iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VI **Month of publication:** June 2021

DOI: https://doi.org/10.22214/ijraset.2021.36068

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI June 2021- Available at www.ijraset.com

Smart Street Lighting System using IoT and Cloud Computing

J. Nausicaa
UG Scholar, Department of Electrical and Electronics Engineering

Abstract: ***Street lights account for the maximum energy expense for any city. A smart street lighting system can cut out lighting costs by almost 70%. A smart street lighting system is a system that adjusts light output based on usage and movement, i.e., automatically detecting movements of either pedestrians or vehicles in the vicinity. For effective street light management, we propose installing a wireless-based system to remotely track and control the energy consumption of street lights of a particular city in real-time and take necessary energy conservation measures through power conditioning and adaptive control. The proposed system should be installed on the street light poles which consist of a wireless module that continuously transmits data to back-end IT systems where we can uninterruptedly monitor the condition of the lights. We can control the LED street lighting based on traffic flow in that particular area. The data from the system can be transferred to a central server using wireless technology and Cloud to have global access to the system. We can automate the system to switch on or off the lights at specific timings. We can also easily identify any glitches or failures in our system because everything is connected over the Internet.***
Keywords: Smart Street Lights, IoT (Internet of Things), Cloud Computing.

I. INTRODUCTION

Streetlights are an elemental part of any city since it facilitates better night visions, secure roads and exposure to the public area but it consumes a large portion of electricity. In the existing system, the lights are powered on from sunset to sunrise even when there is sufficient light available. We can avoid this energy wastage by switching off the lights automatically. The saved energy can be efficiently utilized for residential, commercial, and transportation purposes. This paper aims to propose a system that conserves energy and reduces the manpower involved in the process.

II. LITERATURE SURVEY

The author used smart embedded systems to control the street lights based on the detection of vehicles or other obstacles on the street by using an IR transmitter and IR Receiver couple to sense an approaching vehicle in [1]. This paper focuses on controlling the intensity of light considering object movement near the lights. Light sensors and photoelectric sensors are used to detect sunlight and in the absence of it, the system automatically switches on the lights [2]. The authors propose an adaptive solution that can be implemented in any city where all the street lights are connected to a central server using the Internet and it can be monitored in real-time to check for any glitches or system failures.

They can also transmit information about the pollution levels in that locality using temperature and humidity sensors and air quality sensors [3]. The idea of environment adaptive street lights had put forward in [4] where we can monitor traffic as well as watch the entire system using a surveillance camera fixed on the lamp posts. The author describes an intelligent smart monitoring street light system in [5] and Cloud Computing is used to read the data and update the data whenever needed. A Web-based standalone application is used for controlling and monitoring the lights. In this paper, the wireless microcontroller i.e. NodeMCU is connected to a smartphone, and Blynk IoT services are used as the server to provide an interface between the lights and users[6]. An agent-based traffic management system with mobile agent technology is proposed in [7]. The urban traffic management system uses intelligent traffic clouds for decision support and aids in coping with Big Data. In [9], the authors design an energy-saving solution using a smart embedded system and uses the IR transmitter-receiver couple to sense an approaching vehicle. In [10], the proposed system detects vehicle movement and switches ON only a cluster of lights ahead of the vehicle and switches OFF the lights trailing after the vehicle. They suggest using a Light Dependent Resistor (LDR) to detect the amount of light in the surroundings and a photo-electric sensor to check for the presence/absence of a vehicle. The authors proposed an economical solution for street light control and monitoring by integrating the system with a Vehicular Ad-Hoc Network (VANET) [11]. A system is proposed where the lampposts are furnished with a ZigBee device and they receive control information from the base server where the pedestrians' locations are periodically stored [12].

III. PROPOSED SYSTEM

In the proposed system, the manpower is reduced by introducing automatic switching of the street lights. Energy consumption is also reduced so there is the reduction of CO_2 emission. It is a wireless communication system so the maintenance cost is also reduced. We use Light Emitting Diodes(LED) that consume a very minimal amount of electricity and it is a very efficient alternative for the traditional HID lamps that consume a lot of power. Using the Cayenne application from My Devices, we can easily control the lights with just a tap on our phones/computers. We are using the concept of home automation services but on a larger scale.
We propose to use Cloud to store and manage all the data that the street lights generate. The data being generated by all the street lights collectively is Big Data, which cannot be computed using existing conventional methods. To analyze the data efficiently and get useful information out of the meta-data, Cloud Computing is required.

IV. BLOCK DIAGRAM

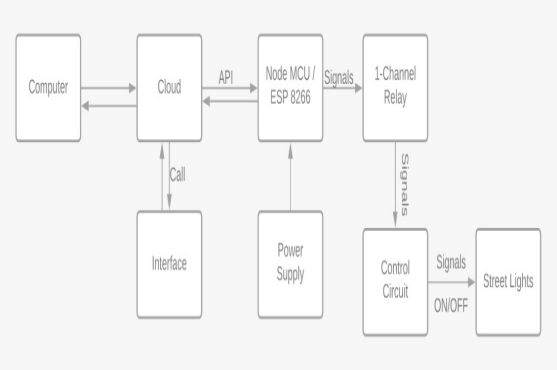


Fig 1. Block Diagram.

The block diagram given above explains the overall working of the proposed system where the street lights can be controlled using back-end IT systems. The NodeMCU ESP8266 has Wi-Fi capability and it is connected to the single-channel relay using connecting wires and the relay here is used for switching purposes i.e. to switch on or off the lights. NodeMCU is interfaced with the Cayenne App in the computer/phone using a USB cable. In the app, we can see the status of the lights and switch on by tapping the power ON button. The Cloud is used to manage the data that is being generated by the street lights. Since numerous lights are connected, the amount of data generated is Big Data. To efficiently manage and store this data, we are using the Cloud Interface.

V. CIRCUIT DIAGRAM

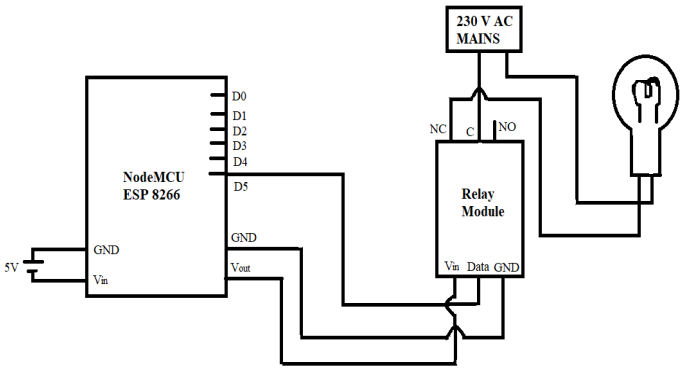


Fig 2. Circuit Diagram.

V_{in} is used to powering the NodeMCU board and here we are using a 5V output. The mini USB cable is connected to the board and any signal from the back-end computer/ smartphone will be passed through the D5 pin to the single-channel relay module. The relay is used to power on/off the bulb.

VI. HARDWARE DESCRIPTION

1) *NodeMCU ESP8266:* NodeMCU is an open-source Lua-based firmware and development board specifically targeted for IoT-based applications. The firmware runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and the hardware is based on the ESP-12 module. It is used for prototyping IoT devices and is also applicable for low-power battery-operated applications.

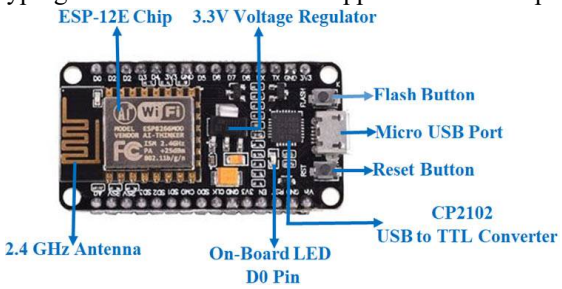


Fig 3. Development Board.

2) *Single-Channel Relay:* A relay is an electromagnetic switch operated by a small current that can control a larger current. IN pin is used to control the relay. It is an active low pin, which means that the relay will be activated when you pull the LOW pin and it will become inactive when you pull the HIGH pin. VCC pin supplies power to the module.

Fig 4. 1-Channel Relay.

3) *LED:* A light-emitting diode (LED) is a semiconductor light source and when current flows through it, it emits light. Electrons from the semiconductor combine with electron holes and release energy in the form of photons. The color of the light is determined by the energy requirement of electrons to cross the bandgap of the semiconductor. White light is obtained with multiple semiconductors or by using a layer of light-emitting phosphor on the semiconductor devices.

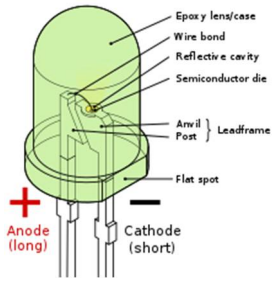


Fig 5. LED

4) *Connecting Wires:* Connecting wires allow an electrical current to travel from one point on a circuit to another because electricity needs a medium through which it can move. The connecting wires are mostly made up of copper or aluminum.
5) *Mini USB Cable:* Universal Serial Bus is a standard that establishes specifications for cables and connectors and protocols for connection, communication, and power supply between computers, peripherals, and other computers.

Fig 6. Mini USB Cable

VII. ADVANTAGES OF PROPOSED SYSTEM

A. Automatic switching of street lights.
B. Maintenance cost reduction.
C. Reduction in CO_2 emission.
D. Wireless communication.
E. Efficient energy consumption.
F. Reduction of Manpower.
G. Easy to identify faults

VIII. WORKING PRINCIPLE AND OUTPUT

Fig 7. Snapshot of the hardware

Our prototype uses a relay to switch on/off the bulb. The NodeMCU gives signals to the 1-channel relay to operate the bulb. The NodeMCU is programmed and interfaced with the Cayenne App and works on local Wi-Fi so we can control the switching mechanism through the app.

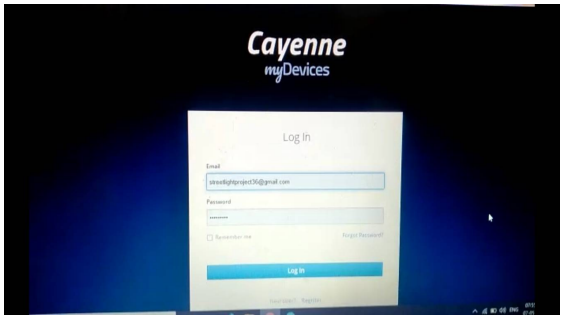


Fig 8. Cayenne App Login

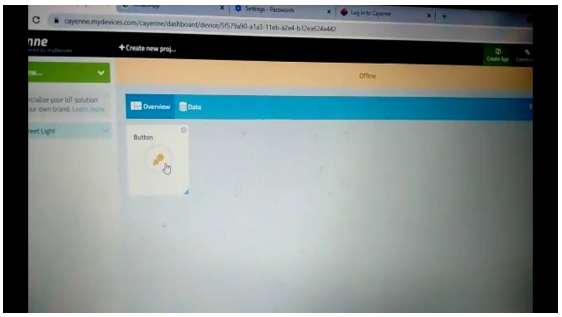


Fig 9. Powering ON the Bulb

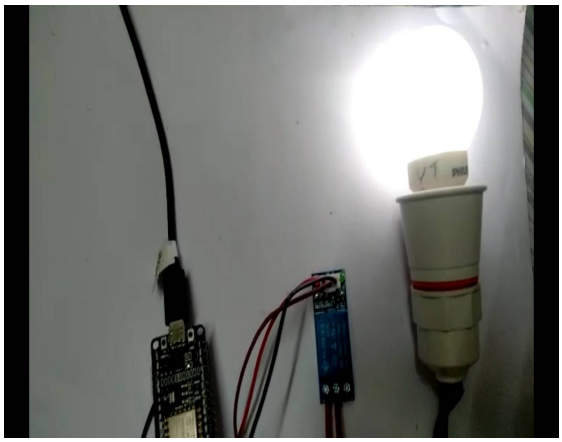


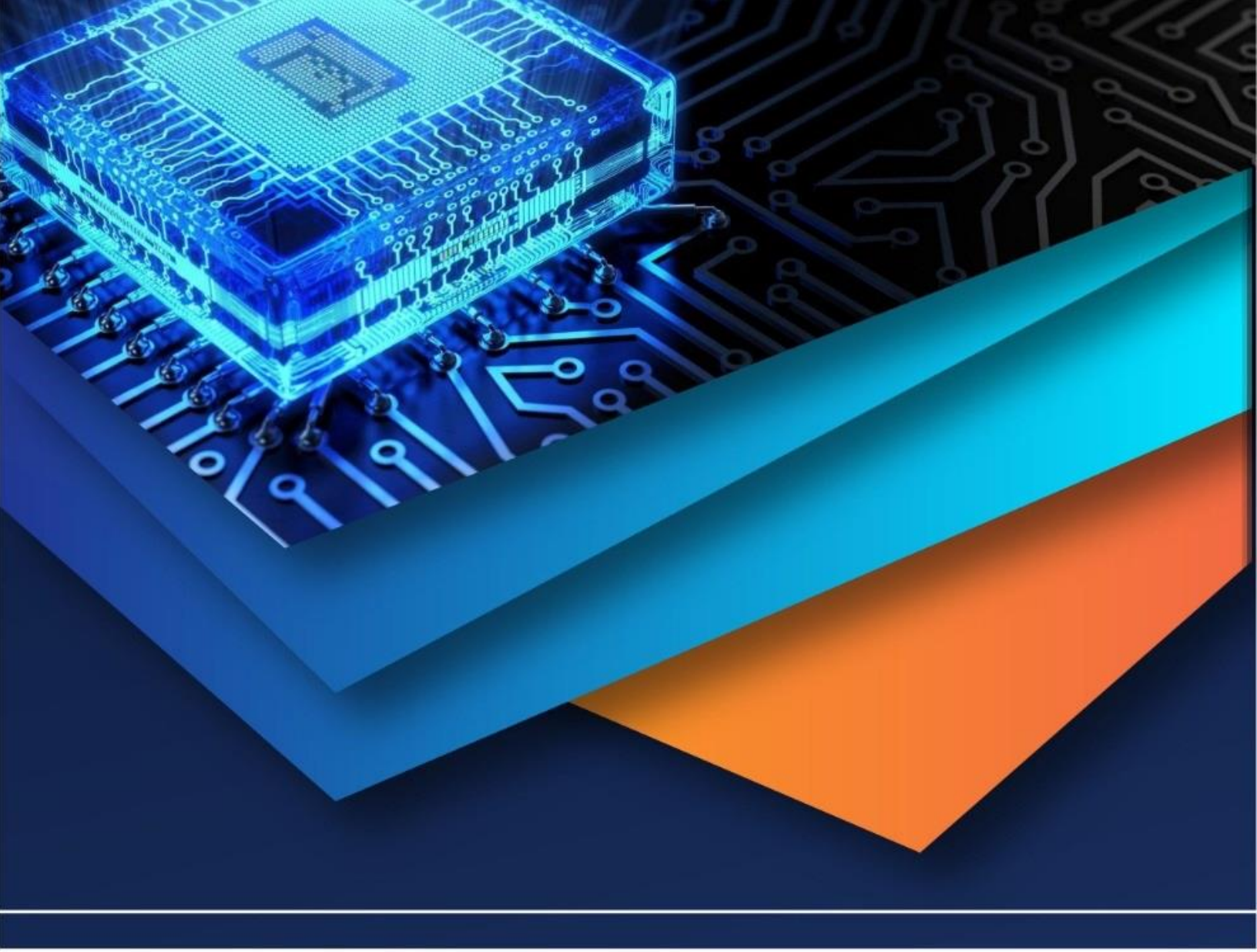
Fig 10. ON State

IX. CONCLUSION AND FUTURESCOPE

We live in an increasingly data-driven world. By implementing Cloud Computing, IoT, and data analytics technology, we can hopefully reduce traffic congestion, better pedestrian safety, tackle crime and save money. Most importantly, the smart city systems don't just reveal what's happening today. They could predict incidents of the future, helping cities have more productive and powerful planning strategies. The intelligent street lighting system described, integrates new technologies, offering ease of maintenance and energy savings. This is obtained by using the highly economic LED technology and by using the intelligent management of the lamp posts. The proposed system is apt for street lighting in both urban and rural areas depending on the vehicle and pedestrian maneuver. Independence of the power network permits to implement it in the areas which are remote where the classical systems are prohibitively expensive. The Smart Street Lighting System is versatile, fully scalable, and adaptive to user needs.

REFERENCES

[1] Mr. Parkash Tambare, Mr. Prabu Venkatachalam – "IoT based Intelligent Street Lighting System for the Smart City", International Journal for Innovative Research in Science, Engineering and Technology, May 2016.
[2] Ms. M. Kokilavani, Dr. Malathi. A – "Smart Street Lighting System using the IoT", International Journal of the Advanced Research in Applied Science and Technology ISSN: 2456-1959 Vol:3, No.11, November 2017.
[3] Ms. Supreetha D, Mr. Vinay Sagar K S, Ms. Sushmitha. S – "A Survey on the IoT based Real-Time, Smart Adaptive Street Lighting System with the Pollution Monitoring for the Smart Cities", International Journal on Recent and Innovation Trends in the Computing and the Communication. ISSN: 2321-8169 Vol:7, No.1, January 2019.
[4] Dr. A. Senthil Kumar, K. Vignesh,M Sakthivel, K. Priya, Princymol Josepp – "A study on IoT based Smart Street Light Systems", International Journal of Engineering Research and Technology, ISSN (Online): 2278-0181 Vol:8, No.7, May 2020
[5] Karthikeyan.M, Saravanan V, Vijayakumar.S, "Cloud-Based Street Light Monitoring System", International Journal of Engineering Research and Technology, ISSN: 2278-0181, Vol:3, Issue:2, February 2018.
[6] Sangameshwar, Akhila Sagi, Hareeeshwar Channapragada, N Preethi, V V Mounika –"Smart Street Light Monitoring using IoT", International Journal of Engineering and Advanced Technology, ISSN: 2249-8958, Vol:9, Issue:4, April 2020.
[7] Li, Z.; Chen, C.; Wang, K. Cloud Computing for Agent-Based Urban Transportation Systems. IEEE Intell. Syst. 2011, 26, 73–79. were Engineering Conference (AUPEC'08).
[8] https://iotdesignpro.com/projects/iot-based-smart-street-light-using-esp8266-and-thingspeak.
[9] Archana. G, Aishwarya. N, Anitha. J -"The Intelligent Street Light System", International Journal of Recent Advances in Engineering & Technology, Vol:3, Issue:4, 2015.
[10] Deepanshu Khandelwal, Bijo M Thomas, Kritika Mehndiratta, Nitin Kumar - "Sensor-Based Automatic Street Lighting System", International Journal of the Education and Science Research Review Volume:2, Issue:2 April-2015.
[11] Sayali Arkade, Akshada Mohite, Shraddha Joshi, "IoT Based Street Lights for Smart City", International Journal for Research in Applied Science and Engineering Technology(IJRASET), Vol.4 Issue:12, December 2016.
[12] Reinhard Mullner, Andreas Riener, "An energy-efficient pedestrian aware Smart Street Lighting System", International Journal of Pervasive Computing and Communications, Vol.7, No.2, February 2011.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY