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IoT Street Light Controller System

Minor Project-I Report

Submitted for the partial fulfillment of the degree of

Bachelor of Technology

In

Internet of Things (IOT)

Submitted By

Shruti Jha
0901IO233D04

UNDER THE GUIDANCE OF

Dr. Nookala Venu
Assistant Professor

Centre for Internet of Things

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR (M.P.), INDIA

माधव प्रौद्योगिकी एवं विज्ञान संस्थान, ग्वालियर (म.प्र.), भारत

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June 2024

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I hereby declare that the work entitled **IoT Street Light Controller System** is my work, conducted under the supervision of **Dr. Nookala Venu, Assistant Professor,** during the session Jun-Dec 2024. The report submitted by me is a record of bonafide work carried out by me.

I further declare that the work reported in this report has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

Shruti Jha
0901IO233D04

B.Tech. V Sem

Date: 19/11/2024
Place: Gwalior

This is to certify that the above statement made by the candidates is correct to the best of my knowledge and belief.

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This is to certify that I/we, a student of B.Tech. in **Internet of Things (IOT)** have checked my complete report entitled **"Iot Street Light Controller System"** for similarity/plagiarism using the "Turnitin" software available in the institute.

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ABSTRACT

The Internet of Things (IoT) is transforming urban infrastructure by enabling physical devices to connect, communicate, and interact over the internet. This technological advancement allows for efficient control, automation, and data-driven decision-making in real-time. In this project, we developed an IoT-based street light controller system aimed at automating street lighting operations. The system employs a NodeMCU microcontroller and IR sensors to monitor motion and measure ambient light levels. These inputs dynamically adjust the brightness of LED street lights, ensuring optimal illumination when required while conserving energy during low-traffic periods.

By integrating IoT technology, the project addresses challenges such as energy wastage, high operational costs, and inadequate responsiveness of traditional street lighting systems. Additionally, it enhances public safety by ensuring well-lit streets during high activity, thus reducing risks of accidents and crime. This approach demonstrates IoT's potential to contribute to sustainable and smarter urban infrastructure.

ACKNOWLEDGEMENT

The full semester Internship/ Project has proved to be pivotal to my career. I am thankful to my institute, **Madhav Institute of Technology & Science** to allow me to continue my disciplinary/interdisciplinary Internship/ Project as a curriculum requirement, under the provisions of the Flexible Curriculum Scheme approved by the Academic Council of the institute. I extend my gratitude to the Director of the institute, **Dr. R. K. Pandit** and Dean Academics, **Dr. Manjaree Pandit** for this.

I would sincerely like to thank my department, **Centre for Internet of Things,** for allowing me to explore this project. I humbly thank **Dr. Praveen Bansal**, Assistant Professor and Coordinator, Centre for Internet of Things, for his continued support during the course of this engagement, which eased the process and formalities involved. I am sincerely thankful to my faculty mentors. I am grateful to the guidance of **Dr. Nookala Venu**, Assistant Professor, and Centre for Internet of Things, for his continued support and guidance throughout the project. I am also very thankful to the faculty and staff of the department.

Shruti.

Shruti Jha

0901IO233D04

Centre for Internet of Things

CERTIFICATE

This is Certified that Shruti Jha (0901IO233D04) has submitted the Minor Project Report of "Minor project -1" under the Mentorship of Dr. Nookala Venu, in partial fulfillment of the requirement for the award of the Degree of Bachelor of Technology in Internet of Things from Madhav Institute of Technology and Science, Gwalior.

Dr. Nookala Venu
Assistant Professor

CONTENT

Acronyms

1. NodeMCU:

The NodeMCU microcontroller, equipped with built-in Wi-Fi, serves as the system's brain. It processes data received from the sensors and controls the LEDs, enabling real-time automation and remote management.

2. IR Sensor:

This sensor detects motion and measures ambient light levels. Its ability to identify changes in the environment triggers the appropriate response from the system, such as turning the lights on, off, or dimming them.

3. LEDs:

Representing the street lights in this prototype, LEDs demonstrate the system's capability to manage light intensity and operational status dynamically.

4. Breadboard and Wires:

The breadboard is used for assembling and testing the prototype. Wires connect the components, forming a complete circuit that facilitates communication between the microcontroller and the sensors.

NOMENCLATURE

1.IoT Street Light Controller System

A system designed to control street lighting using IoT technology, enabling efficient energy management and remote monitoring.

2. NodeMCU

Microcontroller with built-in Wi-Fi for IoT applications, used to process sensor inputs and control outputs.

3.IR Sensor

Infrared sensor used to detect motion or the presence of objects for triggering the street lights.

4.Breadboard and Jumper Wires

Prototyping tools used for creating the system without permanent connections.

5.LEDs

Light-emitting diodes simulating street lights for testing and demonstration purposes.

LIST OF FIGURES

Figure 1.1 Block Diagram

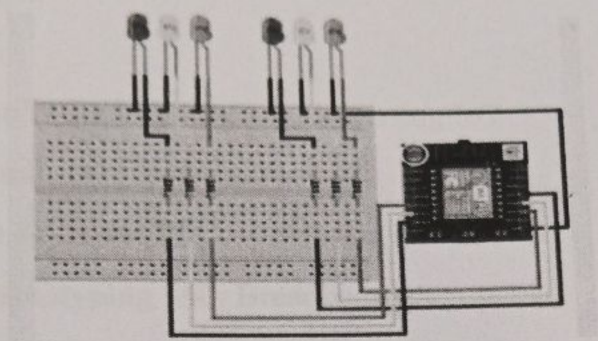
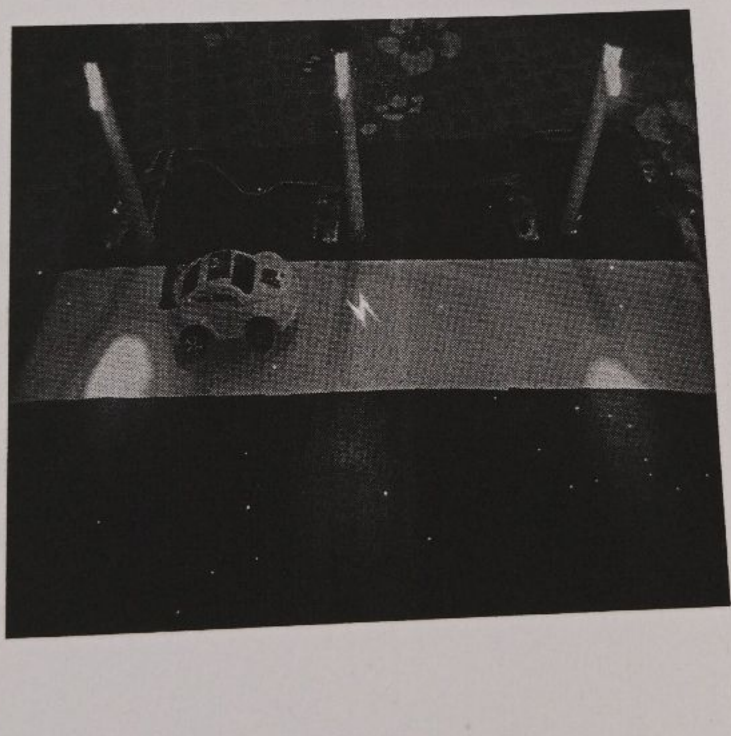


Figure 1.2 Circuit Diagram



LIST OF TABLES

CHAPTER 1: INTRODUCTION

1.1 Overview of the Project

The growing need for sustainable and energy-efficient solutions has made the Internet of Things (IoT) a key enabler in transforming urban infrastructure. Among various applications, smart street lighting systems stand out as an essential component of modern cities. Traditional street lighting systems often operate on fixed schedules, leading to significant energy wastage during low-traffic periods and insufficient responsiveness to real-time conditions.

1.2 Problem Statement

This project aims to bridge this gap by designing and implementing an IoT-based street light controller system. Using real-time sensor data from IR sensors, the system dynamically adjusts the brightness of street lights based on motion detection and ambient light levels. The NodeMCU microcontroller serves as the central processing unit, enabling remote monitoring and control through internet connectivity. The proposed solution is not only energy-efficient but also enhances urban safety and reduces the carbon footprint associated with traditional systems.

CHAPTER 2: LITERATURE SURVEY

2.1 Energy-Efficient Street Lighting Systems Using IoT

- Researchers demonstrated the use of IoT-enabled systems to reduce energy consumption by dynamically controlling street lights based on environmental conditions and motion detection. NodeMCU is widely employed for its low power consumption and integrated Wi-Fi capabilities.

2.2 Motion Detection in IoT Systems

- IR sensors have been validated as effective tools for motion detection in street lighting systems, offering quick response times and reliable performance in various lighting conditions.

2.3 Prototyping with NodeMCU

- NodeMCU, a popular ESP8266-based microcontroller, is noted for its ease of use in IoT projects. It supports lightweight HTTP and MQTT protocols, making it ideal for uploading data to cloud platforms like ThingSpeak or Firebase.

2.4 Cost-Effective Prototyping with Breadboards

- Studies highlight the importance of breadboards and jumper wires for low-cost prototyping of IoT systems, allowing for easy debugging and modifications before final deployment.

2.5 IoT-Based Street Lighting Control in Smart Cities

- Projects have explored integrating street lighting systems into broader smart city frameworks, demonstrating the scalability and adaptability of NodeMCU-based designs.

CHAPTER 3: PROJECT OVERVIEW

3.1Overview of Project

This project focuses on the design and implementation of an IoT-based street light controller system. The system integrates various components such as a NodeMCU microcontroller, LEDs, and IR sensors. Each component plays a critical role in ensuring the smooth operation of the system:

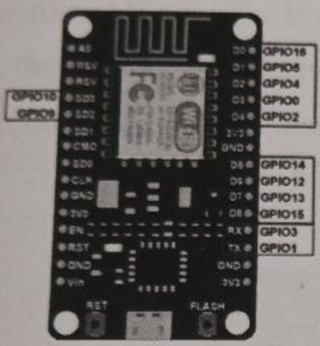
- The NodeMCU microcontroller acts as the central processing and communication unit. It collects data from the IR sensors and adjusts the LED lights accordingly.
- IR sensors detect motion and measure ambient light levels, providing the necessary input for automated control.
- LEDs simulate the functionality of street lights in the prototype, showcasing their ability to dynamically respond to environmental conditions.

The system provides an intelligent solution to energy wastage and safety concerns by optimizing lighting based on real-time data.

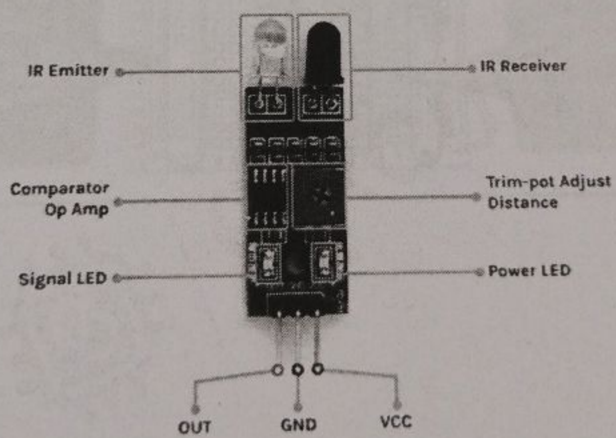
CHAPTER 4: MAIN COMPONENTS

4.1 Components Requirement

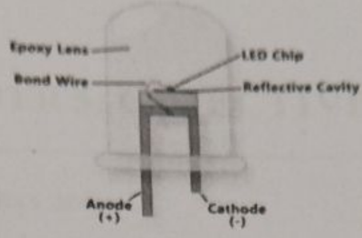
NodeMCU: The NodeMCU microcontroller, equipped with built-in Wi-Fi, serves as the system's brain. It processes data received from the sensors and controls the LEDs, enabling real-time automation and remote management.



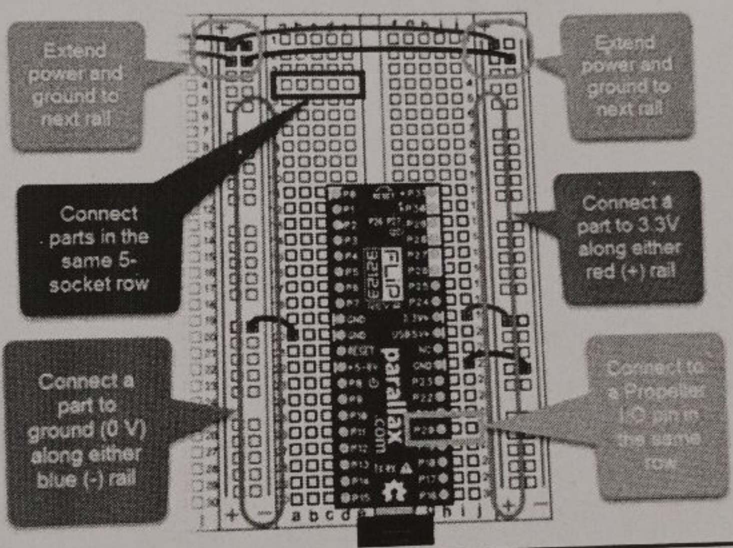
IR Sensor: This sensor detects motion and measures ambient light levels. Its ability to identify changes in the environment triggers the appropriate response from the system, such as turning the lights on, off, or dimming them.



LEDs: Representing the street lights in this prototype, LEDs demonstrate the system's capability to manage light intensity and operational status dynamically.



Breadboard and Wires: The breadboard is used for assembling and testing the prototype. Wires connect the components, forming a complete circuit that facilitates communication between the microcontroller and the sensors.



CHAPTER 5: OBJECTIVES

The primary objectives of the project are:

- To automate the operation of street lights by using IoT-based technology for motion detection and ambient light monitoring.
- To enhance energy efficiency by reducing power consumption during periods of low or no activity.
- To improve urban safety by ensuring that streets are illuminated when needed, especially during high pedestrian or vehicular activity.
- To minimize operational costs and environmental impact by using a sustainable, smart lighting solution.

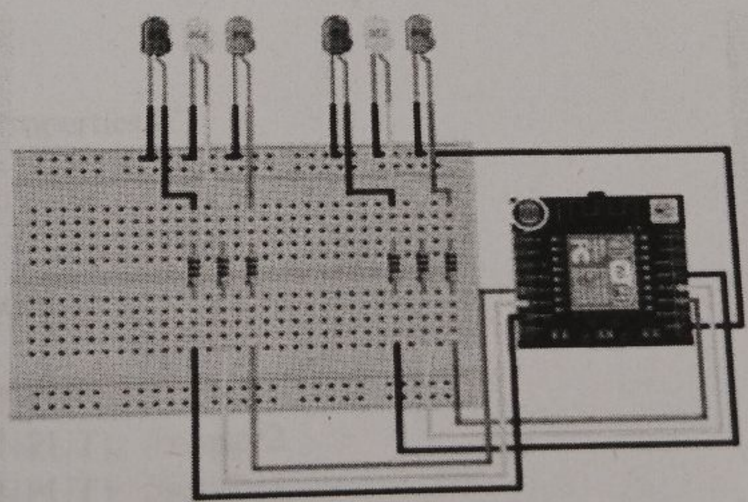
CHAPTER 6: SYSTEM DESIGN

6.1 CIRCUIT DESIGN

The components (NodeMCU, IR sensor, and LEDs) are connected on a breadboard using wires as follows:

- NodeMCU: Connected to the IR sensor and LEDs via GPIO pins.
- IR Sensor: Provides input to NodeMCU to detect light levels or movement.
- LEDs: Act as the output, controlled by the NodeMCU based on sensor inputs.

6.2 SCHEMATIC DIAGRAM



CHAPTER 7: IMPLEMENTATION

7.1 HARDWARE SETUP

- Connect the VCC and GND of the IR sensor to the 3.3V and GND pins of the NodeMCU.
- Connect the OUT pin of the IR sensor to one of the digital input pins (e.g., D1) on the NodeMCU.
- Connect the positive terminal of the LEDs to the digital output pins (e.g., D2) of the NodeMCU, and the negative terminal to the GND.

7.2 SOFTWARE IMPLEMENTATION

Code:

```
#include "thingProperties.h"

void setup() {

 Serial.begin(9600);
 delay(1500);
 pinMode(D1, INPUT);  // sensor1
 pinMode(D2, INPUT);  //sensor2
 pinMode(D3, INPUT);  //sensor3
 pinMode(D4, OUTPUT);  //led1
 pinMode(D5, OUTPUT);  //led2
 pinMode(D6, OUTPUT);  //led3

 initProperties();
 ArduinoCloud.begin(ArduinoIoTPreferredConnection);
 setDebugMessageLevel(2);
 ArduinoCloud.printDebugInfo();
}

void loop() {
```

```
ArduinoCloud.update();

led1 = digitalRead(D1);
if (led1==1)
{
 digitalWrite(D6, 0);}
 else{
  digitalWrite(D6, 1);
 }

led2 = digitalRead(D2);
if (led2==1)
{
 digitalWrite(D5, 0);}
 else{
  digitalWrite(D5, 1);
 }

led3 = digitalRead(D3);
if (led3==1)
{
 digitalWrite(D4, 0);}
 else{
  digitalWrite(D4, 1);
 }
}

void onLedChange()  {}

void onLed1Change()  {}

void onLed2Change()  {}

void onLed3Change()  {}

void onPowerChange()
{
 if (power == 1 )
 {
 digitalWrite(D4, 1);
 digitalWrite(D5, 1);
 digitalWrite(D6, 1);
 }
else
 {
 digitalWrite(D4, 0);
 digitalWrite(D5, 0);
 digitalWrite(D6, 0);
 }}
```

CHAPTER 8: TESTING & EVALUATION

8.1 TESTING

- Test 1: The system was tested by varying the ambient light and simulating motion using the IR sensor. The LED lights successfully turned ON/OFF depending on the sensor input.
- Test 2: Performance was evaluated under different lighting conditions to verify the responsiveness and energy efficiency of the system.

8.2 EVALUATION

The system performed well under testing. It successfully automated the street light control based on sensor data, leading to energy savings and improved public safety. Future improvements may include the integration of multiple sensors and expanding the range of the controller

CHAPTER 9: CONCLUSION

The IoT-based street light controller system represents a significant step towards smarter and more sustainable urban infrastructure. By leveraging real-time sensor data and integrating IoT technology, the system addresses key challenges associated with traditional street lighting, such as energy inefficiency, high operational costs, and limited adaptability.

Through the use of components like NodeMCU, IR sensors, and LEDs, the project successfully demonstrated the automation of street lights based on motion detection and ambient light conditions. The system not only reduces energy consumption but also enhances public safety by ensuring well-lit streets when needed. Additionally, the remote monitoring and control capabilities of the system pave the way for streamlined maintenance and reduced operational overhead.

This project highlights the potential of IoT in optimizing urban utilities and lays the groundwork for future advancements in smart city technologies. The scalability of the system and its applicability in diverse urban settings make it a promising solution for addressing global energy and safety concerns.

References

NodeMCU Documentation: https://nodemcu.readthedocs.io/

IR Sensor Overview: https://www.engineersgarage.com/ir-sensor-working/

ANNEXURE
MPR-1

Component Familiarization and Initial Setup

1. **Activities:**
    - Acquired components (NodeMCU, IR sensor, breadboard, jumper wires, LEDs).
    - Studied specifications and datasheets for NodeMCU and IR sensor.
    - Installed Arduino IDE and set up NodeMCU drivers.
    - Basic coding for LED blinking using NodeMCU.
    - Tested the IR sensor for object detection.
2. **Milestones:**
    - Successfully interfaced NodeMCU with LEDs.
    - Confirmed functionality of IR sensor by detecting motion and printing results in the Serial Monitor.
3. **Challenges:**
    - Calibrating the IR sensor for accurate detection.
    - Troubleshooting NodeMCU driver installation issues

ANNEXURE
MPR-2

System Integration and Prototyping

Activities:

- Connected the IR sensor with NodeMCU to detect motion and trigger LEDs.
- Used jumper wires and breadboard for wiring the components.
- Developed a basic code to light up LEDs when motion is detected.
- Explored and implemented basic Wi-Fi connectivity features.

Milestones:

- Integrated motion detection with lighting control.
- Prototyped a functional circuit on the breadboard.
- Enabled NodeMCU to connect to a local Wi-Fi network.

Challenges:

- Managing power supply fluctuations during testing.
- Understanding and optimizing the IR sensor's range and sensitivity.

Annexure
MPR-3

IoT Features Implementation

Activities:

- Added IoT functionality to the system: remote monitoring and control.
- Configured NodeMCU to send real-time data (motion detected/not detected) to an IoT dashboard (e.g., ThingSpeak or Blynk).
- Implemented a feature to control LEDs remotely via a mobile application or web interface.

Milestones:

- Successfully uploaded data to an IoT platform.
- Demonstrated remote control of LEDs using a smartphone app.
- Enhanced the system's code for stability during continuous operation.

Challenges:

- Ensuring reliable internet connectivity.
- Overcoming latency issues in IoT commands and data updates.

ANNEXURE
MPR-4

Testing, Refinement, and Documentation

1. **Activities:**

   - Conducted rigorous testing of the system in a simulated environment.
   - Refined the code to

ANNEXURE

SELF-EVALUATION OF INTERNSHIP/ PROJECT

onth	Start date – End date (DD/MM/YY) - (DD/MM/YY)	Progress of Internship/ Project
nth- 1	01/08/24 – 31/08/24	Component Familiarization and Initial Setup
nth- 2	01/09/24 – 30/09/24	System Integration and Prototyping
nth- 3	01/10/24 – 31/10/24	IoT Features Implementation
nth- 4	01/11/24 – 19/11/24	Testing, Refinement, and Documentation

Dr. Nookala Venu
Assistant Professor

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