IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.53

Volume 4, Issue 4, May 2024

Development of Solar Based Street Light for College Utility

Prof. M. Botkewar[1], Prof. T. Shelke[2], Pooja G. Wankhede[3], Nikita R. Gudimeshram[4], Prajkta V. Bondgulwar[5], Dharti K. Meshram[6], Pranali V. Madavi[7], Dipali J. Sonwane[8], Himanshi R. Ramteke[9], Sonali N. Ganvir[10], Kiran S. Sirsam[11], Tinku S. Raut[12]

Project Guide, Department of Electrical Engineering[1,2]

Students, Department of Electrical Engineering[3-12]

Nagpur Institute of Technology, Nagpur, India

Abstract*: Solar streetlights have emerged as a sustainable and efficient solution for outdoor lighting, offering numerous advantages over traditional grid-powered lights. This paper presents a comprehensive study on solar streetlights equipped with Light Dependent Resistors (LDR) sensors, focusing on their design, operation, and benefits. The solar street light system consists of photovoltaic panels, a rechargeable battery, LED lamps, and an LDR sensor. Throughout the daytime, the solar panels transform sunlight into electric power, which charges the battery for night time use. LED lamps provide illumination, offering a cost-effective and environmentally friendly alternative to conventional lighting sources. The inclusion of an LDR sensor enhances the efficiency and functionality of solar streetlights by enabling automatic on/off operation based on ambient light levels. When ambient light levels decrease below a certain threshold, indicating dusk or darkness, the LDR sensor triggers the LED lamps to illuminate. Conversely, when ambient light levels increase above the threshold, signaling dawn or daylight, the LDR sensor turns off the LED lamps, conserving energy. The design and implementation of solar streetlights with LDR sensors require careful consideration of various factors, including solar panel orientation, battery capacity, LED luminaire efficiency, and sensor sensitivity*

Keywords: Solar Energy, Automatic Street light, LDR sensor, camera, Battery etc

I. INTRODUCTION

Illumination of urban roads is a significant consumer of municipal energy resources, serving a crucial function in maintaining clear visibility on streets and highways during the nighttime hours. An automated street lighting arrangement has the potential to drastically cut municipal street lighting expenses, by 50% to 70%. The existing mechanism activates the lights prior to the evening sunset and deactivates them in the morning when sufficient natural light is present. However, this strategy wastes some electricity since the lights are turned on according to a set timetable rather than adjusting to the real darkness.

The existing street light systems encounter issues, especially on bright and wet days when the ON and OFF hours differ. To address the issue of energy wastage, a Street Light monitoring system that can be controlled remotely and is built on IoT technology is suggested. The fundamental goal of the "connected to the internet of Solar Street Light Management System" project is to use solar energy to supply electricity to street lights at night. The rising worldwide energy demand, fueled by population increase and economic development, highlights the critical need for creative energy solutions.

The technology is called "smart" since it not only powers lighting on streets but also uses LDR sensor sensing to brighten the way for darkness. Dimming the illumination during off-peak hours is a vital feature for optimising energy use. When light is noticed, the illuminations brighten to their regular state. The technology is called "smart" since it not only powers lighting on streets but also uses motion sensing to brighten the way for walkers. Dimming the illumination during off-peak hours is a vital feature for optimizing energy use. When motion is noticed, the illuminations brighten to their regular state. This strategy not only saves energy but also lowers the operating expenses of streetlights.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, May 2024

II. OBJECTIVES

- Develop a solar street light system capable of harnessing solar energy for illumination.
- Integrate Light Dependent Resistor (LDR) sensors into the solar street light system to enable automatic on/off functionality based on ambient light levels.
- Optimize the efficiency of the solar street light system to ensure reliable performance and maximum energy savings.
- Conduct testing and evaluation of the solar street light prototype to validate its functionality, durability, and suitability for outdoor use.
- Evaluate the economic and environmental benefits of implementing solar street lights with LDR sensors compared to traditional grid-powered lighting solutions.
- Development of power-saving street light system.

III. LITERATURE SURVEY

Ms. M. Kokilavani [1] The writer tested an automated method for conserving energy by controlling the activation and deactivation of streetlights. The system employs sensors that respond to the presence of objects, triggering the lights to switch on or off. Such systems offer enhanced energy efficiency, reliability, and cost savings. The design of this system is intended to sense objects and react appropriately. An infrared (IR) sensor is utilized for object detection, with the IR LED being produced from gallium arsenide. To provide fast internet and network connections, the system incorporates Wi-Fi technology. The setup includes an LED light that illuminates when a multi-sensor detects an object's presence, thereby turning on the light.

K.Tamilselvan [2] The writer carried out tests on a Zigbee-enabled system for monitoring and controlling outdoor lighting that prioritizes energy efficiency., aiming for more efficient monitoring and control of outdoor lights. In this system, the streetlights continually assess sunlight intensity using a sensor, and the microcontroller unit (MCU) makes decisions regarding lamp activation or deactivation based on this data. The microcontroller used in this system comes with built-in Wi-Fi capabilities and is configured to work with a range of communication protocols, including GPIO, SPI, I2C, UART, I2S, and 802.11b/g/n.

Ambient light sensors communicate with the microcontroller unit (MCU) through the I2C interface, allowing for the monitoring of ambient lighting conditions. These sensors measure the intensity of sunlight and relay this information to the MCU, which then adjusts the lighting fixtures to ensure the light levels remain constant. The target illumination levels are set at 15 lux for horizontal surfaces and 50 lux for vertical surfaces. The mechanism involves electric current passing through a coil to the ground once voltage is applied to the main circuit. This action creates a magnetic field that causes the contacts in the secondary circuit to close, enabling current flow to the desired component. When the relay is deactivated and the magnetic field dissipates, a spring plate moves the contacts back to their original open-circuit position, cutting off the power supply.

Nithyashree CM [3] The researcher performed a study using a circuit that includes a Light Dependent Resistor (LDR) sensor followed by a switching relay. This setup takes its input straight from the electrical supply, with the relay adjusting the current to the necessary voltage to switch on the street lamps. Upon examination, it was noted that the lights were on from 6:30 in the evening until 7 in the morning, leading to unnecessary energy use. The system uses light bulbs with a 150-watt rating, which results in a daily energy usage of 39 kilowatt-hours. As a result, the monthly electricity cost is calculated to be 3150. The intelligent system is designed to rectify this inefficiency by introducing a zero percent usage period from 7 in the morning to 7 in the evening, and a 55% usage phase during the tapering period between 2 am and 6 am. The main goal is to reduce energy consumption in comparison to traditional street lighting systems.

Jessin Mathew [4] The author conducted an experiment involving a wireless control monitoring system for street lights, wherein each street light is equipped with various sensors connected to a microcontroller. These detectors keep track of environmental variables, including the levels of illumination, electrical capacity, voltage burden, and ambient temperature. The gathered data is then sent using wireless radio frequency signals. The setup consists of a transmitting unit and a receiving unit, with the former positioned about 500 meters from the latter. Upon detecting a road user, the

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, May 2024

transmitter relays information to the receiver, which triggers the activation of the street lamp. Conversely, if the transmitter does not sense a road user, the receiver independently recognizes their presence and turns on the light. The light switches off in the absence of road users. The transmitting component of the street lighting system incorporates a Raspberry Pi, a LoRauart module, and an ultrasonic sensor. The receiving end uses a Raspberry Pi, LoRauart module, Lidar Lite V3, a PIR sensor, and an LED lamp. An Arduino is implemented to manage the precise timing for the light's activation.

Dr.A.S.C.S.Sastry [5] The author conducted experiments to address energy-saving concerns through intelligent lighting, Utilizing a management and control system for municipal lighting, this setup allows for the remote activation or deactivation and brightness adjustment of lights via a photoresistor. To power the LEDs, it is crucial to connect them correctly by attaching the longer leg to a digital pin on the Arduino board (usually the positive side) and the shorter leg to the ground (GND). The Arduino platform, recognized for its development of single-board microcontrollers and microcontroller kits, is employed in the construction of sophisticated gadgets with sensing and control functionalities.

To implement this system, Utilizing a breadboard, the Arduino's ground and 3.3V pins are bridged to facilitate the integration of LEDs and an infrared sensor. The power supply pin (VCC) of the infrared sensor is attached to the 3.3V output on the Arduino, its ground pin to the Arduino's ground, and its signal pin to the A1 analog input on the Arduino. Additionally, the LED's anode is connected to the Arduino's digital pin 3 and its cathode to the Arduino's ground. The LED's longer lead is connected to digital pin 5 on the Arduino, while the opposite lead of the light-dependent resistor (LDR) is also connected to the A1 analog input. Once these connections are in place, uploading and running the software code on the Arduino initiates the operation of an efficient smart street lighting system that conserves electrical energy.

O. Rudrawar [6] The presented document describes a smart system crafted for the effective supervision of the brightness levels of street lamps. This system incorporates a circuit that controls light intensity, which is built around a TRIAC component. This circuit tracks the voltage provided to the system and compares it with the external light conditions. To monitor the luminosity, the system uses sensors that detect vehicular traffic and gathers sunrise and sunset times from dependable online resources. Consequently, the system is configured to switch the street lights on or off autonomously, guided by this information. By combining IoT sensors and software, the power electronics circuit becomes a self-governing network that successfully minimizes unnecessary energy use in street lighting.

P. C. Veena [7] Utilizing Image Processing, The Intelligent Roadway Illumination Setup is engineered to recognize vehicular motion or the presence of individuals on thoroughfares. The system efficiently activates only a segment of street lights ahead of the detected object while simultaneously turning off the trailing lights. This dynamic control mechanism aims to significantly reduce energy consumption. The process involves image processing of the detected object. Subsequently, a control message is dispatched to the designated section of streetlights in accordance with the system's architectural plan.

A. Rajesh [10] The Intelligent Street Light Control System efficiently manages light switching, voltage regulation based on brightness levels, and operates at lower voltage during nighttime. This system achieves savings in electricity expenses and prolongs the lifespan of street lights and related equipment. It also significantly lowers the expenses for labor and materials needed for upkeep. The Street Light Control and Management System consists of interconnected systems that perpetually check the condition of the devices to guarantee their best performance.

S. Kiwan and A [11] A newly designed controller has been created to continuously track the battery's energy condition. It adeptly modifies the LED light's brightness to suit illumination requirements, guaranteeing that the light stays on for a prolonged period. This intelligent management system prevents over discharge of the battery, promoting an extended lifespan for the system battery.

F. S. El-faouri [12] In a different investigation, the researchers introduce an intelligent street lighting system wherein a traditional street light undergoes modifications to derive power from solar energy. Supplementary functionalities were incorporated to enhance system performance, either by decreasing overall power consumption through the implementation by incorporating a motion detector or embedding a dust removal system, the panel's performance can be perpetually upheld at an elevated efficiency standard.

S. Raj [13] The aim of a streetlight management system that utilizes the Internet of Things (IoT) is to reduce energy consumption and decrease the amount of labor required by cutting down on unnecessary use of electricity. Streetlights

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, May 2024

play a fundamental role in any city, providing improved night vision, ensuring road safety, and enhancing visibility in public areas. However, they contribute significantly to electricity consumption. This setup includes a DHT11 temperature – humidity sensor that is external to the system, providing accurate measurement of both temperature and humidity for a particular area. The DHT11 is an integrated sensor that outputs a calibrated digital signal for both temperature and humidity, and it is recognized for its dependable performance and lasting stability.

IV. PROPOSED SYSTEM

This project proposes that system is designed to harness solar power through Photovoltaic (PV) panels during daylight hours, storing this energy in a battery that is managed by a charge controller. This stored energy is then used to power streetlights throughout the night, ensuring that the lights are entirely dependent on solar energy. Traditional streetlights consume thousands of kWh, while the proposed smart streetlights, powered by solar energy, reduce electricity consumption to just a few kWh. The key components of the system include the Arduino controller with sensor module, a solar panel for battery charging, an LDR sensor for day/night detection and a sensor designed to perceive movement triggers the lights when it detects motion. This system is configured with a timing mechanism to manage when the lights are activated. It guarantees that illumination occurs solely during the night by tracking the voltage from the solar panel. At night, when there is no voltage from the panel, the LED lights switch on.

Fig. 1. Smart Street Light System

V. BLOCK DIAGRAM

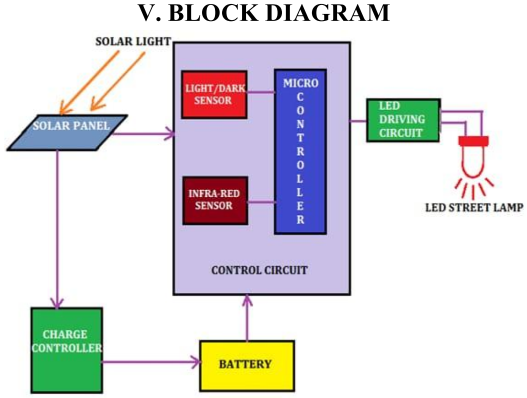


Fig.1. Block Diagram of system

VI. WORKING

The solar powered smart street light using Light Dependent Resistor (LDR) sensor project aims to harness solar energy to illuminate streets while incorporating intelligent features for efficient energy utilization. This project integrates renewable energy sources and smart technologies to create a sustainable and environmentally friendly lighting solution for urban and rural areas.

The operational mechanism of the solar-powered intelligent street lamp starts with the photovoltaic (PV) solar panels that are installed atop the street light unit. Throughout the daytime, these panels collect solar energy and transform it

DOI: 10.48175/568

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, May 2024

into electric power. This energy is then stored in rechargeable batteries that are linked to the system. The batteries serve as a power reserve, ensuring continuous operation of the street light even during periods of limited sunlight.
The Photoresistor, commonly referred to as the Light Dependent Resistor (LDR) sensor, is essential for the operation of the intelligent street lamp. It senses the amount of environmental light in the vicinity. As the daylight fades and environmental illumination drops beneath a certain preset limit, the LDR sensor activates the street lamp to switch on by itself. This guarantees that the street light is only in use, when necessary, which reduces energy use and enhances overall efficiency.

1. Battery Charging:

The Solar Panel attached to the Light Pole will generate electrical power to recharge the battery throughout the daylight hours. A charge controller will regulate the battery's charging process.

2. Solar Panel :

The solar street light's panel transforms daytime solar energy into electrical power, which is then accumulated in the system's lithium battery.

3. LDR Sensor :

An LDR sensor functions to sense ambient light levels, ensuring that street lights automatically turn off in response to the bright sunlight during the day.

4. Charger :

Solar lights operate with photovoltaic (PV) cells that capture solar energy and generate an electrical charge that flows across the panel. Cables linked to the solar cell lead to a battery, where the electrical power is transformed and kept in the form of chemical energy until it is require

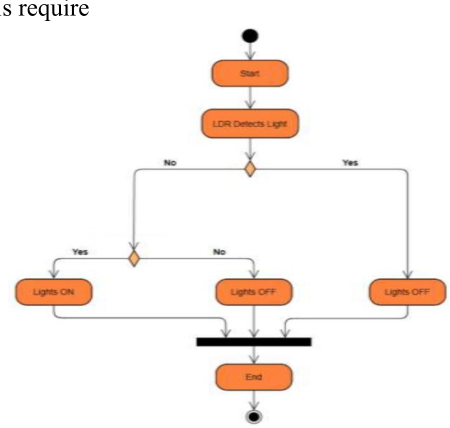


Figure 2: Flow diagram

Components:

- LDR sensor
- Power supply unit
- Solar panel
- Solar charge controller
- Relay Board
- Battery
- LED Light
- Frame
- SMPS/Adapter
- Others.

Fig.3. Design of system

VII. ADVANTAGES

- Solar street lights operate independently of the grid, resulting in significantly lower operating costs.
- Maintenance costs are much lower compared to conventional street lights.
- The environmentally friendly design produces no harmful emissions.
- Solar-powered Street lights typically have a greater longevity than traditional street lighting systems.
- Power consumption is significantly lower in solar street lights.
- Light-Dependent Resistors, commonly known as LDRs, are a type of resistor sensitive to light levels. They offer a cost-efficient solution and are readily accessible in the market. Additionally, they possess commendable power and voltage management properties akin to those of standard resistors.
- Light Dependent Resistors (LDRs) are compact enough to be integrated into almost any electronic gadget, acting as a fundamental element in numerous electrical systems around the globe.
- Photoresistors transform light into electrical energy autonomously, without reliance on any external forces.
- The simple design of photoresistors, using widely available materials, allows for the mass production of annually, several hundred thousand units are produced.

VIII. DISADVANTAGES

- The upfront cost for solar street lights is significantly elevated.
- Rechargeable batteries need periodic replacement.
- The absence of sunlight during the rainy and winter seasons presents a difficulty.
- Accumulated dust on the surface of the panel can lead to problems with its operation.
- The functionality of IoT is dependent on internet connectivity.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, May 2024

IX. RESULT AND DISCUSSION

Fig.4. Actual Model

Result :

The development of the solar-powered IoT-based smart street light system incorporating motion sensors and LDR sensors has yielded promising results. The system effectively harnesses solar energy to power street lights, making them more energy-efficient and environmentally friendly. Here are some key results:

- Energy Efficiency: The integration of solar panels ensures that the street lights operate using renewable solar energy, reducing reliance on traditional grid power sources. This leads to significant energy savings and lower electricity bills for municipalities or communities.
- Automatic Operation: The inclusion of motion sensors enables the street lights to automatically adjust their brightness levels based on detected motion in the vicinity. This feature helps conserve energy by dimming the lights when there is no activity and brightening them when motion is detected, improving overall energy efficiency.
- Adaptive Illumination: Street lights can adjust their illumination intensity in response to the surrounding light environment thanks to the incorporation of LDR sensors. During daylight or well-lit conditions, the lights remain dimmed or turned off, conserving energy. As darkness falls or ambient light levels decrease, the lights automatically increase their brightness to ensure optimal illumination for pedestrians and vehicles.
- Remote Monitoring and Control: The IoT-based architecture enables remote monitoring and control of the street lights via a centralized platform or mobile application. Municipal authorities or maintenance personnel can monitor the status of individual lights, track energy consumption, and receive real-time alerts for any faults or malfunctions.
- Enhanced Safety and Security: The implementation of motion sensors enhances safety and security in the illuminated areas by detecting movement and alerting nearby individuals to potential hazards or intruders. This proactive approach helps deter criminal activities and enhances the overall safety of the environment.

Discussion:

The development of the solar-powered IoT-based smart street light system presents several advantages and implications for urban infrastructure and sustainability. Here are some points for discussion:

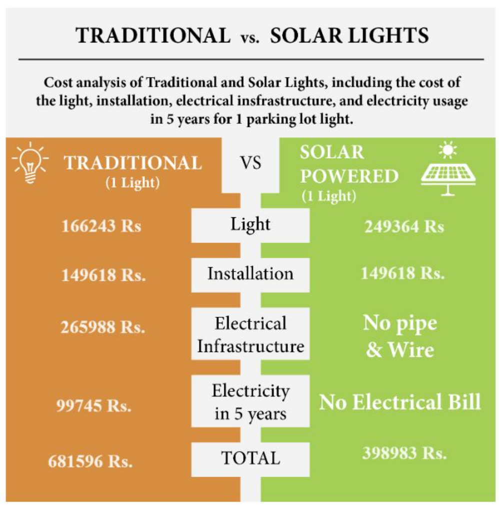
- Sustainability: By harnessing solar energy and employing energy-efficient LED lighting technology, the system promotes sustainability and reduces carbon emissions associated with conventional street lighting systems. This is in harmony with worldwide initiatives to tackle climate change and encourage the uptake of renewable energy sources. Cost Savings: The use of solar power eliminates the need for costly grid connections and reduces electricity bills for municipalities or local authorities. Additionally, the

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 4, May 2024

implementation of motion sensors and LDR sensors optimizes energy usage, further reducing operational costs over time.

- Scalability and Flexibility: The modular and scalable nature of the sensor system allows for easy expansion and adaptation to varying urban environments and lighting requirements. Municipalities can customize the system to suit specific needs and deploy it in diverse locations, from urban streets to rural communities.
- Citizen Engagement: The implementation of smart street lighting systems enhances citizen engagement and public participation by providing improved lighting infrastructure and responsive services. Communities can provide feedback on lighting preferences and report issues through the IoT platform, fostering a sense of ownership and collaboration.
- Integration with Smart City Initiatives: The solar-powered street lighting setup is in harmony with wider initiatives for smart cities that focus on enhancing the efficiency, sustainability, and living standards within urban environments. By integrating with other IoT-enabled infrastructure components such as traffic management systems and environmental sensors, the system contributes to the development of smarter and more livable cities.

Overall, the development and deployment of solar-powered smart street light systems represent a significant step towards creating safer, more sustainable, and technologically advanced urban environments. Continued research and innovation in this field will further enhance the efficiency, reliability, and effectiveness of such systems, paving the way for smarter cities of the future.



X. CONCLUSION

The integration of solar power and smart sensor technologies presents a significant opportunity to transform the energy landscape. By merging the clean energy generation of solar power with the connectivity and smart sensor systems, we can establish a more efficient, sustainable, and reliable energy infrastructure. Solar power offers a renewable and eco-friendly energy source, reducing dependence on fossil fuels and addressing climate change concerns. Smart grids enhance grid stability, enable bidirectional power flow, and optimize energy management for reliable and efficient electricity distribution. The solar powered smart street light using Light Dependent Resistor (LDR) sensor represents a significant advancement in street lighting technology. By harnessing renewable solar energy and integrating intelligent features, this innovative lighting solution offers numerous benefits for urban and rural communities alike

XI. FUTURE SCOPE

The development of solar-powered smart street light systems incorporating LDR sensors presents several avenues for future research, innovation, and implementation. Here are some potential future scope areas:

- Advanced Sensor Integration: Explore the integration of additional sensors, such as temperature sensors, humidity sensors, and air quality sensors, to gather more comprehensive environmental data. This data can be used for adaptive lighting control, urban planning, and environmental monitoring purposes.
- Machine Learning and Predictive Analytics: Implement machine learning algorithms to analyze historical data collected from the IoT sensors and optimize street light operation patterns. Predictive analytics can be used to forecast lighting requirements based on factors such as weather conditions, traffic patterns, and pedestrian activity, improving energy efficiency and resource allocation.
- Wireless Mesh Networking: Investigate the use of wireless mesh networking technologies to create self-organizing networks of street lights. Mesh networks enable seamless communication and data sharing between neighboring lights, enhancing system reliability, scalability, and coverage range.
- Energy Harvesting Solutions: Explore innovative energy harvesting solutions, such as kinetic energy harvesting from pedestrian footsteps or vibration energy harvesting from vehicular traffic, to supplement solar power generation and increase system resilience.
- Smart Grid Integration: Integrate smart street light systems with existing smart grid infrastructure to enable bidirectional communication between street lights and utility grids. This integration allows for real-time monitoring of energy consumption, demand-response capabilities, and dynamic pricing schemes for optimized energy management.
- Autonomous Maintenance and Diagnostics: Develop autonomous maintenance and diagnostic capabilities within the IoT platform to detect and diagnose faults, malfunctions, or performance degradation in street light components. Proactive maintenance alerts and predictive maintenance scheduling can help minimize downtime and optimize system reliability.
- Community Engagement and Participatory Design: Foster community engagement and participatory design approaches to involve citizens, urban planners, and stakeholders in the co-creation of smart street light solutions. Solicit feedback, preferences, and suggestions from residents to tailor lighting strategies to local needs and preferences.

REFERENCES

[1] Dodke, A. Argelwar, R., Dani, B.S., Muley, S.P. “Comparison of cuk and buck converter fed electronically commuted motor drive” International Conference on Electrical, Electronics, and Optimization Techniques, ICEEOT 2016, 2016, pp. 4292–4297, 7755529

[2] Dodke, Amit, R. G. Shriwastava, and K. N. Sawalakhe. "Design and control of CUK converter FED Brushless DC Motor Drive." Journal of Network Communications and Emerging Technologies 3.2 (2015).

[3]. High Voltage Generation by using Cockcroft-Walton Multiplier Nikhil M. Waghamare, Rahul P. Argelwar International Journal of Science, Engineering and Technology Research (IJSETR), Volume 4, Issue 2, February 2015

[4] Wireless Speed and Direction Control of Dc Motor by Using Radio Frequency Technology Ankesh N.Nichat1 , Sheikh Kadir Ali2 ,Yogesh D. Solanke 3 , Amit M. Dodke 4
International Journal of Engineering Trends and Technology (IJETT) – Volume 20 Number 2 – Feb 2015

[5.] Raman, R. S., Kumar, S. V., Reddy, U., Dodke, A., Kumar, A., Jayronia, S., & Adnan, M. M. (2024). Design and CFD Simulation of Supersonic Nozzle by Komega turbulence model for Supersonic Wind Tunnel. In E3S Web of Conferences (Vol. 507, p. 01024). EDP Sciences.

[6.]Argelwar, Rahul P., and V. S. Nandawar. "PFC zeta converter fed BLDC motor drive for fan applications." International Journal of Research in Advent Technology 2.2 (2014).

[7].Ms. M. Kokilavani, Dr. A. Malathi “Smart Street Lighting System using IOT” Government Arts College, Coimbatore, Tamilnadu.

[8]. K.Tamilselvan, K.S. Deepika, A.Gobinath, S.Harhini, S.Gokhulraj “IOT Based Street Light Monitoring System” Nandha Engineering College, Erode, Tamilnadu.

[9]. Nithyashree CM, Vinutha TS, M. Dakshayini, P. Jayarekha “IOT-Smart Street Light System” BMSCE, Bengaluru, Karnataka, India

[10]. Jessin Mathew, Riya Rajan, Rangit Varghese “IOT Based Street Light Monitoring & Control With loRa/LoRaWAn Network” Mount Zion College of Engineering, Kadammanitta, Kerela, India.
[11]. Dr.A.S.C.S.Sastry, K.A.S.K.Bhargav, K.Surya Pavan, M.Narendra “Smart Street Light System using IOT” K L E F, Andhra Pradesh, India.
[12] P. Keni et al., “Automated street lighting system using IoT,” vol. 4, no. 3, pp. 1970–1973, 2018.
[13] M. Revathy, S. Ramya, R. Sathiyavathi, B. Bharathi, and V. M. Anu, “Automation of street light for smart city,” Proc. 2017 IEEE Int. Conf. Commun. Signal Process. ICCSP 2017, vol. 2018- January, pp. 918–922, 2018.
[14] O. Rudrawar, S. Daga, J. R. Chadha, and P. S. Kulkami, “Smart street lighting system with light intensity control using power electronics,” Int. Conf. Technol. Smart City Energy Secur. Power Smart Solut. Smart Cities, ICSESP 2018 - Proc., vol. 2018-January, pp. 1–5, 2018.
[15] P. C. Veena, P. Tharakan, and H. Haridas, “Smart Street Light System based on Image Processing,” 2016.
[16] A. Rajesh, A. Antony, F. Jose, and R. S. Kumar, “IoT Based Smart Street Light System,” vol. 2, no. 1, pp. 312–320, 2018.
[17] S. Kiwan and A. Al-ghasem, “Smart Solar-Powered LED Outdoor Lighting System,” no. August, 2018.
[12] F. S. El-faouri, M. Sharaiha, D. Bargouth, and A. Faza, “A Smart Street Lighting System Using Solar Energy,” no. October, 2016.
[13] F. D. P. P, G. S. Raj, G. Dutt, and V. J. S, “IOT Based Smart Street Light Management System,” pp. 368–371, 20