequency of light is low the resistance of the LDR is high. This prevents current from flowing to the base of the transistors. Thus the street lights do not glow. As soon as the light level goes high or if light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance.

II. LITERATURE SURVEY

The paper by Archana.M, Mahalahshmi.R have used a system that automate the street lighting based on climate condition and vehicle movement. Climate condition are checked using different sensor, street light are also controlled on the movement of vehicles , when vehicle moves the street light are switched on and switched off automatically. Furthermore, this system has auto-alarm function which will set off if any light is damaged and will show the serial number of the damaged light, thus it is easy to be found and repaired the damaged light[1].

The paper proposed by Ms Pallavi Choudekar, Ms. Sayanti Banerjee, Prof.M.K.Muju proposed a system for controlling the traffic light by image processing. The system will detect vehicles through images instead of using electronic sensors embedded in the pavement. A camera will be installed alongside the traffic light. It will capture image sequences. The image sequence will then be analysed using digital image processing for vehicle detection, and according to traffic conditions on the road traffic light can be controlled [2].

The paper by Musa M Gujja, Babagana D. M,Sadiq.A.G and Hajja I Usman aimed at the use of image as a street light switch. The system is design in such a way that, the circuit will be in a casing, where there will be a provision for the sensor (LDR) to be outside the case to enable the light dependent resistor (LDR) senses either light of dark. If the LDR senses darkness, it will serve as a switch to ON the circuit where the output will display a 220v output, which any form of 220v bulb can be attached or connected serially or parallel inform of a street light. Likewise if the LDR senses light, it switches OFF automatically. The system work with respect to environmental sensor, which respond to the illumination intensity that switches ON when senses darkness and equally switches OFF when senses light. The application is made up of three units, the power control unit, the operating unit or sensor and the control system[3].

III. HARDWARE DESCRIPTION

1. Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

2. Infrared LED

An IR LED, also known as IR transmitter, is a special purpose LED that transmits infrared rays in the range of 760 nm wavelength. Such LEDs are usually made of gallium arsenide or aluminum gallium arsenide. They, along with IR receivers, are commonly used as sensors. The appearance is same as a common LED. Since the human eye cannot see the infrared radiations, it is not possible for a person to identify whether the IR LED is working or not, unlike a common LED.

3. Photodiode

A photodiode is a semiconductor device that converts light into current. The current is generated when photons are absorbed in the photodiode. A small amount of current is also produced when no light is present. Photodiodes may contain optical filters, built-in lenses, and may have large or small surface areas. Photodiodes usually have a slower response time as their surface area increases.

4. LDR

A photoresistor (or light-dependent resistor, LDR, or photocell) is a light-controlled variable resistor. The resistance of a photoresistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photoresistor can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits.

5. Camera

A camera is an optical instrument for recording or capturing images, which may be stored locally, transmitted to another location, or both. The images may be individual still photographs or sequences of images constituting videos or movies. The camera is a remote sensing device as it senses subjects without physical contact.

IV. PROPOSED METHODOLOGY

The highway model consists of 2 pairs LED's as streetlights controlled by a pair of photodiodes-IR diodes which are used as sensors, variable resistors act as switch. The IR diodes and photodiodes are placed on the one side of the road. LED 1 and 2 are connected to IR1 and LED 3 and 4 are connected with IR2 as shown in Fig.2.

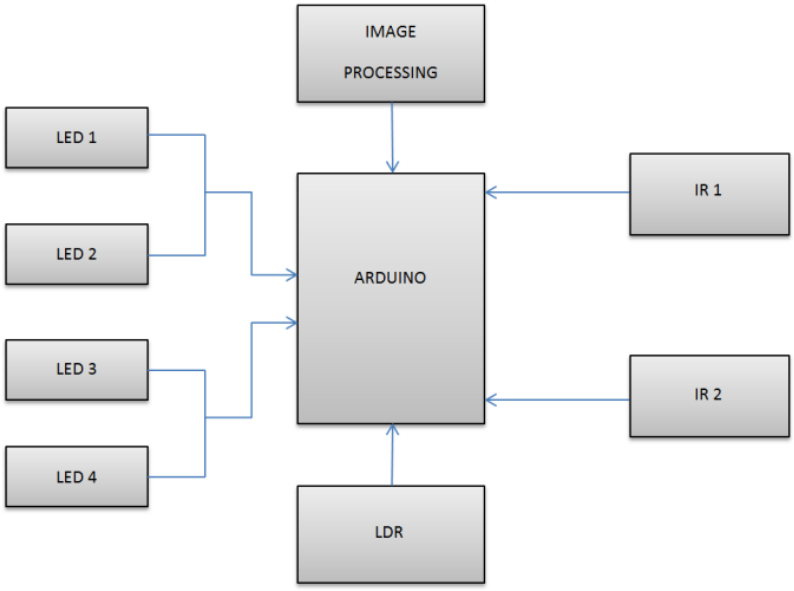

Fig. 2 Block Diagram

Arduino checks for the input from the LDR, if the value from the LDR is more than the threshold, it implies night. And the LED's brightness is at 20%. When the object is near the system it gets detected by the camera, images are processed and the input is send to Arduino. Say that an object is coming near to the system during the night, it gets detected by the camera, all the LED's are at 100%.

Case1: No vehicle

The IR radiation emitted from the IR diode directly falls on the photodiode which is exactly opposite to it. This causes the photodiode to fall in conduction state. Thus input to the system is 0, hence no power to LED's.

Case2: Presence of vehicle

In the presence of vehicle, vehicle obstructs the IR radiation path. No conduction in photodiode. Thus input to the system is 1, hence power to LEDs.

V. EXPERIMENTAL RESULTS

The system waits for the evening to fall which is detected by the LDR, system gets activated and keeps all the street light (LED) at 20% brightness.

Whenever the system detects an object (human), all the LEDs are powered to 100% brightness. If an object cuts the IR the associated LEDs are powered to 100% brightness. After objects moves out of the system reach all the street light are reset to 20%.

VI. CONCLUSION

The street light has been successfully controlled by microcontroller. With commands from the controller the lights will be ON in the places of the movement when it's dark. The system automates the street light, helps to save a significant amount of power. This helps the organisations to save resources and money. This can be utilized in other areas for improvement and development. This control circuit can be used in long roadways between the cities. In future this system can be used for security and traffic monitoring purpose as it takes input from a camera. This system can also report street light failure, which make the repair of street light easier and less effort is required.

ACKNOWLEDGEMENT

The team would like to thank our dissertation guide, Assoc. Professor Kaushik K.S. for all his advice, help, guidance and encouragement throughout the progress of our project work. He has always been helpful and enthusiastic and we could not have finished our project without his assistance.

The team would also like to thank, Department of Information Science and Engineering, Canara Engineering College, Mangaluru for providing all the facilities and continuous support required to complete our project.

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