VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnana Sangama, Belagavi – 590014.

Internship Report

On

“Smart intelligent street lighting System”

Submitted in partial fulfillment of the requirement for the award of degree of

BACHELOR OF ENGINEERING

By

Chethana N	**USN:1AP21IS006**
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Under the guidance of:

Sai Charan Teja

2023 - 2024

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

A P S COLLEGE OF ENGINEERING

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PROJECT COMPLETION CERTIFICATE

I, **Chethana N** (Roll No:1AP21IS006), here by declare that the material presented in the Project Report titled **"SMART INTELLIGENT STREET LIGHTING SYSTEM"** represents original work carried out by me in the **Department of Information Science and Engineering** at the **APS college of Engineering, Bangalore** during the tenure **2 October, 2024 – 12, December, 2024**.

With My signature, I certify that:

- I have not manipulated any of the data or results.
- I have not committed any plagiarism of intellectual property and have clearly indicated and referenced the contributions of others.
- I have explicitly acknowledged all collaborative research and discussions.
- I understand that any false claim will result in severe disciplinary action.
- I understand that the work may be screened for any form of academic misconduct.

Date: **Student Signature**:

In my capacity as the supervisor of the above-mentioned work, I certify that the work presented in this report was carried out under my supervision and is worthy of consideration for the requirements of the B.Tech. Internship Work.

Advisor's Name: Dr. Shivamurthaiah **Guide Name:** Sai Charan Teja

Advisor's Signature **Guide Signature**

PROJECT COMPLETION CERTIFICATE

I, **Ajoy Anthony A** (Roll No:1AP21CS005), here by declare that the material presented in the Project Report titled **"SMART STREET LIGHTING SYSTEM"** represents original work carried out by me in the **Department of Computer Science and Engineering** at the **APS college of Engineering, Bangalore** during the tenure **2 October, 2024 – 12, December, 2024**.

With My signature, I certify that:

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Advisor's Name: Dr. Shivamurthaiah **Guide Name:** Sai Charan Teja

Advisor's Signature **Guide Signature**

PROJECT COMPLETION CERTIFICATE

I, **Vinod N** (Roll No: 1AP22EC409), hereby declare that the material presented in the Project Report titled **"SMART INTELLIGENT STREET LIGHTING SYSTEM"** represents original work carried out by me in the **Department of Electronics and Communication Engineering** at the **APS college of Engineering, Bangalore** during the tenure **2 October, 2024 – 12, December, 2024**.

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Advisor's Name: Dr. Prakash Jhadav **Guide Name:** Sai Charan Teja

Advisor's Signature **Guide Signature**

Evaluation Sheet

Title of the Project: Smart intelligent street lighting System

Name of the Students:

1. **Chethana N**
2. **Ajoy Anthony A**
3. **Vinod N**

External Supervisor:

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Internal Supervisor:

____

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Date:

Place:

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ABSTRACT

The advent of the Internet of Things (IoT) has paved the way for innovative solutions to urban challenges, including energy efficiency and smart infrastructure. This paper explores the design and implementation of a *Smart Street Lighting System* using IoT technology. The proposed system leverages sensors, microcontrollers, and wireless communication to intelligently manage streetlights, ensuring optimal energy usage while enhancing public safety and convenience.

Key features include automatic dimming or activation based on ambient light conditions, motion detection for adjusting brightness levels in real-time, and remote monitoring via a centralized dashboard. The system also incorporates fault detection and alerts, allowing for prompt maintenance and reduced downtime.

Through data analytics and machine learning, the system can predict usage patterns, enabling further energy savings and better resource allocation. This scalable and cost-effective solution demonstrates significant potential for reducing carbon footprints and operational costs, contributing to the development of smart and sustainable cities.

Chapter 1

ABSTRACT

In the future, urban infrastructure will increasingly incorporate smart technologies to improve energy efficiency and environmental sustainability. The proposed project, Intelligent Street Lighting System using Raspberry Pi, will aim to revolutionize traditional street lighting systems by integrating advanced automation, sensor technology, and IoT connectivity.

The system will utilize a Raspberry Pi as its central processing unit, which will coordinate various functions based on inputs from connected sensors such as light-dependent resistors (LDRs), motion detectors, and environmental sensors. The streetlights will dynamically adjust their brightness levels based on real-time conditions. For instance, during low-traffic periods, the lights will dim to conserve energy but will automatically brighten when motion is detected.

This system will also feature IoT capabilities, allowing it to transmit performance data and alerts to a central monitoring hub. The Raspberry Pi will communicate wirelessly with a cloud-based platform, enabling remote monitoring, diagnostics, and scheduling of maintenance. Integration with renewable energy sources, like solar panels, will further enhance its sustainability.

By implementing this intelligent lighting system, cities will reduce energy consumption and operational costs significantly while improving safety and reducing light pollution. The project will contribute to smart city initiatives and pave the way for more efficient urban infrastructure.

Chapter 2

INTRODUCTION

The Intelligent Street Lighting System using Raspberry Pi will be designed to enhance energy efficiency and automation in urban lighting. By leveraging the Raspberry Pi, sensors, and IoT technologies, the system will adapt streetlight brightness based on real-time factors like traffic movement and ambient light levels. This approach will reduce energy wastage, operational costs, and environmental impact. Additionally, the system will enable remote monitoring and maintenance through cloud connectivity, aligning with the vision of smarter and more sustainable cities.

2.1. Objective:

The objective of a smart street lighting system using IoT is to create an intelligent, energy-efficient, and sustainable lighting infrastructure that enhances urban living. By leveraging IoT technology, the system aims to optimize energy consumption through real-time adjustments in light intensity based on environmental and traffic conditions. It enables remote monitoring and control, ensuring timely fault detection and predictive maintenance, which reduces operational costs and downtime. Additionally, the system seeks to improve safety and convenience for pedestrians and vehicles by providing adaptive lighting tailored to specific scenarios. By incorporating renewable energy sources such as solar power, the solution promotes sustainability and reduces the carbon footprint. Furthermore, the system facilitates data collection and analytics to support smarter urban planning and efficient energy management.

2.2.Problem Statement:

1. **Energy Wastage**: Traditional street lighting systems consume excessive energy due to constant illumination at fixed intensities, regardless of environmental or traffic conditions.

2. **High Maintenance Costs**: Conventional systems lack remote monitoring, leading to delays in fault detection and increased maintenance costs due to manual inspections.

3. **Limited Adaptability**: Traditional streetlights cannot adjust their intensity based on real-time requirements, resulting in inefficient lighting during low-traffic hours or adverse weather conditions.

4. **Safety Concerns**: Inconsistent lighting levels may lead to unsafe conditions for pedestrians and drivers, particularly in areas with sudden changes in traffic or weather.

5. **Incompatibility with Renewable Energy**: Traditional street lighting systems often do not integrate with renewable energy sources, missing opportunities for sustainability.

Chapter 3

APPLICATIONS

1. Urban Street Lighting: Automating city streetlights to reduce energy consumption and ensure proper illumination based on traffic and environmental conditions.

2. Highways and Expressways: Enhancing safety on highways by dynamically adjusting brightness based on vehicle movement and weather conditions.

3. Industrial and Commercial Complexes: Providing efficient lighting for large campuses, warehouses, and factories to optimize energy use.

4. Residential Areas: Implementing energy-efficient lighting in residential neighborhoods to improve safety and reduce operational costs.

5. Smart Cities: Contributing to smart city infrastructure by integrating with IoT platforms for centralized control and monitoring.

6. Parks and Recreational Areas: Managing lighting in parks and public spaces by adjusting brightness based on human presence or scheduled activities.

7. Remote and Rural Areas: Providing sustainable lighting solutions in off-grid locations using renewable energy sources like solar power.

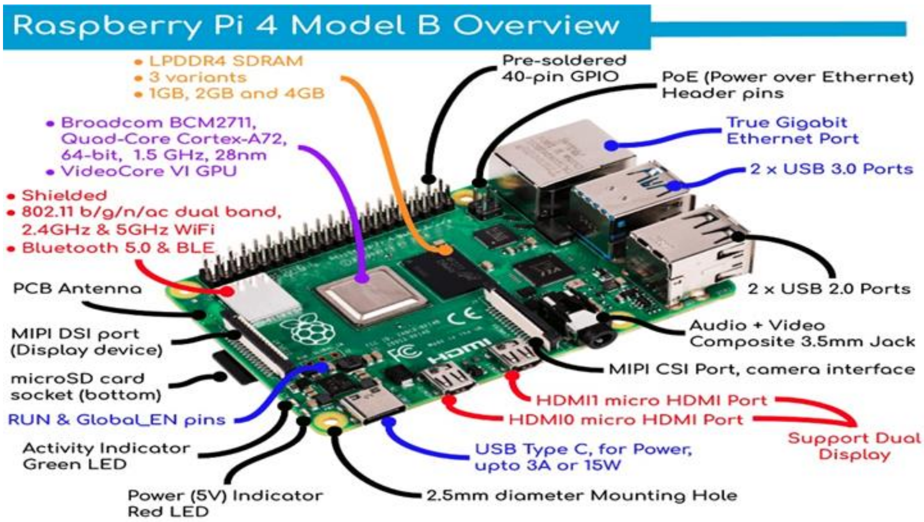
8. Disaster Management Zones: Ensuring proper illumination in emergency or disaster-hit areas with minimal human intervention.

9. Airport Runways and Railway Stations: Enhancing safety and visibility by automating lighting in transportation hubs.

10. Energy Conservation Initiatives: Supporting governmental and non-governmental programs aimed at reducing carbon footprints and promoting green energy solutions.

Chapter 4

COMPONENTS REQUIRED

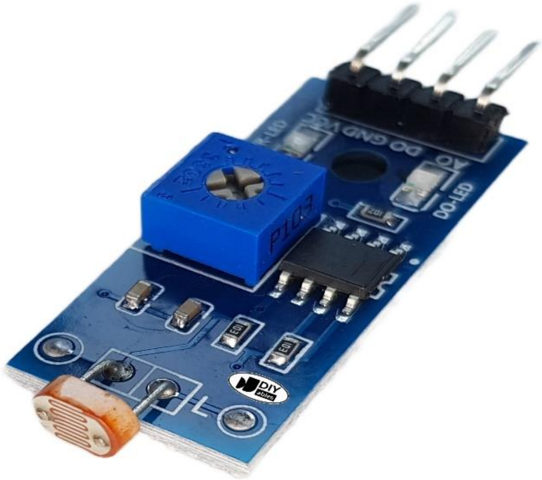


Raspberry PI 4 Model B

Raspberry Pi 4 model B is a compact, low-cost, and powerful single-board computer that supports various programming languages and interfaces with sensors and external devices. It is equipped with GPIO (General Purpose Input/Output) pins, Wi-Fi, and Bluetooth capabilities, making it ideal for IoT and automation projects.

Usage of raspberry pi in this project:

Raspberry Pi 4 model B is used in the Intelligent Street Lighting System due to its versatility and computing power. It serves as the central controller, processing input from sensors (like motion detectors and light sensors) and making real-time decisions to adjust the lighting. Additionally, its built-in connectivity features allow integration with IoT platforms for remote monitoring and control.

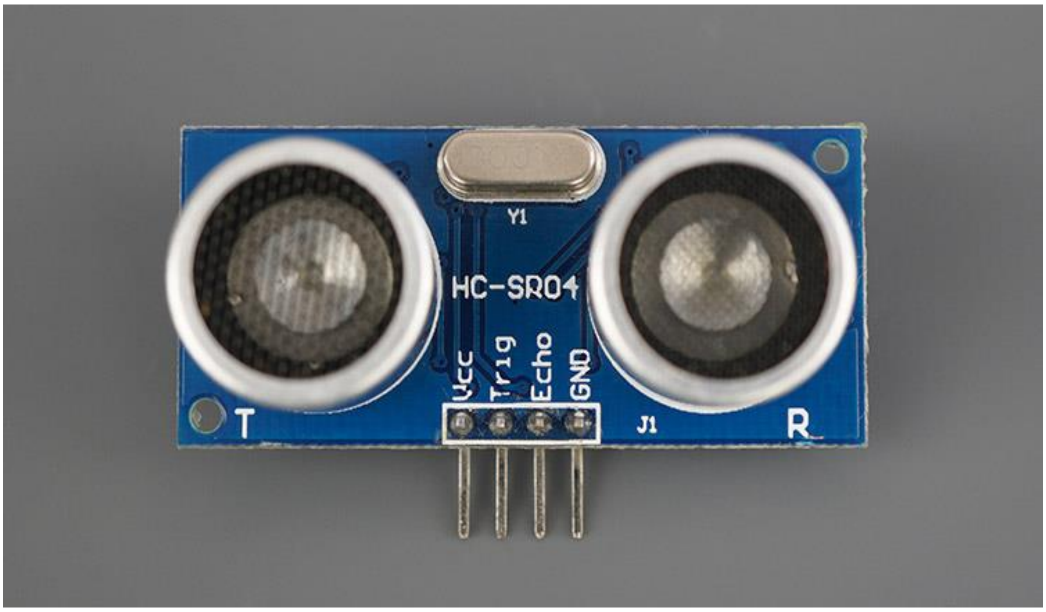


Light sensor:

A light sensor, also known as a photoresistor or LDR (Light Dependent Resistor), is an electronic component that detects light intensity. It changes its resistance based on the amount of light falling on it—resistance decreases as light intensity increases. These sensors are commonly used in applications requiring automatic lighting control and brightness adjustment.

Usage of light sensor in this project:

In the Intelligent Street Lighting System, the light sensor is crucial for detecting ambient light levels. It helps the system determine whether streetlights should be on or off based on natural light availability, such as during dusk or dawn. By automatically adjusting the streetlight brightness depending on the surrounding light conditions, it ensures energy efficiency by only using electricity when necessary.

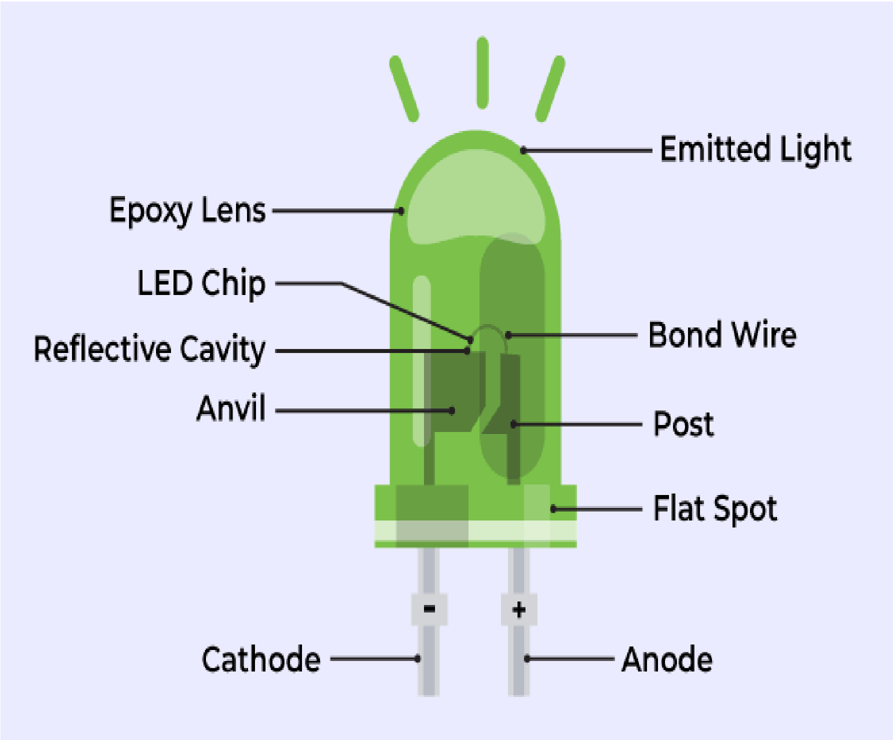


Ultrasonic sensor:

An ultrasonic sensor is a device that uses sound waves to measure the distance between thesensor and an object. It emits high-frequency sound waves and measures the time taken for the waves to bounce back after hitting an object. The sensor then calculates the distance based on the time delay.

Usage of ultrasonic sensor in this project:

In the Intelligent Street Lighting System, the ultrasonic sensor is used to detect the presenceand movement of vehicles or pedestrians. When movement is detected, the sensor signals the Raspberry Pi to adjust the streetlight's brightness accordingly. This helps optimize energy usage by dimming lights when no movement is detected and brightening them when movement occurs, improving both safety and energy efficiency.



LED:

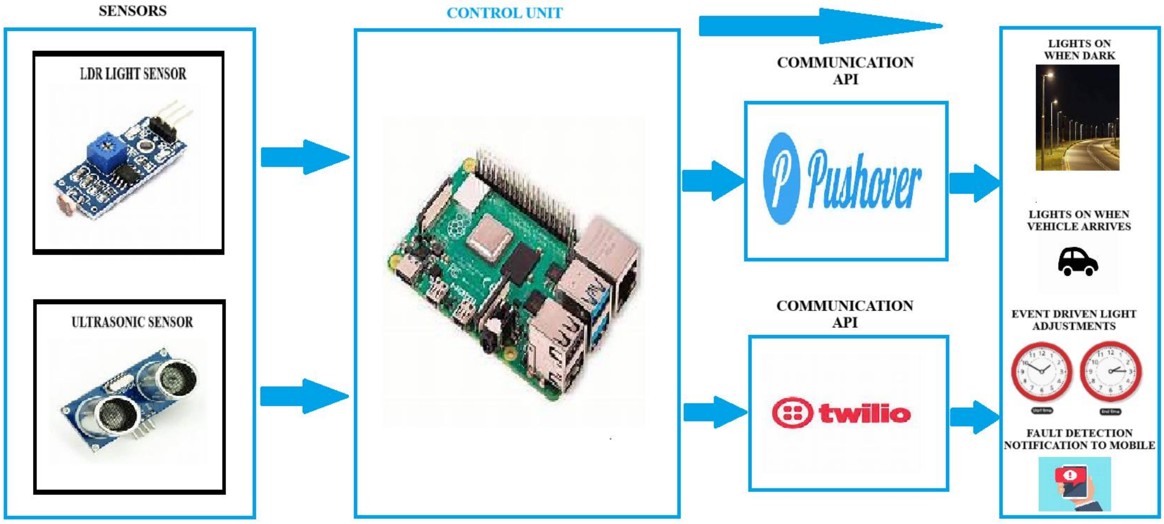
LED (Light Emitting Diode) is a semiconductor light source that emits light when current flows through it. LEDs are known for their energy efficiency, long lifespan, and ability to produce bright light while consuming very little power compared to traditional incandescent bulbs.

Usage of LED in this project:

LEDs are used in the Intelligent Street Lighting System because of their energy efficiency, durability, and cost-effectiveness. They provide the optimal brightness needed for street lighting while consuming less energy, thus supporting the project's goal of reducing energy consumption and operational costs. Additionally, LEDs can be easily controlled and dimmed, making them suitable for dynamic adjustments based on real-time data, such as traffic flow and ambient light levels.

Chapter 5

FLOW CHART



Chapter 6

CONCLUSION

The Intelligent Street Lighting System project implemented using Raspberry Pi successfully demonstrates the potential of IoT-based solutions in modernizing urbaninfrastructure. The use of Raspberry Pi as the central controller highlights its versatility, low cost, and efficiency in managing and automating street lighting systems.

Key outcomes of the project include:

1. Energy Efficiency: The system dynamically controls streetlights based on real-time inputs from sensors (e.g., motion detectors, ambient light sensors), reducing unnecessary power consumption.

2. Cost-Effectiveness: Raspberry Pi provides a low-cost yet powerful platform for integrating hardware and software, significantly lowering the overall system cost compared to proprietary solutions.

3. Real-Time Monitoring: The system enables real-time monitoring and control through wireless communication, ensuring proactive maintenance and reducing downtime.

4. Environmental Sustainability: The reduced energy usage and optimized operations contribute to lower carbon emissions, supporting sustainable urban development goals.

5. Scalability and Flexibility: The modular architecture using Raspberry Pi makes the system scalable for larger deployments and allows easy integration of additional features, such as air quality sensors or data analytics.

In conclusion, the project demonstrates that a Raspberry Pi-based intelligent street lighting system is a feasible, sustainable, and cost-efficient solution for modern cities. It provides a strong foundation for future research and development in smart city initiatives, paving the way for greener and smarter urban environments.

Chapter 7

FUTURE WORK

The Intelligent Street Lighting System using Raspberry Pi has significant potential for future enhancements and expansions. Some of the future work includes:

1. Integration of More Sensors: Adding additional sensors, such as air quality monitors, CO2 sensors, or weather stations, to further optimize lighting control and enhance environmental awareness.

2. Machine Learning for Predictive Lighting: Implementing machine learning algorithms to predict traffic patterns and environmental conditions, allowing the system to adjust lighting preemptively and further reduce energy consumption.

3. Integration with Smart Grid Systems: Connecting the lighting system with smart grid technologies for better energy distribution, real-time data sharing, and improved grid management.

4. Renewable Energy Optimization: Incorporating more advanced renewable energy solutions, such as solar power with energy storage systems, to make the street lighting system completely autonomous and self-sustaining.

5. Adaptive Lighting for Different Zones: Developing more sophisticated algorithms that enable the system to adapt to different urban zones (e.g., residential, commercial, industrial) with unique lighting needs.

6. Real-Time Data Analytics: Expanding cloud-based monitoring and analytics to collect and analyze system data for predictive maintenance, fault detection, and performance optimization.

7. Wide-Scale Deployment: Extending the system for large-scale deployment in cities, towns, and highways, improving the infrastructure of smart cities globally.

These advancements will further enhance the system's effectiveness, scalability, and sustainability, making it a key component in the development of smart, energy-efficient cities of the future.

Chapter 8

Appendix

8.1 Psuedo Code

```
1. Initialize System:
   - Setup sensors (Light sensor, Motion sensor)
   - Setup actuators (LED lights, Dimmer control)
   - Establish network communication (Wi-Fi/LoRaWAN)
   - Initialize microcontroller (Arduino, Raspberry Pi, etc.)

2. Define Parameters:
   - MAX_BRIGHTNESS: 100% (fully on)
   - MIN_BRIGHTNESS: 10% (dim mode)
   - NO_MOTION_TIMEOUT: 5 minutes (time to dim lights when no motion is detected)
   - LIGHT_THRESHOLD: Value from light sensor to differentiate day/night

3. Main Loop:
   While True:
     a. Read Sensors:
        - Ambient_Light = Read from Light Sensor
        - Motion_Detected = Read from Motion Sensor

     b. Determine Lighting Conditions:
        - If Ambient_Light > LIGHT_THRESHOLD:
            Set Light Intensity to OFF
        - Else:
            If Motion_Detected:
                Set Light Intensity to MAX_BRIGHTNESS
                Reset NO_MOTION_TIMER
            Else:
                If NO_MOTION_TIMER expires:
                    Set Light Intensity to MIN_BRIGHTNESS
c. Send Data to Server:
        - Transmit the current state (Light Intensity, Motion, Ambient Light) to the IoT server.
```

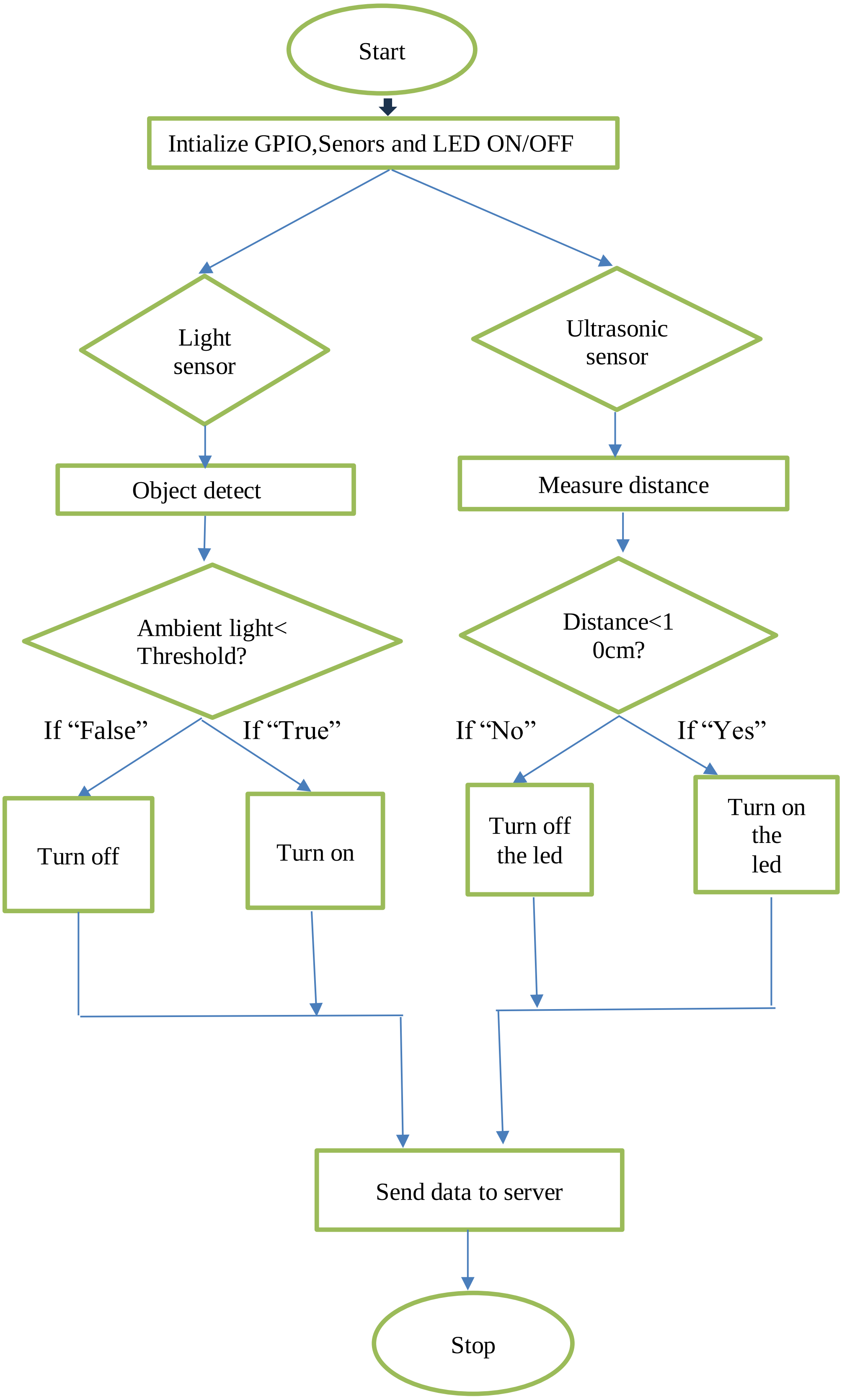
d. Remote Control Check:

- Receive remote commands (e.g., override intensity, schedule changes) from the server if available.

4. Error Handling:
   - Monitor Sensor Connectivity.
   - Log and Report Issues to Server.

5. Power Optimization:
   - Sleep mode for microcontroller during inactivity.

6. End Loop.


Start
Intialize GPIO,Senors and LED ON/OFF
Light sensor
Ultrasonic sensor
Object detect
Measure distance
Ambient light< Threshold?
Distance<1 0cm?
If “False”
If “True”
If “No”
If “Yes”
Turn off
Turn on
Turn off the led
Turn on the led
Send data to server
Stop