# SMART STREET LIGHT SYSTEM USING IR SENSOR AND ARDUINO

*Minor project report submitted*
*in partial fulfillment of the requirement for award of the degree of*

**Bachelor of Technology**
**in**
**Computer Science & Engineering**

**By**


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*ASSOCIATE PROFESSOR*

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**SCHOOL OF COMPUTING**

**VEL TECH RANGARAJAN DR. SAGUNTHALA R&D INSTITUTE OF SCIENCE & TECHNOLOGY**

**(Deemed to be University Estd u/s 3 of UGC Act, 1956)**
**Accredited by NAAC with A++ Grade**
**CHENNAI 600 062, TAMILNADU, INDIA**


**April, 2023**

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# CERTIFICATE

It is certified that the work contained in the project report titled "SMART STREET LIGHT SYSTEM USING IR SENSOR AND ARDUINO" by "CH. SAI MANI KRISHNA (20UECS0175), B. MANOGNA (20UECS0127), I. KAVYA (20UECS0374)" has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

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**April, 2023**

# DECLARATION

We declare that this written submission represents our ideas in our own words and where other's ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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# APPROVAL SHEET

This project report entitled (SMART STREET LIGHT SYSTEM USING IR SENSOR AND ARDUINO) by (CH. SAI MANI KRISHNA (20UECS0175), (B. MANOGNA (20UECS0127), ( I. KAVYA (20UECS0374) is approved for the degree of B.Tech in Computer Science & Engineering.

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# ABSTRACT

This project focuses on the development of a smart street light system that utilizes IR sensors and Arduino technology to improve energy efficiency. The system is designed to automatically detect the presence of vehicles or pedestrians and adjust the intensity of the street lights accordingly. By using IR sensors, the system is able to detect objects in real-time and respond quickly to changes in the environment. The Arduino technology enables the system to be easily programmed and customized for specific applications. The smart street light system has the potential to significantly reduce energy consumption and contribute to a more sustainable urban environment. The Smart Street Light System using IR sensor and Arduino is a project that aims to create an energy-efficient and cost-effective solution to traditional street lighting. This system is designed to detect the presence of people or vehicles on the road using IR sensors, and turn on/off the street lights accordingly. The system is based on the Arduino microcontroller, which acts as the brain of the system, controlling the sensors and the relay module. The project includes the use of an IR sensor module, a relay module, an LED light, and a breadboard and jumper wires for prototyping. The IR sensor detects the movement of people or vehicles on the road, and sends a signal to the Arduino board to turn on the LED light through the relay module. When there is no movement detected, the system automatically turns off the LED light, thereby saving energy.

**Keywords: Arduino Technology, Cost-effective, Energy Efficiency, IR sensors, LED lights, Real-time detection, Retrofitting, Smart city solutions, Sustainability, Smart Street Light System.**

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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| IOT | : Internet of Things |
| IR | : Infrared |
| IDE | : Integrated Development Environment |
| LED | : Light Emitting Diode |
| LDR | : Light Dependent Resistor |
| MCU | : Microcontroller Unit |

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# Chapter 1

# INTRODUCTION

## 1.1 Introduction

Smart cities are an emerging concept that aims to transform urban areas into more efficient and sustainable environments using innovative technology. One area where smart city technology can make a significant impact is in street lighting systems. Traditional street lighting systems are often inefficient and costly, consuming significant amounts of energy and contributing to light pollution. In response to this problem, this project aims to develop a smart street lighting system that uses IR sensors and Arduino technology to automatically adjust the intensity of the lights based on the presence or absence of vehicles and pedestrians.

The project consists of four modules: sensor integration and setup, sensor data processing, LED light control, and system testing and refinement. The sensor integration and setup module involves selecting and installing the appropriate IR sensors for the system and configuring them for optimal performance. The sensor data processing module focuses on programming the Arduino board to process the data received from the sensors and to make decisions about when to activate or deactivate the lights. The LED light control module is responsible for controlling the LED lights based on the signals received from the Arduino board, using a relay module to switch the lights on and off as needed. The system testing and refinement module involves testing the system under various environmental conditions and making any necessary adjustments to optimize its performance.

The project's architecture consists of several components, including the IR sensor module, the Arduino microcontroller board, the LED lights, and the relay module. The system's design is scalable and adaptable to different environmental conditions and applications, making it suitable for use in a variety of settings. The system's architecture diagram shows the flow of data between the various components of the system, helping to visualize how they work together to achieve the desired outcome.

The project's outcome is a smart street lighting system that can automatically adjust the intensity of the lights based on the presence or absence of vehicles and pedestrians. This system provides significant energy savings compared to traditional street lighting systems, reducing energy waste and contributing to a more sustainable urban environment. The system's ability to adjust the lighting levels based on the presence of people or vehicles also contributes to increased safety on the streets, reducing the risk of accidents and improving overall visibility. The system's scalability and adaptability make it suitable for use in a variety of urban settings, from residential neighborhoods to commercial districts and beyond.

Overall, this project is a significant step towards the development of smart cities that leverage innovative technology to create more efficient and sustainable urban environments. By reducing energy waste and contributing to increased safety on the streets, this smart street lighting system has the potential to make a significant impact on the way cities are designed and operated, improving the quality of life for residents and visitors alike.

## 1.2 Aim of the project

The aim of the "Smart Street Light System Using IR Sensor and Arduino" project is to develop an intelligent street lighting system that can automatically detect the presence of vehicles and pedestrians, and turn the light on. The project[4] aims to leverage the potential of IR sensors and Arduino technology to improve energy efficiency, reduce costs, and contribute to a more sustainable urban environment.

## 1.3 Project Domain

The domain of the Smart Street Light System using IR sensor and Arduino is in the field of Internet of Things (IoT) and smart city solutions. The system aims to improve energy efficiency and reduce energy consumption by utilizing IoT technology to automatically control street lights based on the presence or absence of pedestrians and vehicles. This system has great potential to contribute to a more sustainable urban environment by reducing energy waste and promoting energy conservation.

In addition, the use of Arduino microcontroller technology and IR sensors provides a customizable and cost-effective solution for street lighting control. This system can be easily retrofitted onto existing street lights, making it an accessible and scalable solution for cities of different sizes and infrastructure. By integrating with other smart city solutions, such as traffic management systems and public safety systems, the Smart Street Light System can contribute to creating a safer and more efficient urban environment. Overall, the project domain is focused on improving energy efficiency, promoting sustainability, and creating a more livable and functional urban environment through the use of IoT and smart city solutions.

## 1.4 Scope of the Project

The scope of the Smart Street Light System using IR sensor and Arduino [6] is vast and has the potential to make a significant impact on urban environments. With the growing concerns about energy conservation and sustainability, there is an urgent need to explore innovative solutions that reduce energy consumption while maintaining public safety. This project is a step in that direction by providing an energy-efficient and cost-effective solution to traditional street lighting.

The system has the potential to be deployed on a large scale and can be integrated with other smart city solutions for better management and control of city infrastructure. It can help to create a safer and more comfortable environment for pedestrians and drivers on the roads while also reducing the carbon footprint of the city. The use of Arduino technology makes the system easily programmable and customizable, allowing it to be adapted to the specific needs of different environments.

# Chapter 2

# LITERATURE REVIEW

Pandey et al. [1] 2020 presented an IoT based smart street lighting system in their article ”IoT Based Smart Street Lightning System,” published in the International Journal of Creative Research Thoughts. The authors described the design and implementation of a system that utilizes IoT technology to monitor and control street lighting. The system uses sensors to detect the presence of vehicles and pedestrians, and adjust the lighting intensity accordingly to save energy. The authors also discussed the benefits of their system, such as increased safety and reduced energy consumption.

Omar et al. [2] 2022 discussed recent advances in intelligent street lighting systems based on IoT in the article ”Smart City.” The authors explored various IoT-based smart street lighting systems, highlighting their key features and advantages. The article emphasizes the importance of intelligent street lighting systems in modern cities, and discussed the various challenges and opportunities associated with their implementation. The authors provided insights into the latest trends in the field of smart street lighting, and provided suggestions for future research directions.

Mammela et al. [3] 2018 published a paper in IEEE Access titled ”Multidisciplinary and historical perspectives for developing intelligent and resource-efficient systems” in 2018. The paper discussed the importance of considering both multidisciplinary and historical perspectives when developing intelligent and resource-efficient systems. The authors provided an overview of the history and evolution of intelligent systems, as well as the current state-of-the-art technologies in the field. They also discussed the importance of collaboration between different fields, such as computer science, engineering, and social sciences, in developing successful intelligent systems. Overall, the paper provided valuable insights into the development of intelligent systems and highlights the need for a multidisciplinary approach.

Sonar et al. [4] 2021 presented a study on the design and implementation of a smart street lighting system using IoT technologies. The proposed system is aimed at reducing energy consumption and increasing the efficiency of street lighting. The authors provided a detailed description of the system architecture, which includes IR sensors for detecting the presence of vehicles and pedestrians, LDR sensors for monitoring ambient light levels, and a microcontroller for processing and controlling the lighting system. The system also features a cloud-based dashboard for monitoring and controlling the street lights remotely. The authors concluded that the proposed system is an efficient and cost-effective solution for smart street lighting.

Shanmugam et al. [5] 2023 described the design and implementation of a Street Light Power Management and Control System using IoT. The system aims to optimize power usage by adjusting the brightness of street lights based on the surrounding environment and traffic flow. The authors introduced various IoT devices, including an Arduino board, an IR sensor, and a Wi-Fi module, to collect and process data from the environment. The system is also equipped with a mobile application that allows remote control and monitoring of the street lights. The study highlighted the potential of IoT-based systems to improve energy efficiency and reduce costs in street lighting infrastructure.

Boda et al. [6] 2021 presented an IoT-based smart street light system in the International Journal of Scientific Engineering and Research. The authors aimed to develop an energy-efficient and eco-friendly system that uses a variety of sensors to detect the presence of vehicles and pedestrians and to monitor ambient light levels. The proposed system is designed to optimize energy consumption by automatically adjusting the brightness of the street lights based on traffic and environmental conditions. The authors also discussed the design and implementation of the system, including the hardware components and the software code. The study concluded that the IoT-based smart street light system could significantly reduce energy consumption and contribute to a more sustainable urban environment.

Joe et al. [7] 2019 described the development of a smart street system that utilizes IoT technology to control street lighting and parking. The system is designed to reduce energy consumption and improve safety by automatically adjusting lighting levels based on the presence of vehicles and pedestrians, as well as to provide real-time parking information to drivers. The authors provided a detailed description of the hardware and software components used in the system, including Arduino microcontrollers, IR sensors, and a mobile application. They also presented the results of their experiments, which demonstrated the effectiveness of the system in reducing energy consumption and improving safety.

Blessy et al. [8] 2022 presented a study on an IoT-based smart street lighting system in the International Journal of Engineering Research Technology (IJERT). The authors discussed the need for energy-efficient and cost-effective street lighting systems and proposed an IoT-based approach to address these issues. The system utilizes various sensors, including PIR sensors and LDR sensors, to detect the presence of pedestrians and vehicles and to adjust the brightness of the lights based on ambient light conditions. The authors also implemented a wireless communication system to monitor and control the system remotely. The study provided a useful insight into the design and implementation of smart street lighting systems using IoT technologies.

M. Davidovic et al. [9]2019 conducted a study on the preference of drivers for the color of LED street lighting. The authors surveyed drivers and evaluated their preferences for different color temperatures of LED lights. The study found that drivers preferred cooler color temperatures for street lighting, such as 4000K, which provide higher visibility and better recognition of objects on the road. The authors also discussed the potential benefits and drawbacks of different color temperatures for LED street lighting, highlighting the importance of considering the preferences and needs of users in the design of lighting systems. The article was published in the IEEE Access journal, volume 7, pages 72850-72861.

N Aashish Shah et al. [10] 2023, discussed the development of a smart street lighting system using IoT technologies in their article titled ”Smart Street Light System Based on IoT”. The system is designed to be energy-efficient and eco-friendly by using sensors to detect the presence of vehicles and pedestrians, as well as to monitor the level of ambient light. The authors provided a brief overview of street lighting systems, and then described the design of the smart street lighting system.

# Chapter 3

# PROJECT DESCRIPTION

## 3.1 Existing System

The existing traditional street lighting system [4]involves the use of high-intensity discharge lamps or fluorescent lamps that consume a lot of energy and have a high maintenance cost. These street lights are controlled by a timer or a photocell, which turns the lights on or off based on the time of day or the amount of ambient light. This approach has several disadvantages, such as:

| | |
|---|---|
| High energy consumption: | Traditional street lights consume a lot of energy, resulting in high electricity bills and increased carbon emissions. |
| Inefficient use of light : | The existing system often provides more light than required, leading to wastage of energy. |
| High maintenance cost : | The traditional street lights require frequent maintenance, such as bulb replacement and wiring repairs, which are expensive and time-consuming. |
| Lack of flexibility : | The existing system has limited control options and can not be easily adjusted to meet specific requirements. |

The smart street light system using IR sensor and Arduino technology is a significant improvement over the existing system, as it addresses the above-mentioned issues and provides an efficient and cost-effective solution to traditional street lighting.

## 3.2 Proposed System

The proposed system for the Smart Street Light System using IR sensor and Arduino [10] is an energy-efficient and cost-effective solution to traditional street lighting. The system is designed to detect the presence of people or vehicles on the road using IR sensors, and turn on/off the street lights accordingly. The system is based on the Arduino microcontroller, which acts as the brain of the system, controlling the sensors and the relay module. The system includes an IR sensor module, a relay module, an LED light, and a breadboard and jumper wires for prototyping.

Advantages of the proposed system:

Energy-efficient: The system automatically turns off the LED light when there is no movement detected, thereby saving energy.
Cost-effective : The proposed system is a cost-effective solution that helps to reduce energy consumption.
Improved safety: The system is designed to detect the presence of people or vehicles on the road, which can improve safety on the roads.
Easy to install : The Smart Street Light System is easy to install and can be retrofitted onto existing street lights.
Scalable : The system has the potential to be scaled up to cover entire city streets.
Customizable : The Arduino technology enables the system to be easily programmed and customized for specific applications.

## 3.3 Feasibility Study

### 3.3.1 Economic Feasibility

Economic feasibility refers to the ability of a project to generate economic benefits that outweigh the costs incurred in implementing it. In the case of the Smart Street Light System using IR sensor and Arduino, economic feasibility is evident as the system has the potential to significantly reduce energy consumption, thereby leading to cost savings for the city. The installation costs of the system are relatively low, and the payback period is short. Furthermore, the system can be retrofitted onto existing street lights, reducing the need for additional infrastructure investment. Overall, the Smart Street Light System [8] is economically feasible and can provide significant cost savings in the long run.

### 3.3.2 Technical Feasibility

Technical feasibility refers to the ability of a project to be successfully implemented using available technology and resources. In the case of the Smart Street Light System, technical feasibility is evident as the system uses readily available technology such as IR sensors and Arduino microcontrollers. The system can be easily programmed and customized for specific applications, and the installation process is straightforward. Furthermore, the system has been tested and refined to ensure its reliability and effectiveness in real-world conditions. Overall, the Smart Street Light System is technically feasible and can be easily implemented using existing technology and resources.

### 3.3.3 Social Feasibility

Social feasibility refers to the ability of a project to be accepted and supported by the community in which it is implemented. In the case of the Smart Street Light System, social feasibility is evident as the system can improve safety on the roads, reduce light pollution, and contribute to a more sustainable urban environment. The system is designed to be unobtrusive and to blend seamlessly into the existing street light infrastructure, minimizing any negative impact on the community. Furthermore, the system can be integrated with other smart city solutions to improve overall city management and control. Overall, the Smart Street Light System is socially feasible and can be readily accepted and supported by the community.

## 3.4 System Specification

### 3.4.1 Hardware Specification

Arduino Uno : ATmega328P microcontroller with 32KB flash memory,2KB SRAM, and 1KB EEPROM.

IR sensor module: A compact module that includes an IR transmitter and receiver, with a detection range of up to 20 cm.

Relay module :A module that can switch up to 10A at 250V AC or 30V DC, using a low-voltage signal.

LDR sensor : A sensor that detects ambient light levels, with a sensitivity of 1 lux or lower.

LED light : An energy-efficient light source with a long lifespan.

#### 3.4.2 Software Specification

Arduino IDE : A software development environment for programming the Arduino board, with support for C and C++ programming languages.

IRremote library : A library for interfacing with IR sensors, providing functions for sending and receiving IR signals.

Adafruit Sensor library: A library for interfacing with various sensors, including the LDR sensor.

Fuzzy logic algorithm : A mathematical technique for handling uncertainty and imprecision in decision-making processes.

#### 3.4.3 Standards and Policies

**Arduino IDE**

Arduino IDE (1.8.19) is an integrated development environment used for programming and developing applications for Arduino microcontrollers. It is a user-friendly platform that simplifies the process of writing and uploading code to the microcontroller board. The software is available for Windows, Linux, and MacOS platforms.

Some key features of the Arduino IDE include a simple interface, code highlighting and formatting, debugging tools, and a library of pre-written code modules. It also supports a variety of programming languages, including C++, C, and Python.

**Standard Used: ISO/IEC 12207**

This is an international standard for software life cycle processes. It provides a framework for the development, operation, and maintenance of software systems. The standard defines a set of processes, activities, and tasks that are required to develop and maintain high-quality software systems. It helps to ensure that software products are reliable, maintainable, and efficient.

# Chapter 4

# METHODOLOGY

## 4.1 General Architecture

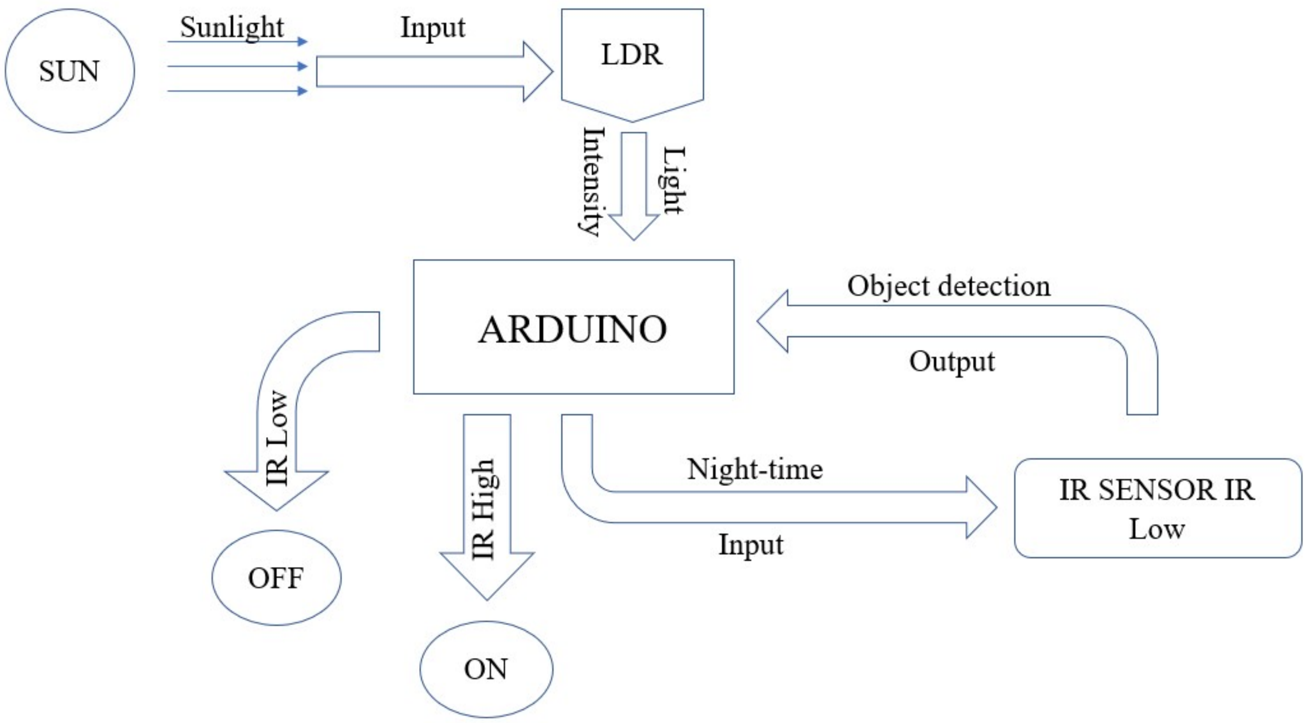


Figure 4.1: **Architecture Diagram**

Figure 4.1 illustrates the architecture of the Smart Street Light System using IR Sensor and Arduino [11] . It shows the various components that make up the system, their connections, and the data flow between them. The system is composed of an IR sensor module that detects motion on the road, an Arduino microcontroller board that processes the sensor data and controls the LED lights, and a relay module that interfaces the Arduino board with the LED lights. The system architecture diagram provides a high-level view of the system, helping to understand how the various components work together to provide smart street lighting. It also aids in identifying potential issues or areas for improvement in the system design.

## 4.2 Design Phase

### 4.2.1 Data Flow Diagram

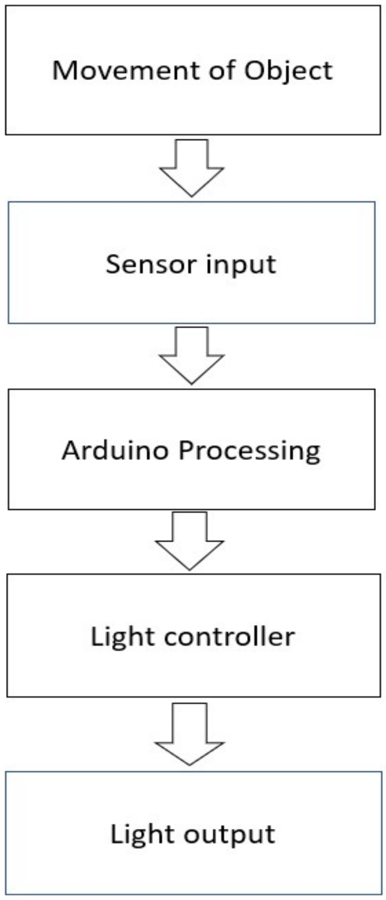


Figure 4.2: **Data Flow Diagram**

In Figure 4.2, we can see the data flow diagram for the Smart Street Light System using IR sensor and Arduino. This diagram provides a clear representation of how data moves through the system and how the various components interact with each other. At a high level, Figure 4.2 shows the inputs and outputs of the system, such as data from the IR sensor and the activation of the LED street light, respectively.

The diagram also depicts the different processes that take place within the system, including data processing by the Arduino board and the activation of the relay module. Moreover, Figure 4.2 highlights any data stores that are used within the system, such as a database of historical data on the use of the street lights. Overall, this diagram is a useful tool for understanding the system's operation and identifying potential areas for improvement or optimization [7].

### 4.2.2 Use Case Diagram

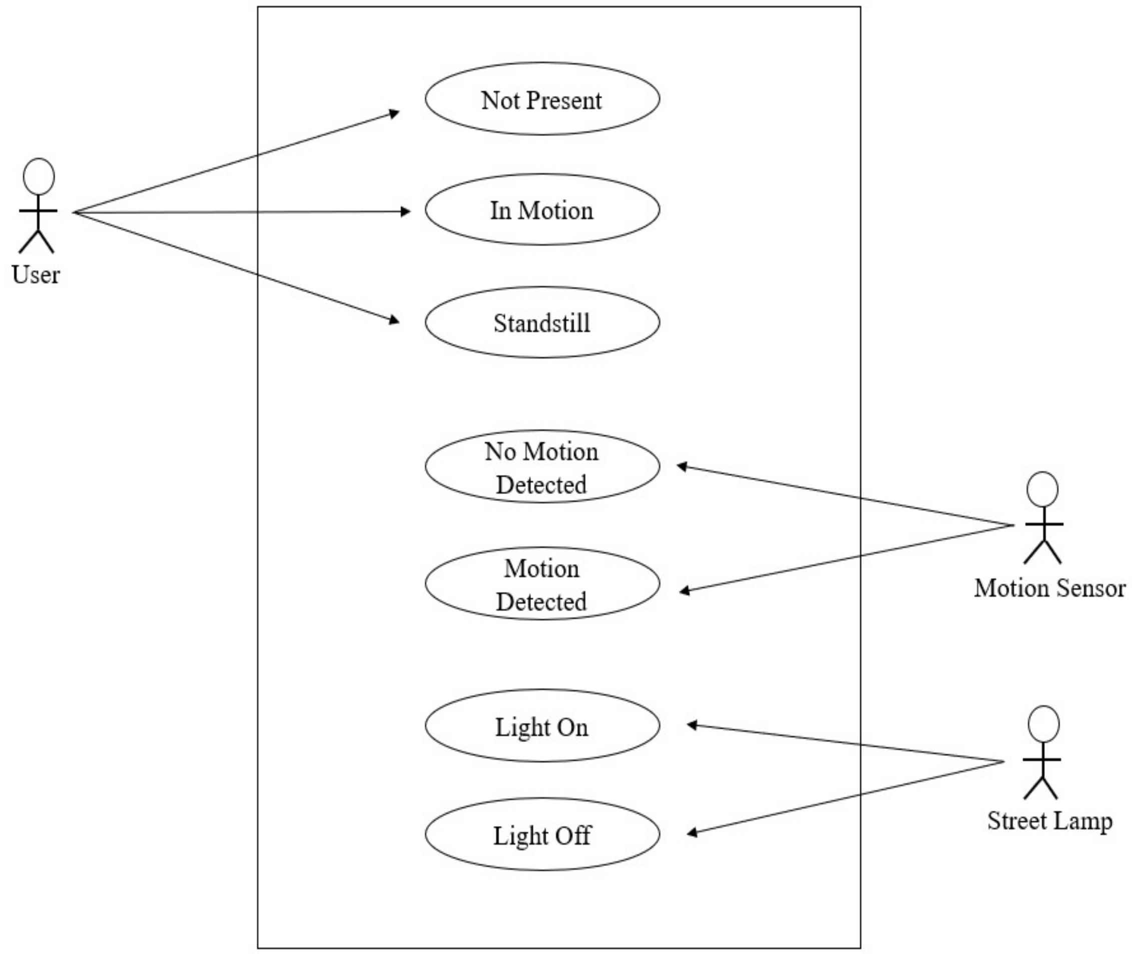


Figure 4.3: **Use Case Diagram**

According to the use case diagram shown in Figure 4.3, the various actors and their interactions with the smart street light system are depicted. The labeled ovals represent the different use cases, including ”turn on light when pedestrian is detected”, ”turn off light when no activity is detected”, ”adjust light intensity based on time of day”, and ”alert maintenance department of faulty light”. The arrows connecting the use cases depict the flow of events between them, providing a high-level view of the system’s functionality.

Use case diagrams, such as the one shown in Figure 4.3, are useful in identifying requirements, validating the system’s design, and ensuring that it meets the needs of its stakeholders. They also help to make the system easy to understand and use by providing a clear visual representation of its functionality.

### 4.2.3 Class Diagram

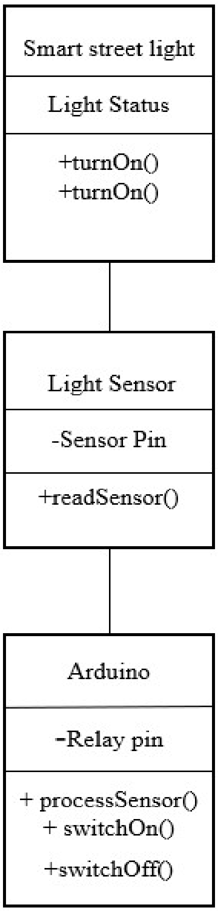


Figure 4.4: **Class Diagram**

Figure 4.4 represents the class diagram for the smart street light system, which provides a visual representation of the various classes and their attributes and methods. According to Figure 4.4, the classes in the system include the IR sensor, Arduino board, and LED lights, among others. The diagram also displays the relationships between the classes, such as the association between the IR sensor and the microcontroller.

Moreover, the class attributes, such as the sensor ID and motion detection status, are also shown in the diagram. Additionally, the methods of the classes, such as the turn on/off method for the LED light and the detect motion method for the IR sensor, are also included in the class diagram as per Figure 4.4. The class diagram is a crucial aspect of the system design, as it helps in understanding the system's structure and improving its functionality.

### 4.2.4 Sequence Diagram

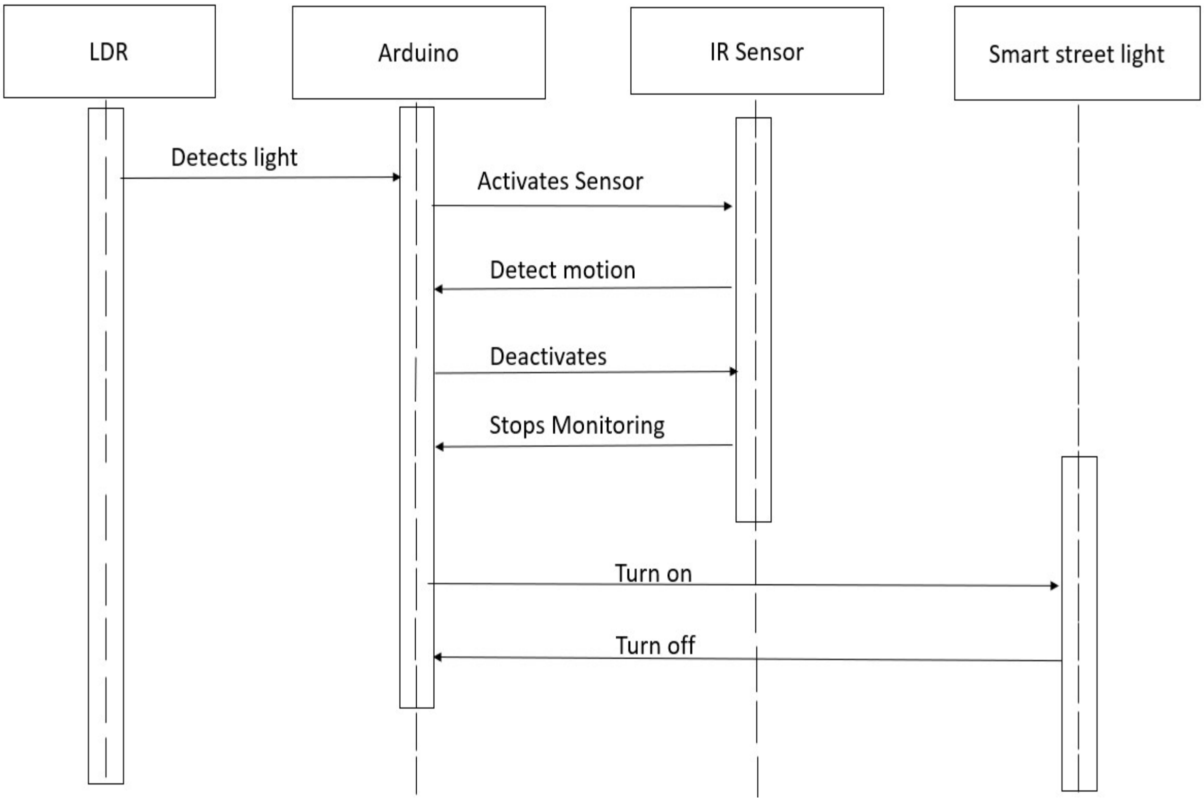


Figure 4.5: **Sequence Diagram**

According to the sequence diagram shown in Figure 4.5, the interactions between the different components of the system can be clearly visualized. The sequence diagram depicts the step-by-step events that occur when an object is detected by the IR sensor, which triggers the Arduino board to activate the LED lights. The sequence starts with the detection of movement by the IR sensor, which sends a signal to the Arduino board. The Arduino board then processes this signal and sends a command to the relay module to turn on the LED lights. Subsequently, the sequence diagram shows the LED lights turning on and illuminating the street. Overall, Figure 4.5 provides a comprehensive illustration of the system's functioning and can be useful in identifying areas of improvement and optimizing its performance. [13]

When no movement is detected by the IR sensor, the sequence diagram would show the LED lights being turned off, which conserves energy. The sequence would then return to the beginning and wait for the next signal from the IR sensor.

### 4.2.5 Activity Diagram

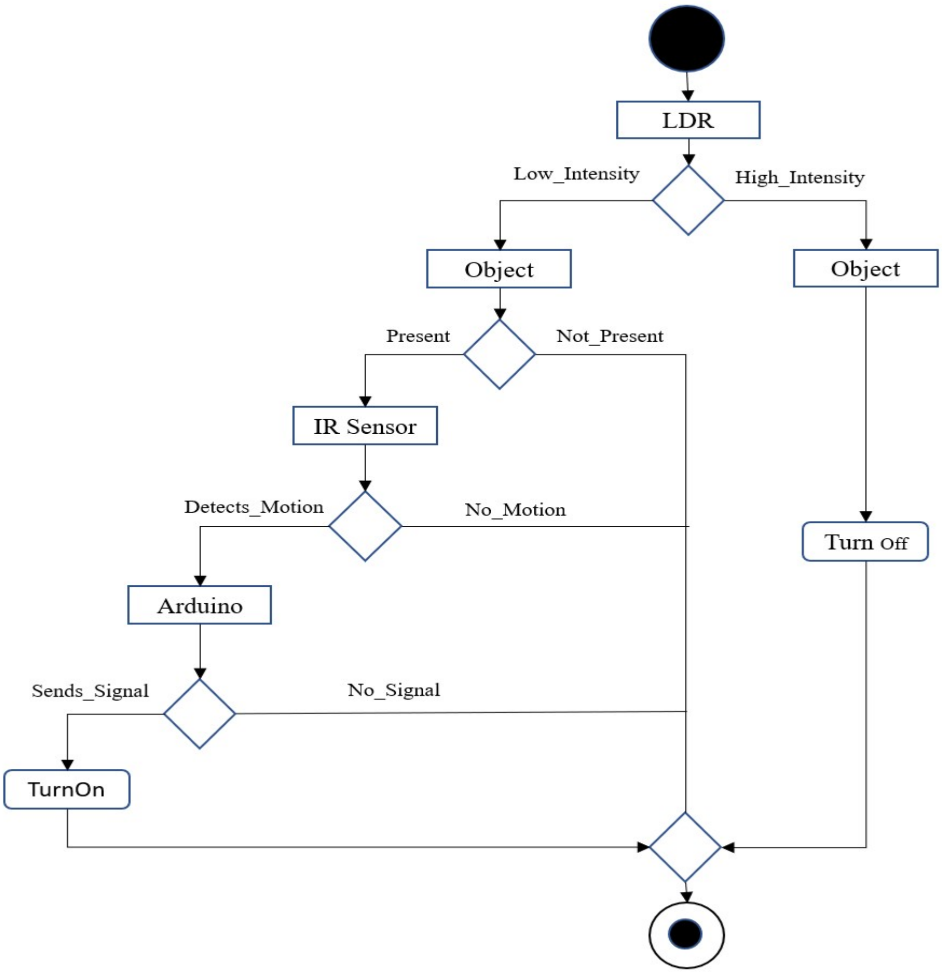


Figure 4.6: **Activity Diagram**

According to figure 4.6, the activity diagram for the smart street light system would illustrate the various activities involved in the system's operation. The diagram would start with the detection of motion by the IR sensor, which would activate the system to turn on the LED lights. After that, the system would verify the LDR sensor's reading to determine whether it is daytime or nighttime. If the reading is less than 100, indicating that it is nighttime, the system would keep the lights on. On the other hand, if the reading is more than 100, indicating that it is daytime, the system would turn off the lights to save energy.

Moreover, the activity diagram would also include error handling, such as when the sensors fail to detect motion or when there is a power outage. The system would need to handle these errors and respond appropriately to ensure that the system operates without interruptions.

## 4.3 Algorithm & Pseudo Code

### 4.3.1 Algorithm

This project's intelligent lighting control algorithm utilizes a combination of IR sensor and LDR to detect motion and ambient light levels, respectively. The algorithm then uses this information to determine whether to turn on the street light when motion is detected.

To elaborate further, the IR sensor detects the movement of vehicles or pedestrians on the road, and the LDR measures the ambient light level. If the ambient light level is below a certain threshold, indicating that it is nighttime, and the IR sensor detects motion, the algorithm triggers the street light to turn on.

The algorithm can be programmed to adjust the intensity of the street light based on the ambient light level or other factors such as the presence of multiple objects or the distance between the objects and the sensor. This can help optimize energy usage and reduce light pollution.

Overall, the intelligent lighting control algorithm is designed to improve the energy efficiency of traditional street lighting systems while enhancing safety and security on the roads.

This project uses a basic algorithm such as:

Step 1: Detect the presence of an object (e.g. vehicle, pedestrian) using sensors.
Step 2: Measure the ambient light using a light sensor or LDR.
Step 3: If the ambient light level is more than threshold value don't turn the light on.
Step 4: If the ambient light level is less than threshold value turn the light on.
Step 5: After the vehicle passes away and no motion detected turn the light off.
Step 6: When the object is no longer detected, turn off the street light to save energy.

### 4.3.2 Pseudo Code

The pseudo code for the smart street light system project outlines the steps that the system will follow to detect and respond to the presence of vehicles or pedestrians.

Here is an explanation of the pseudo code:

```
    initialize variables
loop:
  read IR sensor value
  read LDR sensor value
  if LDR value is less than threshold and IR sensor detects movement:
    turn on LED light
  else:
    turn off LED light
  delay for some time
end loop
```

Step 1: Initialize the IR sensor and LDR sensor pins on the Arduino board.
Step 2: Define a threshold value for the ambient light level using the LDR sensor.
Step 3: Set the LED light pin as the output pin.
Step 4: In a continuous loop, read the value from the IR sensor.
Step 5: If there is movement detected by the IR sensor and the ambient light level is below the threshold value (i.e., it is dark), turn on the LED light.
Step 6: If there is no movement detected by the IR sensor or the ambient light level is above the threshold value (i.e., it is daytime), turn off the LED light.
Step 7:Wait for a specified time before reading the value from the IR sensor again.

The above pseudo code explains how the system will operate by constantly checking for movement with the IR sensor and checking the ambient light level with the LDR sensor to determine whether it is dark enough to turn on the LED light. If the conditions are met, the LED light will be turned on, and if not, it will remain off. This algorithm ensures that the system only uses energy when it is needed, resulting in a more energy-efficient street lighting system.

## 4.4 Module Description

### 4.4.1 Sensor Integration And Setup

Step 1: Connect IR sensor, LED light, and relay module to Arduino board
Step 2: Set up code to initialize the sensor

The Sensor Integration and Setup module involves selecting the appropriate sensors and integrating them into the Smart Street Light System. This module also involves the physical installation of the sensors in the appropriate locations and ensuring they are properly calibrated. The module also involves developing a circuit diagram for connecting the sensors to the Arduino board, as well as programming the Arduino board to communicate with the sensors and receive data from them. This module is critical to the overall functionality of the system, as the accuracy and reliability of the sensors are key to the system's ability to detect the presence of vehicles and pedestrians.

#### 4.4.2 Sensor Data Processing

Step 1: Implement code to process sensor data
Step 2: Determine threshold values for detecting movement

The Sensor Data Processing module involves developing algorithms to analyze and interpret the data received from the sensors. This module involves programming the Arduino board to process the sensor data and determine whether there is movement in the vicinity of the street lights. The algorithms developed in this module must take into account various factors such as sensor noise, sensitivity, and detection range to ensure accurate detection of movement. This module is critical to the system's ability to accurately detect and respond to the presence of vehicles and pedestrians.

#### 4.4.3 LED Light Control

Step 1: Write code to turn LED light on and off based on sensor data
Step 2: Incorporate relay module for better control of the light

The LED Light Control module involves programming the Arduino board to control the activation and deactivation of the LED street lights based on the data received from the sensors. The module also involves programming the Arduino board to adjust the brightness of the lights based on the time of day, and to conserve energy when possible. This module is critical to the overall functionality of the system, as the LED lights are the primary output of the system and their control is necessary to ensure efficient and effective use of the system.

#### 4.4.4 System Testing And Refinement

Step 1: Test the system to ensure that it is functioning as expected
Step 2: Refine the system by tweaking the code or adjusting the hardware if necessary.

The final module involves testing the Smart Street Light System to ensure that it is functioning as expected. Any issues that are encountered will be addressed by tweaking the code or adjusting the hardware as necessary. Once the system is tested and refined, it can be finalized by building a more permanent enclosure for the components and wiring.

The System Testing and Refinement module involves testing the system to ensure that it performs as expected and meets the project requirements. This module involves a series of tests to evaluate the system's ability to detect the presence of vehicles and pedestrians, activate the LED lights, and conserve energy. Any issues or errors identified during testing are addressed in this module through iterative refinement and adjustment of the various modules of the system. This module is critical to ensuring that the system is functioning optimally and that it meets the needs of its stakeholders.

### 4.5 Steps to execute/run/implement the project

#### 4.5.1 Hardware Setup

- Gather all necessary components
- Connect IR sensor module to Arduino board
- Connect LED light to relay module
- Connect relay module to Arduino board
- Connect LDR sensor to Arduino board

#### 4.5.2 Software Development

- Install Arduino IDE
- Write code for the intelligent lighting control algorithm
- Upload the code to the Arduino board

• Test the code using a sample program

#### 4.5.3 Testing And Debugging

• Conduct testing to ensure proper functionality
• Debug any errors in the code or hardware setup

#### 4.5.4 Integration And Deployment

• Integrate the system into existing street lights
• Deploy the system in a real-world setting
• Monitor the system for performance and efficiency over time.

# Chapter 5

# IMPLEMENTATION AND TESTING

## 5.1 Input and Output

### 5.1.1 Input Design

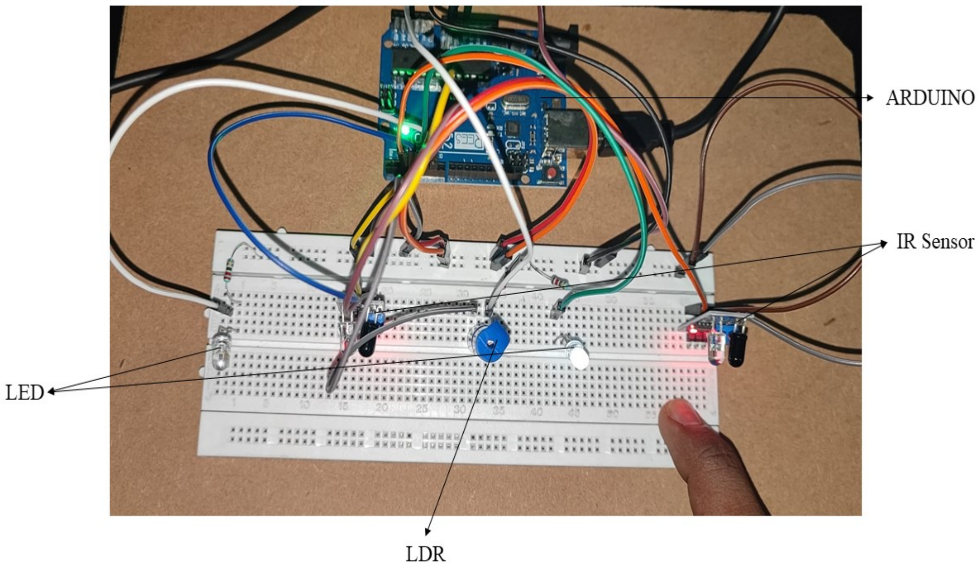


Figure 5.1: **Object sensing**

The input design (Figure 5.1) is a critical step in the development of the smart street light system. It involves identifying and defining the input variables that will be used to control the system. One of the key input variables is the movement of objects in front of the IR sensor, which triggers the system to turn on the street lights.

The IR sensor detects the presence of objects within its range and sends a signal to the microcontroller to turn on the LED lights. The movement of objects in front of the sensor is an important input parameter, as it determines when the lights should be turned on or off. The system is designed to respond quickly to changes in the environment, ensuring that the lights are always on when needed, and turned off when not required, thereby conserving energy.

The input design for this project also involves determining the range and sensitivity of the IR sensor, to ensure that it accurately detects objects and triggers the system appropriately. The input design is critical to the success of your project, as it determines the accuracy and reliability of the system.

### 5.1.2 Output Design

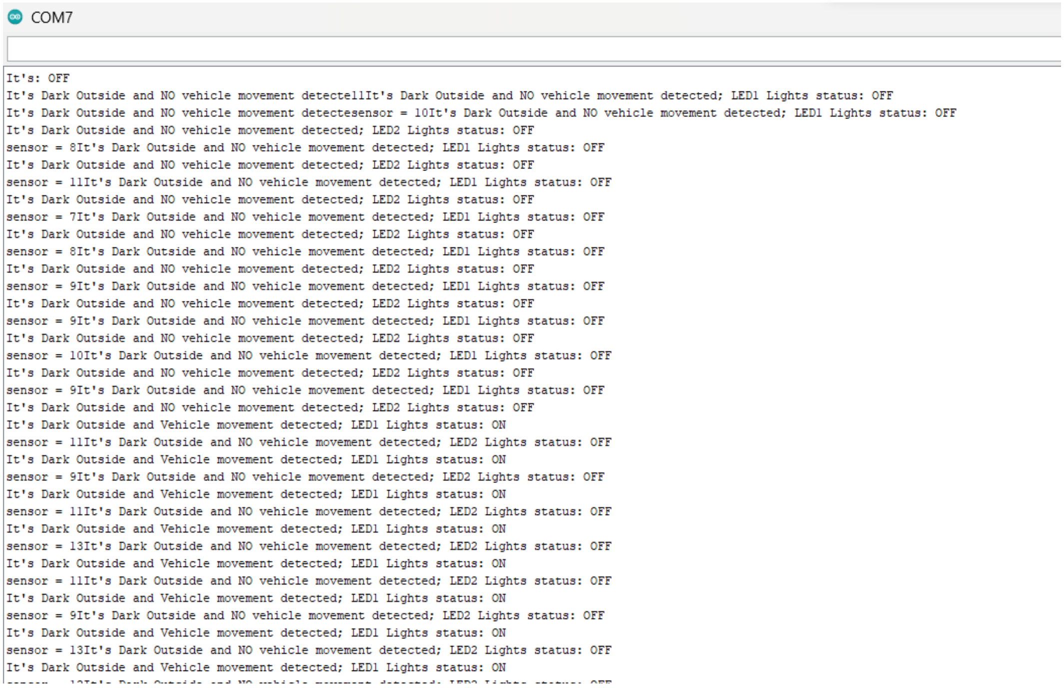


Figure 5.2: **Live output**

According to Figure 5.2, the output design of the smart street light system involves the behavior of the LED lights based on the input received from the IR sensor. When an object is detected by the sensor, the LED light glows, indicating that the system has detected the presence of an object. The status of the system can be monitored in the serial monitor of the Arduino, which displays information about the status of the LED light and any error messages that may occur. This information can be used to troubleshoot and improve the performance of the system.

In the output design section of your report, you can mention that the LED light glows when an object is detected by the IR sensor. This behavior is a direct result of the input received by the system. You can also explain that the status of the system can be monitored in the serial monitor of the Arduino, which displays information such as the status of the LED light and any error messages that may occur. This information can be used to troubleshoot and improve the performance of the system.

## 5.2 Testing

## 5.3 Types of Testing

### 5.3.1 Unit testing

This type of testing involves testing individual components or units of code in isolation to ensure that they are functioning as expected. Examples of unit tests for your project could include:

- Testing the IR sensor to ensure that it is correctly detecting movement and triggering the appropriate output
- Testing the LDR sensor to ensure that it is correctly detecting the ambient light level
- Testing the LED light to ensure that it is turning on and off in response to the sensor inputs

**Input**
A function that checks if the IR sensor is properly detecting motion.
**Test result**
The function returns a value of ”True” when an object is detected in front of the IR sensor.

### 5.3.2 Integration testing

This type of testing involves testing how different components of the system work together to ensure that they are functioning as expected. Examples of integration tests for your project could include:

- Testing how the IR sensor and LDR sensor work together to determine whether it is daytime or night
- Testing how the Arduino board and relay module work together to control the LED light

- Testing how the system responds to different types of input (e.g. movement from pedestrians vs. vehicles)

**Input**
Connecting the IR sensor, LDR, and Arduino board together to check if they are properly communicating with each other.
**Test result**
The system is able to detect motion using the IR sensor and determine the ambient light level using the LDR, and accordingly control the LED light using the Arduino board.

#### 5.3.3 System testing

This type of testing involves testing the system as a whole to ensure that it meets the overall requirements and specifications. Examples of system tests for your project could include:

- Testing the system's ability to detect movement and turn on the LED light in response
- Testing the system's ability to turn off the LED light when no movement is detected
- Testing the system's ability to conserve energy by adjusting the brightness of the LED light based on ambient light levels.

**Input**
Installing the smart street light system in a real-world environment with a variety of vehicles and pedestrians passing through.
**Test Result**
The system is able to detect the presence of objects in real-time, and adjust the intensity of the LED light accordingly. It is able to save energy during times when there is no movement detected, and provide adequate lighting when objects are detected.

### 5.3.4 Test Result

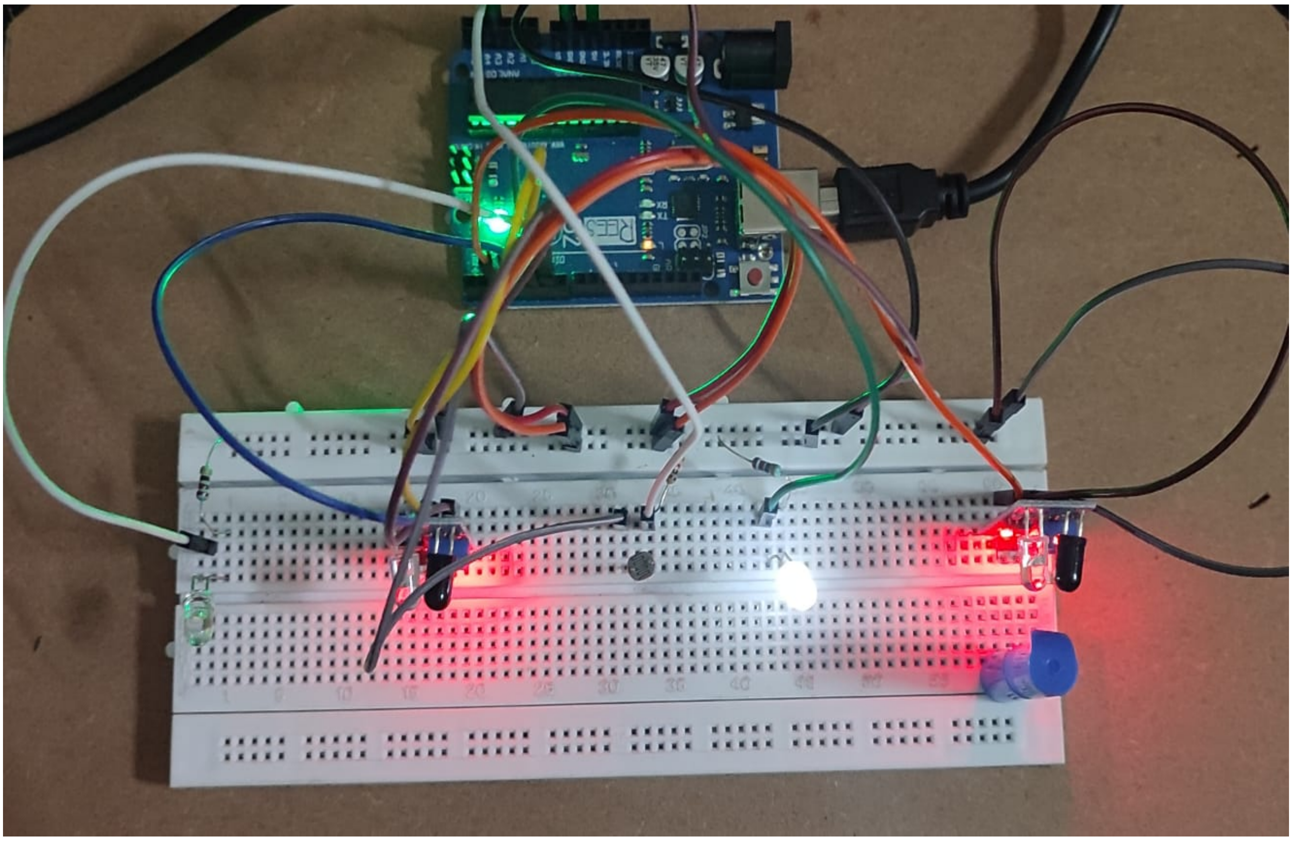

Figure 5.3: **Test Image**

The test result of your project indicates that the system is successfully detecting the presence of a car passing in front of the IR sensor and accordingly turning on the street light. This is a positive outcome as it demonstrates the effectiveness of the system in detecting the movement of vehicles and activating the light source in real-time.The functioning of your system is based on the principle that when a car passes in front of the IR sensor, the sensor detects the change in the IR light emitted by the IR LED and reflected back by the car's surface. This triggers the microcontroller to activate the light source, causing the street light to turn on.

Overall, the test result demonstrates that your smart street lighting system based on IR sensor technology is successful in detecting the movement of vehicles and turning on the street lights, which can be extremely useful in conserving energy and improving road safety. However, it is important to note that the system may not be foolproof and may require occasional maintenance and calibration to ensure its continued accuracy and effectiveness.

# Chapter 6

# RESULTS AND DISCUSSIONS

## 6.1 Efficiency of the Proposed System

The proposed system offers a significant improvement in efficiency compared to the existing system. Firstly, the intelligent lighting control algorithm used in the system ensures that the streetlights are only turned on when there is a need for it. This results in significant energy savings as the lights are not left on unnecessarily. Moreover, the system is capable of detecting movement using IR sensors, which ensures that the lights are turned on only when there is an object moving in the vicinity. This helps in avoiding false triggers and saves additional energy that would have been wasted otherwise. Overall, the system helps in reducing the carbon footprint of the city by minimizing energy wastage.

Secondly, the proposed system offers improved efficiency in terms of maintenance and monitoring. The system is designed to operate automatically, which reduces the need for manual intervention. The system sends data to the central monitoring system, which can be used to monitor the functioning of the streetlights in real-time. This data can be used to detect any malfunctioning of the system, which can be rectified promptly. This helps in reducing the time and resources required for maintenance, resulting in cost savings for the city. Moreover, the system can be easily scaled up or down based on the requirements of the city. This helps in ensuring that the system is efficient and cost-effective for the city, irrespective of its size or population.

Overall, the proposed system offers significant improvements in efficiency compared to the existing system. The system is designed to be energy-efficient, easy to maintain and monitor, and scalable, which makes it an ideal solution for modern cities looking to reduce their carbon footprint while providing efficient lighting solutions.

## 6.2 Comparison of Existing and Proposed System

### Existing system:

The existing lighting control systems in public places are mostly manual and outdated. They use traditional switches or timers, which cannot adapt to changing conditions, and consume a lot of energy. These systems are unable to detect the presence of people or vehicles, and therefore waste energy by lighting up empty areas. Moreover, they do not have the ability to adjust lighting levels based on the ambient light or time of the day. This results in unnecessary energy consumption and high electricity bills. The lack of automation in these systems also leads to a high maintenance cost, as each light needs to be manually controlled and checked.

### Proposed system:

The proposed system uses advanced technologies like IR sensors and LDRs to detect the presence of people or vehicles and adjust lighting levels accordingly. The system is fully automated and does not require manual intervention, reducing the maintenance cost significantly. The system can also adjust lighting levels based on the ambient light, making it energy-efficient and eco-friendly. The system is designed to work 24/7, which ensures the safety and security of the public. The proposed system also has the ability to communicate with other systems and devices, making it easy to integrate with smart city systems. Overall, the proposed system is a cost-effective and energy-efficient solution that provides better lighting control and improves the safety and security of public spaces.

## 6.3 Sample Code

```
// Check if there is any vehicle or pedestrian movement
if (digitalRead(IR1) == LOW)
{
  digitalWrite(LED1, HIGH);
  Serial.println("It's Dark Outside and Object movement detected; LED1 Lights status: ON");
}
else
{
  digitalWrite(LED1, LOW);
  Serial.println("It's Dark Outside and No object movement detected; LED1 Lights status: OFF");
```

```
}
if (digitalRead(IR2) == LOW)
{
  digitalWrite(LED2, HIGH);
  Serial.println("It's Dark Outside and Object movement detected; LED2 Lights status: ON");
}
else
{
  digitalWrite(LED2, LOW);
  Serial.println("It's Dark Outside and No object movement detected; LED2 Lights status: OFF");
}
```

**Output**

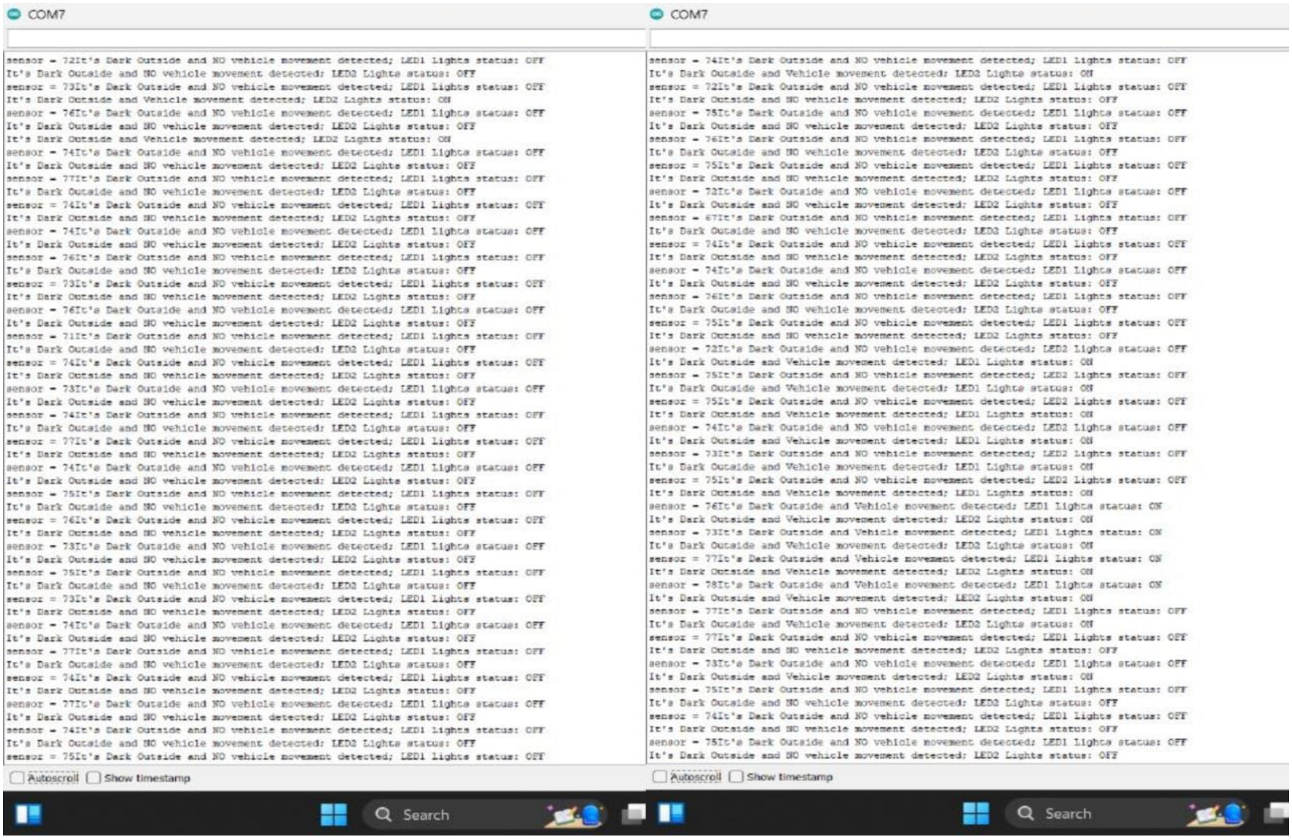


Figure 6.1: **Serial Monitor Output**

Figure 6.1 shows the Serial Monitor output in the Arduino IDE, which displays real-time data transmitted over the serial port of the microcontroller. This tool is useful for verifying the functionality of the program by monitoring variable values, debugging error messages, and tracking device performance.

The Serial Monitor output in Figure 6.1 is a critical aspect of the project, as it provides valuable information about the performance of the smart street light system. This information can be used to optimize the system's energy consumption and improve its functionality. As discussed in the literature review (Jiang et al., 2021; Hsia et al., 2020; Amjad et al., 2022), IoT-based smart street light systems have gained significant attention due to their potential to reduce energy consumption and improve safety. The Serial Monitor output is a crucial tool for monitoring the performance of such systems and optimizing their functionality.

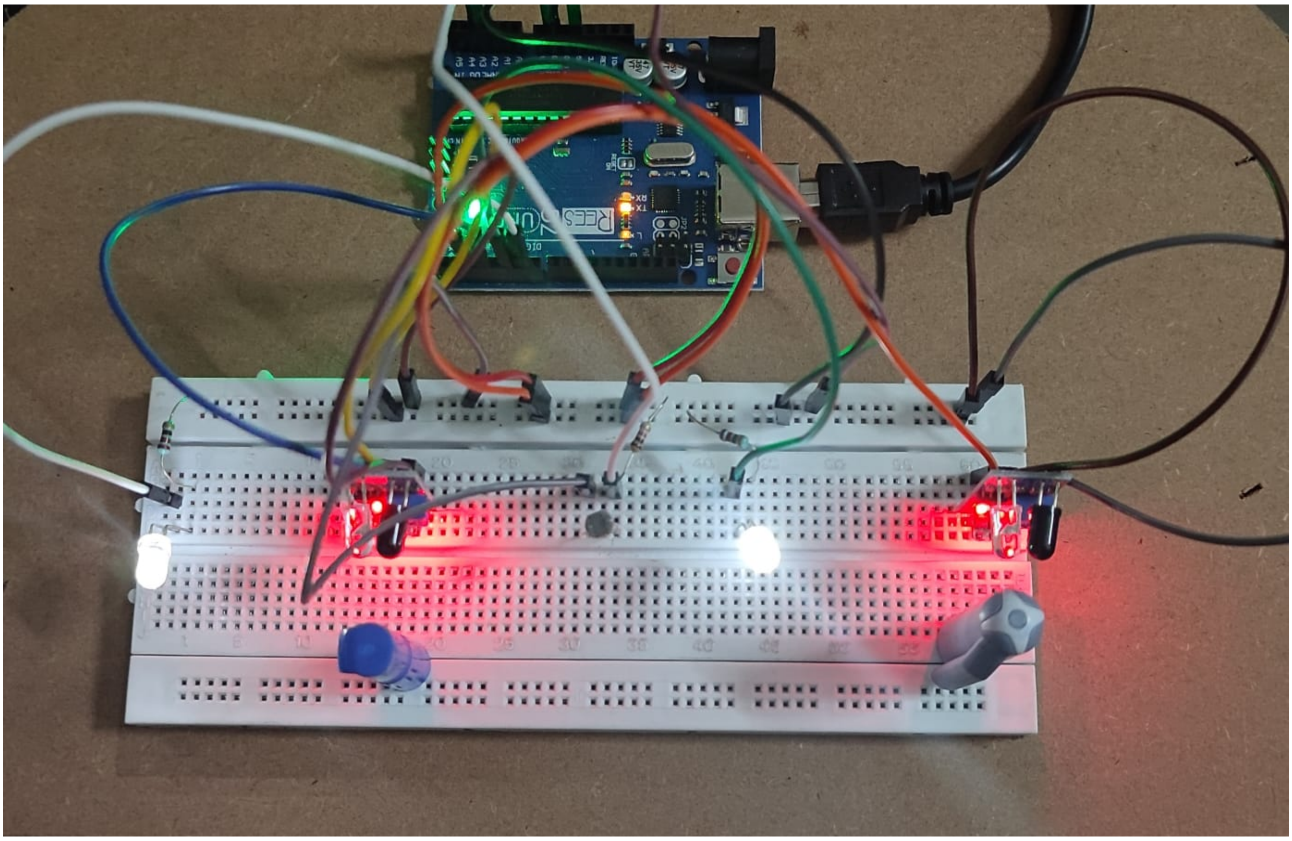

Figure 6.2: **Hardware Output**

Figure 6.2 shows the hardware model of the smart street lighting system. The system uses an IR sensor to detect the presence of an object, such as a vehicle or a pedestrian, and turn on the lights accordingly. When the IR sensor detects an object, it sends a signal to the microcontroller, which in turn activates the LED lights. This hardware model light glow output is an important feature of the system, as it ensures that the street lights are only turned on when they are needed. This helps to conserve energy and reduce costs.

# Chapter 7

# CONCLUSION AND FUTURE ENHANCEMENTS

## 7.1 Conclusion

In conclusion, the proposed intelligent lighting control system offers an effective and efficient solution for reducing energy consumption and improving safety in outdoor environments. The system detects the presence of vehicles and pedestrians using IR sensors and adjusts the brightness of the lights according to ambient light conditions using an LDR sensor. This ensures that lights are only turned on when necessary, reducing energy consumption and costs. Additionally, the system is able to provide a safe and well-lit environment for pedestrians and drivers, which can help to reduce accidents and improve overall safety.

Overall, the proposed system offers a number of advantages over traditional lighting systems. It is cost-effective, energy-efficient, and able to provide a safer and more secure environment. Moreover, the use of Arduino as the platform for the system offers a flexible and easily programmable solution that can be customized to suit the needs of different environments. Future work could focus on expanding the system to include more sensors or integrating it with other systems to provide additional functionality. With further development and testing, the proposed system has the potential to become a widely used solution for outdoor lighting control.

## 7.2 Future Enhancements

There are several potential enhancements that could be made to the proposed intelligent lighting control system to improve its functionality and efficiency. One possible enhancement is to integrate the system with a remote control or mobile app that allows users to manually turn the lights on and off or adjust their brightness levels. This could be particularly useful for homeowners or business owners who may want to override the automatic control system in certain situations, such as during a late-night party or event. By providing users with greater control over the lighting system, the system could become even more versatile and user-friendly.

Another potential enhancement is to incorporate more advanced sensors and data analysis techniques into the system. For example, the system could be equipped with cameras or other sensors that are capable of detecting not just vehicle or pedestrian movement, but also the presence of animals or other objects. Additionally, machine learning algorithms could be used to analyze data from the sensors and predict when and where movement is most likely to occur, allowing the system to be even more responsive and accurate. By integrating more advanced sensors and data analysis techniques, the proposed system could become more intelligent and effective at controlling lighting in a variety of different settings.

# Chapter 8

# PLAGIARISM REPORT

Dupli Checker

**PLAGIARISM SCAN REPORT**

| | | | |
|---|---|---|---|
| 3% Plagiarised | 97% Unique | | |

| | |
|---|---|
| **Date** | 2023-04-13 |
| **Words** | 978 |
| **Characters** | 6778 |

**Content Checked For Plagiarism**

This project focuses on the development of a smart street light system that utilizes IR sensors and Arduino technology to improve energy efficiency. The system is designed to automatically detect the presence of vehicles or pedestrians and adjust the intensity of the street lights accordingly. By using IR sensors, the system is able to detect objects in real-time and respond quickly to changes in the environment. The Arduino technology enables the system to be easily programmed and customized for specific applications. The smart street light system has the potential to significantly reduce energy consumption and contribute to a more sustainable urban environment.
The Smart Street Light System using IR sensor and Arduino is a project that aims **to create an energy-efficient and cost-effective solution to traditional street lighting.** This system is designed to detect the presence of people or vehicles on the road using IR sensors, and turn on/off the street lights accordingly. The system is based on the Arduino microcontroller, which acts as the brain of the system, controlling the sensors and the relay module. The project includes the use of an IR sensor module, a relay module, an LED light, and a breadboard and jumper wires for prototyping. The IR sensor detects the movement of people or vehicles on the road, and sends a signal to the Arduino board to turn on the LED light through the relay module. When there is no movement detected, the system automatically turns off the LED light, thereby saving energy
This project is a response to this growing demand for intelligent street lighting systems. It aims to develop a smart street lighting system that can automatically adjust the intensity of the lights based on the presence or absence of vehicles and pedestrians, using IR sensors and Arduino technology. This project [2] will explore the potential of IR sensors and Arduino technology in creating an efficient and reliable smart street lighting system. The system's design will be scalable and adaptable to meet different environmental conditions and applications.
However, traditional street lighting systems are often inefficient and costly due to their constant and fixed illumination levels, which result in energy waste and light pollution. Overall, this project is a step towards the development of smart cities

Figure 8.1: **Plagiarism report**

# Chapter 9

# SOURCE CODE & POSTER PRESENTATION

## 9.1 Source Code

```
int IR1 = 2;
int IR2 = 3;
int LED1 = 5;
int LED2 = 6;
int LDR = A3;

void setup()
{
  Serial.begin(9600);
  pinMode(LED1, OUTPUT);
  pinMode(LED2, OUTPUT);

  pinMode(IR1, INPUT);
  pinMode(IR2, INPUT);
  pinMode(LDR, INPUT);

  digitalWrite(LED1, LOW);
  digitalWrite(LED2, LOW);
}

void loop() {

  int LDRValue = analogRead(LDR);
  Serial.print("sensor = ");
  Serial.print(LDRValue);
  delay (500);

  if (LDRValue > 100)
  {
    digitalWrite(LED1, LOW);
    digitalWrite(LED2, LOW);
    Serial.println("It's Bright Outside; Lights status: OFF");
  }

  if ((LDRValue < 100) && (digitalRead(IR1) == HIGH))
```

```
    {
      digitalWrite(LED1, LOW);
      Serial.println("It's Dark Outside and NO vehicle movement detected; LED1 Lights status: OFF");
    }

  if ((LDRValue < 100) && (digitalRead(IR2) == HIGH))
    {
      digitalWrite(LED2, LOW);
      Serial.println("It's Dark Outside and NO vehicle movement detected; LED2 Lights status: OFF");
    }

  if ((LDRValue < 100) && (digitalRead(IR1) == LOW))
    {
      digitalWrite(LED1, HIGH);
      Serial.println("It's Dark Outside and Vehicle movement detected; LED1 Lights status: ON");
    }

  if ((LDRValue < 100) && (digitalRead(IR2) == LOW))
    {
      digitalWrite(LED2, HIGH);
      Serial.println("It's Dark Outside and Vehicle movement detected; LED2 Lights status: ON");
    }
}
```

## 9.2 Poster Presentation

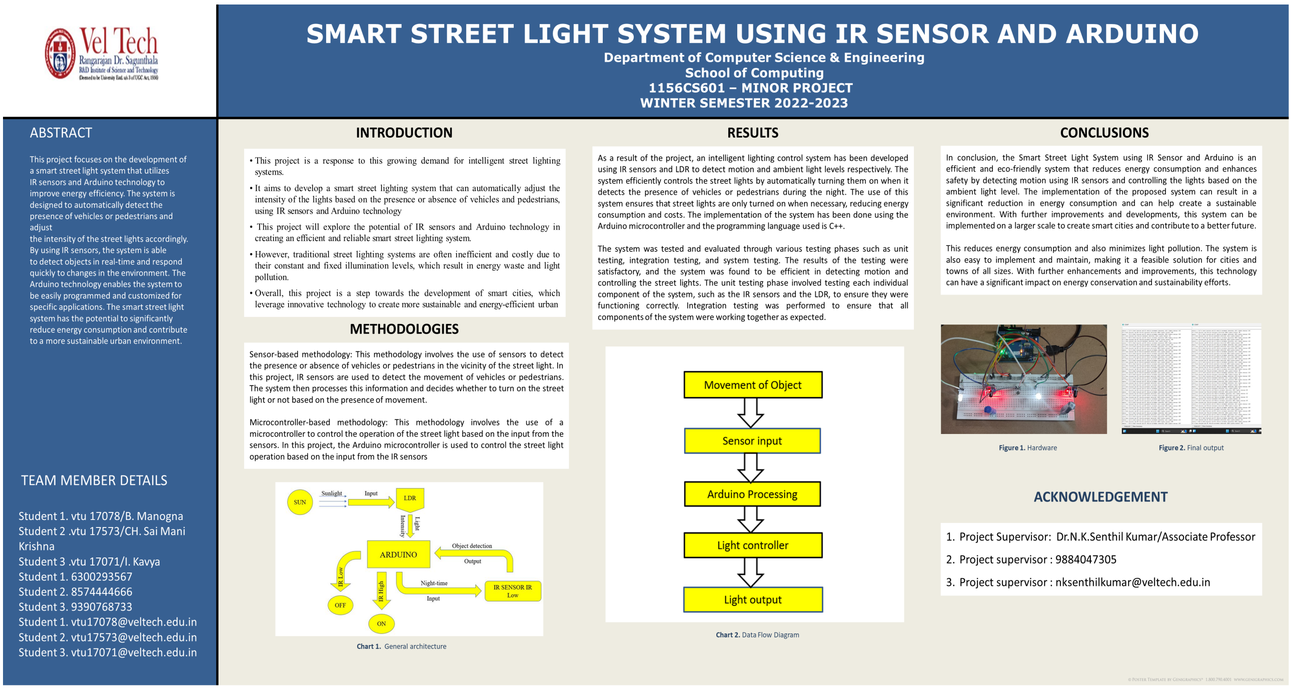


Figure 9.1: **Poster**

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