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Intelligent Street-Light System using Arduino UNO

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Abstract:
A huge amount of electrical power of many countries is consumed in lighting the streets. However, vehicles pass with very low rate in specific periods of time and parts of the streets are not occupied by vehicles over time. In this project, we propose a system that automatically switches off the light for the parts of the streets having no vehicles and turns on the light for these parts once there are some vehicles that are going to come. Logically, this system may save a large amount of the electrical power. In addition, it may increase the lifetime of the lamps. This system automatically controls and monitors the light of the streets. It can light only the parts that have vehicles and help on the maintenance of the lighting equipments. Conventional street lighting systems in areas with a low frequency of passerby are online most of the night without purpose. The consequence is that a large amount of power is wasted meaninglessly. The purpose of this work is to describe the Intelligent Street Lighting (ISL) system, an approach to accomplish the demand for flexible public lighting systems. The present system is like, the street lights will be switched on in the evening before the sun sets and they are switched off the next day morning after there is sufficient light on the roads. This project gives the best solution for electrical power wastage. Also the manual operation of the lighting system is completely eliminated. In this project, sensors used are, Light Dependent Resistor (LDR) to indicate a day/night time and the photoelectric sensors to detect the movement on the street. The Arduino Uno is used as brain to control the street light system. Results show that the saved energy may reach up to 65% and an increase of the lifetime of the lamps of 53%.

Keywords: Arduino UNO, LDR, Relay

1. INTRODUCTION

The idea of designing a new system for the street-light that do not consume huge amount of electricity and illuminate large areas with the highest intensity of light is concerning each engineer working in this field. Providing street lighting is one of the most important and expensive responsibilities of a city. Lighting can account for 10–38% of the total energy bill in typical cities worldwide [1].

Street lighting is a particularly critical concern for public authorities in developing countries because of its strategic importance for economic and social stability. Inefficient lighting wastes significant financial resources every year, and poor lighting creates unsafe conditions. Energy efficient technologies and design mechanism can reduce cost of the street lighting drastically. Manual control is prone to errors and leads to energy wastages and manually dimming during mid-night is impracticable. Also, dynamically tracking the light level is manually impracticable. The current trend is the introduction of automation and remote management solutions to control street-lighting [2].

In this paper LDR is used as sensor. The main objective is to provide an efficient & energy saving lighting system by evaluating the outside lighting condition and then adjusting the lights accordingly. The circuit mainly consists of a sensing element known as LDR, which is followed by processing unit Arduino which takes input for sensing element and gives its output to the LEDS (lighting units).Though other units like relays, transistors are also be used for higher voltage supply.

2. PROPOSED SYSTEM

The system basically consists of a LDR, power supply, relays and Arduino Uno. The pictorial representation of system is given below:

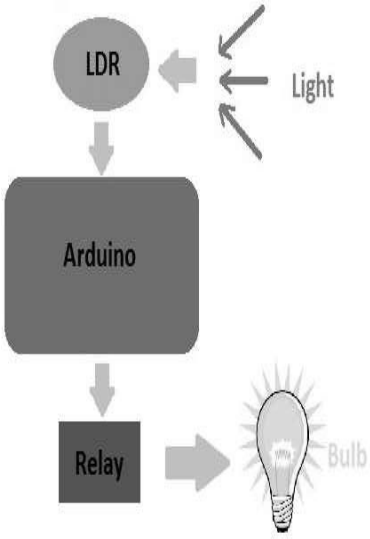

Figure.1. Pictorial representation of system

The LDR senses the light and sends the data to Arduino. The Arduino analyze the data and gives its response to the LEDs through the relay mechanism. The Arduino is programmed in such a way it automatically adjusts the lights to give most accurate result possible.

3. COMPONENTS USED

3.1 Light *Dependent* Resistor (LDR) sensor (As receiver)

Light Dependent Resistor as the name suggests the resistance is dependent upon the light incident on it. The theoretical concept of the light sensor lies behind, which is used in this circuit as darkness detector. The LDR is a resistor as shown in Fig. 2

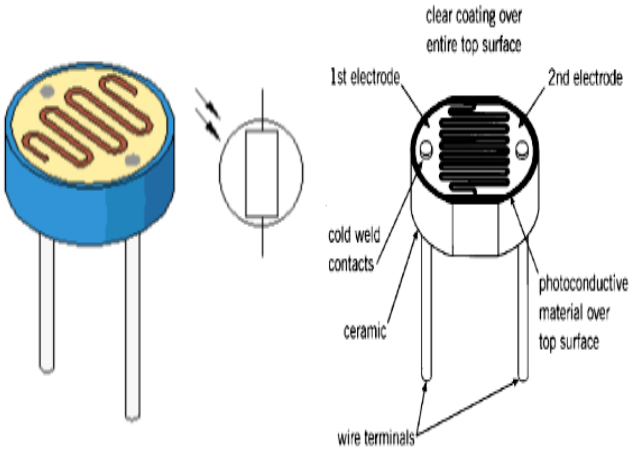

Figure.2. Light dependent resistor (LDR)

The LDR resistance changes with intensity of light, with increase in light intensity the resistance offered by the sensor decreases and with decrease in light intensity the resistance offered by the sensor increases. Hence it acts as variable resistor with change in light intensity. These helps in finding the amount of light intensity at that instant of time and thus helping in regulating the lighting of our lighting system accordingly. Mathematical representation of LDR can be given as,

Resistance α 1/ Intensity of light

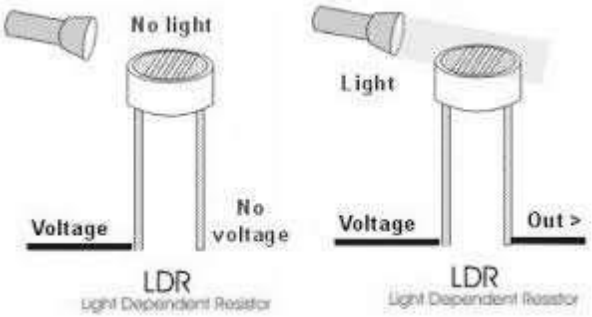

Figure. 3. Working of LDR

3.2 Arduino UNO

Arduino is an open-source physical platform based on microcontroller board having the ATmega32 series controllers and Integrated Development Environment for writing and uploading codes to the microcontroller. It has input and output pins for interaction with the outside world such as with sensors, switches, motors and so on. To be precise it has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller .It can take supply through USB or we can power it with an AC-to-DC adapter or a battery Arduino acts as the processing module of the system. It takes input from the LDR, processes the data and gives the output to LEDS directly or through a relay and a transistor mechanism. Arduino is open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project is based on microcontroller board designs, manufactured by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can be interfaced to various expansion boards ("shields") and other circuits. The boards feature serial communications interfaces, USB on some models, for loading programs from personal computers. The microcontrollers are primarily programmed using a dialect of features from the C and C++ programming languages. In addition to using traditional compiler tool chains, the Arduino project provides an integrated development environment (IDE) based on the Processing project. The Arduino project started in 2005 as a program for students at the Interaction Design Institute Ivrea in Ivrea, Italy, aiming to provide an inexpensive and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors. Arduino boards are available commercially in preassembled form, or as do-it-yourself kits.

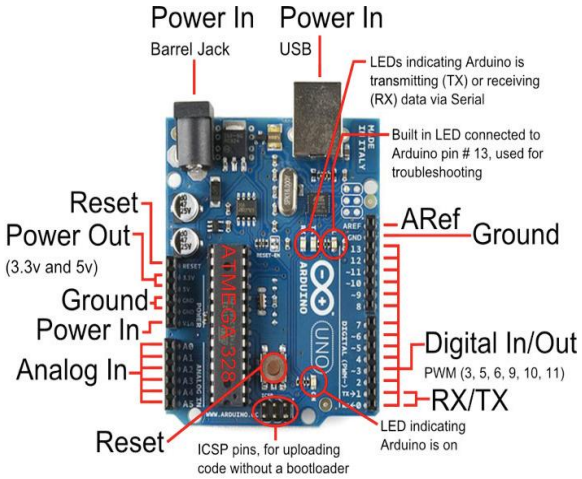

Figure.4. Arduino UNO board

a) ***Software development***

Arduino programs may be written in any programming language with a compiler that produces binary machine code. Atmel provides a development environment for their microcontrollers, AVR Studio and the newer Atmel Studio, which can be used for programming Arduino. The Arduino project provides the Arduino integrated development environment (IDE), which is a cross-platform application written in the programming language Java. It originated from the IDE for the languages Processing and Wiring. It was created for people with no profound knowledge of electronics. It includes a code editor with features such as syntax highlighting, brace matching, cutting/pasting text, searching/replacing text and automatic indentation, and provides simple one-click mechanism to compile and upload programs to an Arduino board. It also contains a message area, a text console, a toolbar with buttons €for common functions and a series of menus. A program written within the IDE for Arduino is called a "sketch". Sketches are

saved on the development computer as files with the file extension .ino. Arduino Software (IDE) prior to 1.0 saved sketches with the extension .pde. The Arduino IDE supports the languages C and C++ using special rules to organize code. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two functions, for starting the sketch and the main programs loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU tool-chain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal coding that is loaded into the Arduino board by a loader program in the board's firmware.

b) ***Specifications***

- Microcontroller: ATmega328
- Operating Voltage:5V
- Input Voltage(recommended): 7-12V
- Input Voltage(limit): 6-20V
- Digital I/O Pins: 14(of which 6 provide PWM Output3.3)
- PWM Digital I/O Pins: 6
- Analog Input Pin: 6
- DC Current per I/O Pin: 20mA
- DC Current for 3.3V Pin: 50Ma
- Flash Memory: 32 KB(ATmega328) of which 0.5KB used by bootloader
- SRAM: 2KB
- EEPROM: 1KB
- Clock Speed: 16MHz
- LED Built-in: 13
- Length: 68.6 mm
- Width: 53.4mm
- Weight: 25g

3.3Relays

Relays are remote control electrical switches that are controlled by another switch, such as a horn switch or a computer as in a power train control module. Relays allow a small current flow circuit to control a higher current circuit. Several designs of relays are in use today, 3-pin, 4-pin, 5-pin, and 6-pin, single switch or dual switches. Relays which come in various sizes, ratings, and applications, are used as remote control switches. Fig. 5 shows different types of relays.

Figure.5. Different types of relays

3.4 Light Emitting Diode (LED)

A light-emitting diode (LED) is a p-n junction diode, which emits light when activated. When we apply voltage across its leads, electrons are able to recombine with holes within the LED, releasing energy in the form of photons which gives the light. Hence, it is a two-lead semiconductor light source. Light emitting diodes represents our lighting system and the amount of light emitted by it is directly related to the amount of light in the environment that is when outside light is less than the light given by LEDS is more and vice-versa.

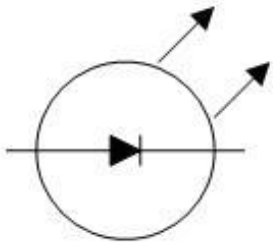

Fig. 6(a) Schematic

Fig. 6(b) LED bulbs

Structure of LED

LEDs produce more light per watt than incandescent bulbs; this is useful in battery powered or energy-saving devices. LEDs can emit light of an intended color without the use of color filters that traditional lighting methods require. This is more efficient and can lower initial costs. The solid package of the LED can be designed to focus its light. Incandescent and fluorescent sources often require an external reflector to collect light and direct it in a usable manner. When used in applications where dimming is required, LEDs do not change their color tint as the current passing through them is lowered, unlike incandescent lamps, which turn yellow. LEDs are ideal for use in applications that are subject to frequent on-off cycling, unlike fluorescent lamps that burn out more quickly when cycled frequently, or High Intensity Discharge (HID) lamps that require a long time before restarting.

3.5 LASERs (As transmitter)

LASER is a device which emits light based on stimulated emission of radiation. A LASER differs from other sources by the property of emitting light in a single direction. The use of LASER in this Project is done as per the following figure.

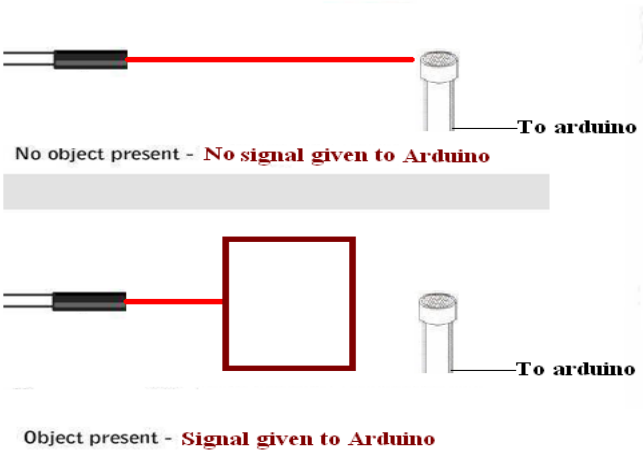

Figure.7. Working of LASER module.

4. WORKING OF THE SYSTEM

4.1 Working principle

The working of the model is very simple. The supply is given through the power jack. From the Arduino we take 5v supply and connect it to one of the terminal of photo resistor and other end is connected to a resistor of 10k which acts as a voltage divider and then final connected to ground. The output is given by output pin 13 of the Arduino which is connected to the led through a 220ohm resistor. The other end of LED is perfectly grounded. The LDR senses the amount of light in the atmosphere at that moment of time and accordingly sends the data is to Arduino .The Arduino converts the data received into various discrete levels .For example from 0 to 1023 discrete levels for a given data then 0 represents maximum darkness and 1023 represents maximum brightest so light is received is converted into one of the discrete value from 0 to 1023.Now depending upon the discrete value that we get (0 to 1023) we adjust the output voltage accordingly from 0 to 5v.So, when complete darkness (night time) that is discrete level 0 than the output is 5v as a result LED is brightest or when partially dark (dawn/evening) that is discrete level of 512 then the output is 2.5 v as a result LED is half of the maximum brightest or when completely bright that is discrete level 1023 then the output voltage is 0v as a result LED switched off. Thus, the LED not only just automatically switches on and off but also adjusts the amount of light emitted according to the outside condition. The usage of such kind of application in the headlights of cars, park lights, street lights is very useful.

4.2 Flowchart

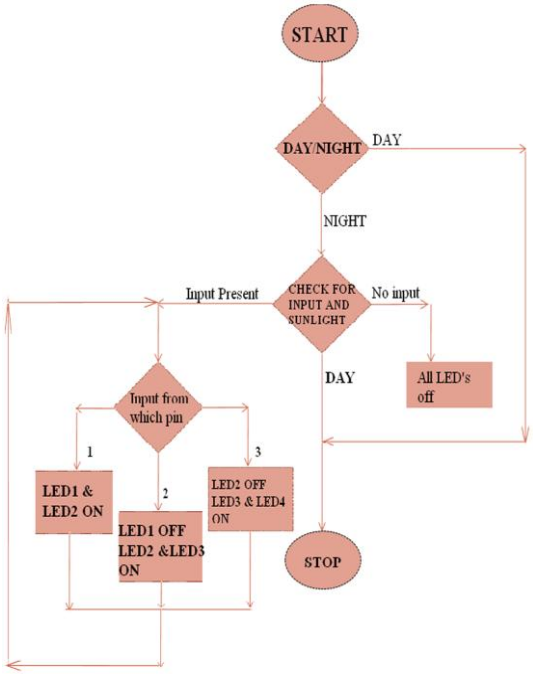

Figure.8. Flowchart of the system

5. CONCLUSION

This Arduino based project will provide a competent method for lighting systems and make the whole process of energy saving easier and efficient. With a capability to change the amount of light emitted depending upon the outside condition is no doubt an innovation with many future applications apart from the fact that it can also be used in many present day tech such as head lights, street light, park lights, industrial lights and many more. The usage of the smart lighting system will undoubtedly change the world that we see today.

6. REFERENCES

[1]. D. A. Devi and A. Kumar, Design and Implementation of CPLD based Solar Power Saving System for Street Lights and Automatic Traffic Controller, *International Journal of Scientific and Research Publications,*

[2]. J. Mohlnikova, Electric Energy Savings and Light Guides, Energy& Environment, *3rd IASME/WSEAS International Conference on, Cambridge, UK*, February 2008, pp.470-474.

[3]. A.A.Nippun Kumaar, Kiran.G, Sudarshan TSB," Intelligent Lighting System Using Wireless Sensor Networks", International Journal of Ad hoc, Sensor & Ubiquitous Computing (IJASUC) Vol.1, No.4, December 2010, pp 17-27

[4]. Y. K. Tan; T. P. Huynh; Z. Wang," Smart Personal Sensor Network Control for Energy Saving in DC Grid Powered LED Lighting System", IEEE Trans. Smart Grid

[5]. Mustafa Saad, Abdalhalim Farij, Ahamed Salah And Abdalroof Abdaljalil "*Automatic Street Light Control System Using Microcontroller*" Department of Control Engineering College of Electronic Technology/ Baniwalid Baniwalid- Libya LIBYA, Mathematical Methods and Optimization Techniques in Engineering.