Smart indoor lighting system
with
motion detection and mobile app control

Group Members:

Registration Number	Name
UOG01024051	Lakmi Jayanetti
UOG01024048	Sandithi Perera
UOG01024014	Methmi Anjana
UOG01024028	Nimsara Kavishi
UOG01024011	Kavishi Pramodya

LNBTI

Final project report submitted to the LNBTI, Sri Lanka in partial fulfillment of the requirements of the University of Greenwich - BSc (Hons) Computing and BSc (Hons) Information Systems.

Declaration

We declare that this thesis is our work and has not been submitted in any form for another degree or diploma at any university or other institution of higher education. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

Name of Student (s) Signature of Student (s)

Date:

Name of supervisor: Signature of Supervisor

Date:

Dedication

This report is dedicated to LNBTI,

all the lecturers who encouraged us to build up this project

and all those who helped to make this project a success.

Acknowledgment

We sincerely thank our lecturers at the Department of Computing, LNBTI for their guidance and support throughout this project.

We also appreciate all of our team members for their dedication and collaboration, our parents for their unwavering support, and our friends for their encouragement and valuable feedback.

Thank you all for your contributions to the success of this project.

Abstract

Lighting control in smart homes is crucial for energy efficiency and convenience. This project introduces an automated smart home lighting system that integrates a Passive Infrared (PIR) sensor, Arduino Uno, and the Blynk app. The system detects motion and controls indoor lighting accordingly.

The main objective is to automate lighting based on occupancy, reducing energy wastage while providing manual control via a mobile app. Traditional lighting systems require manual operation, which can be inconvenient and inefficient. This system ensures lights turn on when someone enters a room and turn off when no movement is detected for a set duration. Additionally, users can control the lights remotely through the Blynk app.

The system design prioritizes affordability and ease of integration into existing home environments. Testing confirmed its ability to enhance energy efficiency, provide user convenience, and support remote operation through the mobile application.

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Chapter 1

1 Introduction

1.1 Aims and Objectives

Aim:
Develop an automated lighting system using IoT to improve energy efficiency and user convenience in indoor spaces.

Objectives:

- Automate lighting based on motion detection.
- Enable remote control and monitoring through the Blynk app.
- Reduce energy wastage by turning off lights when no motion is detected.

1.2 Motivation

Traditional lighting systems require manual operation, leading to unnecessary energy consumption when lights are left on. This project aims to develop an intelligent system that optimizes lighting based on occupancy, ensuring energy efficiency and convenience.

1.3 Method

The system uses a PIR motion sensor to detect movement, an Arduino Uno for processing, and the Blynk app for remote control. When the PIR sensor detects motion, the light turns on; when no movement is detected for a specified time, the light turns off automatically.

1.4 Overview

The smart lighting system is designed for indoor use and integrates IoT technology to provide an efficient and user-friendly lighting solution. It supports both automatic and manual control via a mobile app.

Chapter 2

2 Background and Problem Statement

2.1 Introduction

Managing home lighting efficiently can be challenging, especially when lights are left on unintentionally. This project addresses the need for an automated system that enhances convenience while reducing electricity costs.

2.2 Literature Review

Existing smart lighting solutions often focus on large-scale automation but lack affordability and simple home-use integration. This project aims to bridge that gap by providing a cost-effective, easy-to-install system.

2.3 Problem Statement

Traditional lighting systems are inefficient and require manual operation. There is a need for an intelligent lighting solution that automatically responds to room occupancy while offering remote control options.

Chapter 3

3 project management

3.1 Introduction

Effective project management ensures the successful development and implementation of the smart home lighting system.

3.2 Approach

The project follows an iterative development approach, focusing on hardware and software integration with continuous testing.

3.3 Initial Project Plan

3.4 Problems and Changes to the Plan

Challenges such as sensor sensitivity adjustments and mobile app connectivity were addressed during development.

Chapter 4

4 Proposed Solution

4.1 Introduction

The solution provides an energy-efficient lighting system that operates based on occupancy detection and manual control via a mobile application.

4.2 Solution

The smart lighting system:

- Uses a PIR sensor to detect motion and control the light accordingly.
- Integrates an Arduino Uno for processing and automation.
- Allows manual operation through the Blynk app for remote access.

Chapter 5

5 Analysis and Design

5.1 Introduction

This section outlines the feasibility, design, and requirements of the system.

5.2 Feasibility study

- **Time Feasibility:** The project was completed within one month, including testing.
- **Cost Feasibility:** The system uses affordable components like PIR sensors and Arduino Uno.
- **Scope Feasibility:** The system can be adapted to various home environments.
- **Technical Feasibility:** IoT components ensure reliable automation.
- **Economic Feasibility:** By reducing unnecessary energy consumption, the system lowers electricity costs.

5.3 Requirement Gathering for the Design Phase

- **Hardware:** PIR sensor, Arduino Uno, relay module, LED bulb.
- **Software:** Blynk app for remote control and monitoring.

5.4 Hardware and software requirements

- **Hardware:** PIR motion sensor, Arduino Uno, relay module.
- **Software:** Blynk app, Arduino IDE (for coding).

5.5 Designing Process of the System (System design diagrams, User Interface designs)

- Motion detection triggers light activation.
- Integration with the Blynk app for manual control.
- Timer-based light deactivation when no movement is detected.

5.6 Evaluating solutions

The system was tested against traditional lighting methods to ensure efficiency and reliability.

Chapter 6

6 Implementation

6.1 Introduction

Implementation involves the integration of hardware and software components to achieve a fully functional smart lighting system.

6.3 Implementation Environment & Development Tools

- **Hardware:** PIR sensor, Arduino Uno, relay module.
- **Software:** Blynk app, Arduino IDE.

Chapter 7

7 Testing

7.1 Introduction

Testing ensures system functionality and reliability.

7.2 Test plan

- Test PIR sensor accuracy and responsiveness.
- Validate remote control functionality via the Blynk app.

7.3 Test Cases

- Light turns on when motion is detected.
- Light turns off when no motion is detected for a specific time.
- User can manually turn the light on/off via the Blynk app.

Chapter 8

8 Conclusion & Further Work

8.1 Introduction

The project demonstrates how IoT can enhance home automation for better energy management and user convenience.

8.2 How the process was carried out?

Development included iterative hardware-software integration and continuous testing.

8.3 Critical Appraisal

Strengths:

- Simple and cost-effective solution.
- Reliable automation and remote control features.

Challenges:

- Sensor sensitivity required fine-tuning for optimal performance.

8.4 Further work

Future improvements may include:

- Integration with voice assistants like Google Assistant or Alexa.
- Advanced motion detection to distinguish between humans and pets.
- Customizable lighting settings based on user preferences.

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