SMART SOLAR-POWERED STREET LIGHTING SYSTEM WITH MOTION DETECTION

A MINI-PROJECT REPORT

Submitted by

KARTHIC S 210701107

KIRAN M 210701122

KOUSHIK H 210701125

in partial fulfilment of the award of the degree

of

BACHELOR OF ENGINEERING

IN

COMPUTER SCIENCE AND ENGINEERING

RAJALAKSHMI ENGINEERING COLLEGE, CHENNAI

RAJALAKSHMI ENGINEERING COLLEGE, CHENNAI

An Autonomous Institute

CHENNAI

APRIL 2024

BONAFIDE CERTIFICATE

Certified that this project **"SMART SOLAR-POWERED STREET LIGHTING SYSTEM WITH MOTION DETECTION"** is the bonafide work of "**KARTHIC S(210701107),KIRAN M(210701122),KOUSHIK H(210701125)"** who carried out the project work under my supervision.

SIGNATURE
Dr. P. Kumar,
HEAD OF THE DEPARTMENT,
Professor and Head,
Computer Science & Engineering
Rajalakshmi Engineering College (Autonomous)
Thandalam, Chennai -602105.

SIGNATURE
Dr.N. Duraimurugan, M,E., Ph.D.
Academic Head, Associate Professor,
Computer Science & Engineering
Rajalakshmi Engineering College (Autonomous)
Thandalam, Chennai -602105.

Submitted for the **ANNA UNIVERSITY** practical examination Mini-Project work viva voce held on __________ _

INTERNAL EXAMINER

EXTERNAL EXAMINER

ACKNOWLEDGEMENT

We express our sincere thanks to our beloved and honourable chairman **MR. S. MEGANATHAN** and the chairperson **DR. M. THANGAM MEGANATHAN** for their

timely support and encouragement.

We are greatly indebted to our respected and honourable principal **Dr. S.N. MURUGESAN** for his able support and guidance.

No words of gratitude will suffice for the unquestioning support extended to us by our head of the department **Dr. P. Kumar** for being ever supporting force during our project work.

We also extend our sincere and hearty thanks to our internal guide **Dr.N.Duraimurugan,M.E., Ph.D** for his valuable guidance and motivation during the completion of this project. Our sincere thanks to our family members, friends and other staff members of information technology.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATION

ABBREVIATION	ACCRONYM
SSLS	Sustainable Solar Lighting System
SPBS	Solar Panels and Bateery Storage
BE	Battery Energy
MD	Motion detection
IR	Sensor Infra-Red Sensor
LCD	Liquid Crystal Display

Abstract

This study explores a sustainable approach to street lighting through the integration of solar panels and battery storage systems. By harnessing solar energy during the day, stored in batteries, street lights are powered during the evening, reducing reliance on conventional grid electricity. The system incorporates an automatic activation mechanism that triggers the street lights to illuminate after sunset, ensuring optimal visibility during nighttime hours. To further enhance energy efficiency, an additional feature has been implemented wherein street lights remain active only in the presence of vehicles or pedestrians on the road, otherwise remaining off. This innovative approach not only addresses the challenge of energy consumption associated with traditional street lighting but also promotes environmental sustainability by utilizing renewable energy sources and minimizing unnecessary illumination. The integration of solar panels and battery storage not only reduces operational costs but also contributes to the reduction of carbon emissions, making it a viable solution for urban lighting infrastructure. The study highlights the importance of adopting smart and energy-efficient technologies in urban development, offering a model for municipalities and urban planners seeking to enhance sustainability in their communities. Future research may focus on optimizing the system for different geographical locations and scaling its implementation to wider urban areas, thus further advancing the transition towards sustainable and smart cities.

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The study explores a sustainable street lighting system using solar panels and battery storage systems. The system uses solar energy during the day and stores it in batteries, reducing reliance on grid electricity. It also features an automatic activation mechanism for optimal visibility during nighttime hours. This innovative approach reduces energy consumption and carbon emissions, making it a viable solution for urban lighting infrastructure. Future research could focus on optimizing the system for different locations.

1.2 SCOPE OF THE WORK

The project involves designing, implementing, and integrating a solar-powered street lighting system. It uses photovoltaic panels to convert sunlight into electricity, which is stored in batteries for later use. The system also features automatic dusk-to-dawn functionality, reducing power consumption during daylight hours. Motion sensors detect vehicle or pedestrian presence, triggering lights only when necessary, minimizing energy wastage and contributing to sustainability efforts.

1.3 PROBLEM STATEMENT

The problem statement entails the development of an energy-efficient street lighting system utilizing solar panels and batteries. The system aims to store solar energy during the day and utilize it to power street lights during the evening, with automatic activation after sunset. Furthermore, an additional feature is required wherein the street lights only illuminate when vehicles or pedestrians are detected on the road, remaining off otherwise. This design seeks to optimize energy consumption, providing illumination precisely when needed while minimizing unnecessary usage.

1.4 AIM AND OBJECTIVES OF THE PROJECT

The project aims to design and implement a solar-powered street lighting system that stores energy in batteries for evening illumination. The system will automatically activate street lights after sunset, ensuring optimal usage of stored energy. A sensor-based mechanism will activate lights only when vehicles or pedestrians are detected, minimizing unnecessary illumination during low activity periods. The project aims to optimize efficiency, ensure reliability, and be cost-effective, balancing initial investment with long-term savings through reduced energy consumption and maintenance costs. This smart, eco-friendly street lighting system will enhance safety and visibility while minimizing energy usage and environmental impact.

CHAPTER 2

LITERATURE SURVEY

Energy efficiency is a key goal of smart cities. In this sense, public lighting installations provide a great variety of energy consumption, as they are turned on all night regardless of whether the considered area is occupied. The main objective of public lighting systems is to achieve safe and comfortable vision at night

Street lighting is a vital aspect of modern city life. It has become commonplace because of a need for continuous and unperturbed movement of people after dusk and before dawn. Beyond the city status elevation and nighttime security enhancement provided by street lighting, the current drive for sustainability in energy utilization has resulted in an increasing demand for high-efficiency light emitting diode (LED) lamps and advanced (data-driven) control systems

Lighting infrastructure is centrally located in city, close to people and activities. It provides excellent opportunity to collect and deliver information and services also beyond lighting. In this paper, we introduce smart lighting control system capable of tracking people movement in urban environment.

Road lighting aims at increasing the available reaction time to unexpected hazards on the road. The earlier the detection, the more time is left for the subsequent subtasks of object identification/classification and avoidance.

To quantify lighting quality, the link between driver's perception and the lighting system is operationalized by photometry. This includes the use of psychophysical models of human visual performance, in order to select the relevant parameters and to set the required performance levels

The increasing design and development of intelligent systems capability of adapting to several parameters in real-time has continued to emerge. Traffic lights in these intelligent systems are designed to literally be adjusted by the traffic itself at any time (i.e., both peak and off peak periods).

CHAPTER 3

SYSTEM SPECIFICATIONS

3.1 HARDWARE SPECIFICATIONS FOR APPLICATION

Processor	:	Pentium IV Or Higher
Memory Size	:	256 GB (Minimum)
HDD	:	40 GB (Minimum)

3.2 SOFTWARE SPECIFICATIONS

Operating System	:	WINDOWS 10 AND PLUS
Application	:	ARDUINO IDE

3.3 HARDWARE COMPONENTS FOR PROTOTYPE

Sensor	:	IR-Sensor
Board	:	Arduino Uno
Actuator	:	Micro Servo Motor 9g
Screen	:	16x2 LCD Display & I2C Module

CHAPTER 4

MODEL DESCRIPTION

Solar Panel Module:

This module comprises photovoltaic panels installed on designated areas to harness solar energy during daylight hours. The panels convert sunlight into electrical energy, which is then stored in a connected battery system for later use.

Battery Storage Module:

This module consists of rechargeable batteries that store the excess energy generated by the solar panels during the day. The stored energy serves as a power reservoir for the street lights during nighttime operations.

Automatic Street Light Control Module:

This module includes sensors or timers programmed to detect sunset times. When the ambient light levels drop below a certain threshold, indicating dusk, this module automatically activates the street lights.

Motion Detection Module:

This module integrates motion sensors strategically placed along the street. These sensors detect the presence of vehicles or pedestrians passing by. When motion is detected, the street lights are triggered to illuminate the area. Conversely, when no motion is detected for a predetermined period, the lights remain off to conserve energy.

Energy Saving Algorithm Module:

This module comprises software algorithms that optimize energy usage. It coordinates the operation of the street lights based on input from the automatic control and motion detection modules. By activating the lights only when necessary, this module helps minimize energy consumption and prolong the battery life.

CHAPTER 5

SYSTEM DESIGN

5.1 FLOW CHART

A flowchart is a type of diagram that represents an algorithm, workflow or process. The flowchart shows the steps as boxes of various kinds, and their order by connecting the boxes with arrows. This diagrammatic representation illustrates a solution model to a given problem.

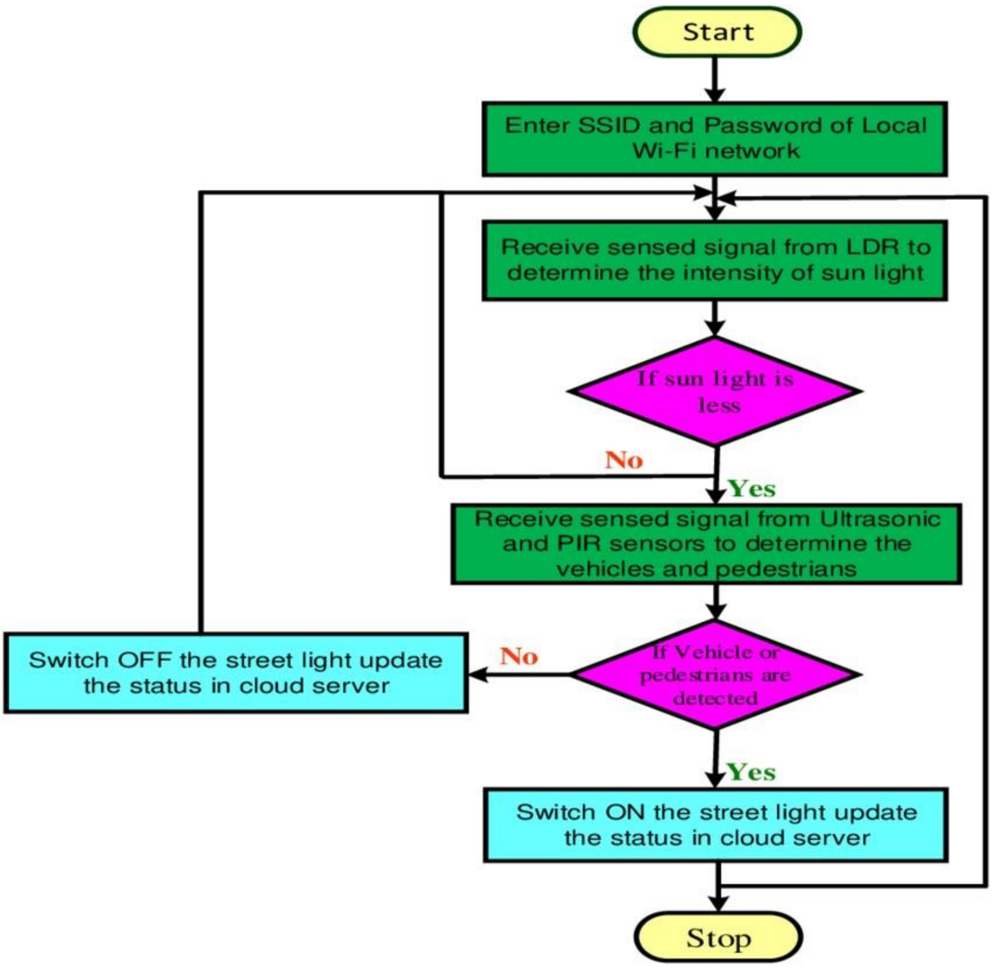

Figure 5.1 Flow Chart

5.2 CIRCUIT DIAGRAM

The circuit diagram explains the connections made with the hardware components and the board. The Arduino uno is connected with the breadboard as the VCC and GND are connected with the rails. The Sensors, LCD and Servo motor is given connection with the rails and the other input/output pins are connected to digital as per the requirements.

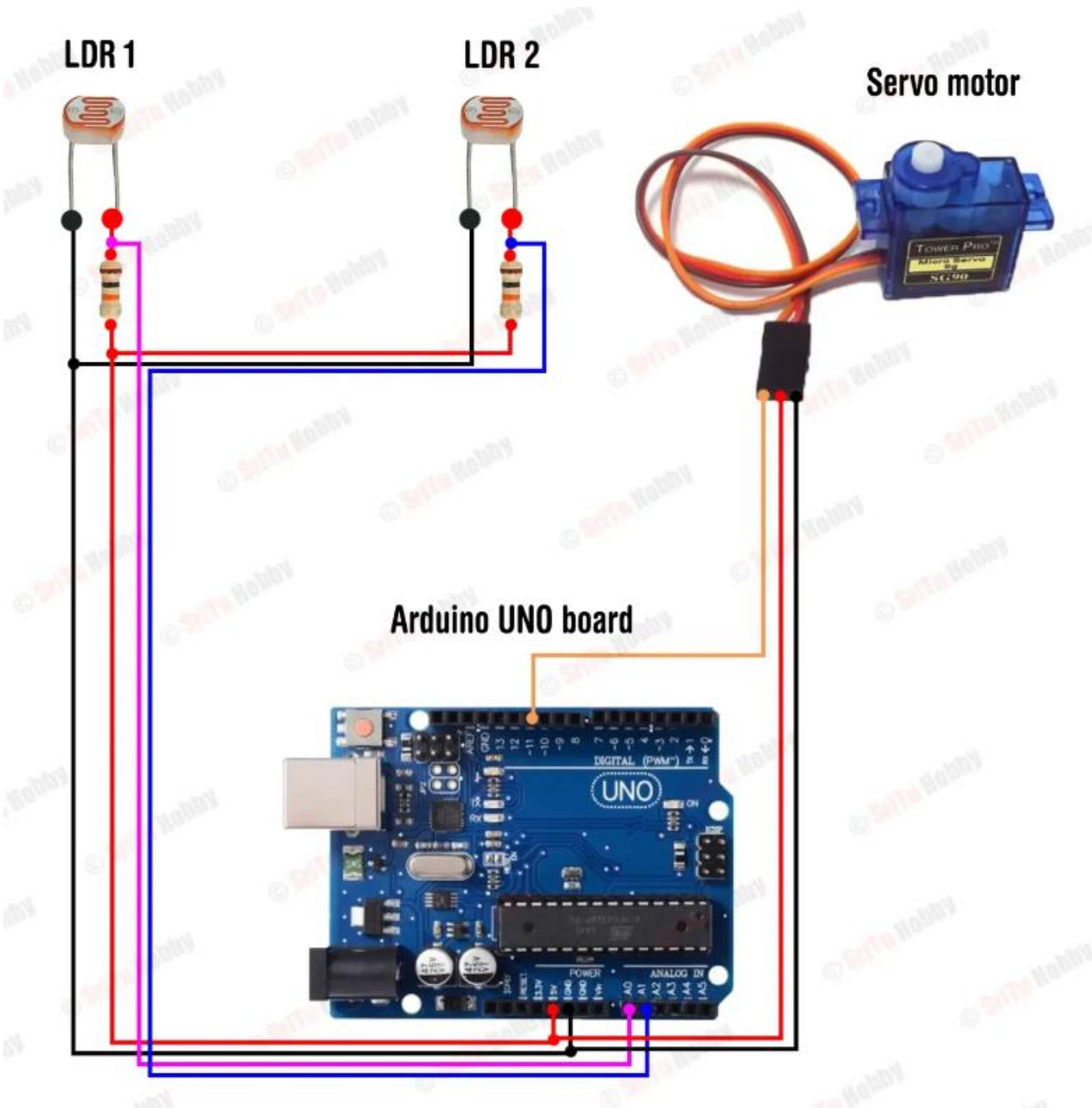

Figure 5.2 Circuit diagram

From the above figure 5.2, the connections are made

CHAPTER 6

CODING

```
/*Solar tracking system
   https://srituhobby.com
*/

//Include the servo motor library
#include <Servo.h>
//Define the LDR sensor pins
#define LDR1 A0
#define LDR2 A1
//Define the error value. You can change it as you like
#define error 10
//Starting point of the servo motor
int Spoint =  90;
//Create an object for the servo motor
Servo servo;

void setup() {
//Include servo motor PWM pin
  servo.attach(11);
//Set the starting point of the servo
  servo.write(Spoint);
  delay(1000);
}
```

```
void loop() {
//Get the LDR sensor value
  int ldr1 = analogRead(LDR1);
//Get the LDR sensor value
  int ldr2 = analogRead(LDR2);

//Get the difference of these values
  int value1 = abs(ldr1 - ldr2);
  int value2 = abs(ldr2 - ldr1);

//Check these values using a IF condition
  if ((value1 <= error) || (value2 <= error)) {

  } else {
    if (ldr1 > ldr2) {
      Spoint = --Spoint;
    }
    if (ldr1 < ldr2) {
      Spoint = ++Spoint;
    }
  }
//Write values on the servo motor
  servo.write(Spoint);
  delay(80);
}
```

CHAPTER 7

SCREEN SHOTS

1. CONNECTION

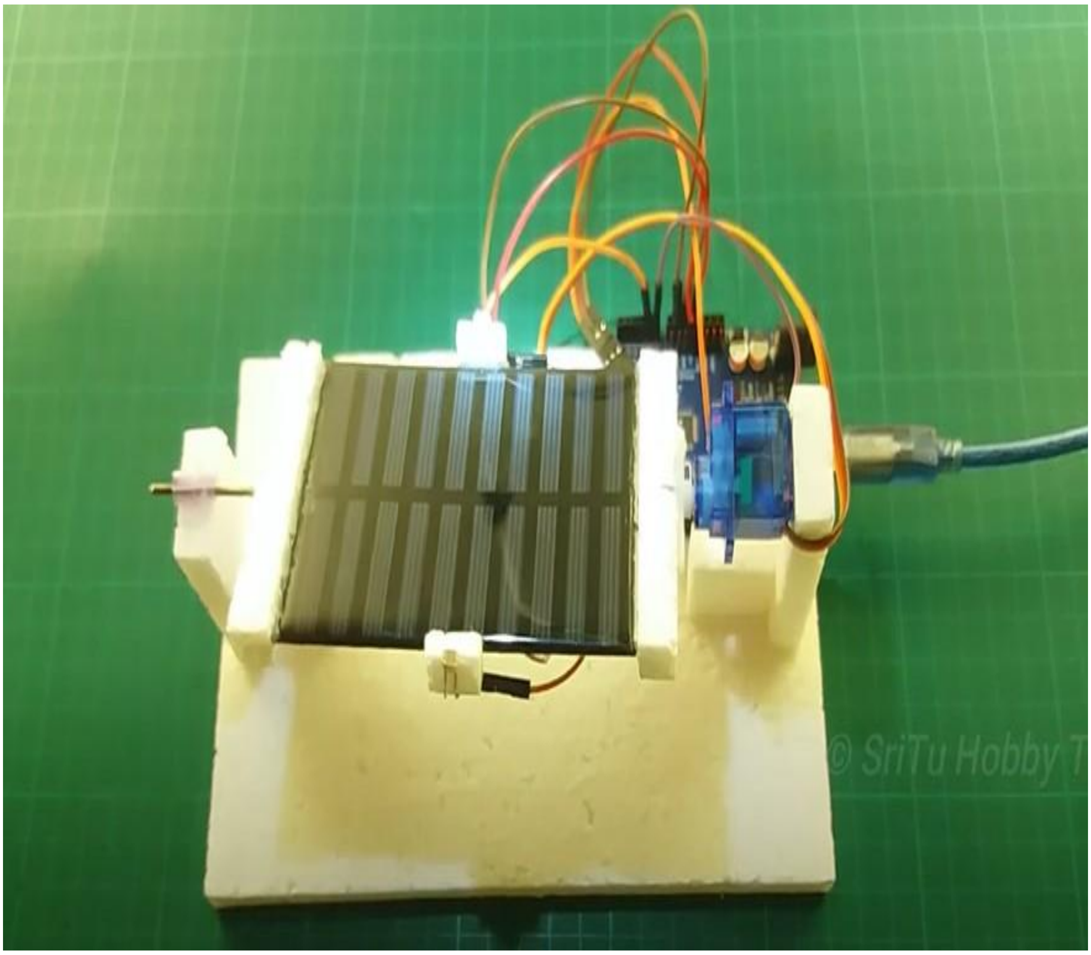

Figure 7.1 Connection Setup

The proposed system uses solar panels to convert solar energy into electrical energy, which is stored in a battery and used to power street lights during the evening hours. Sensors detect natural light decreases, triggering lights to turn on automatically. Motion sensors strategically placed along the road enable street lights to remain on only when there is activity, conserving energy and enhancing safety in urban environments.

CHAPTER 8

CONCLUSION AND FUTURE ENHANCEMENT

In conclusion, the integration of solar panels with street lights, coupled with energy storage in batteries, presents a sustainable and efficient solution for illuminating roads during the evening hours. This system not only harnesses renewable energy but also utilizes it intelligently by automatically activating the street lights after sunset. Additionally, the incorporation of sensors to detect the presence of vehicles or pedestrians further optimizes energy usage by ensuring that the lights remain off when not needed.

Looking ahead, there are several avenues for enhancing this system. One potential improvement could involve refining the sensor technology to increase accuracy and responsiveness, thereby minimizing instances of unnecessary illumination. Furthermore, incorporating smart algorithms could enable dynamic adjustments in lighting intensity based on real-time traffic or pedestrian flow, optimizing energy consumption even further. Additionally, exploring ways to integrate connectivity features could allow for remote monitoring and control, facilitating maintenance and enhancing overall system reliability. Overall, by continually innovating and refining such systems, we can pave the way for more sustainable and efficient urban lighting solutions in the future.

REFERENCES

1)Chiradeja, P., & Yoomak, S. (2023, November 1). Development of public lighting system with smart lighting control systems and internet of thing (IoT) technologies for smart city. Energy Reports. https://doi.org/10.1016/j.egyr.2023.10.027

2)Akindipe, D., Olawale, O. W., & Bujko, R. (2022, September 1). Techno-Economic and Social Aspects of Smart Street Lighting for Small Cities – A Case Study. Sustainable Cities and Society. https://doi.org/10.1016/j.scs.2022.103989

3)Juntunen, E., Sarjanoja, E. M., Eskeli, J., Pihlajaniemi, H., & Österlund, T. (2018, September 1). Smart and dynamic route lighting control based on movement tracking. Building and Environment. https://doi.org/10.1016/j.buildenv.2018.06.048

4)Mayeur, A., Brémond, R., & Bastien, J. C. (2010, May 1). Effects of the viewing context on target detection. Implications for road lighting design. Applied Ergonomics/Applied Ergonomics. https://doi.org/10.1016/j.apergo.2009.10.002

5)Osigbemeh, M., Onuu, M., & Asaolu, O. (2017, February 1). Design and development of an improved traffic light control system using hybrid lighting system. Journal of Traffic and Transportation Engineering/Journal of Traffic and Transportation Engineering. https://doi.org/10.1016/j.jtte.2016.06.001