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IOT BASED SMART STREET LIGHT SYSTEM

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Abstract: The "IOT BASED SMART STREET LIGHT SYSTEM" project is an Internet of Things application. The system's primary goal is to use Arduino to develop a smart street light controller system. The primary goal of the system, which is designed to save energy, is to prevent energy waste caused by street lights that turn on automatically at dusk and off at dawn. It makes use of an Arduino Uno board along with an IR and LDR sensor. Arduino is an open-source platform for prototyping built on user-friendly hardware and software. To write code and upload it to your board, Arduino offers an intuitive and open-source programming tool. It's often known as the Arduino IDE. The LDR sensor, which regulates the brightness that the infrared sensor is exposed to, is unquestionably the primary controller in use. The vehicle or any obstructions in the path are detected using an infrared sensor. The system will turn on a led when it detects a car or obstruction. A portion of the lights in our system are ON, while others are OFF. Lights turn on when there is an obstruction or when cars approach. The light will turn off after the car or obstruction has moved.

I. INTRODUCTION

The main controller used is certainly the LDR sensor which controls the brightness subjected to the infrared sensor. An IR The system's primary goal is to use Arduino to develop a smart street light controller system. The primary goal of the system, which is designed to save energy, is to prevent energy waste caused by street lights that turn on automatically at dusk and off at dawn. It makes use of an Arduino Uno board along with an IR and LDR sensor. Arduino is a free to use platform for prototyping built on user-friendly hardware and software. To write code and upload it to your board, Arduino offers an intuitive and open-source programming tool. The Arduino IDE is a common name for it.

1.1 SMART STREET LIGHT:

LED lamps LEDs are current driven devices that react instantaneously to changes in power input. This allows for dynamic or adaptive lighting. The semiconductor nature of LEDs facilitates electronic control and drives the digital transformation of street lighting. A combination of cameras and sensors to detect light-levels and movement. Individual lamp controllers to effect on/off/dimming or adaptive lighting. Lamp controllers can also provide operational data and data related to maintenance requirements.

1.2 REVIEW:

B. A. Muthu, Z. Chen, and C. B. Sivaparthipan [1] This study presents a smart street light controlling system to improve the city's energy efficiency. Nowadays, people are always too busy to remember to switch off the light when it's not in use. This results in a high energy usage. The system that this essay proposes would switch on street lights shortly before sunset and turn them off in the morning when there is enough light for the streets.As a result, less energy is consumed.This technology detects human and vehicle activity on highways to turn on a portion of the street light ahead of them. This gadget turns on a part of the street light ahead of it when it detects car and human activity on highways.

This technology turns on part of the street light ahead of it and turns out the trailing lights when it detects vehicle and human movement on a roadway. This is achieved by transferring control commands to the street light block and processing the image of the object. Additional features of the system include the use of a suitable sensor to identify a failed street light and then transmitting an SMS via GSM mode to the control authority, instructing them to take the necessary action.

1.3 PROBLEM DESCRIPTION:

This project discusses about street Light Control using IOT Sensor It makes use of the sensors to control the lighting. The system will turn on a led when it detects a car or obstruction. A portion of the lights in our system are 4 ON, while others are OFF.When the obstacle or vehicles are come lights are ON. After the vehicle or obstacle goes away the light OFF.

1.4 GOAL:

These devices can be installed on regular streetlights and used to detect movement to provide dimming and dynamic lighting. Additionally, it enables communication between nearby fixtures. All nearby lights will illuminate whenever a car or pedestrian is detected until motion is no longer recorded.

1.5 PERSPECTIVE:

Future solar street lights should be able to work to other smart city systems including trash management, traffic signals, and public safety systems. Through integration, these systems will operate more effectively and efficiently and use less energy.

II. SYSTEM SPECIFICATION

2.1 HARDWARE REQUIREMENTS:

- Node MCU
- IR Sensor
- LDR Sensor
- LED

2.2 SOFTWARE REQUIRMENTS:

- Object system - Windows 10
- IDE – Arduino

III. PROJECT DESCRIPTION

3.1 BLOCK DIAGRAM:

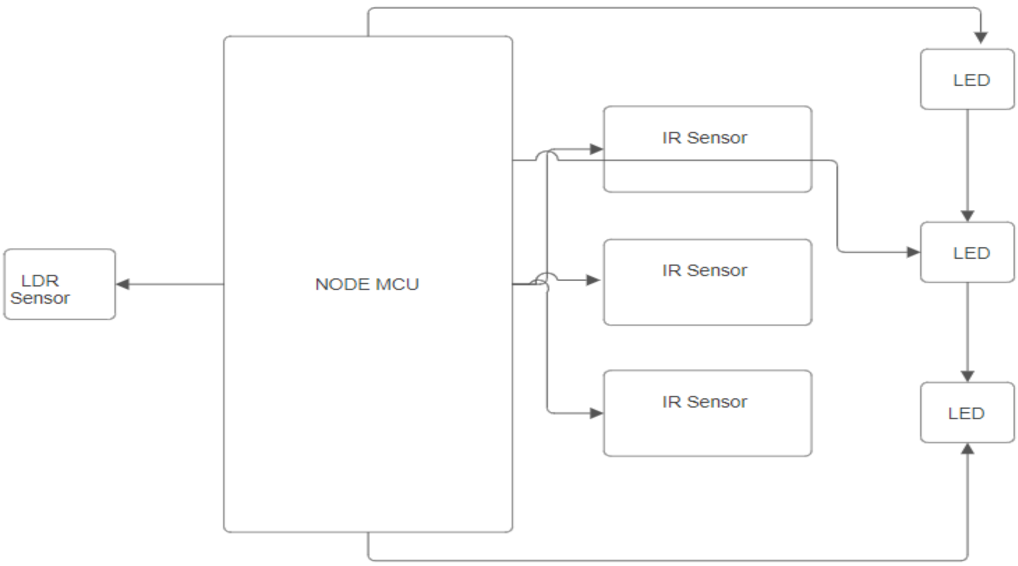

Figure 3.1-Block diagram

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3.2 BLOCK EXPLANATION:

3.2.1 Node MCU:

NodeMCU is an open-source firmware and development kit based on the ESP8266 WiFi module. The ESP8266 is a low-cost, highly-integrated wireless microcontroller that gained significant popularity for its ability to provide WiFi connectivity to various electronics projects The NodeMCU project provides an intuitive development environment and firmware to enable developers and enthusiasts to interact wit the ESP8266 module more easily.

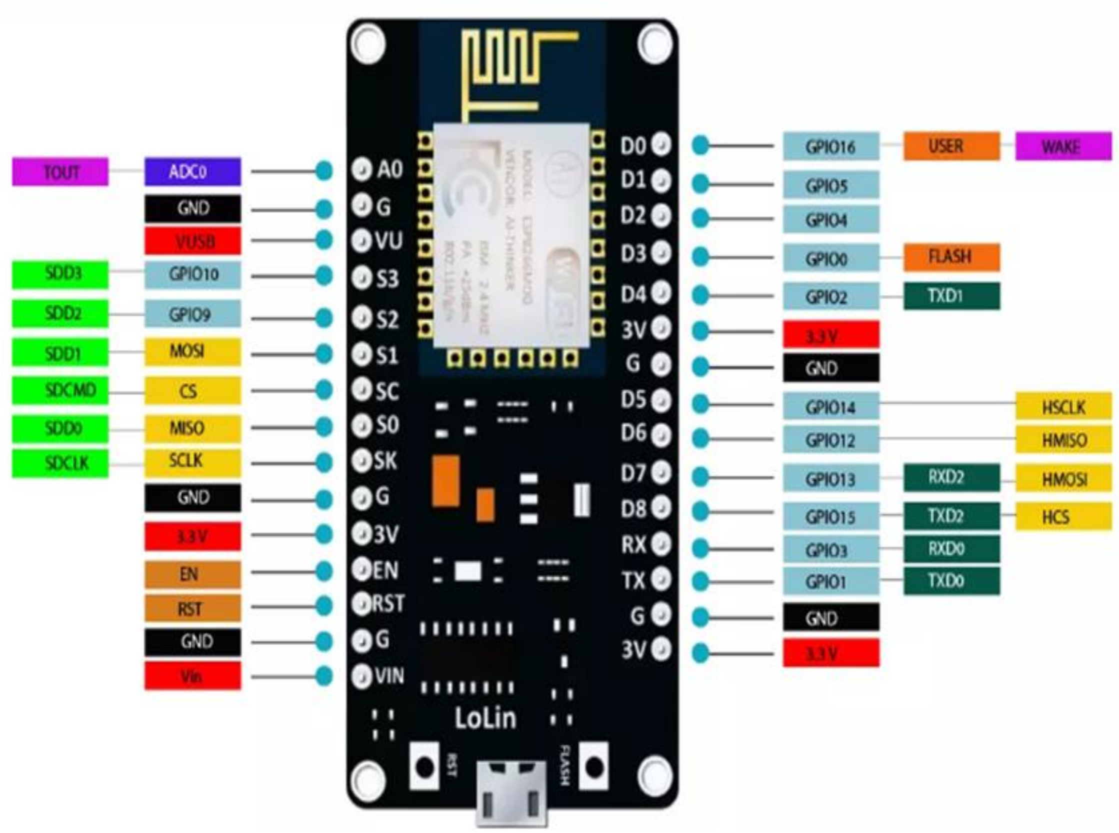

Figure 3.2.1-Node MCU

Lua Scripting: NodeMCU originally provided a Lua-based scripting environment, allowing developers to write code directly on the module using the Lua programming language. This made it accessible to those who were not familiar with embedded programming.

WiFi Connectivity: The main purpose of the NodeMCU firmware is to enable WiFi connectivity for IoT (Internet of Things) applications. The module can connect to local WiFi networks and communicate with other devices over the internet.

3.2.2 BOARD ARCHITECTURE:

On the NodeMCU v1.0 board, several pins offer Pulse Width Modulation (PWM) capabilities, providing a means to finely control the intensity and behavior of various components in your projects. Pin D1 (GPIO5), D2 (GPIO4), D3 (GPIO0), D5 (GPIO14), D6 (GPIO12), and D7 (GPIO13) all support PWM. This function gives you the ability to precisely control devices like servos, motors, and LEDs by allowing you to modify the duty cycle of the output signal. The PWM signal's on-off ratio allows you to control brightness, speed, and location. As a result, these pins are crucial for creating dynamic, responsive projects with variable output levels. Remember to consult the documentation and appropriate programming libraries to utilize these pins effectively for PWM-based applications.

- GND (3): Short for 'The Arduino has multiple GND pins that you can utilize to ground your circuit.
- 3.3V (5): Provides an external component with a controlled 3.3V power source. This voltage is the operating level for several of the board's components.

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- D0 (GPIO16): General-purpose digital I/O pin, usable for input or output tasks. Can also wake the ESP8266 from deep sleep.
- D1 (GPIO5, SCL): Serves as the clock (SCL) pin for I2C communication, a two-wire serial communication protocol used to connect sensors and devices.
- D2 (GPIO4, SDA): Acts as the data (SDA) pin for I2C communication, facilitating the exchange of data between devices.
- D3 (GPIO0): General-purpose digital I/O pin. During boot-up, it influences the boot mode of the ESP8266.
- D4 (GPIO2): General-purpose digital I/O pin. Also affects boot mode during the boot-up process.
- D5 (GPIO14, SCLK): Clock (SCLK) pin used in SPI communication for synchronizing data transfer between devices. It also supports PWM.
- D6 (GPIO12, MISO): Master In Slave Out (MISO) pin used in SPI communication for data transmission from the slave to the master. It also supports PWM.
- D7 (GPIO13, MOSI): Master Out Slave In (MOSI) pin used in SPI communication for data transmission from the master to the slave.
- D8 (GPIO15): General-purpose digital I/O pin. It supports PWM and can be used as an input or output.
- TX (GPIO1): Transmit pin for UART serial communication, allowing data to be sent from the board to other devices.

3.2.3 RESET BUTTON:

The reset button (10) on the Arduino is identical to that of the original Nintendo. Pressing it will Restart every program that is currently loaded on the Arduino by momentarily connecting the reset pin to ground. If you want to test your code more than once but it doesn't repeat, this can be quite helpful. On the other hand, unlike the original Nintendo, issues are typically not resolved by blowing on the Arduino.

3.2.4 POWER LED INDICATOR:

There is a little LED next to the word "ON" (11) on your circuit board, directly beneath and to the right of the word "UNO." Every time you plug your Arduino into a power source, this LED ought to turn on. It's likely that there's a problem if this light doesn't turn on.

3.3 IR SENSOR:

An electrical device known as an infrared sensor uses infrared radiation to either emit or detect specific 1 features of its environment. Along with these features, it can detect motion and measure an object's heat. Human vision cannot detect infrared radiation. Wavelengths longer than visible light but shorter than microwaves are found in the region of the electromagnetic spectrum known as infrared radiation.

3.3.1 WORKING PRINCIPLE:

Working of an IR Sensor The IR transmitter continuously emits the IR light and the IR receiver keeps on checking for the reflected light. If the light gets reflected back by hitting any object in front it, the IR receiver receives this light. This way the object is detected in the case of the IR sensor.

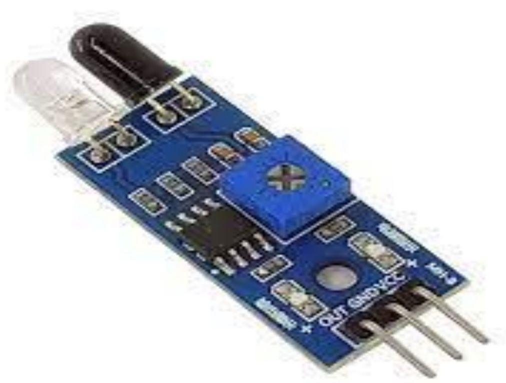

Figure 3.3 - IR Sensor

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3.3.2 SPECIFICATION:

- Main Chip LM393
- Operating Voltage (VDC) 3.6 ~ 5
- Average Current Consumption (mA) 0.06
- Detection Angle 35 Â°
- Distance Measuring Range (CM) 2 ~ 30

3.4 LDR SENSOR:

A device whose resistance depends on the electromagnetic radiation that is incident is called a photo resistor, or LDR.They are therefore light-sensitive gadgets. They can also be referred to as photoconductive cells, photoconductors, or just photocells. They are composed of highly resistant semiconductor materials. There are numerous symbols that can be used to denote an LDR; the graphic below is one of the most widely used symbols. The arrow points to where light is shining on it

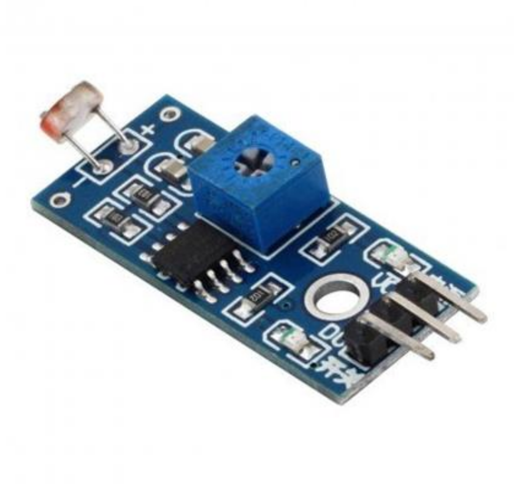

Figure 3.4 -LDR sesnsor

3.4.1 LIGHT DEPENDENT RESISTORS TYPES:

Self-Contained Photoresistors:

Pure semiconductor materials, like silicon or germanium, are used to make these. When photons with 3 sufficient energy strike an electron, the number of charge carriers increases and the electron is stimulated from the valance band to the conduction band.

Extrinsic photoresistors:

These are semiconductor materials that have been doped with dopants, or impurities. Above the electronfilled valence band, these dopants produce new energy bands. As a result, the bandgap is lowered and less energy is needed to excite them. Long wavelengths are typically employed with extrinsic photo resistors.

3.4.2 SPECIFICATIONS:

- Operating Voltage:3V to 5V DC.
- Operating Current: 15milli amps.
- LED indicating output and power.
- LM393 based design.
- Output Digital: 0V to 5V, Adjustable trigger level from preset.
- Output Analog:0V to 5V based on light falling on the LDR.

3.5 LIGHT EMITTING DIODE, OR LED:

A semiconductor material, usually a compound semiconductor composed of elements from Group III and Group V of the periodic table, is used to build LEDs. Gallium arsenide (GaAs), gallium phosphide (GaP), or indium gallium nitride (InGaN) are examples of common materials. Two electrodes are positioned between the semiconductor material.

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3.5.1 OPERATIONAL CONCEPT:

The semiconductor material moves electrons from the n-type (negative) area to the p-type (positive) region when a voltage is applied across it by connecting it to a power source. Photons, or light, are produced as these electrons recombine with holes, or vacant electron sites, in the p-type region. The light's emission color is determined by the bandwidth of the semiconductor material's energy.

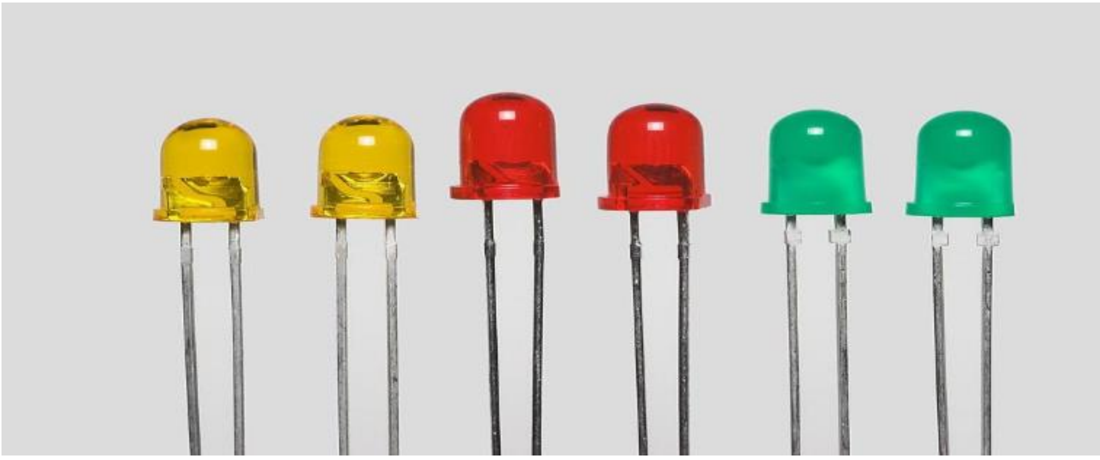

Figure 3.5 -Light Emitting Diode

3.8 CIRCUIT DIAGRAM:

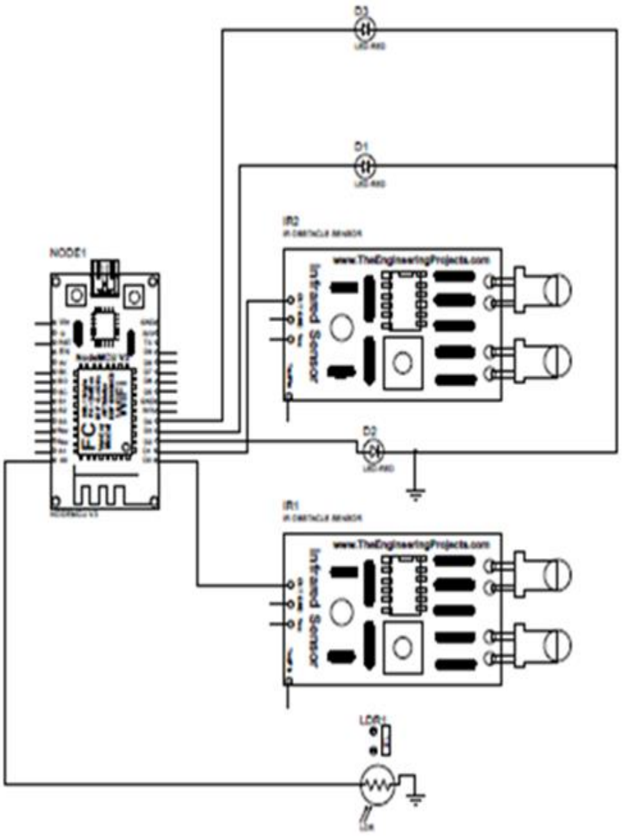

Figure 3.7-Circuit Diagram

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IV. IMPLEMENTATION AND RESULT ANALYSIS

4.1 STEPS TO CONNECT:

Connect IR Sensor With Node mcu

- Connect the pin 1- out in IR Sensor to pin 2 in NodeMCU
- Connect the GND pin IR Sensor in to GND pin in NodeMCU
- Connect the VCC pin in IR Sensor to 5.5 V in NodeMCU

Connect LDR Sensor With Arduino

- Connect the pin 1 in LDR Sensor to A0 in NodeMCU
- Connect the pin 2 in LDR Sensor to GND pin in NodeMCU
- Connect the pin 3 in LDR Sensor to +5V in NodeMCU

Connect the LED to NODEMCU

- Connect the two wires of the bulb to the two pins in the Nodemcu Board.

V. RESULT ANALYSIS

Energy Savings: Measure the reduction in energy consumption achieved by using smart street lights compared to traditional lighting systems. This can involve comparing energy bills before and after implementation, as well as conducting energy audits to quantify the savings.

Cost Savings: Evaluate the financial benefits of smart street lights by comparing the total cost of ownership, including installation, maintenance, and energy costs, with the savings generated over time. Consider factors such as reduced maintenance expenses and potential revenue from energy efficiency incentives or rebates.

Environmental Impact: Assess the environmental benefits of smart street lights, such as reduced carbon emissions and light pollution. Monitor air quality and other environmental indicators to gauge improvements resulting from energy efficiency and reduced energy consumption.

Safety and Security: Analyze the impact of smart street lights on public safety and security. Evaluate crime rates, accident statistics, and citizen feedback to determine whether the technology has contributed to improved safety outcomes, such as reduced crime or enhanced visibility in high-risk areas.

Operational Efficiency: Measure the efficiency gains achieved through remote monitoring, predictive maintenance, and real-time data analytics. Assess factors such as response times to maintenance issues, downtime reduction, and overall system reliability to quantify improvements in operational efficiency.

5.1 PROBLEM FORMULATION & SOLVING:

- Identify the Problem
- Define Objectives
- Gather Data and Information
- Generate Solution Ideas
- Evaluate Solutions

5.2 ADVANTAGES:

- Energy Efficiency.
- Cost Savings.
- Environmental Sustainability.
- Improved Visibility and Safety.
- Remote Monitoring and Control.
- Smart City Integration.

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5.3 DISADVANTAGES:

- Initial Cost.
- Complexity.
- Privacy Concerns.

VI. CONCLUSION

The "IOT based smart street light system" has passed all validations and been successfully finished. The system operates as intended. This system's features have been built to be user-friendly. The power of electronics is growing at an exponential rate in many facets of human existence. Sensors and Arduino, two of the system's components, are gradually becoming necessary elements of our everyday lives. Thus, it makes sense that we apply them to raise productivity in all spheres of life. Keeping in mind the urgent need for energy conservation, Smart Street Light System with IoT is an excellent and effective solution. It combines safe lighting protocols with consumption of minimal amount of power.

6.1. FUTURE ENHANCEMENT:

Environmental Sensors: Integrating sensors for monitoring air quality, temperature, humidity, and noise levels can provide valuable data for urban planning and environmental management. For instance, detecting high pollution levels could trigger actions like adjusting traffic flow or alerting residents to take precautions.

Traffic Management: Incorporating cameras and traffic flow sensors can enable real-time monitoring of traffic congestion and accidents. Street lights could then adjust their brightness or display dynamic traffic signals to optimize traffic flow and enhance safety.

Security Features: Enhancing street lights with built-in cameras and motion sensors can improve security in public spaces. These lights could detect suspicious activities and alert authorities, helping to prevent crime and enhance public safety.

VII. SCREEN SHOTS

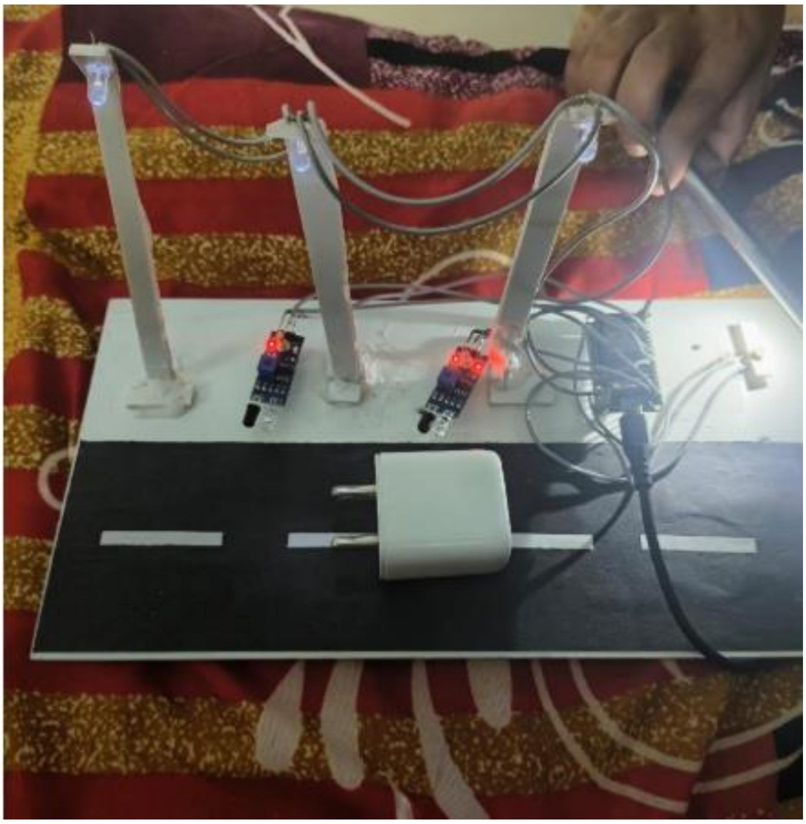

Figure 7.1 – Smart street light system

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Figure 7.2 – work on LDR sensor

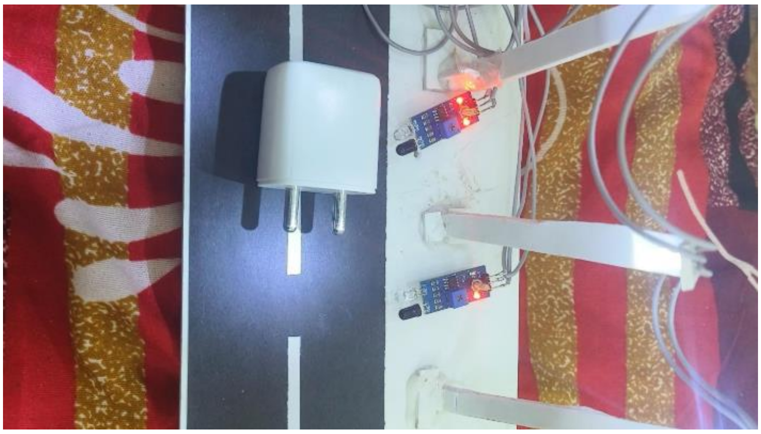

Figure 7.3 – working mechanism

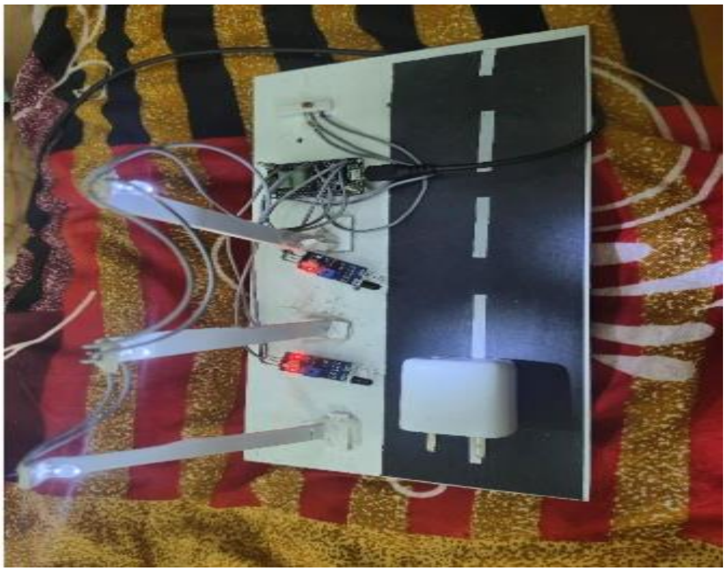

Figure 7.4 – Working on IR sensor

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