WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

A Study on IoT based Smart Street Light Systems

Mrs. Chhaya Sharma[1], Abhishek Kaushik[2], Akash Kumar[3], Vasu Pal[4], Shakti Singh Pundir[5]

[1]Associate Professor, Department of Computer Science and Engineering, Raj Kumar Goel Institute of technology, Ghaziabad India
[2,3,4,5]B. Tech (CSE) Students, Department of Computer Science and Engineering, Raj Kumar Goel Institute of technology, Ghaziabad India

ABSTRACT

The Street Light Monitoring System project presents an innovative solution for efficient management and optimization of street lighting infrastructure. Leveraging the power of IoT (Internet of Things) technology, this system offers real-time monitoring and control capabilities, enabling proactive maintenance and energy savings. By integrating intelligent sensors, data analytics, and network connectivity, the project aims to enhance public safety, reduce energy consumption, and improve the overall quality of urban environments. The Street Light Monitoring System employs intelligent sensors installed on street lights to collect data on their operational status, including power usage, light intensity, and fault detection. This data is transmitted wirelessly to a centralized control system, enabling real-time monitoring and analysis. By promptly identifying faulty lights, maintenance teams can quickly address issues, minimizing downtime and ensuring well-lit streets for residents and pedestrians. The Street Light Monitoring System demonstrates the potential for smart city technologies to revolutionize urban infrastructure management.

Keywords: IR sensor, GSM, Light Dependant Resistor [LDR], Arduino

INTRODUCTION

A well-designed, street lighting system should permit users to travel at night with good visibility, in safety and comfort, while reducing many malfunctions occurs during night and enhancing the appearance of the neighbourhood. Conversely, poorly designed lighting systems can lead to poor visibility which may not be helpful for any pedestrian and who are passing by that street. To address these challenges, the Street Light Monitoring System (SLMS) project proposes a cutting-edge solution that harnesses the power of advanced technologies to revolutionize the way street lighting is managed. By integrating state-of-the-art sensors, communication networks, and data analytics, the SLMS aims to create a smart and interconnected lighting infrastructure that offers numerous benefits for both city authorities and citizens. The primary objective of the SLMS is to provide real-time monitoring and control of street lights, enabling efficient energy consumption, proactive maintenance, and improved public safety. The system utilizes a network of intelligent sensors installed on each street light, capable of collecting valuable data such as light intensity, power consumption, and operational status. This data is then transmitted wirelessly to a centralized control centre, where it is analysed and used to make informed decisions regarding lighting operations and maintenance activities. The application is designed in such a way that we place light sensors in all the street lights circuit and which are responsible to switch on and off automatically. Once the lights are switched on, current sensors placed at every light pole are responsible to report problem status to the centralized system with the help of GSM module attached with the circuit. With the status available in the centralized system, the workman now can easily locate the light to be taken care which minimizes the time to search it and repair. The system also collects useful information from each street light at the end of each day. The information is stored in the database and based on this information charts are derived.

LITERATURE SERVEY

Automatic Street Light [1] This research paper proposes a smart street lighting control system based on wireless sensor networks (WSNs). The authors present a detailed architecture that incorporates sensor nodes, communication protocols, and data analysis algorithms to monitor and control street lights. The study demonstrates the effectiveness of the proposed system in terms of energy efficiency, cost reduction, and enhanced lighting performance.
Street Light Automated System [2] This study focuses on developing an intelligent street lighting system using light-emitting diodes (LEDs) and wireless communication technologies. The authors propose an energy-saving algorithm that adjusts lighting levels based on ambient light conditions and traffic patterns. The research highlights the significant energy savings achieved by the system and its potential for reducing carbon emissions.
This paper presents a real-time street light monitoring and control system designed for smart cities. [3] The authors propose a framework that integrates IoT (Internet of Things) devices, cloud computing, and data analytics to monitor street lights' operational status and energy consumption. The study demonstrates the system's ability to optimize lighting operations, reduce energy waste, and enhance maintenance practices.
[4] This research paper introduces a wireless sensor network (WSN)-based intelligent street lighting system for smart cities. The authors present a hierarchical architecture that incorporates sensor nodes, gateways, and a central control system. The study focuses on optimizing energy consumption, reducing maintenance costs, and enhancing the reliability of street lighting infrastructure.

[5] This study proposes a smart street lighting control and monitoring system that utilizes IoT and cloud computing technologies. The authors present a comprehensive architecture that enables real-time monitoring, automated fault detection, and dynamic control of street lights. The research emphasizes the system's ability to optimize power management, reduce energy consumption, and enhance overall operational efficiency**.**

Hardware Modules

Arduino

Arduino is an open-source electronics platform that consists of both hardware and software components. It provides a simple and accessible way for individuals, hobbyists, Arduino Boards are programmed using the Arduino Integrated Development Environment (IDE), a software tool that simplifies the process of writing, compiling, and uploading code to the microcontroller. The Arduino IDE uses a simplified version of the C and C++ programming languages, making it accessible to beginners while still providing flexibility for advanced users. Arduino provides a user-friendly and flexible platform that empowers individuals to bring their creative ideas to life and experiment with electronics and programming in an accessible way.

Figure 1: Arduino Uno

LED

LED lights, or light-emitting diode lights, are a type of lighting technology that use light-emitting diodes to produce light. LEDs are semiconductor devices that emit light when an electric current passes through them. LED lights have gained popularity in recent years.

Figure 2: LED

IR Sensor

IR sensors typically consist of an IR emitter and an IR receiver. The emitter emits infrared radiation, while the receiver detects the reflected or emitted infrared radiation. When an object or a person comes within the detection range of the IR sensor, it detects the infrared radiation reflecting off or emitted by the object, and triggers a response or action based on that detection.

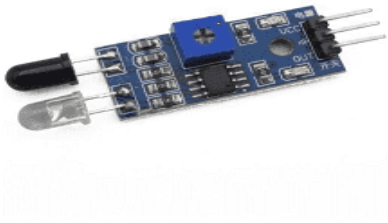


Fig 3.4 IR Sensor

Resistor

In the context of IoT (Internet of Things), registers typically refer to data storage elements within IoT devices or microcontrollers. These registers are used to store and manage data, control settings, and facilitate communication between different components of an IoT system. Here are a few types of registers commonly used in IoT.

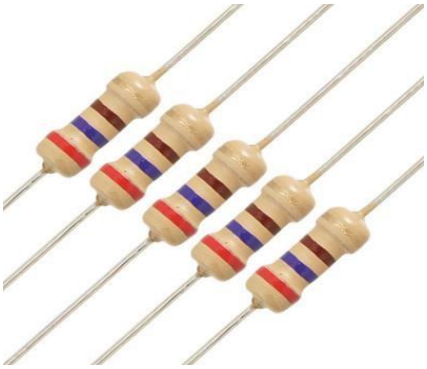
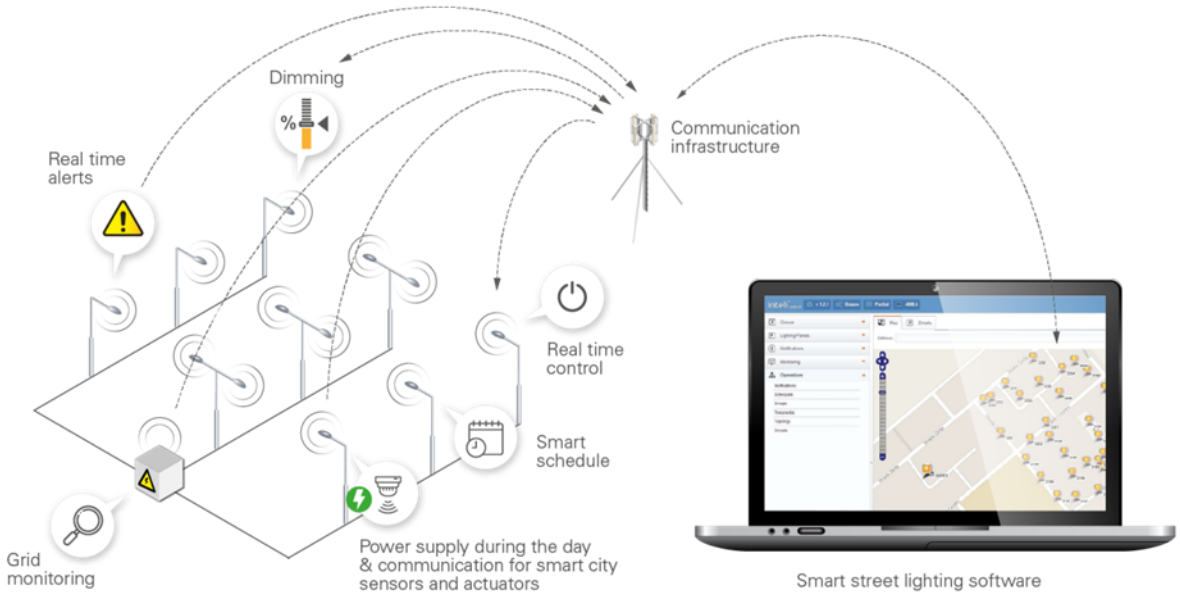


Fig 3.5 Resistor

Architecture of Streer Light Monitoring System using IOT

The idea of street lighting control appeared long ago, from the struggle of managing large numbers of lamps. A solution was needed so that the lamps could be clustered in smaller numbers and handled more efficiently in terms of powering on and off, power outages, maintenance etc. Thus, lighting panel control and monitoring units (power cabinets, feeder pillars) were invented and used to restructure public lighting. This allowed for each light segment to be manually powered on. Later, controllers were installed on these lighting control units. They took the place of human intervention, functioning as an automation for switching the light on and off**.**



Since then, street lighting needed to become more effective, less energy consuming, and less polluting. So, control systems have evolved to become ‘smart’ by allowing lamp control and data collection. This was made possible by allowing segment-level and lamp level control via cabinet or luminaire controllers respectively. Smart LED streetlight system is one of the enabling technologies for a smart city, giving low-cost, low power outdoor lighting also with benefits for vehicle users as well as pedestrians**.**

The system starts with the installation of smart street lights equipped with sensors and control mechanisms. These lights can be energy-efficient LEDs or other intelligent lighting fixtures capable of adjusting their brightness levels.

Sensors are deployed within each street light to collect relevant data. These sensors may include light intensity sensors, motion sensors, power consumption sensors, and environmental sensors.
The street light monitoring system can be integrated with other smart city applications and systems, such as traffic
management, parking systems, or emergency response systems, to create a cohesive and interconnected urban infrastructure.
It is important to note that the specific architecture of a street light monitoring system can vary depending on the implementation, scalability requirements, and available technologies. The components provide a generalized overview of the key elements involved in a typical street light monitoring system.

Implementation

The implementation of a street light monitoring system involves several steps and considerations. Here is a general outline of the implementation process:
1. Sensor Selection and Installation:
Select appropriate sensors based on the desired data collection parameters (e.g., light intensity, power consumption). Install the sensors in each street light, ensuring proper placement and connectivity.
2. Communication Network Setup:
Establish a communication network to connect the street lights and facilitate data transmission. Choose the appropriate network technology (e.g., wired, or wireless) based on the coverage area, available infrastructure, and data transfer requirements. Set up necessary network components like gateways, routers, or access points.
3. Central Monitoring System Setup:
Set up the central monitoring system, which can be cloud-based or on-premises. Install the required hardware and software components to receive, store, analyse, and manage data from the street lights. Configure the system to handle real-time data streaming and processing.
4. Control and Management Functionality:
Develop or configure the control and management features of the system. This includes the ability to remotely monitor the operational status of street lights, adjust lighting parameters, set schedules, and receive notifications or alerts for faults authentication and access control mechanisms for system administrators.
5. Integration with Existing Systems:
Integrate the street light monitoring system with other relevant smart city applications or systems, if required. This may involve integrating with traffic management systems, emergency response systems, or other urban infrastructure.
6. Testing, Deployment, and Maintenance:
Thoroughly test the street light monitoring system before deployment to ensure proper functionality and performance. Deploy the system in the target area, ensuring proper connectivity and synchronization. Establish a maintenance plan to monitor the system's performance, conduct regular updates, and address any issues that may arise.

Conclusion

In conclusion, the Street Light Monitoring System project has proven to be a highly effective and innovative solution for managing and optimizing street lighting infrastructure. By leveraging advanced technologies such as IoT (Internet of Things) and data analytics, this system has provided numerous benefits to both the local government and the community. Through the implementation of intelligent sensors and network connectivity, the Street Light Monitoring System ensures that street lights operate efficiently and reliably. Real-time monitoring capabilities allow for proactive maintenance, reducing downtime and minimizing energy wastage. Moreover, the system provides accurate and timely information on faulty lights, enabling swift repairs and ensuring well-lit and safe streets for residents and pedestrians. The data collected by the monitoring system offers valuable insights into energy consumption patterns, allowing for better planning and resource allocation. By optimizing the operation of street lights based on usage data, significant energy savings can be achieved, contributing to environmental sustainability and cost reduction for the municipality. Furthermore, the integration of smart features in the Street Light Monitoring System enables additional functionalities, such as adaptive lighting based on traffic patterns and weather conditions. This flexibility ensures that lighting levels are tailored to specific needs, further enhancing energy efficiency and overall public safety.

REFERENCES

[1] 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 overview and case study,” Energies, vol. 14, no. 11, p. 3018, 2021.
[2] 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.
[3] K. A. Kabir, P. L. Sikdar, and P. K. G. Thakurta, “Energy efficient street lighting: a GIS approach,” in Proceedings of the 6th International Conference on Advance Computing and Intelligent Engineering, pp. 583–593, Springer, Singapore, 2023.
[4] M. Mahoor, Z. S. Hosseini, A. Khodaei, A. Paaso, and D. Kushner, “State-of-the-art in smart streetlight systems: a review,” IET Smart Cities, vol. 2, no. 1, pp. 24–33, 2020.
[5] K. A. Bajaj and T. S. Mote, “Review on intelligent street lightening system,” International Journal of Science and Research, vol. 4, pp. 1624–1626, 2013.
[6] R. Paul, S. Ghosh, S. Chandra, S. K. Saha, S. Paul, and A. Mandal, “Review of controller - based smart street lighting systems. International journal of innovative research in electrical, electronics,” Instrumentation and Control Engineering, vol. 7, 2019.
[7] J. Corburn, “Confronting the challenges in reconnecting urban planning and public health,” American Journal of Public Health, vol. 94, no. 4, pp. 541–546, 2004.

[8] C. Villa, R. Bremond, and E. Saint-Jacques, "Assessment of pedestrian discomfort glare from urban LED lighting," Lighting Research & Technology, vol. 49, no. 2, pp. 147–172, 2017

[9] R. Ciriminna, L. Albanese, F. Meneguzzo, and M. Pagliaro, "LED street lighting: a looking ahead perspective," Green, vol. 5, no. 1-6, pp. 83–94, 2015.

[10] L. T. Doulos, I. Sioutis, P. Kontaxis, G. Zissis, and K. Faidas, "A decision support system for assessment of street lighting tenders based on energy performance indicators and environmental criteria: overview, methodology and case study," Sustainable Cities and Society, vol. 51, pp. 101759–106523, 2019.

[11] P. Dupuis, L. Kukačka, L. Canale, M. Vik, A. Richter, and G. Zissis, "Calibration of a brightness matching experiment setup in mesopic and scotopic conditions," Fifth Junior Conference on Lighting (Lighting), vol. 2020, pp. 1–6, 2020.

[12] H. Jin, S. Jin, L. Chen, S. Cen, and K. Yuan, "Research on the lighting performance of LED street lights with different color temperatures," IEE Photonics Journal, vol. 7, no. 6, pp. 1–9, 2015.