Major Project 1

Report On

Street Light Control System

Submitted By :-

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Thank you once again for your invaluable contribution in the development of this Project.

Sincerely,
Hardik Gupta _________
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Sign: ______________

Panel:

Prof. Prateek Gupta

Sign: ____________

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Abstract

The Smart Street Light Control System is a cutting-edge project that presents a comprehensive and sustainable solution for street lighting. This project aims to optimize energy usage, reduce operational costs, and contribute to environmental sustainability by incorporating advanced technologies and intelligent control mechanisms.

The system utilizes a Light Dependent Resistor (LDR) to monitor ambient light levels and adjust the intensity of the street lights accordingly. This real-time adjustment ensures that the lights are only operating at their full capacity when required, thereby conserving energy during periods of low activity.

To further enhance the system's sustainability, a solar panel is integrated to harness clean and renewable solar energy. This provides an independent power source, reducing reliance on the conventional electrical grid and minimizing carbon footprint.

In order to improve safety and efficiency, an ultrasonic sensor is employed to detect the presence of objects or individuals within the vicinity of the street lights. When an object is detected, the system intelligently increases the light intensity, ensuring better visibility and enhancing overall safety for pedestrians and drivers alike.

Overall, the Smart Street Light Control System demonstrates the potential to revolutionize traditional street lighting infrastructure by integrating smart technologies. By optimizing energy usage, utilizing renewable energy sources, and implementing intelligent control mechanisms, this system contributes to sustainability efforts, reduces operational costs, and enhances safety in urban environments. This project sets the stage for smarter and greener cities, ensuring a brighter and more efficient future for street lighting.

Chapter 1: Introduction

The evolution of smart technologies has paved the way for innovative solutions to enhance the efficiency and sustainability of various systems, and street lighting is no exception. Traditional street lighting systems often operate at a fixed intensity throughout the night, leading to unnecessary energy consumption and increased operational costs. To address these challenges, this project introduces a Smart Street Light Control System that leverages advanced technologies to optimize the use of street lights, reduce energy wastage, and contribute to environmental sustainability.

Safety being one of the major concern on roads has been taken into account as well. There are only few who take into consideration both sustainability and security into account. Sustainability and controlled energy consumption are few of the major factors that we looked upon when considering building this project. We have added a sensor which upon detecting motion increases the light intensity for a limited time span so that anyone walking by can see clearly which makes it very useful for everyone's safety.

It represents a sustainable and efficient approach to street lighting, leveraging advanced technologies to optimize energy usage, reduce operational costs, and contribute to environmental sustainability. By integrating LDR-based intensity control, solar power utilization, object detection, and a user-friendly application, this project showcases the potential for smarter and greener cities. The implementation of this system has the potential to transform traditional street lighting infrastructure, ensuring a brighter, safer, and more sustainable future.

Chapter 2: Problem Statement

Traditional street lighting systems are often inefficient and consume excessive amounts of energy, resulting in high operational costs and a significant environmental impact. Fixed-intensity lighting throughout the night leads to unnecessary energy wastage. Additionally, the lack of adaptive control mechanisms poses safety concerns as it fails to address variations in pedestrian and vehicular activity. Therefore, there is a pressing need for a sustainable street light control system that optimizes energy usage, reduces operational costs, enhances safety, and contributes to environmental sustainability.

Existing solutions often rely on manual adjustments, making it difficult to achieve real-time adaptability. Furthermore, conventional power sources contribute to carbon emissions, aligning poorly with the growing emphasis on renewable energy. Consequently, a comprehensive solution that incorporates advanced technologies, such as a Light Dependent Resistor (LDR), a solar panel, an ultrasonic sensor, and a control application, is required to address these challenges effectively.

The proposed Smart Street Light Control System aims to tackle these issues by dynamically adjusting the intensity of street lights based on ambient light levels, leveraging solar energy to power the system, and enhancing safety through object detection. The integration of these components, along with a user-friendly control application, will revolutionize street lighting infrastructure, making it more sustainable, cost-effective, and responsive to the needs of urban environments.

Chapter 3: Objectives

1. Develop a sustainable street light control system that utilizes a LDR to regulate the intensity of the street lights based on ambient light levels.
2. Evaluate the performance of the system through comprehensive testing and data analysis to validate its effectiveness in optimizing energy usage and improving safety.
3. Showcase the feasibility and scalability of the proposed system by implementing a pilot project in a real-world urban environment and gathering feedback from users and stakeholders.
4. Use only renewable, sustainable and energy efficient components.
5. Power the system using only renewable energy.

Chapter 4: Literature

A modern street lighting system that uses network protocols like Zigbee to control the intensity of street lights based on vehicle movements and atmospheric conditions is considered much more accurate [1].

An individual control system for street luminaries that turns them on and off based on the speed of change of natural light in the evening and by calendars in the morning is more complex, but can provide valuable insights [2].

This paper proposes an intelligent lighting control system for street lighting, using sensors to adjust brightness based on presence of vehicles and pedestrians, saving energy and improving safety [4].

The system is automatic controlling of street light according to seasonal variations, which includes auto loop system with respective time dependent, while vehicle crossing the road. It will give large impact of saving electricity [5].

Chapter 5: Methodology & Outcomes

Working:

The proposed system will activate once the LDR detects that the ambient light is below the threshold level. As soon as this condition is met, the LED light will switch on in proportion to the surrounding light.

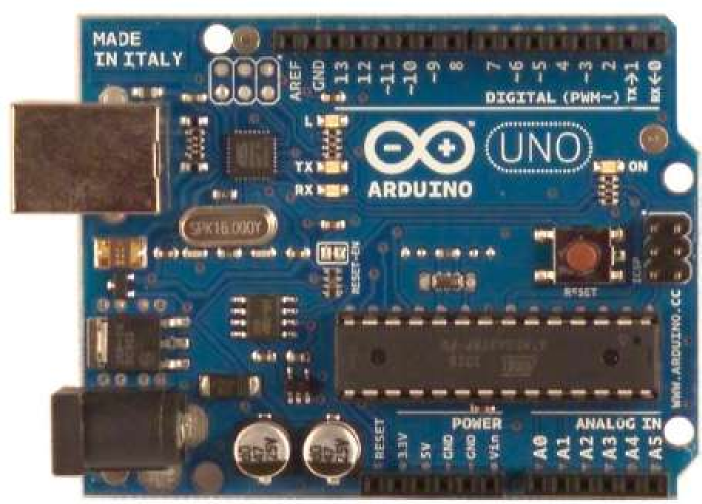
They will work completely on clean and renewable energy which will be provided by the solar panels installed. The Light works on 60% intensity, irrespective of the ambient light in order to save energy.

An Ultrasonic sensor is placed in such a way that, when a pedestrian is in close proximity of the light, it will temporarily increase the brightness of the light, so that the illumination aids the pedestrian while walking across.

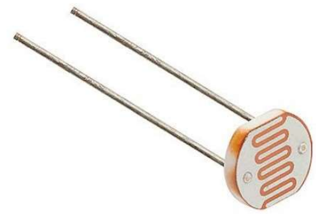
The whole system is powered by Two 3.7v Li-Po battery, which is powered by 4 solar panels, which are connected in Parallel to provide maximum energy, which ultimately powers the Arduino.

Arduino can run on a fixed voltage of 5v. If powered by variable current, it might cause a short circuit in the Arduino. To prevent that we are using LM2596 Buck Converter to step down the voltage to exactly 5v.

Components used in the Project:



- *Arduino Uno*

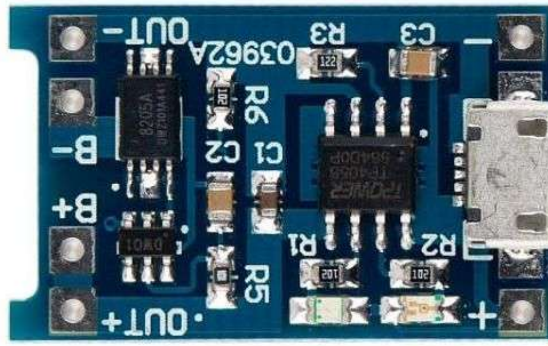


- *LDR (Light Dependent Resistor)*

- *Solar Panel*

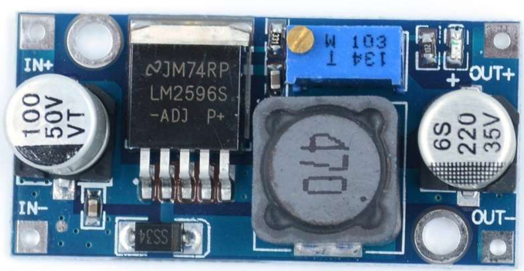
- *Ultrasonic Sensor*

- *03962a Module*



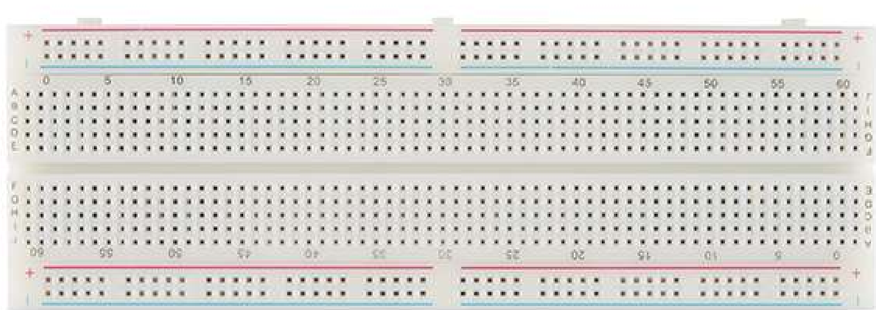
- *3.7v 2600mAH Li-Po Battery*

- *LM2596 Buck Converter*

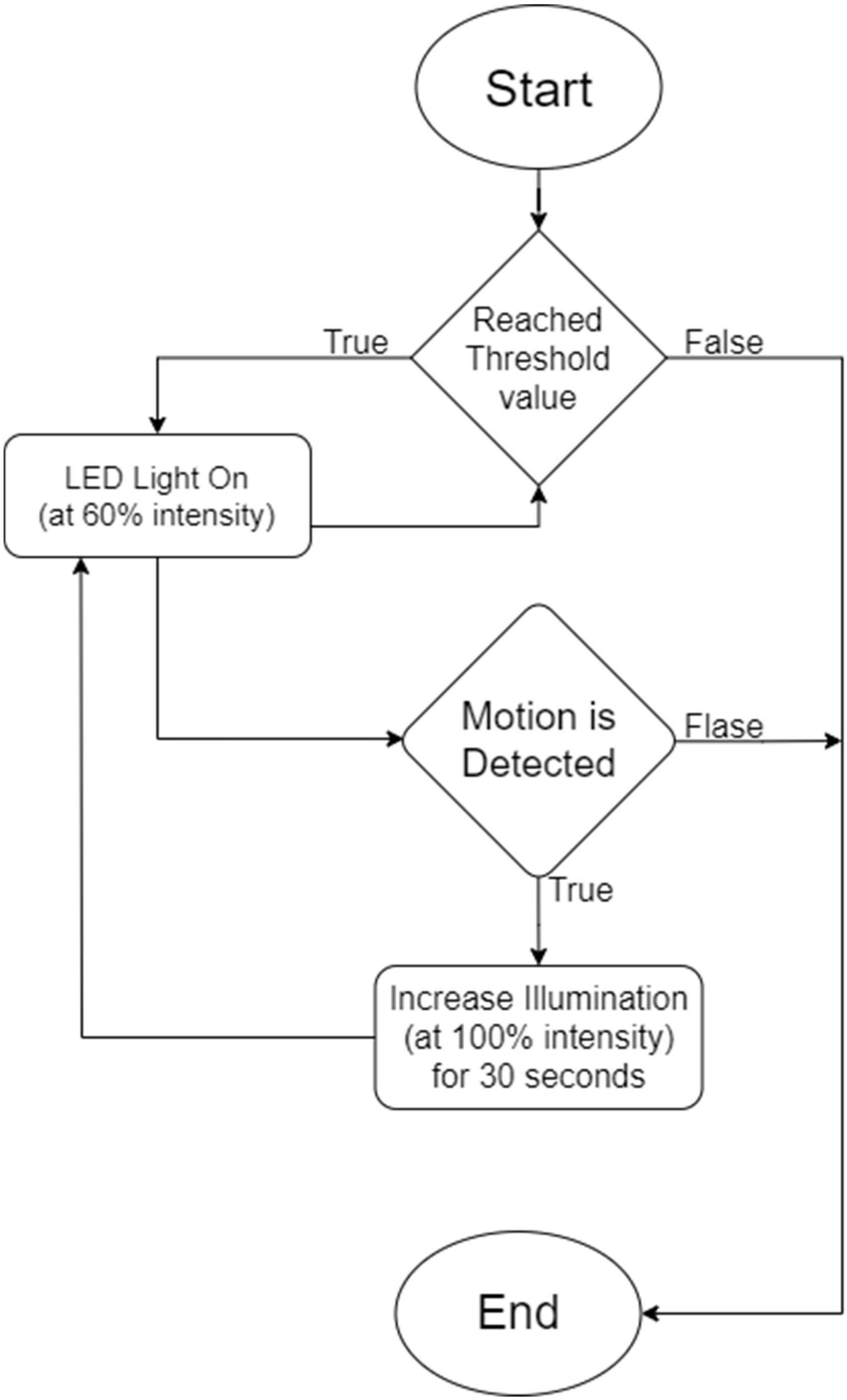


- *Jumper Cables*

- *Breadboard*



Flow Chart:



Start
Reached Threshold value
True
False
LED Light On (at 60% intensity)
Motion is Detected
Flase
True
Increase Illumination (at 100% intensity) for 30 seconds
End

Psudocode:

Inputs:

1. LDR sensor reading

2. Ultrasonic sensor reading

Outputs:

1. LED light brightness (PWM)

```
Start:
Initialize:
    Set thresholdLightLevel, minLightIntensity,
    maxLightIntensity, proximity,
    increasedLightIntensity
    Initialize LDR and Ultrasonic sensors
    Initialize LED light and PWM pin
    Initialize LM2596 Buck Converter
Loop:
Read:
    Read LDR sensor value
    Read Ultrasonic sensor value
Process:
    If LDR reading < thresholdLightLevel:
        Calculate desired light intensity:
            If Ultrasonic reading < proximity:
                Intensity = maxLightIntensity
            Else:
                Intensity = minLightIntensity
        Convert intensity to PWM value
        Set LED brightness using PWM
    Else:
        Turn LED off
Delay:
    Wait for a short interval before next loop
End loop
```

Algorithm:

1. Initialize the LDR (Light Dependent Resistor) pin to detect ambient light levels.
2. Initialize the LED pin to control the LED light intensity.
3. Initialize the ultrasonic sensor to detect pedestrian proximity.
4. Set the threshold level for the LDR to determine when the ambient light is below the desired level.
5. Set the initial LED light intensity to 60% to save energy.
6. Continuously monitor the ambient light level using the LDR.
7. If the ambient light level is below the threshold:

   a. Calculate the proportion of surrounding light based on the LDR reading.
   b. Adjust the LED light intensity accordingly, considering the proportion and the 60% baseline intensity.
8. Continuously monitor the ultrasonic sensor for pedestrian proximity.
9. If a pedestrian is detected in close proximity: a. Temporarily increase the brightness of the LED light to aid the pedestrian while walking. b. After a certain duration or when the pedestrian moves away, restore the LED light intensity to the previous level.

Output:

```
Distance: 192
600
Distance: 192
595
Distance: 192
593
Distance: 191
595
Distance: 34
594
```

```
Distance: 1181
348
Distance: 4
Activity Alert
366
Distance: 222
357
Distance: 221
355
Distance: 222
355
```

Model:

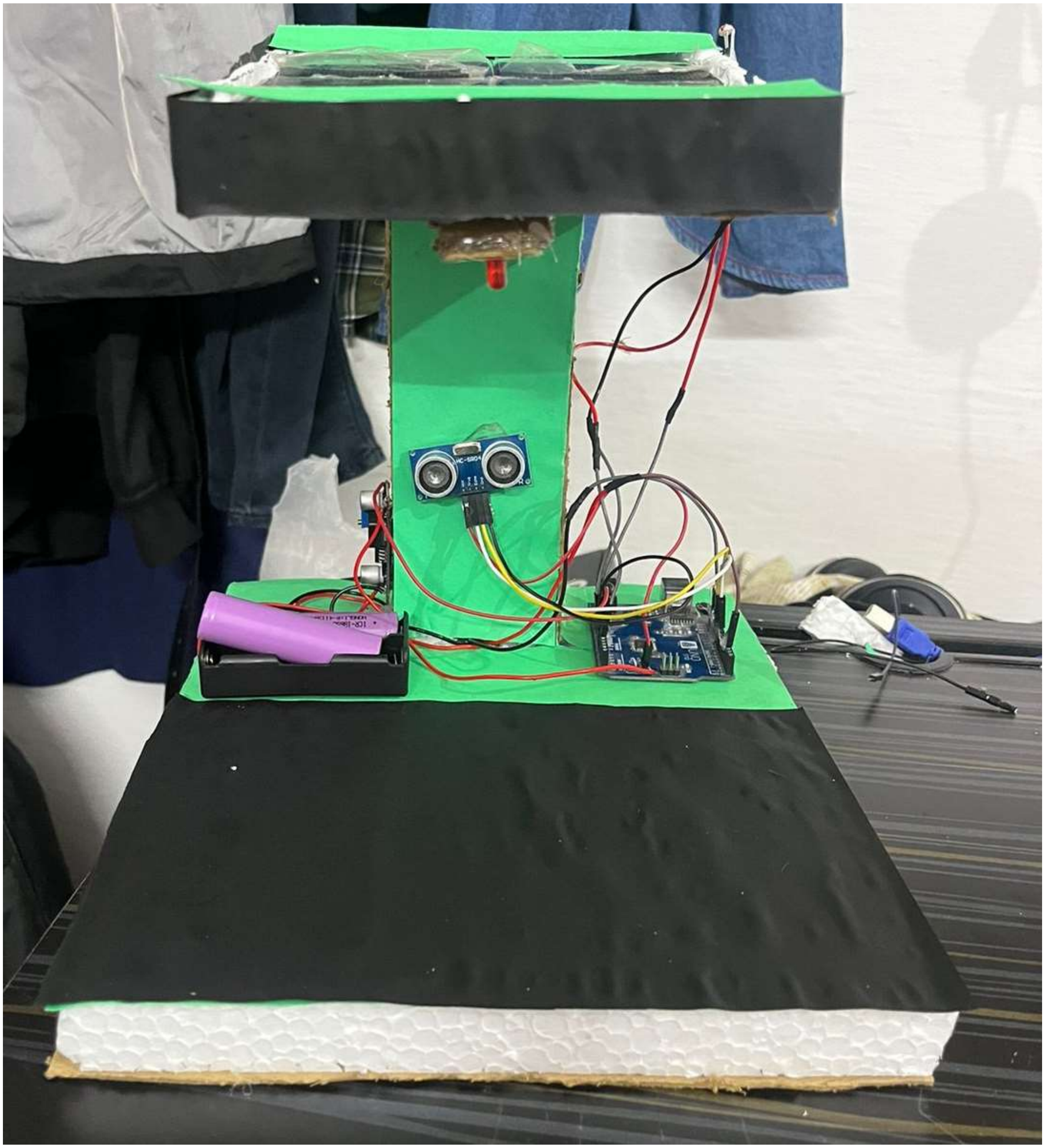


Fig: Front Model View

We can clearly see the components shown in the model. In the middle there is the Ultrasonic sensor to detect motion and switch on the light.

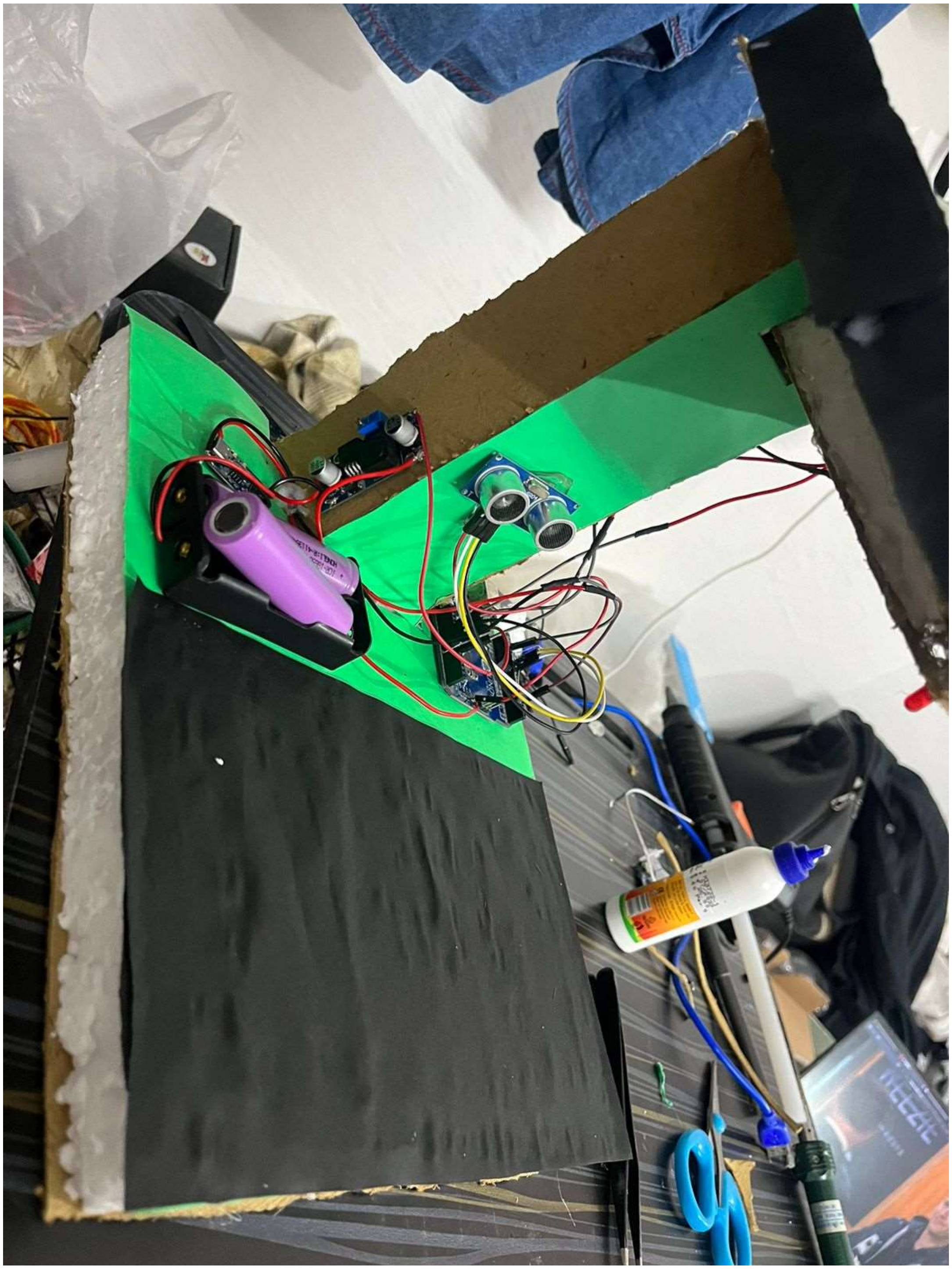


Fig: Left side Model View

On the left side, we have the Lipo Battery, 03962a Module and LM2596 Buck Converter. It essentially manages the power supply.

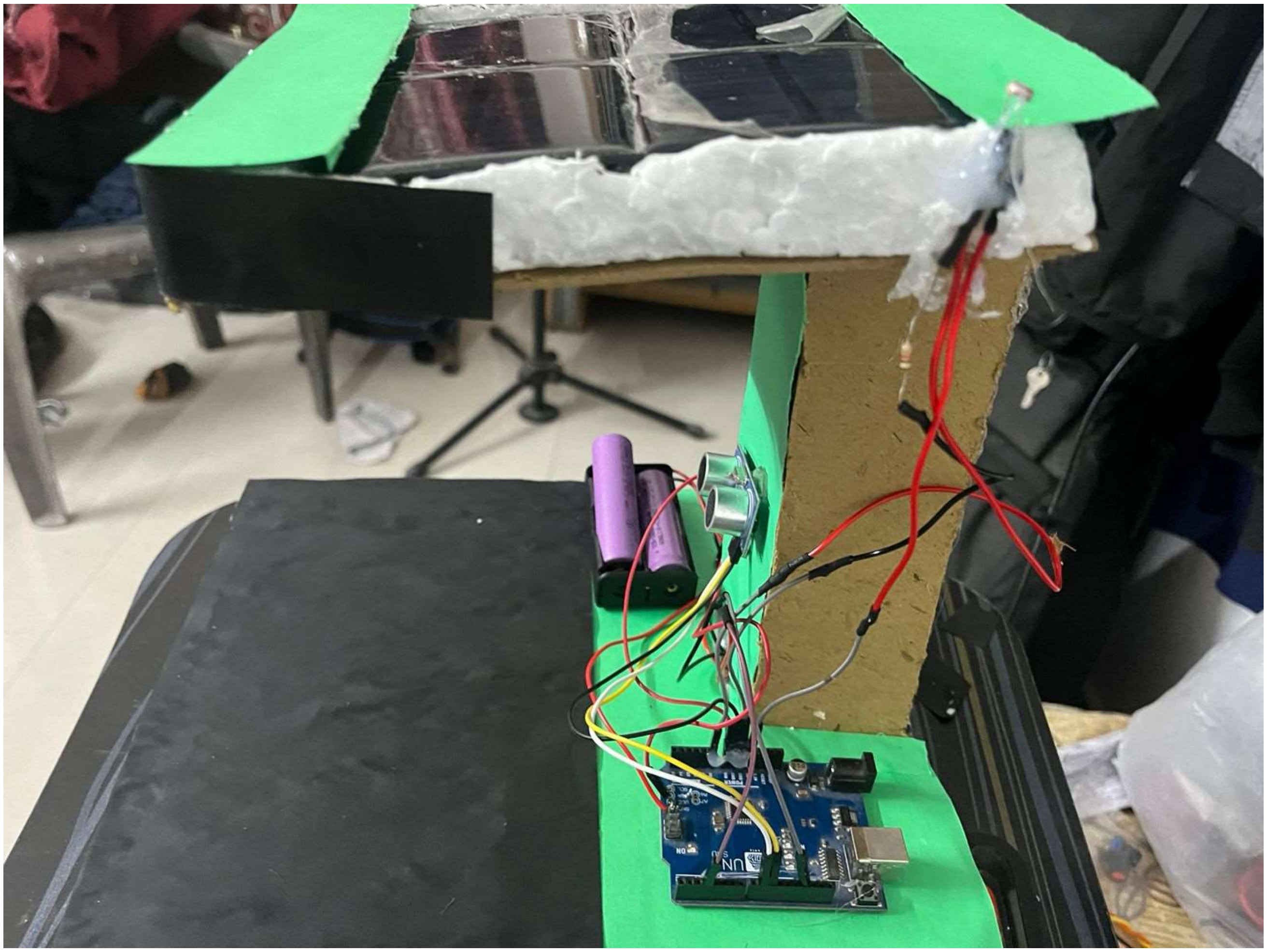


Fig: Right Side Model View

On the right side, we can see the Arduino UNO Microcontroller and the LDR on top. The connections from the LDR are not hidden to demonstrate the working.

Fig: Top Model View

On the Top, we can see 4 solar panels are installed in Parallel which charges the LiPo Battery along with the LDR to measure the level of ambient light.

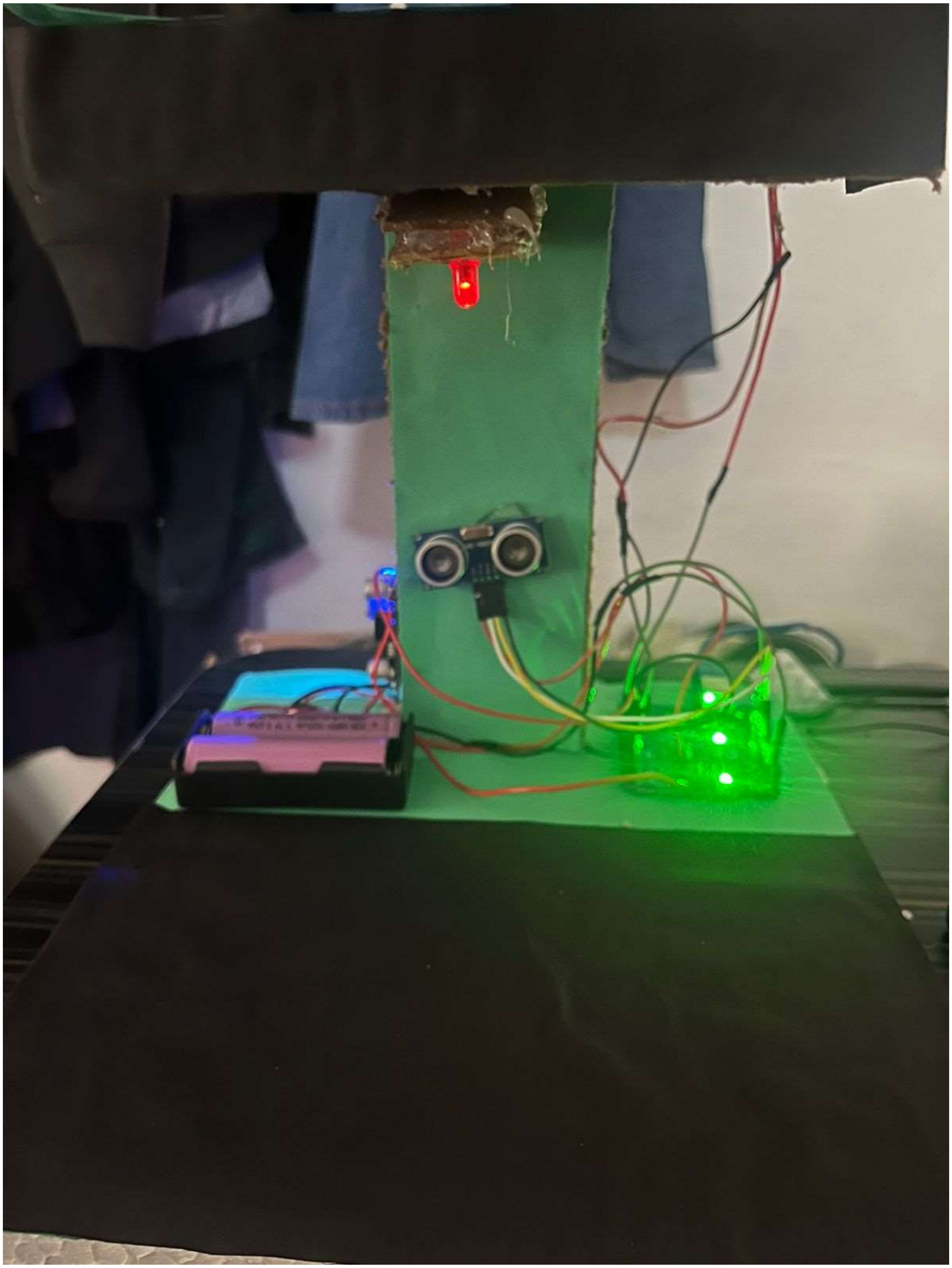
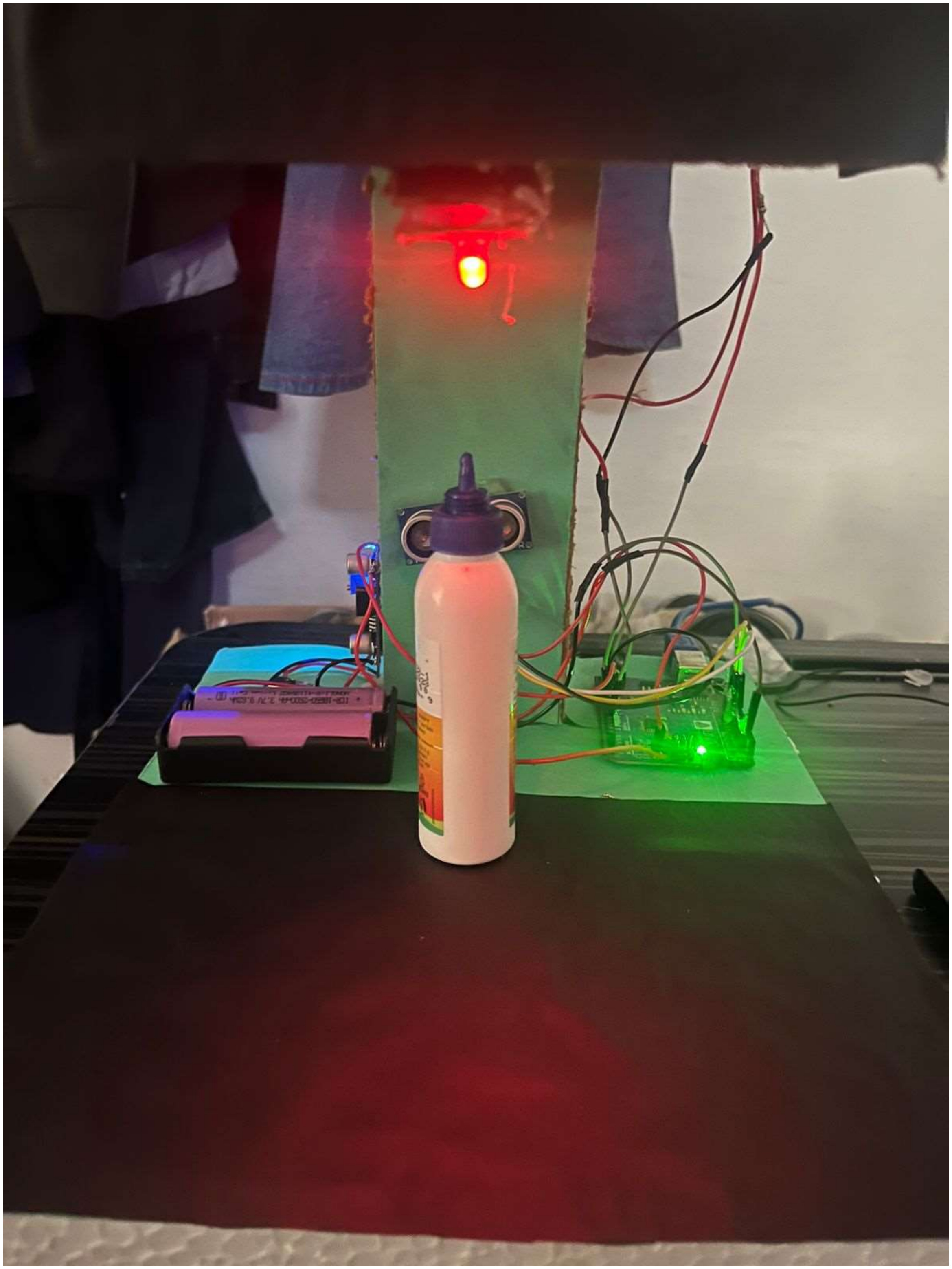


Fig: Front Model View (Switched on)

After the system is switched on, The LDR detected the LOW ambient Light and set the intensity of the LED accordingly.



<u>Fig: Front Model View with object detection</u> (Switched on)

An object (i.e. Fevicol tube) is placed in front of the Ultrasonic sensor to demonstrate the full intensity light function of the project.

Chapter 6: Conclusion

This IoT program delivers an intelligent and sustainable lighting solution, seamlessly integrating automation, energy efficiency, and user convenience. By leveraging ambient light detection and ultrasonic sensors, it adapts to its surroundings, providing optimal illumination only when needed.

Operating at a baseline 60% intensity and powered by renewable solar energy, the system minimizes energy consumption while ensuring sufficient lighting. Furthermore, the ultrasonic sensor detects nearby pedestrians, automatically increasing brightness for enhanced visibility and safety.

This combination of adaptability, sustainability, and user-centric design makes the proposed IoT program a compelling solution for smart cities, public spaces, and even residential settings. As smart technologies continue to evolve, this innovative approach to lighting promises a brighter and more sustainable future.

References:

[1] S. A. Bhosale and T. Ankalkote, "Modern Street Lighting System with Intensity Control based on Vehicle Movements and Atmospheric Conditions using Zigbee," 2018 International Conference on Information, Communication, Engineering and Technology (ICICET), Pune, India, 2018, pp. 1-4, doi: 10.1109/ICICET.2018.8533817.

[2] A. Pachamanov, D. Pavlov, K. Kassev and K. Nikolova, "Individual Control of Street Luminaries by Speed of Change of Natural Light in the Evening and by Calendars in the Morning," 2021 Sixth Junior Conference on Lighting (Lighting), Gabrovo, Bulgaria, 2021, pp. 1-4, doi: 10.1109/Lighting49406.2021.9599034.

[3] https://www.instructables.com/LDR-Sensor-Module-Users-Manual-V10/

[4] T. P. Nam and N. Van Doai, "Application of Intelligent Lighting Control for Street Lighting System," 2019 International Conference on System Science and Engineering (ICSSE), Dong Hoi, Vietnam, 2019, pp. 53-56, doi: 10.1109/ICSSE.2019.8823357.

[5] Github Repository