K J Somaiya College of Engineering
A Constituent College of Somaiya Vidyavihar University

Project Report

on

Smart Street Light System

Submitted in the partial fulfillment of the requirements

for the Course on

Project Based Learning

by

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Introduction

In our quest to make cities smarter, we're turning to technology for solutions. One such solution is our project: an Arduino-powered smart street light system. It's designed to make traditional street lighting better by using automation. This system adjusts brightness automatically based on what's happening around it. Our goal is to save energy and reduce the need for people to manually control the lights. This report will walk you through our journey, explaining the challenges we faced and what we achieved with this innovative project for smarter, more efficient cities.

In our modern world, cities are constantly evolving, and making them smarter is crucial for their sustainable development. Our project focuses on enhancing urban infrastructure through technology, specifically by creating a smart street light system powered by Arduino. This system aims to revolutionize traditional street lighting by incorporating automation, allowing the lights to adjust their brightness levels automatically. By doing so, we not only improve energy efficiency but also reduce the need for manual control, making city management more efficient.

The journey of developing this smart street light system involved various stages of planning, designing, and implementation. We started by researching the existing challenges in urban lighting infrastructure and identifying opportunities for improvement. With a clear understanding of the project's objectives, we proceeded to select appropriate Arduino microcontrollers and sensors to enable the desired functionalities. Through iterative prototyping and testing, we fine-tuned the system to ensure its reliability and effectiveness in real-world scenarios. Additionally, we collaborated with urban planners and environmental experts to gather insights and ensure alignment with the broader goals of smart city development.

One of the standout features of our smart street light system is its ability to adjust brightness levels autonomously based on environmental conditions and user requirements. By leveraging sensors to detect factors such as ambient light levels and human presence, the system optimizes energy usage without compromising on safety or visibility. Moreover, the automation reduces the need for manual intervention, freeing up manpower resources for other essential tasks. This not only enhances operational efficiency but also contributes to cost savings and a more sustainable urban environment.

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Literature Survey

- **Smart City Development and Urban Infrastructure:**

The concept of smart cities has gained traction in recent years as urban populations continue to grow, placing increasing demands on infrastructure and resources. Smart city initiatives aim to leverage technology to improve efficiency, sustainability, and quality of life for residents. One key aspect of smart city development is the optimization of urban infrastructure, including lighting systems. Various studies have highlighted the importance of smart lighting solutions in reducing energy consumption, enhancing safety, and creating more livable urban environments.

- **Arduino Microcontrollers and Sensor Applications:**

Arduino microcontrollers have emerged as a popular platform for prototyping and implementing innovative solutions in various domains, including urban infrastructure. These versatile microcontrollers, coupled with an array of sensors, enable developers to create responsive and adaptive systems capable of gathering and processing real-time data. In the context of smart street lighting, Arduino-based solutions offer the flexibility to adjust brightness levels based on environmental factors such as ambient light levels, traffic patterns, and pedestrian activity.

- **Automated Street Lighting Systems:**

The implementation of automated street lighting systems represents a significant advancement in urban lighting infrastructure. By incorporating sensors and intelligent control algorithms, these systems can dynamically adjust lighting levels to meet changing conditions, thereby optimizing energy usage and enhancing visibility. Numerous studies have demonstrated the efficacy of automated street lighting in reducing energy consumption and operational costs while improving safety and security for residents and commuters.

- **Challenges and Opportunities:**

While automated street lighting systems offer promising benefits, their successful deployment also poses challenges. Ensuring seamless integration with existing infrastructure, addressing technical complexities, and navigating regulatory requirements are among the key challenges faced by developers. Additionally, considerations such as system reliability, maintenance requirements, and cost-effectiveness must be carefully evaluated to maximize the long-term sustainability and scalability of these solutions. Despite these challenges, the growing body of research and practical implementations underscores the immense potential of Arduino-powered smart street lighting systems in advancing the goals of smart city development and creating more resilient and sustainable urban environments.

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Problem statement

Objectives

- Environmental Impact
- Low Maintenance Design
- Optimized Workforce Utilization
- Energy Efficiency
- Safety and Visibility
- Reduced Light Pollution

Functions

Automatic On/Off: Turn the street light on/off based on the absence or presence of external light sources.

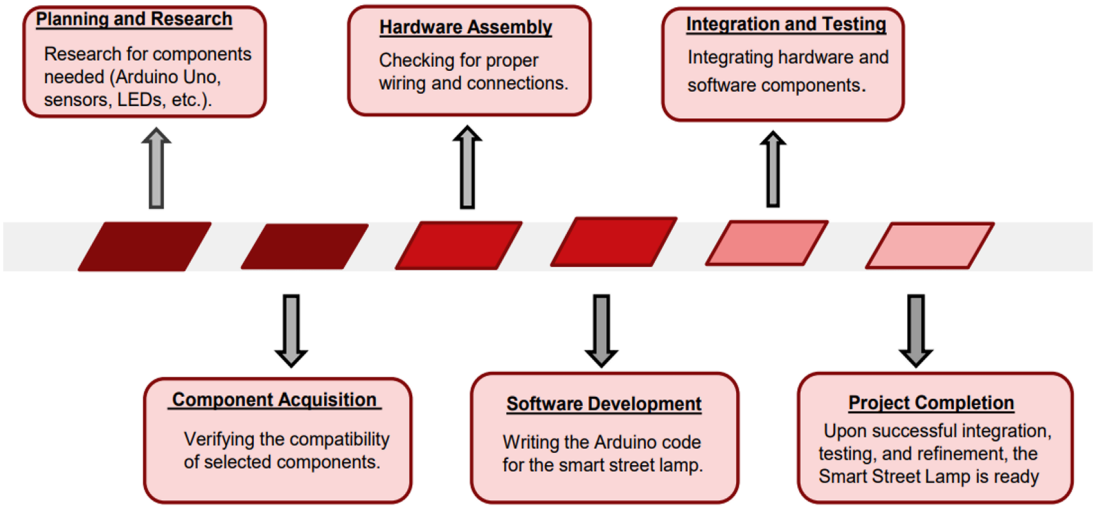
Constrains

Sensor Accuracy: The system relies on accurate sensor data.
Cost: Balancing functionality with cost-effectiveness.

Final Problem Statement

"To Create an Arduino-powered smart street light system that adjusts brightness automatically, improving energy efficiency and reducing manpower needs for Smart City Development."

Timeline chart



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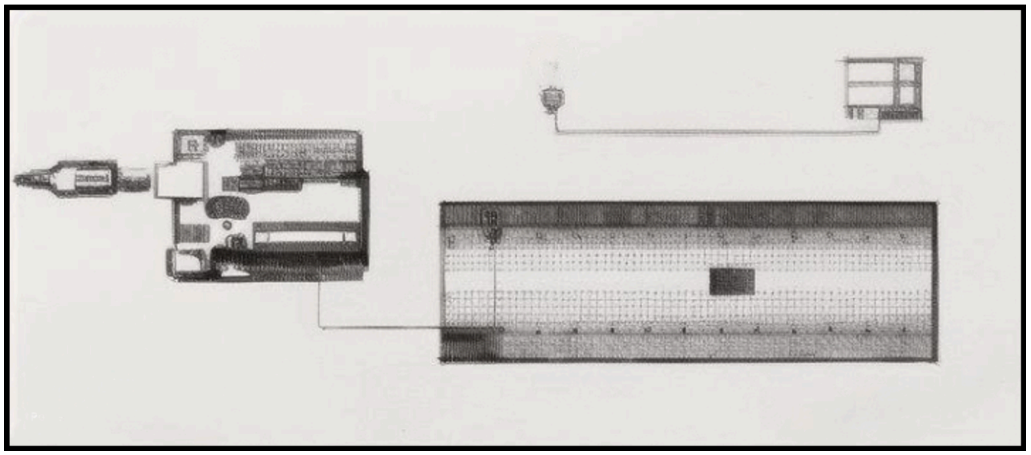
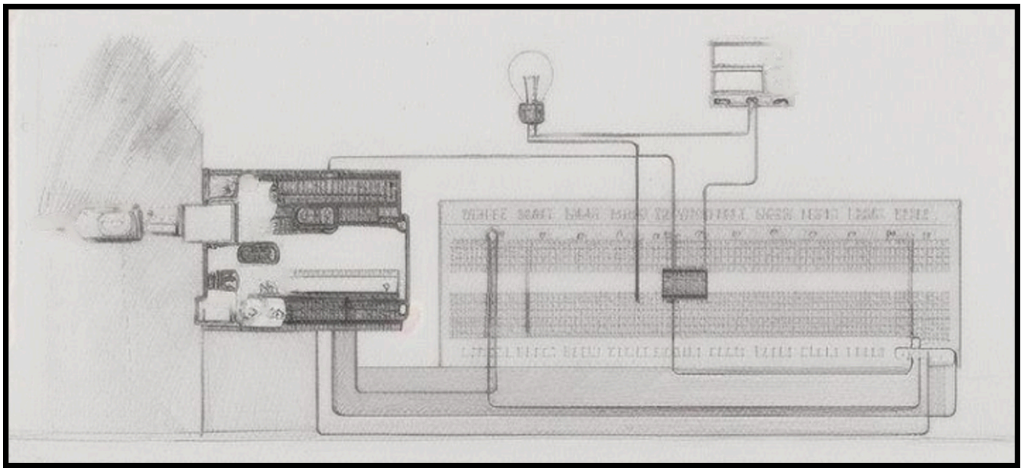
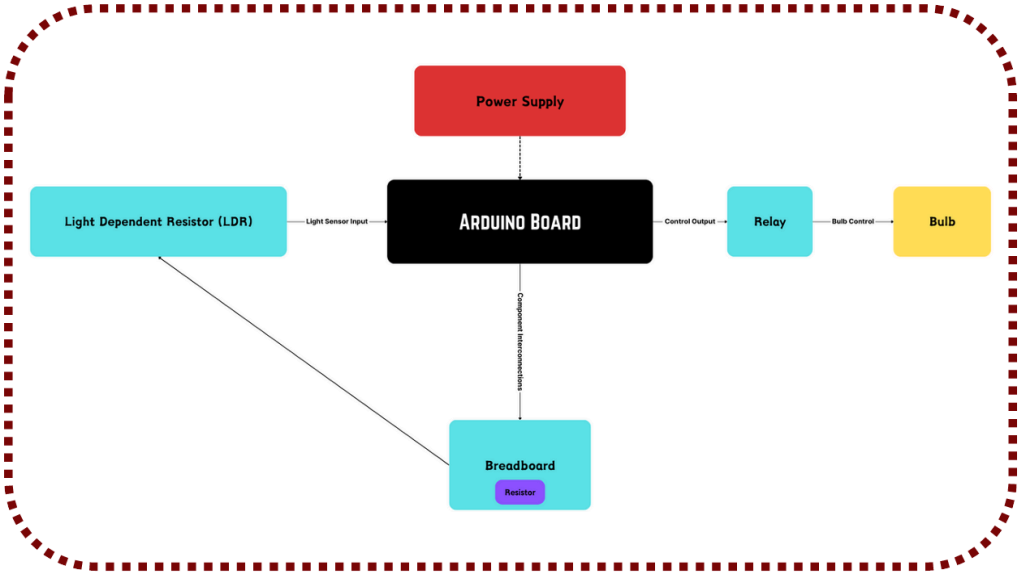
Sketches , Block diagram of project







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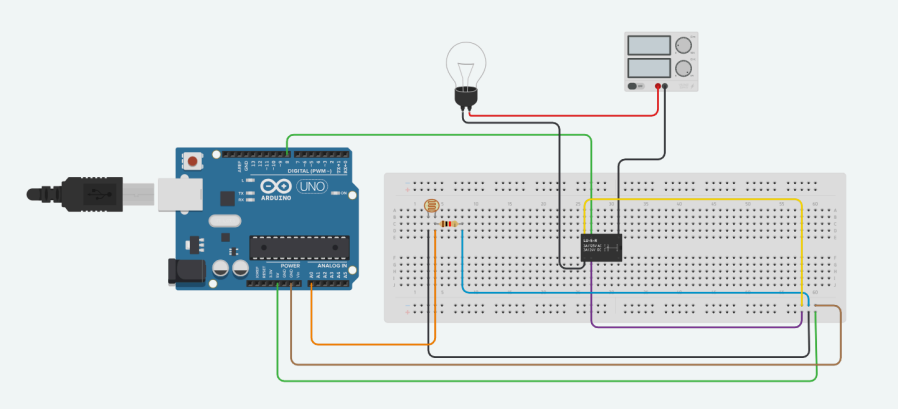
Implementation details

Circuit diagram



List of software/ hardware

Software Requirements :
Arduino Code/Program
Arduino Libraries
Device Drivers
Code Editor
Arduino IDE (Integrated Development Environment)

Hardware Requirements :
Arduino Uno - Microcontroller Board
Electromechanical Relay
Light Dependent Resistor
1K ohm resistor
Solderless
Breadboard
Jumper Wires
Light Bulb (Street Light)
Bulb Holder - Lamp Holder (or Bulb Socket)

Cost of material

NAME OF COMPONENT	SPECIFICATIONS	APPROXIMATE COST (₹)
Arduino UNO	Microcontroller	450
Breadboard	Prototyping	65
Relay	Switching	65
LDR	Senses surrounding light	14
Resistor	1Kohm	12
Jumper wires	Dupont	16
Bulb	Socket	50
Bulb holder	Light source	100

Function and working of circuit

Light Dependent Resistor (LDR) senses the ambient light level. When it's dark, the resistance of the LDR increases, indicating low light conditions.
The Arduino Uno, acting as the microcontroller, reads the resistance value from the LDR through an analog pin.
Based on the resistance value received from the LDR, the Arduino determines whether it's dark enough to trigger the street light to turn on.
If the light level falls below a predefined threshold, the Arduino sends a signal to activate the electromechanical relay.
The electromechanical relay, upon receiving the signal from the Arduino, switches the circuit connected to the street light, allowing electricity to flow through the bulb holder.
The light bulb, connected to the bulb holder, illuminates, providing light in the dark environment.
Conversely, when the ambient light level increases above the threshold, the resistance of the LDR decreases, signaling the Arduino to deactivate the relay, thereby turning off the street light.

Program Code :

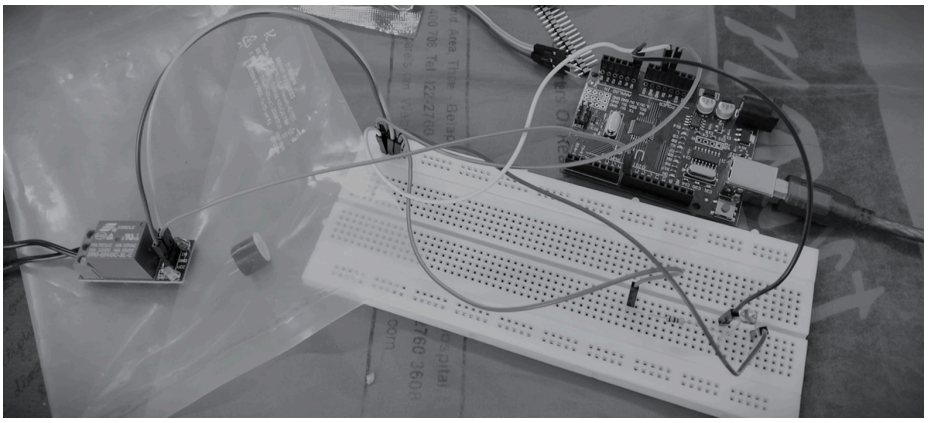
```
int sensorPin = A0;
int relayPin = 8;

void setup()
{
 Serial.begin(9600);
 pinMode(sensorPin, INPUT);
 pinMode(relayPin, OUTPUT);
}
void loop()
{
 int sensorValue = analogRead(sensorPin);
 if( sensorValue <= 50 )
 {
  digitalWrite(relayPin, LOW);
  Serial.println(sensorValue);
  delay(2000);
 }
 else
 {
  digitalWrite(relayPin, HIGH);
  Serial.println(sensorValue);
 }
}
```

Results

Observations/ Photographs

The intelligent street light system effectively detected changes in ambient light levels and switched the light bulb on or off accordingly. The system responded promptly to sudden changes in light, ensuring efficient energy consumption. Improves street safety better than manual street lights.



Limitations of project if any

- Sensor accuracy: The system's efficacy hinges on the precision of sensor data, necessitating reliable and accurate sensing capabilities.
- Cost: Achieving optimal functionality while maintaining cost-effectiveness is a critical consideration in system design and implementation.
- Weather resilience: Extreme weather conditions can potentially impact the system's performance, underscoring the importance of designing for resilience and adaptability.
- Lighting pattern variability: Inconsistencies in lighting patterns within urban areas may pose challenges to the system's operation, requiring adaptive algorithms and strategies for mitigating disruptions.

Conclusions and Future work

This project served as a catalyst for a deep dive into the realm of Arduino microcontrollers and sensor applications within the context of urban development. As we meticulously crafted solutions to enhance city infrastructure, we encountered the intricate dance between technological innovation and practical implementation. Beyond mere technical proficiency, we grappled with the ethical considerations inherent in deploying technology within urban spaces, prompting us to strive for solutions that not only function efficiently but also prioritize inclusivity and sustainability. This journey illuminated the immense possibilities inherent in leveraging technology to create more livable, resilient, and equitable cities for generations to come.

Moreover, this project fostered a collaborative spirit, as we worked hand in hand with urban planners, environmental experts, and community stakeholders to ensure that our solutions resonated with diverse perspectives and addressed multifaceted challenges. Through workshops, brainstorming sessions, and iterative prototyping, we cultivated a nuanced understanding of the interconnectedness of urban systems, inspiring us to design solutions that harmonize with the existing urban fabric while paving the way for future advancements. This collaborative approach not only enriched our learning experience but also reinforced the importance of interdisciplinary collaboration in shaping the sustainable cities of tomorrow.

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