

Energy Efficient And Intelligent Street Light Using IoT

¹ Ramejun Nisa, ² Pavithra P, ³ Balambika P, ⁴ P. Veeralakshmi

1,2,3 Student, Prince Shri Venkateshwara padmavathy engineering college, Chennai-600127, India

4, Professor, Prince Shri Venkateshwara padmavathy engineering college, Chennai-600127, India

ABSTRACT

Internet of Things (IoT) is a network of objects like vehicles, buildings, devices other items embedded with systems, software, sensors, and network connectivity that allow these objects to collect and exchange data. Smart street lights are a system of intelligent illumination control of street lights to eliminate the problem of power consumption and the illumination of the streets in the late night. So, this system gives the better solution for electrical power wastage. Also, the manual operating and monitoring of the lighting system is eliminated. This system consists of four sensors which are LDR (Light Dependent Resistor) sensor to indicate a day/night time and the Ultrasonic sensors to detect the movement on the street. A temperature sensor measures the temperature of its environment and converts the input data into electronic data to record monitor, or signal temperature changes.

Keywords: Streetlight, IoT, intelligent.

1. INTRODUCTION

Internet of things (IoT) is not a new technology it is around 16 years old. But the idea of connecting devices is much older than IoT itself, it has been around us at least for the past three decades. But this concept was known to people as "embedded internet" or "pervasive computer". The term "Internet of Things" was coined by Kevin Ashton in 1999. The concept of IoT gained popularity around the year 2010 and since then various applications of IoT have been developed for its use in different platforms.

IoT has played a big role in Industrial Automation too. There are various instances where IoT is being applied in industries to make smart predictions based on previous data collected and these IoT devices deployed are capable of making accurate decisions as compared to humans by collecting and communicating real-time data.

In any city "STREET LIGHT" is one of the major power-consuming factors. Most of the time we see street lights are ON even after sunrise thus wasting a lot of energy. Over here we are avoiding the problem by having an automatic system that turns ON & OFF the street lights at a given time or when the ambient light falls below a specific intensity. Each controller has an LDR which is used to detect the ambient light. If the ambient light is below a specific value the lights are turned ON.

In a developing country like India, the difficulty of power consumption is very much headstrong. Streetlight monitoring and control plays a vital role in this power consumption process. The street lights consume more electricity which is incurred by the government. The proposed work consists of LED and wireless sensor network streetlight monitoring and controlling system. The proposed system work in automatic mode, which will make streetlight adjustments according to the intensity of the brightness. When compared with the conventional streetlights which will be ON for the entire night time but whereas the proposed system will save a lot more of electricity.

When there is sufficient light, the project supplies the lower voltage to the lights and as the darkness increases with the sunset, the voltage supplied to the lights is gradually increased to full. We need to save or conserve energy because most of the energy sources we depend on, like coal and natural gas can't be replaced. Once we use them up, they're gone forever. Saving power is very important, instead of using the power at unnecessary times, it should be switched off.

2. RELATED WORK

The paper explained about the system where street light changes to ON state in the evening before the sun goes down and they are switched off in the morning after sun rises or when there is enough light on the street. In this system, the movement of the vehicle and also humans are detected according to which the streetlight is turned on and switches off when no vehicle or humans are detected.

[1]

In this paper, they have explained how it provides an efficient and smart automatic street light control system using the LDR. It reduces energy consumption and maintains the cost. This system can be applied in urban and rural areas. The main focus of this system is to reduce the maintenance cost and to increase the lifespan of the system. Initial cost and maintenance are some disadvantages of this system. [2]

This paper explains the smart city where the available solutions for the urban IoT implementation were mentioned. The Internet of things technology aspects towards energy-efficient systems design is also mentioned. This system is about to save energy and minimize power wastage. Using this method, the energy can be used more efficiently in a smart street lighting system. The paper mainly focuses on IoT and its cloud convergences. [3]

In this paper, they have describes the development of the monitoring part as pretty much basic & simple but able to satisfy the general need for this system. This project is easy, reliable, cost-effective, and significant in daily life. This monitoring system has made the entire system IoT based system because every type of hardware, sensors, software, and cloud has been combined here to make an effective smart system.[4]

This paper, explains the use of IoT as the wireless communication medium and control of the system. This system gives the solution to the energy conservation problem the LED lighting can be expected to replace the HID lamps to a greater extent. The system is equipped with an indicator function that will indicate the damaged condition of the streetlights through a wireless network medium. [5]

This paper explains the new model that has been proposed to manage the streetlights with the help of IoT, Machine Learning, Image processing, and cloud for the power consumption in streetlights. In this paper, the proposed model uses IoT to manage the streetlights and also uses the traffic density parameters to power on the lamps of streetlights. The smart street lighting system is very flexible and it also consists of various sensors and controllers which make as an intelligent and smart street lighting system.[6]

This paper describes the proposed as an autonomous street lighting system, where it uses solar energy as the primary source, batteries as a secondary source, and LED's as a lighting source. This system shows an effective and reliable solution for remote localities, as for roads and streets. This system shows high efficiency where all the power stages are DC-DC. This type of conversion makes it easy implementation and control.[7]

3. PROBLEM DESCRIPTION

The proposed model of "Energy-efficient automatic streetlight". It is based on the interface of several sensors, resistors, solar panels, etc. with an Arduino microcontroller.

i. Arduino Uno:

The Arduino Software (IDE) is open source software and it makes it easy to code and uploads to the board. It runs on different platforms like Windows, MAC OS, and Linux. The environment is written in Java and before running the IDE Java software to be installed on the machine this software can be used with any Arduino board.

ii. LDR (Light Dependent Resistor):

A Light Dependent Resistor (LDR) or a photoresistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light-sensitive devices. They are also called photoconductors, photoconductive cells, or simply photocells. They are made up of semiconductor materials having high resistance. A light-dependent resistor works on the principle of photoconductivity which is an optical phenomenon in which the conductivity of the material i.e., resistivity reduces when light is absorbed by the material.

iii. PIR (Passive Infrared Sensor):

A passive infrared sensor is an electronic sensor that measures infrared light radiating from objects. They are most often used in PIR-based motion detectors. PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use, and don't wear out.

iv. Humidity Sensor:

A humidity sensor senses and measures both moisture and air temperature. The system also includes a DHT11 Temperature-Humidity sensor that provides exact information on the temperature and humidity of the region.

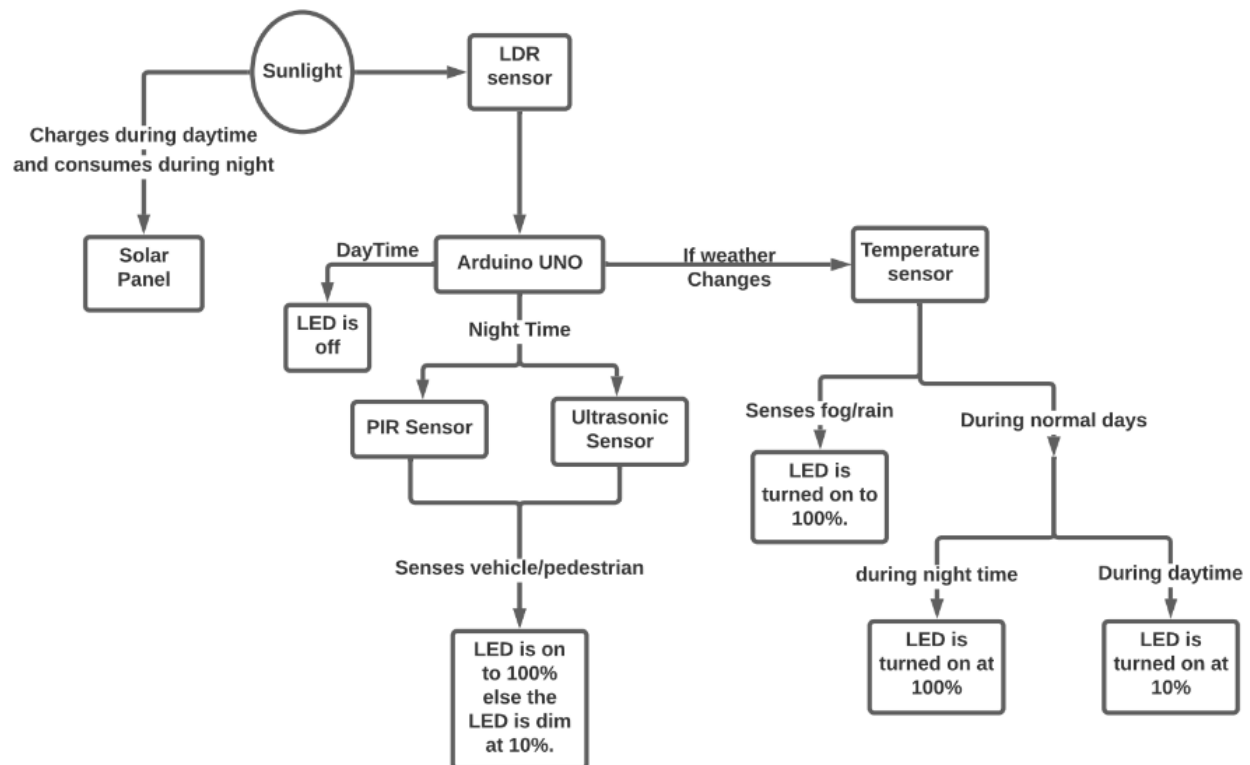


Fig. 1 Architecture of the system

Fig.1 shows the overview of the automatic street light. There are several sensors used, When the sunlight falls on LDR, it senses the intensity of the light outside and the LED light is OFF. But when the LDR does not sense the light from outside then it sends the input to the Arduino UNO microcontroller and through the resistor and relays the LED is turned ON. A solar panel is used here to convert the light energy to electrical energy that is during the daytime it conserves the energy and night time it consumes the energy with the help of a battery. This all process is done with the Wi-Fi module, where it is used for the communication between the base station and the IoT module. The ultrasonic sensor is used for the detection of the vehicle coming in distance. A temperature sensor measures the temperature of its environment and converts the input data into electronic data to record monitor, or signal temperature changes.

4. WORKFLOW OF THE SYSTEM

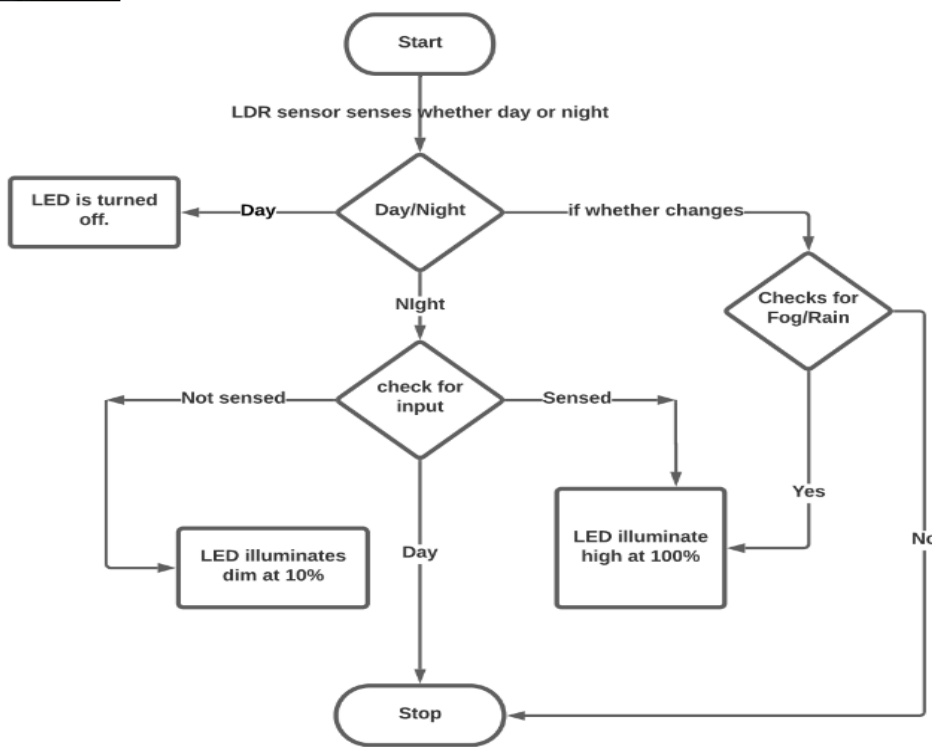


Fig. 2 Workflow of the system

Fig 2 Explains how the system works, The external brightness of the environment is sensed by the LDR and it is given to the Arduino as input and the LED's brightness is adjusted correspondingly as the output. When light falls on the light-dependent resistor, then its resistance will be decreased, the intensity of the light will be less. But when there is no light falling on the LDR then its resistance will be increased and LED will be illuminated to full. In addition to that, a PIR sensor is used for human detection. When a person is detected at a distance of 10 Meters then it sends a signal to the microcontroller and LED's are illuminated. An ultrasonic sensor is used for vehicle detection that is when a vehicle coming at a distance of 11 Meters, sends data to the Arduino controller, and LED's are turned ON. Humidity sensor for the detection of the amount of humidity present in the atmosphere. Solar panels are used here which are connected with the rechargeable battery. During the daytime the solar panels absorb the sunlight and convert them into electrical energy and conserve them in the daytime and night time it consumes the energy stored. And the outputs of these sensors will turn on or off the LED light accordingly.

5. IMPLEMENTATION AND RESULT

After implementation of the following results is obtained. By using our methodology, a huge amount of power about 30-40% can be saved. The energy efficiency has been improved than the conventional Street Light System where the Street lights will be in ON condition throughout the night. Each device is connected to another device in the desired manner so that it helps in understanding whole connections in an easy, simple, and flexible way.

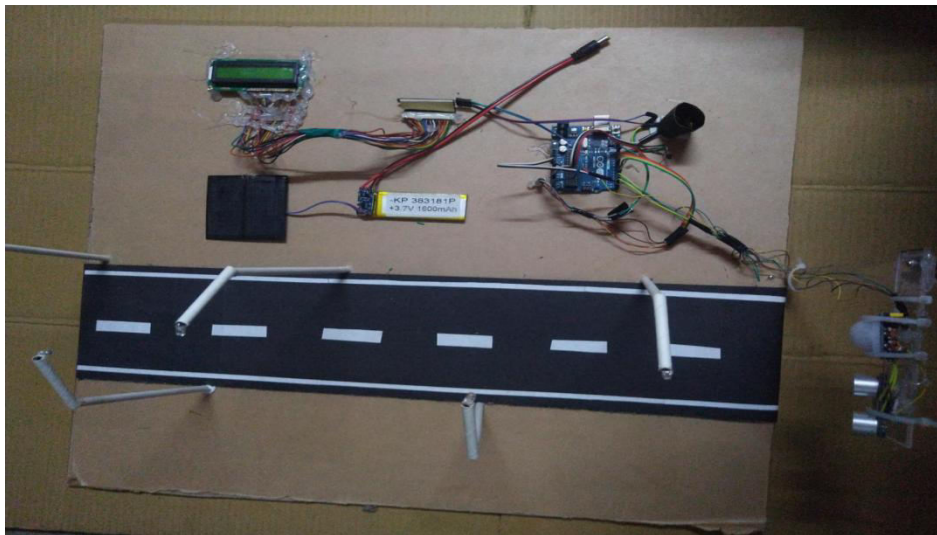


Fig. 3 overview of our system



Fig. 4 Night mode ON



Fig.5 Night mode OFF

Fig. 4 and Fig. 5 explains the result obtained from our proposed smart system. Which shows the status of the LED and power saving. By using this method the energy can be used more efficiently in the smart street lighting system.

6. CONCLUSION

This paper introduces an IoT-based system for Energy Efficient and Intelligent Street Light. By the usage of several sensors like PIR, LDR, humidity sensors, etc., and IoT as the wireless communication medium this system will make the existing streetlight system highly energy-efficient and intelligent. The scope of the automatic streetlight system in the present scenario is uplifted by this system. In a world where the usage of the limited energy resources is being overexploited which in turn leads to the extinction of the same, this system will be of great use, unlike the existing systems.

REFERENCES

- [1]. M. Caroline Viola Stella Mary, T. Anto Theepak, G. Prince Devaraj, D. Joseph Pushparaj, J. Monica Esther, "Intelligent Energy Street Light Controlling System based on IoT for Smart City" IEEE International Conference on Smart Systems and Inventive Technology, 2018.
- [2]. Fathima Dheena P.P1, Greema S Raj, Gopika Dutt, Vinila Jinny S, "IOT Based Smart Street Light Management System", Proceedings of 2017 IEEE International Conference Circuits and Systems.
- [3]. Ravikishore Kodali, Subbachary Yerroju, "Energy-efficient Smart Street Light", IEEE on International Conference on Applied and Theoretical Computing and Communication Technology 2019.
- [4]. Mohd. Saifuzzaman, Nazmun Nessa Moon, Fernaz Narin Nur, "IoT Based Street Lighting And Traffic Management System", IEEE Region 10 Humanitarian Technology Conference 2017.
- [5]. M.Sahithi Prasanthi, Y Meher Teja, TSK Perraju, M.S.Lalitha Ramya, M Abhiram, Dr. Y Srinivasa, M Subrahmanya Sarma, "IOT Based Streetlight Management" IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology, 2018.
- [6]. Anjali V, Nithin Raj R, Nakul Nair, Rahul T M, "IoT Based Energy Efficient Automatic Streetlight", IEEE Conference on International Conference on Intelligent Computing and Control Systems 2018.
- [7]. Shahzad, G., Yang, H., Ahmad, A.W. & Lee, C. (2016). "EnergyEfficient Intelligent Street Lighting System Using Traffic-Adaptive Control", IEEE Sensors Journal, 16 (13), 5397 – 5405.
- [8]. Kelly, S.D.T., Suryadevara, N.K., and Mukhopadhyay, S.C. (2013). "Towards the Implementation of IoT for Environmental Condition Monitoring in Homes", IEEE SENSORS JOURNAL, 13(10), 3846 – 3853.
- [9]. Costa, M.A.D., Costa, G.H., Santos, A.S., Schuch, L. & Pinheiro, J.R. (2009). "A high-efficiency autonomous street lighting system based on solar energy and LED's", IEEE Xplore, Power Electronics Conference. COBEP '09.