AUTOMATED STREET LIGHTING SYSTEM FOR ENERGY CONSERVATION

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Abstract - Automatic Street Lighting is a simple and efficient idea, which uses LDR sensor to operate. By using this concept, efficiency is increased, energy is conserved and human work is reduced. LDR sensor senses the light actually like our eyes and processes the functioning of the street LED lamps. LDR sensor switches off the street lamp whenever the light on the road becomes sufficient without risking any human life. By using this system energy consumption is also reduced because nowadays, the manually operated street lights are not switched off even when there is sufficient sunlight. In this project, less manual functioning is needed. In this we are using Relay Driver Modules to detect the intensity of sunlight and for switching the street light on and off. The system uses **NodeMcu ESP8266** for wireless connectivity and Arduino board for controlling the entire system. It also collects data about the usage of street lamps and sends it to the cloud for storage and analysis. In this system the intensity of street lamp can also be controlled and improper functioning can also be monitored while sitting far away from the lamp. With the help of this system, accidents due to improper lighting and energy consumption can be reduced to minimum rate.

Keywords - Light Dependent Resister, ESP8266, Light Emitting Diode, Relay Driver Module, Arduino Uno

I. INTRODUCTION

It is very essential currently to save energy because most of the energy sources like coal, oil, etc. once used cannot be replaced by any current measures.
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During night one of the major requirements in today's life of transportation for safety purposes and avoiding accidents are street lights. Being busy in today's world lifestyles no one bothers to switch it off/on when not required. This requires four basic components i.e. LDR, ESP8266, IR Sensor and LED. The current is being prevented by it from flowing to the base of the transistors. Thus, the street lights do not glow. As soon as the 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, hence it lowers the resistance. Now the circuitry goes in on condition and the block diagram represented starts working. While reducing energy a well-designed, energy-efficient street lighting system use and costs and enhancing the appearance of the neighbourhood and should permit users to travel at night with good visibility, in safety and comfort. Disadvantage of lighting system is that poorly designed lighting systems can lead to poor visibility or light pollution, or both.
Street lights uses obsolete lighting technology that is most of the time is poorly designed and inadequately maintained, as a result they often fail to provide high quality lighting inspite of the consumption of the large amounts of energy and financial resources. The major disadvantages of using timer circuits or manual is that the ON time and OFF time differ significantly in the sunny and rainy days. From the saturation region and cut-off region to switch ON and switch OFF the lights, the working of a transistor is exploited in this project, at appropriate time with the help of an electromagnetically operated switch.

The schematic (Fig 1) uses two sensors i.e. LDR sensor to detect the darkness on the street and the Photoelectric sensor to detect the movement. Firstly, the LDR sensor detects the lighting on the street and if the light is insufficient then it activates the system then the work of the photoelectric sensor starts, it detects the movement and if there is any movement it turns the LED (used in place of street lamp) light ON.

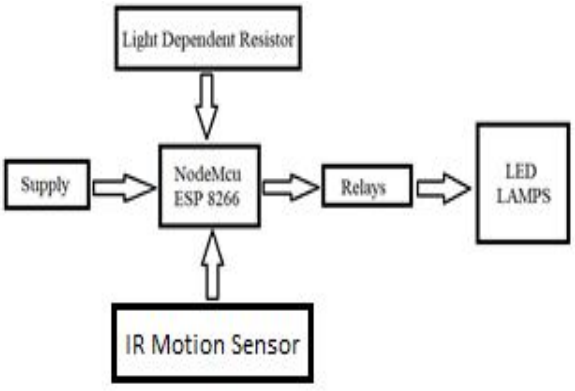


Fig 1 Block Diagram

II. AUTOMATED STREET LIGHTING SYSTEM

The system consists of a LDR, ESP8266, Relays, Power Supply, IR Motion Sensor and LEDs.

2.1 IR Motion Sensor

This sensor is also known as obstacle detector sensor. It consists of an infrared emitter, infrared receiver and potentiometer as shown in Fig 2(a).

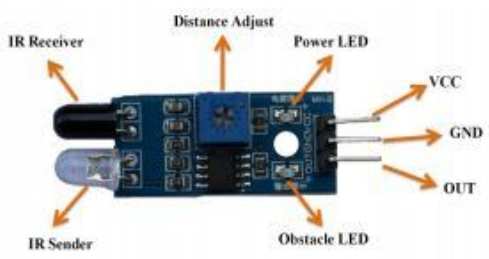


Fig 2(a): IR Motion Sensor

Whenever any object comes in front of the sensor, the rays emitted from the infrared emitter knocks the object and return back to the infrared receiver considering it as motion, as shown in Fig 2(b).The potentiometer is given for adjusting the working distance of the IR motion sensor.

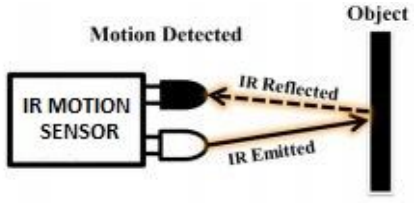


Fig 2(b): Working of IR Sensor

2.2 ESP8266

The ESP8266 (Fig 3 and 4) is a very powerful and famous Wi-Fi Module which is also popular in the Internet of Things world. The microcontrollers can access the Wi-Fi network with the ESP8266 that is integrated with TCP/IP protocol stack. The storage capabilities of the ESP8266 is very powerful and sometimes is integrated with the sensors. The ESP8266 is embedded with a self-calibrated RF that allows it to work under all the operating conditions, hence it supports the VoIP applications and Bluetooth co-existence interfaces and requires no external parts.



Fig 3: ESP8266 NodeMcu

Features of the ESP8266 Wi-Fi Module

- Wi-Fi Direct (P2P), soft-AP.
- Integrated TCP/IP protocol stack.
- Integrated TR switch, LNA, power amplifier.
- Power down leakage current of < 10uA.
- 1MB Flash Memory.
- 2 x virtual Wi-Fi Interface
- Wake up and transmit packets in < 2ms.

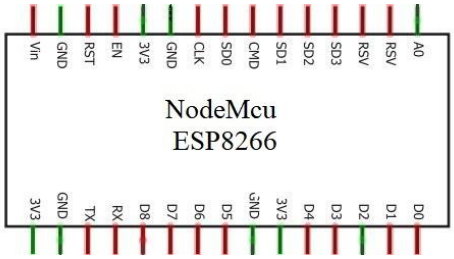


Fig 4: Pin Diagram of NodeMcu8266

2.3 LDR

LDR, is a light controlled variable resistor which exhibits photoconductivity i.e. the resistance goes on decreasing with increasing incident light intensity. The LDR is shown in Fig 5, is made of high resistance semiconductor, in the dark it can have resistance as high as in Megaohms and in light as low as a few hundred ohms.

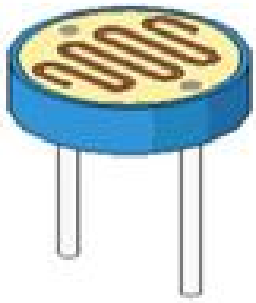


Fig 5: LDR

2.4 LED

A light emitting diode (LED) is a device which converts electrical energy to light energy. We have taken comparison of the most used electrical appliances that are used on highways.

	LED	CFL	HALOGEN
Life Span	25,000 hrs	10,000 hrs	1,000 hrs
*Cost Per Bulb	$12.00	$7.00	$3.00
KWh used over 25,000	175KWh	325KWh	1,075KWh
**25,000 KWh Cost	$12.0	$17.5.0	$75.0

***Prices at the local hardware store.**
**** Based on UPPCL, India**

The compared cost analysis between LED, CFL and HALOGEN is given above.

III. METHODOLOGY

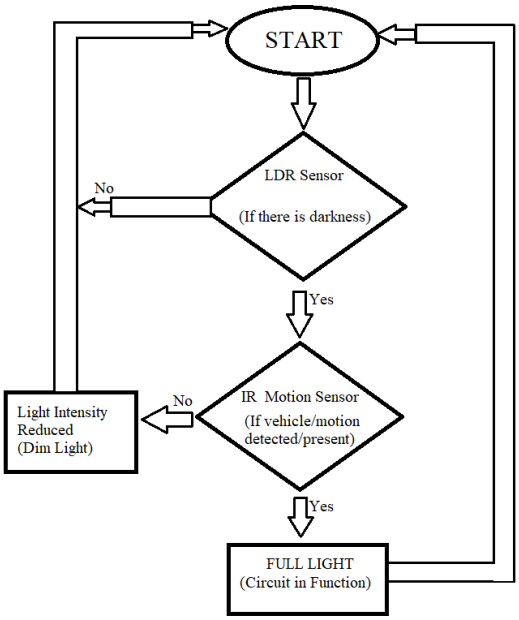


Fig 6 (a)

Step 1: The function initiates with a start and follows up.

Step 2: The LDR sensor detects for the light and goes for a yes or no. If darkness is sensed, the process goes to third step if no, the process goes back to initial step 1.

Step 3: After darkness is sensed, the IR Sensor senses vehicle or motion presence. If the presence is detected the process goes to step 4 else in the Light Intensity decreases ultimately going back to Step 1.

Step 4: After detection of vehicle or motion, the circuit completes giving out fill light and goes back to step 1.

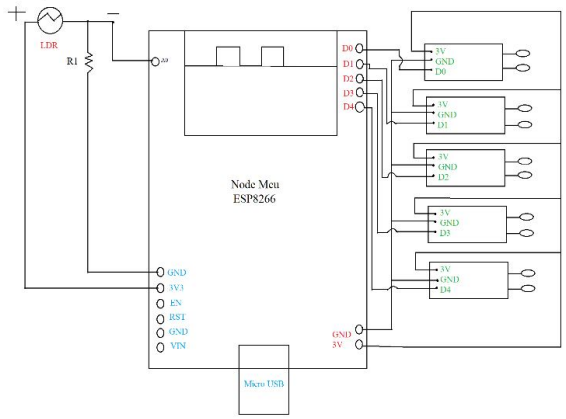


Fig 6 (b)

The schematic diagram Fig 6(b) shows the simple connection of the light dependent resistor and the infrared motion sensor with the ESP8266 microcontroller. The positive terminal of light dependent resistor is connected with the 3V3 pin of microcontroller and the negative terminal is connected to the A0 pin through a 10kohm resistor. Now while connecting the infrared sensor, we know that it has three input pins namely a 3V input pin, a GND pin and a data output pin. Here the 3V pin of IR sensor will be connected with the 3V pin of the microcontroller. Now the GND pin will be connected with the GND of microcontroller. At the end the data output pin will be connected to the D0, D1, D2, D3 and D4 respectively.

RESULTS AND CONCLUSIONS

In this paper, the design and concept of automated street lighting system is implemented in a small project which can be further used in practical purposes saving a lot of energy, manual work and money.

This system is effective in energy saving and provides faster and efficient output.

If it is implemented in cities or college, the amount of power saving can be huge. As this idea implements the use NodeMcu ESP 8266 which directly sends the data to the web server which further keeps a track and records the data (such as timing of LED lights, intensity, etc.) and can be further used for data analysis.

FUTURE WORK

The data transmission is done via cloud which is connected by the WiFi module, this data can be used to calculate various detailed information about the power consumption of LEDs. If this idea is implemented on national highways the data sent via module will serve as a backbone to saving energy.

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