JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

# A SOLUTION FOR ENERGY EFFICIENT CONSUMPTION IN IOT BASED SMART STREET LIGHT SYSTEM

**[1]Gangappa Demannavar, [2]Venugopal D, [3]Deeksha R Gowda, [4] Tarun V, [5]Sneha S**

[1]Asst Prof, Dept of CSE, [2]Student, [3]Student, [4]Student, [5]Student
[1]Computer Science & Engineering,
[1]City Engineering College, Bangalore, India

***Abstract :*** This paper proposes a novel approach to enhance street lighting systems by integrating motion detection and accident detection sensors. It is seen in a number of cities that the street light is one of the huge expenses in a city. The cost spent is huge that all the sodium vapor lamps consume more power. The expense spent on the street light can be used for other development of the nation. Currently a manual system is used where the light will be made to switched ON/OFF i.e, the light will be made to switch ON in the evening and switched OFF in the morning. Hence there is a lot of wastage of energy between the ON/OFF. This is one of the major causes of shifting to the automatic system, since there is less wastage of power and thus saving a lot of monetary expenses. Additionally, accident detection sensors are incorporated to identify potential accidents and promptly notify relevant authorities. Furthermore, all collected information is efficiently transmitted to designated receivers via email, enabling timely response and intervention. Through simulations and real-world experiments, we demonstrate the effectiveness and efficiency of our proposed system in improving safety, energy conservation, and urban management in smart cities.

## I. INTRODUCTION

Street lighting is a core infrastructure piece in urban and semi-urban cities. It provides a number of advantages such as improving safety for drivers and pedestrians. Nowadays, street lighting accounts for about 13–14% of the world's electricity annual production and the market is continuously growing. It is expected that by 2027, there will be about 363 million street lights around the world. Consequently, enormous energy is consumed by the street lights which makes it imperative to work on solutions to reduce street light consumption. IOT is the interface of physical devices which permits the devices to contact with each other and make the devices sensed and controlled remotely. These advanced automation and analytics system use artificial intelligence technology to give automated and advanced products and services. IOT based systems permit better transparency, control, and great performance. IOT has different automation applications like smart parking, smart home, smart roads, smart lighting and so on. Streetlamps are the crucial requirement in present time of transportation for safety purposes and keeping away accidents during night. Despite that in the present occupied life nobody tries to turn it off/on when not needed. This project gives solution to this by reducing manpower and conserving the energy. The current manual streetlamp system has a few problems like timing problem, maintenance issues and connectivity issues. These problems can be eliminated by IOT technology. This system depends on smart and automated street lighting and management. Automation simplifies different issues on the planet economy just as in daily life. A smart street lighting has three layers - sensor layer, communication layer and management layer. All these layers work together and provide a solution for energy efficient consumption in IOT based smart streetlight system. The sensor layer is integrated with the light nodes, interacts with the physical environment and is triggered by external factors like motion of an object. The data collected from various sensors within the system talk to the gateways using different communication protocol and the gateway forward the data to the central management system for further processing. The management layer then analyzes the data, takes decisions and ensure efficient management of the street light system. The point of this paper is to automate the streetlamps to increase the productivity and precision of the system in a practical way and also allows wireless accessibility and control over the system.

## II. LITERATURE REVIEW

Amjad Omar, Sara AlMaeeni, Hussain Attia, Maen Takruri

They can adjust lighting levels based on real-time conditions, saving energy and reducing costs. Additionally, these systems can monitor and report maintenance issues automatically, ensuring timely repairs. Moreover, they enhance public safety by integrating with other smart city devices to provide features like video surveillance and emergency alerts.

The energy-efficient smart street lighting system in Nagpur Smart City leverages IoT to optimize energy consumption. This system reduces electricity costs by dimming or turning off lights when not needed. It also enables remote monitoring and control of street lights, leading to faster fault detection and maintenance. Additionally, the smart lighting contributes to a safer environment by integrating with other smart city technologies for enhanced security and surveillance.

Didar Tukymbekov, Ahmet Saymbetov

The intelligent energy-efficient street lighting system with predictive energy consumption uses advanced analytics to forecast energy needs. This predictive capability allows the system to adjust lighting levels proactively, optimizing energy use. By doing so, it significantly reduces energy costs and carbon emissions. Additionally, the system's smart features enable remote monitoring and proactive maintenance, ensuring efficient operation and longer lifespan of the lighting infrastructure

## III. PROPOSED SYSTEM

A smart street light system incorporating motion detection and an accident alert system operates on a dual-principle mechanism. Firstly, it utilizes motion sensors strategically placed along the street to detect the presence of pedestrians, vehicles, or any motion within its vicinity. Upon detecting motion, the system triggers the street lights to illuminate the area, providing adequate lighting for safe passage. Conversely, when no motion is detected for a certain period, the system automatically dims or turns off the lights to conserve energy. Additionally, the system integrates an accident alert mechanism, wherein sensors embedded in the street can detect sudden impacts or unusual patterns indicative of accidents or collisions. Upon detection, the system promptly notifies relevant authorities or emergency services, enabling swift response and assistance. This seamless integration of motion detection, lighting control, and accident alerting enhances both safety and energy efficiency, making streets safer and more responsive to the needs of pedestrians and motorists alike.

**Node MCU ESP8266**

The NodeMCU is a development board based on the ESP8266 WiFi module. It combines a microcontroller with built-in WiFi capability. Using the Lua-based firmware or Arduino IDE, you can program the NodeMCU to connect to WiFi networks, read sensor data, control outputs, and communicate with other devices via the internet. It's widely used for IoT projects due to its ease of use and connectivity features.

**L293D**

The L293D motor driver controls DC motors by switching their direction and speed. It has inputs to control the motor direction and enable pins to turn motors on/off. When a motor is enabled and direction is set, the L293D provides power to the motor through its output pins. It also includes protection diodes to handle back EMF from the motor, ensuring safe operation. Interfacing with a microcontroller allows for precise control of the motors using PWM signals.

**Chassis**

A chassis with motor set typically consists of a frame or body where motors are mounted. Motors drive wheels or tracks attached to the chassis. When powered, the motors rotate, propelling the chassis forward or backward based on the direction of motor rotation. By controlling the speed and direction of the motors, you can maneuver the chassis to move in various directions. This setup forms the basis for robotic vehicles, allowing them to navigate and perform tasks autonomously or via remote control.

**IR Sensors**

IR sensors emit infrared light and detect its reflection or emission from objects. When an object is within range, the sensor receives the reflected/emitted infrared light and converts it into an electrical signal. The strength of this signal changes based on the distance or presence of the object, allowing the sensor to detect objects, proximity, or motion.


**NEO-6MGPS**

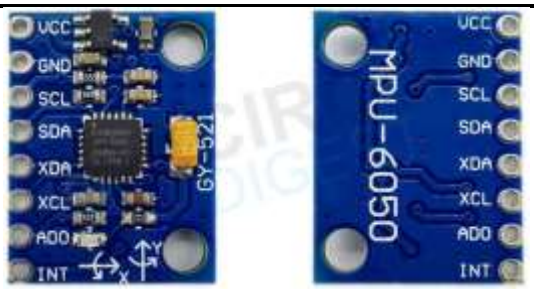
The NEO-6M GPS module receives signals from GPS satellites to determine its location, time, and speed. It has an onboard antenna and receiver that captures satellite signals. After processing these signals, the module calculates its geographical coordinates and other data. This information can be accessed and read through a microcontroller or computer, allowing for precise location tracking and navigation in various applications.

**ARDUINO SOFTWARE (IDE)**

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

**MPU6050**

The MPU6050 is an accelerometer and gyroscope module that measures motion and orientation. It contains MEMS (Micro Electro Mechanical Systems) sensors that detect changes in acceleration and rotation. The accelerometer measures linear acceleration, while the gyroscope measures angular velocity. By combining data from both sensors, the MPU6050 can determine its orientation in space and detect motion in multiple axes. This data is typically accessed and processed by a microcontroller for applications like motion tracking, gesture recognition, and balancing robots.




**Burg Wires**

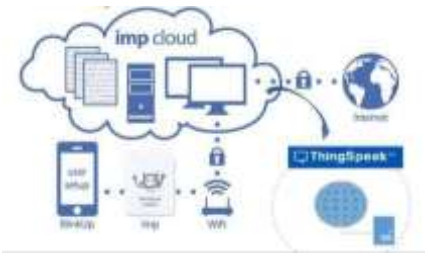
Burg wires, including F2F (Fiber to Fiber) and M2F (Metal to Fiber), are types of optical connectors used to join optical fibers. F2F (Fiber to Fiber): In this type, two optical fibers are aligned and connected directly, allowing light to pass from one fiber to the other with minimal loss. It's often used for splicing fibers together in optical networks.M2F (Metal to Fiber): M2F connectors interface between a metal ferrule (connector end) and an optical fiber. The metal ferrule ensures precise alignment of the fiber with the connector, improving connection accuracy and reducing signal loss.

**LED**

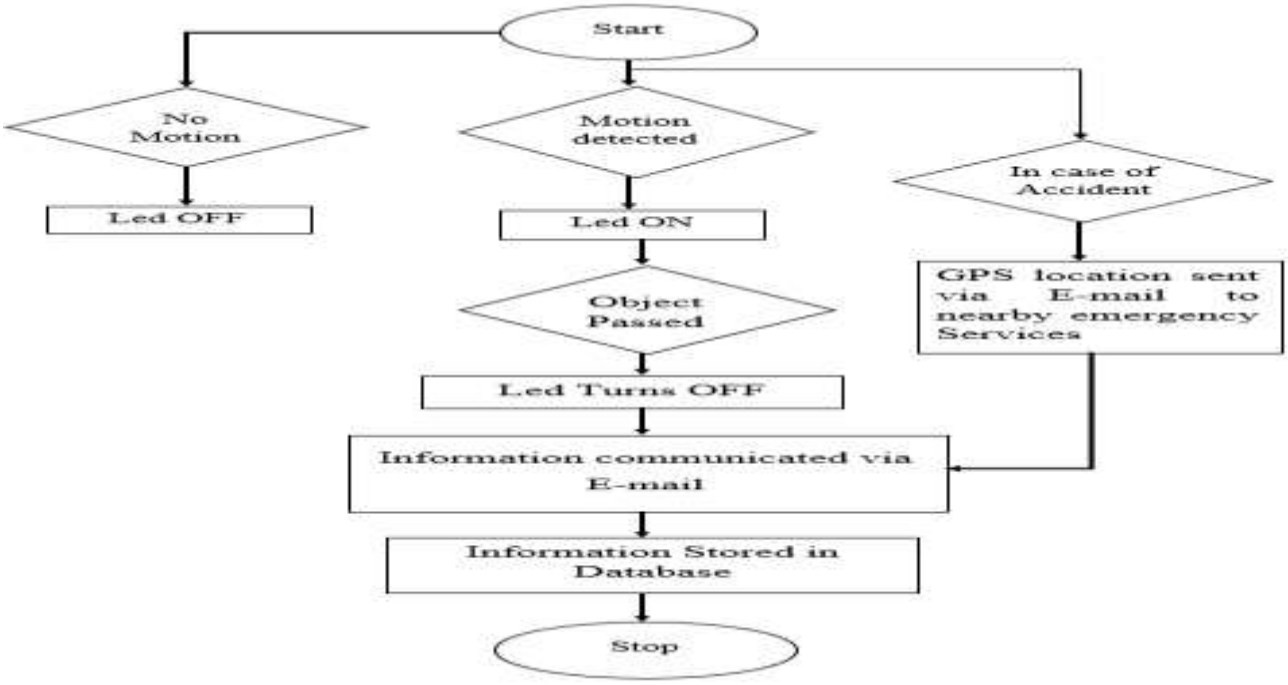
LED stands for Light Emitting Diode. It's a semiconductor device that emits light when an electric current passes through it. LEDs are widely used in various applications such as indicator lights, display screens, automotive lighting, and general lighting due to their energy efficiency, longevity, and compact size.

**IOT PLATFORM- Things Speak**

According to its developers, "Thing Speak is an open source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. Thing Speak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates.

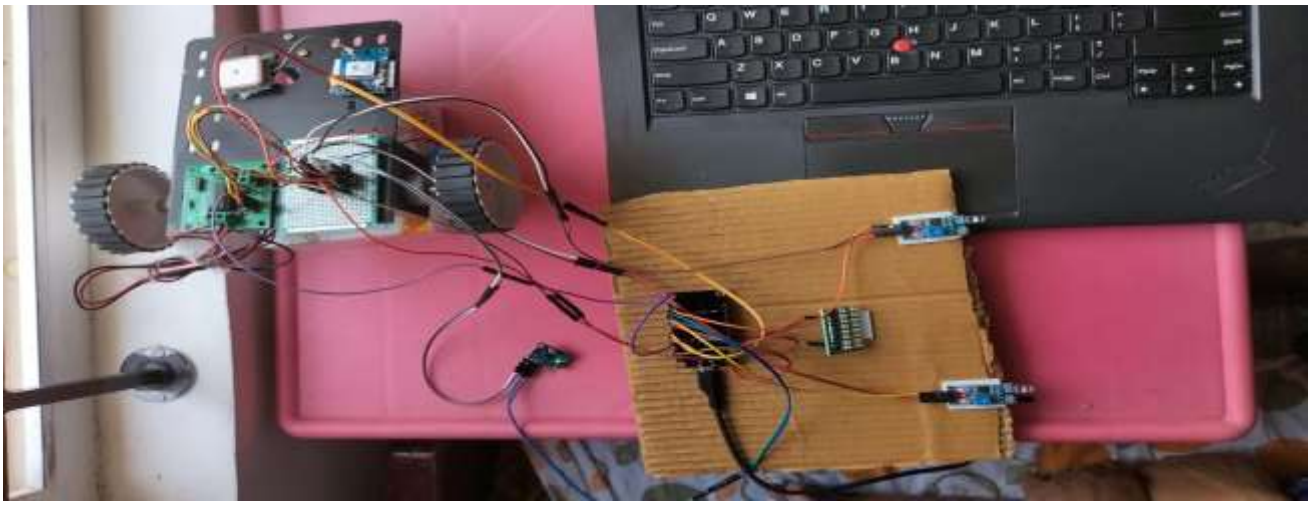


## IV. WORKING FLOW

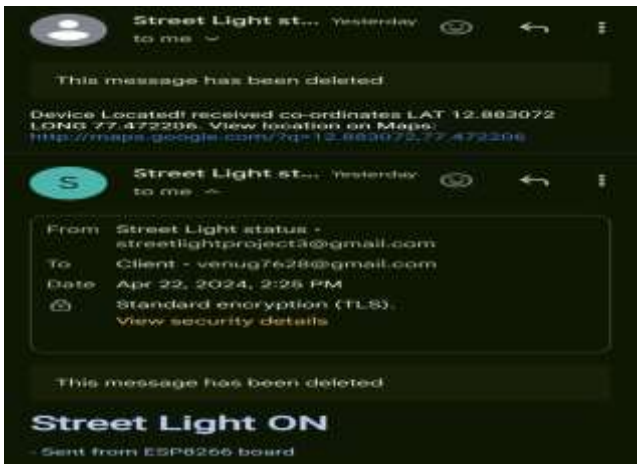



**Working Flow of Smart Street Light System**

## V. RESULT



**Working of Smart Street Light System**




**Mail when Object Detected**


**Mail when Object Passed**

## VI. CONCLUSION

The need of the system is to reduce energy consumption, decrease the maintenance cost and to expand the lifespan of the system. By allowing this method the energy can be used more efficiently in smart street lightning system. This smart and relatively low cost IoT system can also reduce the CO2 emissions and help to protect the environment. IR sensor is used for controlling street lamps so it reduced the cost of the system. For any emergency condition we can manually operate each of the street lights through web interface, which make the system more reliable. It can decrease the energy utilization and maintenance cost. It be applied in urban as well as rural areas. The can system is expandable and absolutely adaptable to the requirements of the user. It establishes a safe environment with maximum intensity light at whatever point required. This system can report street lamp failure, which make the maintenance of street lamp simpler and less formidable. The existing bulbs or lights are also may be linked to this low-cost street light management system. The lights will make good use of the Internet of Things (IoT) connectivity to not only prevent the power wastage but also for better management and fault detection.

## REFERENCES

**[1]** K. A. Kabir, P. L. Sikdar, and P. K. G. Thakurta, "Energy effi-cient street lighting: a GIS approach," in Proceedings of the 6th International Conference on Advance Computing and Intelligent Engineering, pp. 583–593, Springer, Singapore,2023.

**[2**] J.Arthi, W.Lydiapreethi, and B. Gunasundari,"IOT Based Smart LED Street Lighting System" IJRTI | Volume 2, Issue 4 | ISSN: 2456 3315. SayaliArkade, Akshada Mohite, Rutuj, Vikas, "IoT Based Street Lights For Smart City" International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 4 Issue XII, December 2016.

**[3]** G. Zissis, P. Dupuis, L. Canale, and N. Pigenet, "Smart light-ing systems for smart cities," in Holistic Approach for Decision Making Towards Designing Smart Cities. Future City,G. C. Lazaroiu, M. Roscia, and V. S. Dancu, Eds., vol. 18, pp. 75–92, Springer, Cham, 2021.

**[4]** A. K. Tripathy, A. K. Mishra and T. K. Das, "Smart lighting: Intelligent and weather adaptive lighting in street lights using IOT," 2017 International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT), Kerala, India, 2017, pp. 1236-1239, doi: 10.1109/ICICICT1.2017.8342746.

**[5]** N. Ouerhani, N. Pazos, M. Aeberli and M. Muller, "IoT-based dynamic street light control for smart cities use cases," 2016 International Symposium on Networks, Computers and Communications (ISNCC), Yasmine Hammamet, Tunisia, 2016, pp. 1-5, doi: 10.1109/ISNCC.2016.7746112.

**[6]** K. H. Bachanek, B. Tundys, T. Wiśniewski, E. Puzio, and A. Marouškovᡠ, "Intelligent street lighting in a smart city concepts—a direction to energy saving in cities: an over-view and case study," Energies, vol. 14, no. 11, p. 3018, 2021.

**[7]** Z. Chen, C. B. Sivaparthipan, and B. A. Muthu, "IoT based smart and intelligent smart city energy optimization," Sustainable Energy Technologies and Assessments, vol. 49, article 101724, 2022.

**[8]** Rana Manjumdar, Abhishek Srivastava, Ved P Mishra, Devesh Tulsian, "IoT based Street Light Controlling Mechanism", International Conference on Computational Intelligence and Knowledge Economy(ICCIKE), December 11-12, 2019.