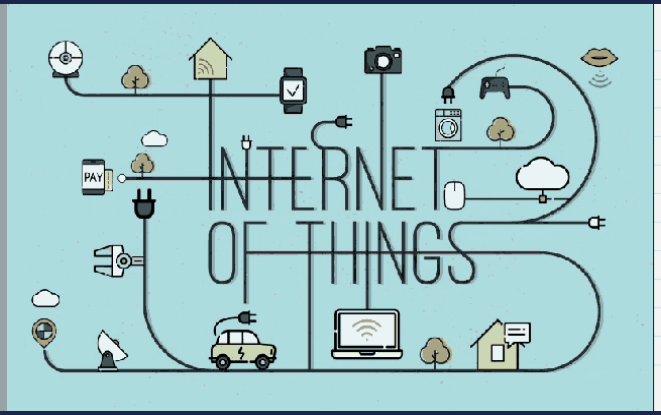
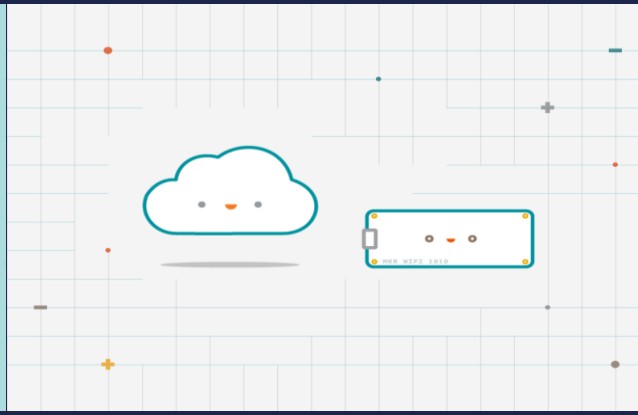
IlluminateTech: Smart Classroom Lighting Solutions





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02 **Literature Review**

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OUTLINE

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Circuit diagram showing circuit connections

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How our project aims at improving the existing system

08 **Conclusion & References**

Conclusion, future work and references

Objective

- To Implement Smart Lighting Solutions: The primary objective of the project is to design and implement an intelligent lighting system utilizing advanced technologies such as motion sensors, light-dependent resistors (LDRs), and IoT platforms to create a more efficient and user-friendly lighting environment.

- To Enhance Energy Efficiency: The project aims to optimize energy usage by deploying automated lighting controls that adjust illumination levels based on factors like occupancy and ambient light, thereby reducing unnecessary energy consumption and promoting sustainability.

- To Facilitate Remote Access: Enable remote access to lighting controls through the integration of an IoT cloud platform, allowing users to conveniently manage lighting settings from smartphones or computers, thereby enhancing flexibility and convenience.

Litertaure Review

We have read several research papers related to automated lights systems. Among these papers,

- The study in [4] introduces the Smart Street Lighting (SSL) system, which addresses the inefficiencies of conventional street lighting by dynamically adjusting lamp operation based on pedestrian presence and safety zones.

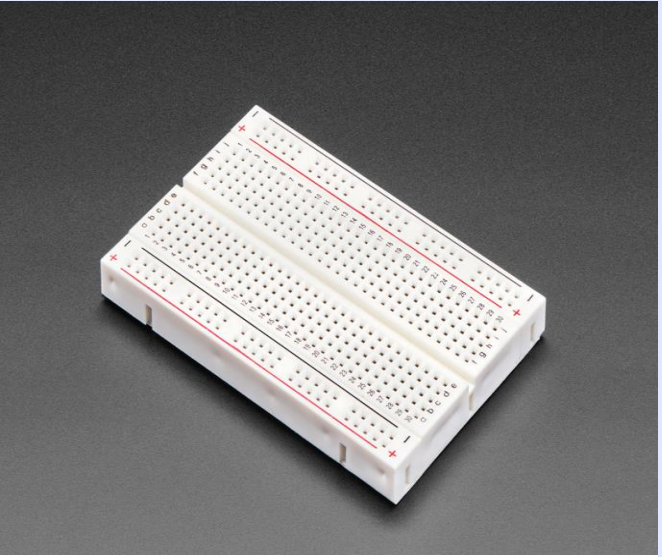
- Again, the study in [5] addresses the need for an ultimate guide to designing energy-efficient green highway lighting systems, given the widespread demand and environmental concerns associated with traditional systems. It reviews existing literature, categorizing it into fundamental design principles, advantages, disadvantages, and research challenges.

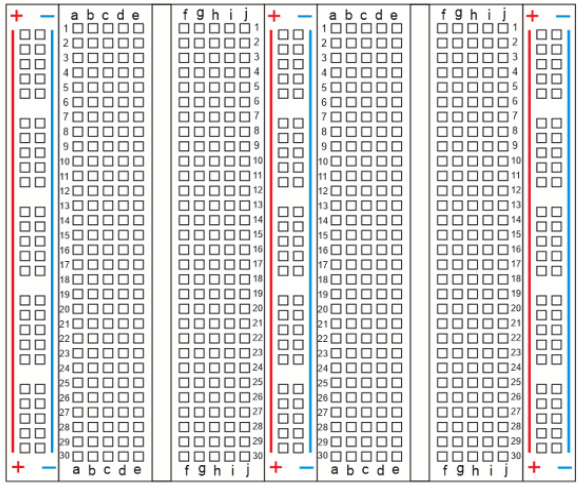
- The study in [7] proposes the development of an intelligent classroom lighting control system that automatically adjusts lighting environments based on the locations and behaviors of the teacher and students, as well as the current class context

- while the authors of [8] introduces the advancement of the PLCBUS protocol and its application in designing an intelligent lighting system using the PLCBUS-9402393 chip. The system comprises transmitters, receivers, and illumination transducers controlled by a circuit automatically.

Components

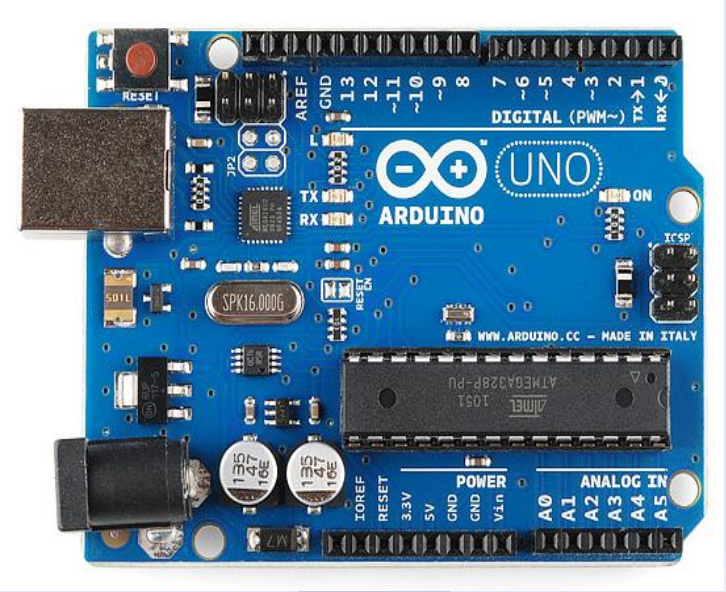
1. BREADBOARD
2. ARDUINO UNO
3. HC-SR501 PIR MOTION SENSOR
4. LDR
5. LED
6. 3.7 V BATTERY
7. BOOST CONVERTER
8. NODEMCU ESP8266 DEVELOPMENT BOARD
9. JUMPER WIRES
10. ARDUINO IOT CLOUD PLATFORM
11. LAPTOP/MOBILE
12. PVC BOARD

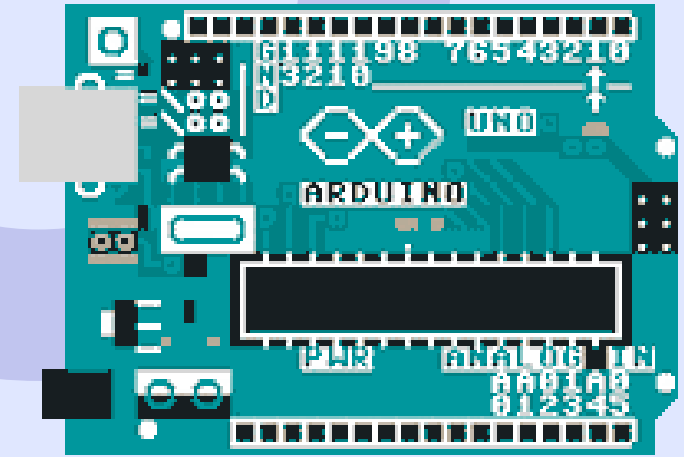




Breadboard

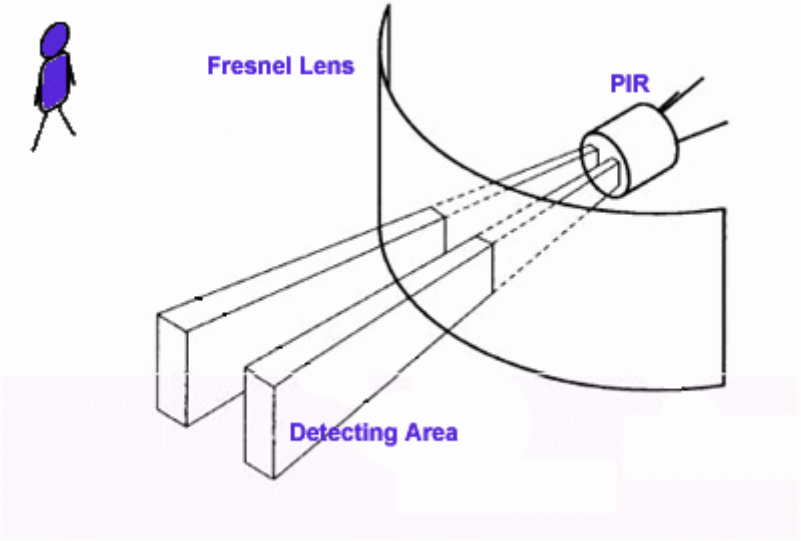
- Breadboard is also known as solderless breadboard or protoboard.
- It is a construction base used to build semi-permanent prototypes of electronic circuits.





Arduino Uno

- The Arduino Uno is a popular microcontroller board based on Atmega328P microcontroller.
- It has various input/output pins for connecting sensors, actuators and other components.
- It also includes a USB port for programming the microcontroller and powering the device as well as a power jack for external power sources.

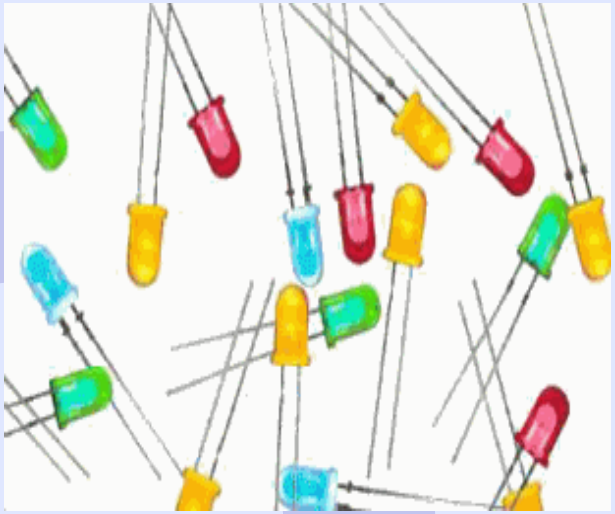


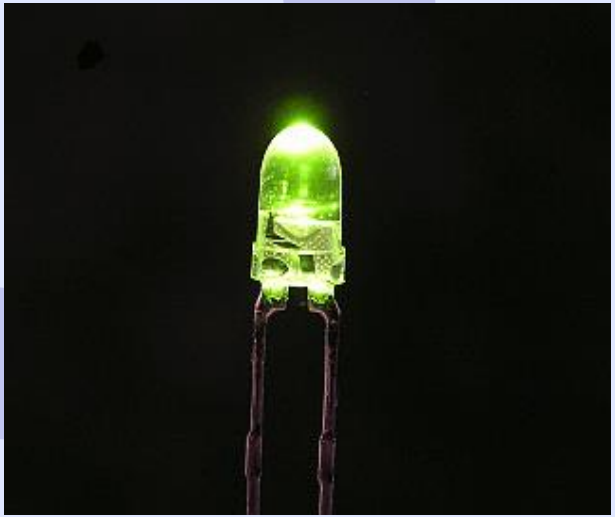
HC-SR501 PIR Motion Sensor

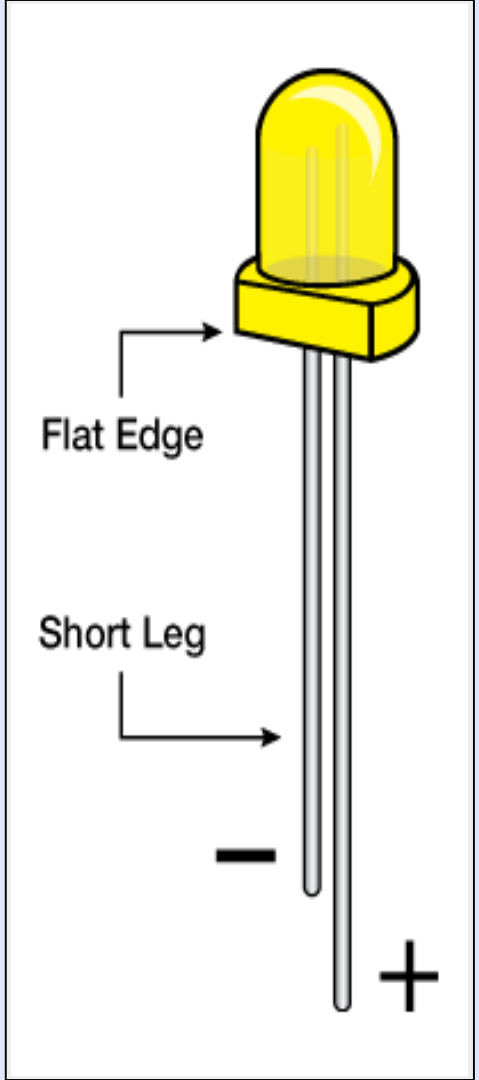
- HC-SR501 PIR Motion Sensor is a commonly used to detect infrared radiation emitted by objects in its field of view to sense motion.
- It detects the motion and sends a signal, typically a digital output, indicating the presence of motion.
- It is typically considered omnidirectional.

LDR

- LDR stands for Light Dependent Resistor.
- LDR changes its resistance with the amount of light falling on it.
- In bright light, the resistance of an LDR decreases and in darkness, its resistance increases.
- LDRs are commonly used in light-sensitive circuits, such as automatic street lights project.





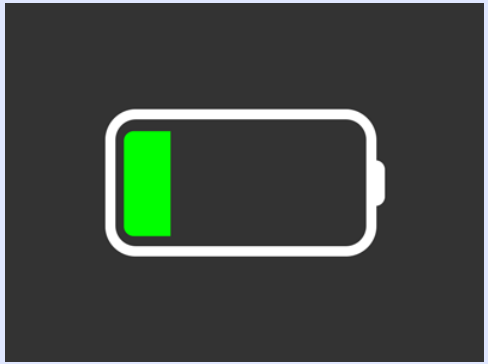


LED

- The full form of LED is Light Emitting Diode.
- LED is a semiconductor device that emits light when an electric current flows through it.
- We used 3 LED in our project.

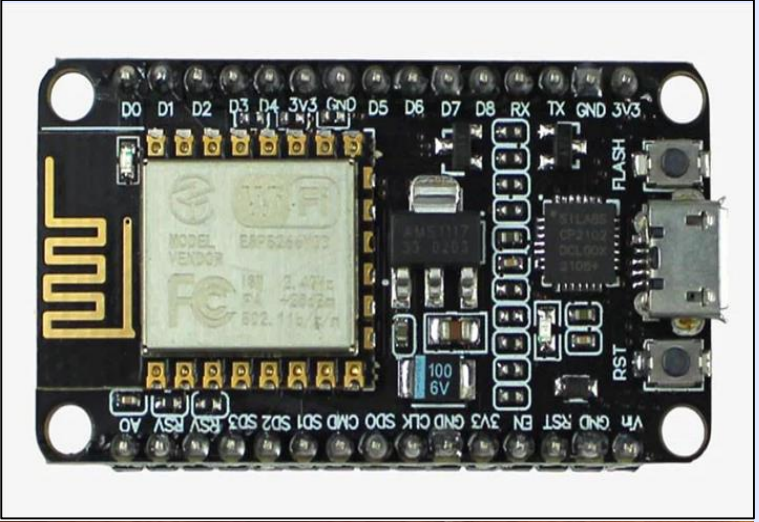
3.7V Battery

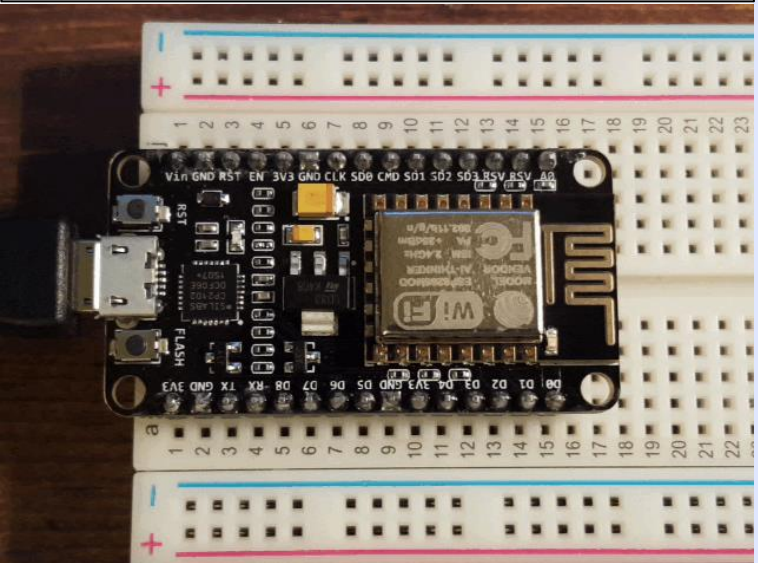
- Battery Type: Lithium-Ion Battery
- Shape: Cylindrical Battery
- High Performance and Capacity
- High Energy Density
- Long Life Cycle



Boost Converter

- A boost circuit is a type of DC-DC converter circuit that steps up voltage from a lower level to a higher level.
- The main component used in a boost circuit is typically called a "boost converter" or a "boost regulator."

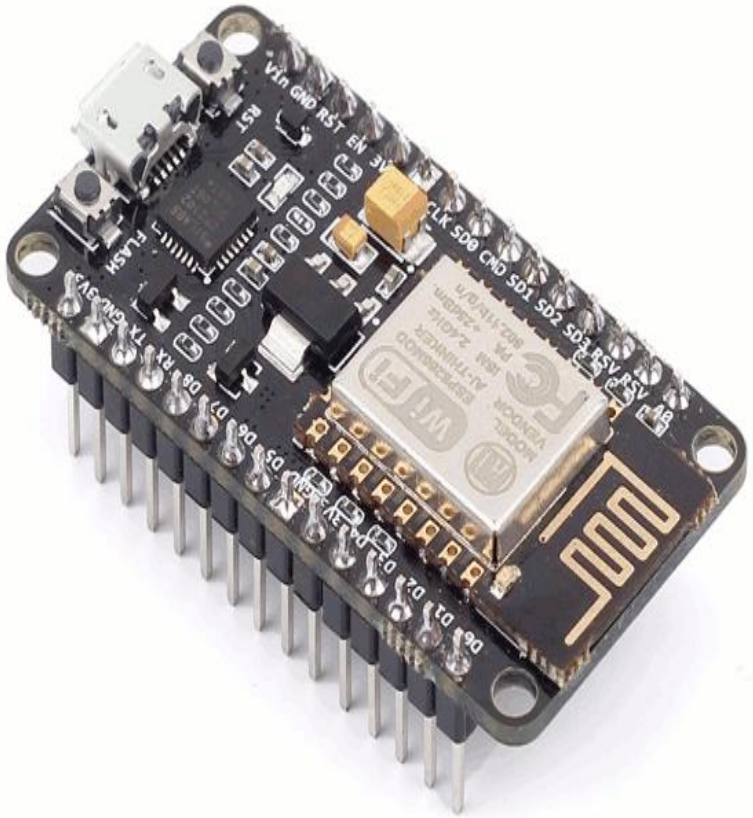




NodeMCU ESP8266

- Its compact size, coupled with built-in Wi-Fi capabilities, makes NodeMCU ESP8266 an ideal choice for prototyping IoT projects such as home automation

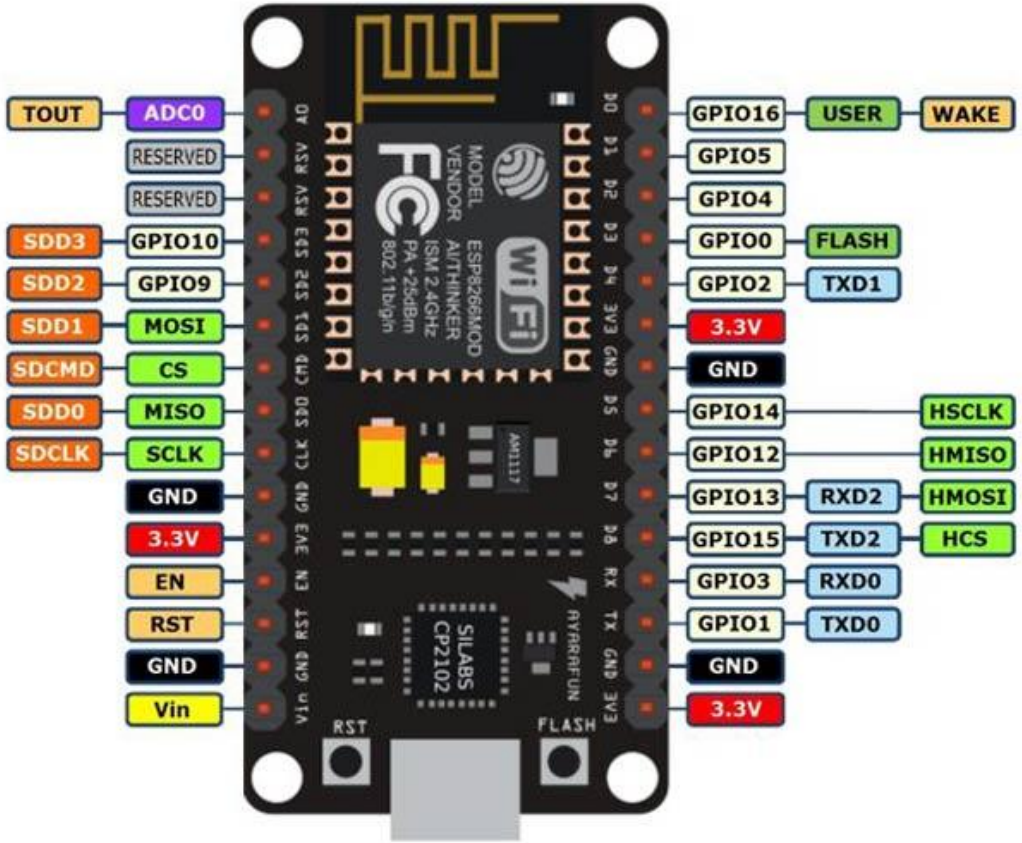
- It is not an Arduino-branded product, but it is often used in Arduino-compatible development boards.

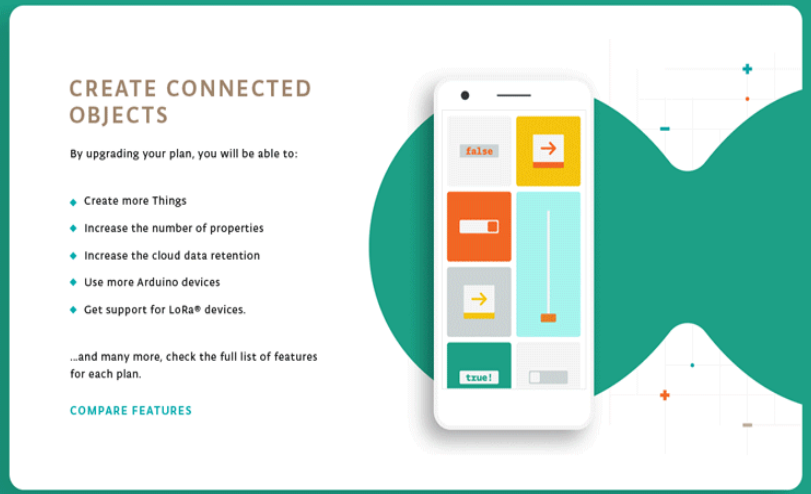


Features of ESP8266

- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- PCB Antenna
- Small Sized module to fit
- smartly inside our IoT projects

Pin Diagram of ESP8266





Arduino IoT Cloud

Arduino IoT Cloud is a cloud-based platform that simplifies building, managing, and controlling Internet of Things (IoT) projects using Arduino boards.

Features:

- Supports various connections (Wi-Fi, LoRa, Ethernet, and Cellular)
- Easy setup
- Remote control
- Scheduler
- Share data between devices

Methodology

We followed the following steps for implementation:

- Collecting our parts such as Arduino Uno [Arduino Uno board], HC-SR501 PIR sensor, Breadboard [Breadboard],Jumper wires [Jumper wires],Resistor (10kΩ) [Resistor], LED etc.
- Downloading and installing the Arduino IDE software.

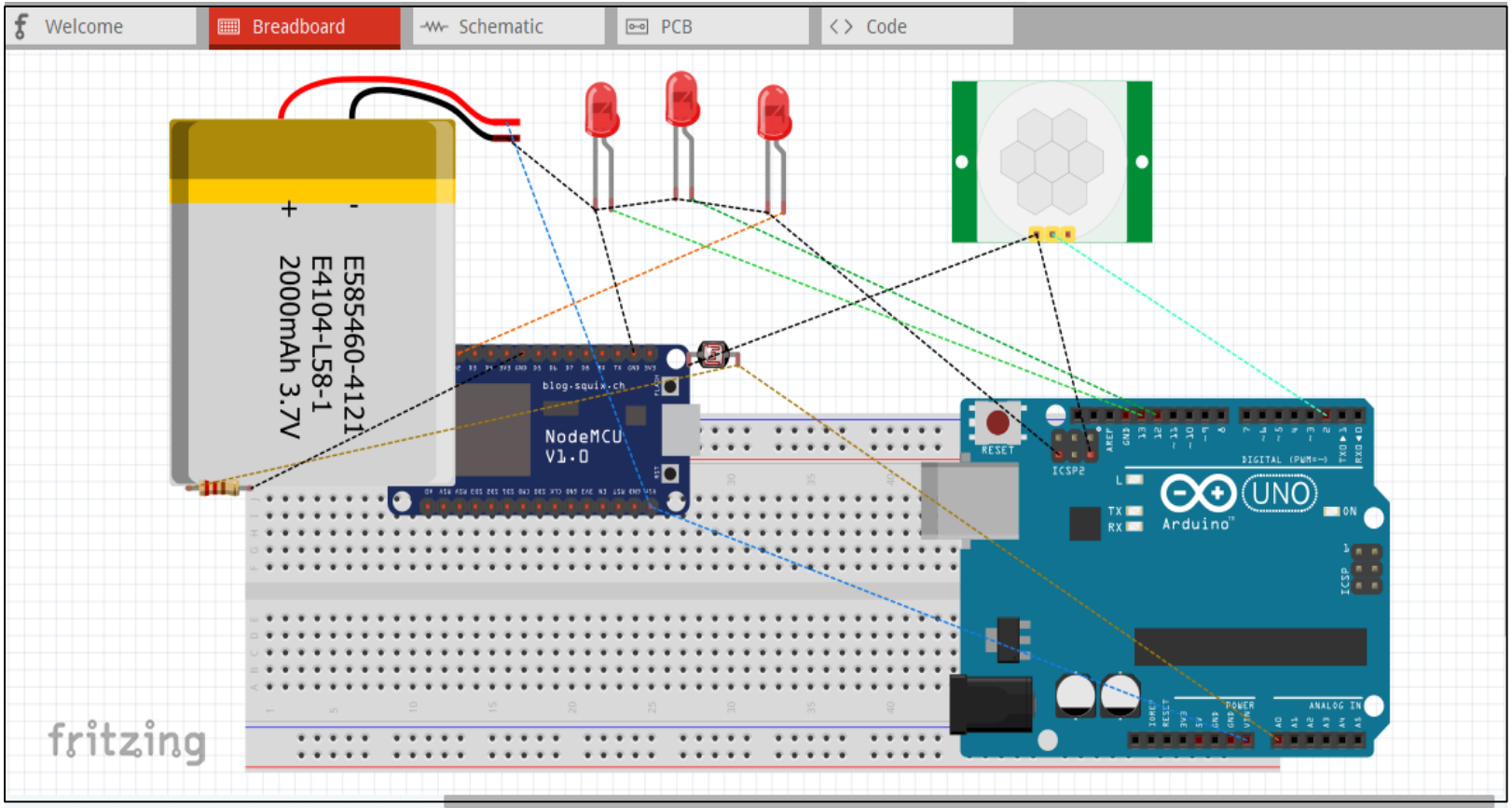
  Preparing the breadboard.

- Connecting HC-SR501 to Arduino
  - Connecting the VCC pin of the HC-SR501 to the 5V pin of the Arduino Uno.
  - Connecting the GND pin of the HC-SR501 to the GND pin of the Arduino Uno.
  - Connecting the Out pin of the HC-SR501 to the pin3 of the Arduino Uno.

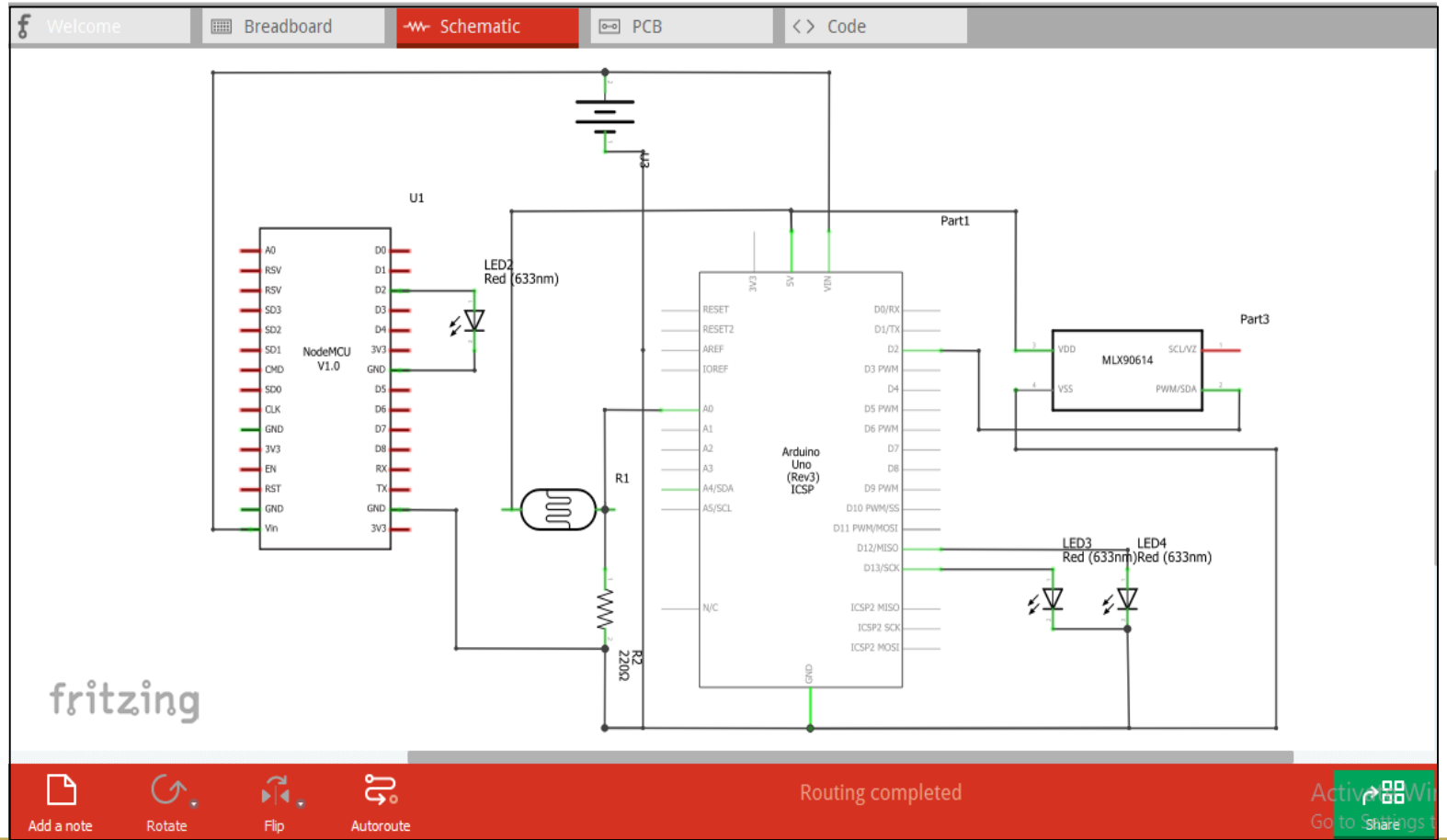
Methodology (Cont.)

- Connecting the LEDs to the Arduino Uno.
  - Connecting the long leg (positive) of each LED to a current limiting resistor (e.g., 10kΩ). Connect one resistor to each LED.
  - Connecting one resistor to pin D13 of the Arduino Uno and the other resistor to pin D12 of the Arduino Uno.
  - Connecting the short leg (negative) of each LED to GND.
- Uploading the Arduino & NodeMCU code.
- Drawing the circuit diagram using Fritzing software.

Circuit Diagram I



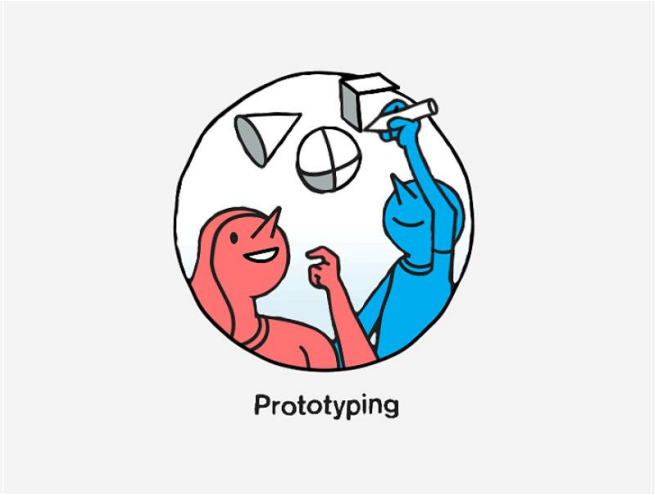
Circuit Diagram II



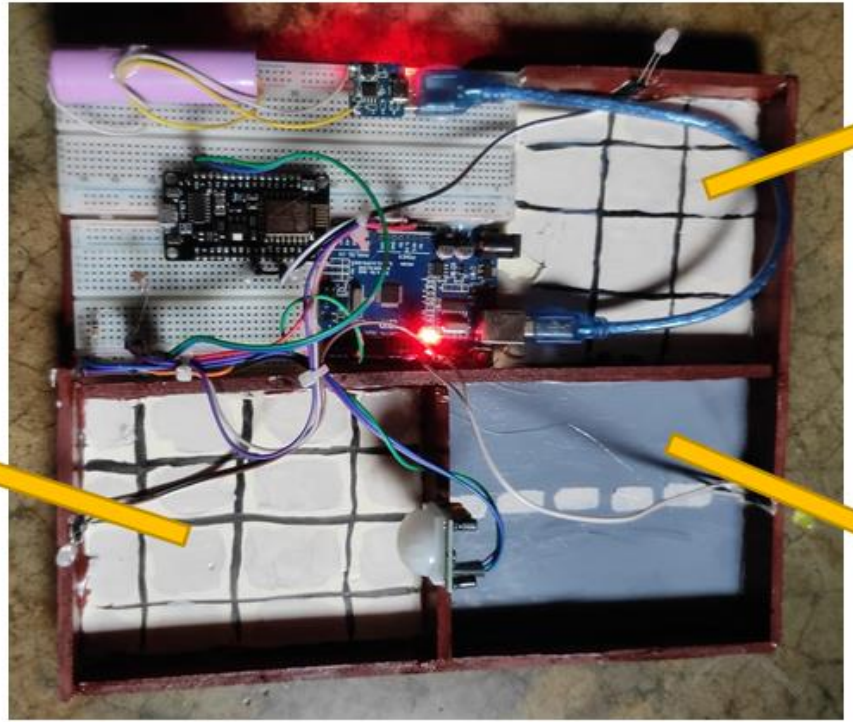
Prototype

We have built a prototype using cardboard where we have shown two classrooms (room 101 and room 102) and a street.

- **Room 101: Motion Sensitive**
- **Room 102: Blynk IoT Remote Access**
- **Streetlight: Light sensitive**



Prototype (Cont.)



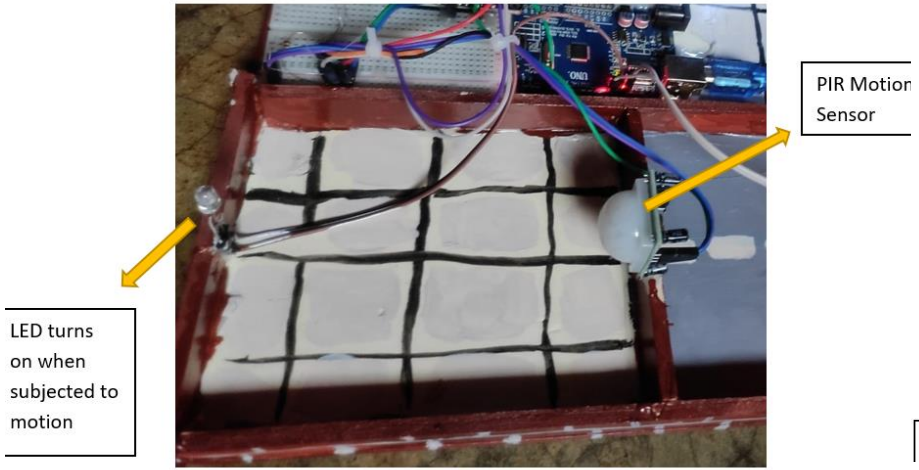
Classroom 102: IoT Blynk Remote Access

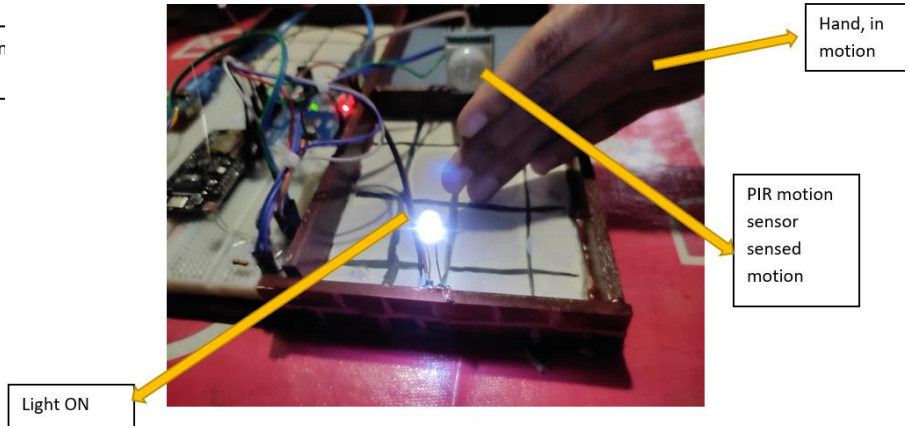
Classroom 101: Motion Sensitive

Streetlight: Light Sensitive

Prototype (Cont.)

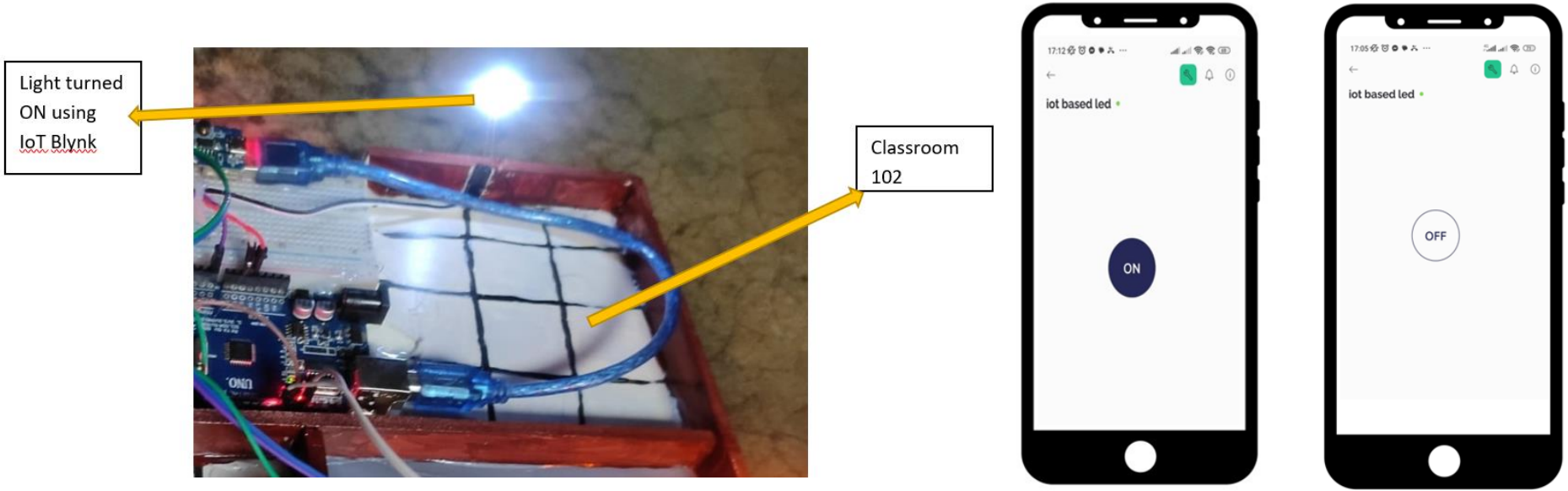
- Lights in room 101 are shown to be sensitive to motion as we have used PIR motion for its implementation.





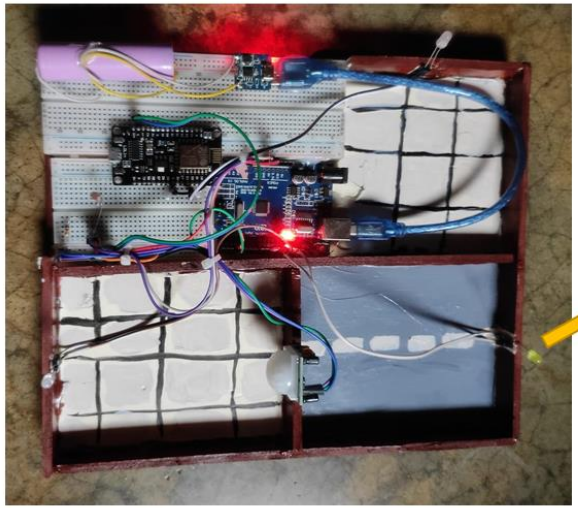
Prototype (Cont.)

- Lights in room 102 are shown to be connected to the user's smartphone using IoT cloud platform which enables the user to turn the lights on or off by clicking a button on the user's phone any time.



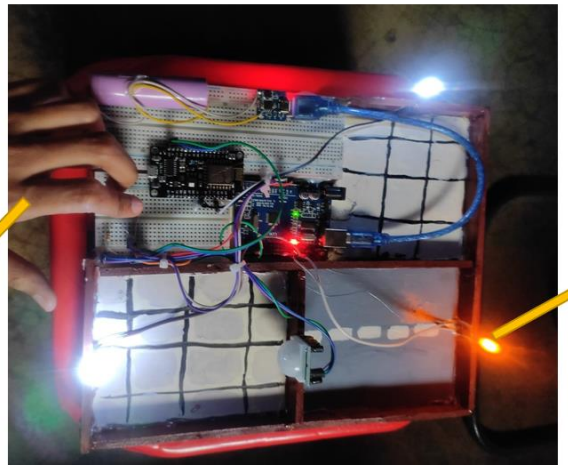
Prototype (Cont.)

- Streetlights are light sensitive as we have used LDR sensor so that in the daylight the streetlights can automatically turn off and at night when there is no light, the streetlights automatically turns on.



Streetlight OFF due to LDR sensing broad daylight

Hand covering the LDR induces darkness



Streetlight ON

Benefits

- **Energy Efficiency:**
  - **Optimized Lighting Control**: Ensures that lights are only on when needed.
  - **Energy Savings**: Automated systems can lead to significant energy savings, lowering electricity bills and environmental impact.
- **Convenience and Flexibility:**
  - **Remote Access**: Automated system offer remote access capabilities, allowing teachers or administrators to control lighting settings from anywhere using a smartphone or computer.
- **Maintenance and Longevity:**
  - **Extended Bulb Lifespan**: Automated system can extend the lifespan of light bulbs, reducing the frequency of replacements and maintenance.

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Benefits

- **Sustainability and Environmental Impact:**
  - **Reduced Carbon Footprint**: By conserving energy and promoting efficient usage, automated lighting systems contribute to sustainability efforts by reducing carbon emissions associated with electricity generation.
- **Cost Savings:**
  - **Lower Operational Costs**: While there may be an initial investment in installing automated lighting systems, the long-term savings from reduced energy consumption, maintenance, and replacement costs often outweigh the upfront expenses.

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Future Work

- Future work for "IlluminateTech: Smart Classroom Lighting Solutions" could involve several avenues for further exploration and enhancement. Firstly, the integration of additional sensors, such as temperature and occupancy sensors, could enable more advanced lighting control strategies, further optimizing energy usage and enhancing user comfort.

- Additionally, the incorporation of machine learning algorithms could enable the system to learn and adapt to user preferences over time, providing personalized lighting experiences.

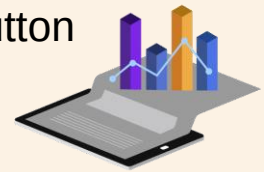
CONCLUSION

Motion Sensitive

In this project, we have implemented the prototype of an automated lighting system of the department of CSE at Jahangirnagar University where lights of room 101 are motion sensitive.

Remote Access

Lights of room 102 can be remotely accessed with smartphones or computers where the lights can be turned off or on with the click of button remotely.



Light Sensitive

We have implemented an automatic street lighting system which is sensitive to light. The project delivers an intelligent solution tailored for educational institutions.

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Thanks!

Questions? Comments? Let us Know

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