SMART STREET LIGHT WITH AUTOMATIC LIGHT SENSING

MINI PROJECT REPORT

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ABSTRACT

Smart Street light is an automated system which automates the street. The main aim of Smart Street light is to reduce the power consumption when there are no vehicle movements on the road. The Smart street light will glow with high intensity when there are vehicles on the road otherwise the lights will remain dim. With advancement of technology, things are becoming simpler and easier for everyone in the world today. Automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services. In the scope of industrialization, automation is a step beyond mechanization, whereas mechanization provided human operators with machinery to assist the users with the muscular requirements of work, automation greatly decreases the need for human sensory and mental requirements as well. Automation plays an increasingly important role in the world economy and in daily experience. Automatic systems are being preferred over manual system. The research work shows automatic control of streetlights as a result of which power is saved to an extent. The Smart street light provides a solution for energy saving which is achieved by sensing an approaching vehicle using the IR sensors and then switching ON a block of street lights ahead of the vehicle with high intensity. As the vehicle passes by, the trailing lights turn dim automatically. Thus, we save a lot of energy. So when there are no vehicles on the highway, then all the lights will remain dim. Automation plays an increasingly very important role in the world economy and in daily life. Automatic systems are being preferred over any kind of manual system. We can also call it an “SMART STREET LIGHT SENSING”.

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LIST OF ABBREVIATION

MCU	Micro Controller Unit
IR	Infrared Sensor
LDR	Light Dependent Resistor
LED	Light Emitting Diode

CHAPTER 1

INTRODUCTION

1. 1 OBJECTIVE :

The main objective of Smart street light with automatic light sensing

- The aim of the project is to reduce the power consumption.
- To control LED lights to turn on and off offering cities a chance to maximize low - energy lighting benefits through this project.
- The Smart street light provides a solution for energy saving which is achieved by sensing an approaching motion using the IR sensors and then switching ON a block of street lights ahead with high intensity.
- IR sensors can detect the movement of people and vehicles, allowing street lights to turn on and off automatically as needed. This helps to save energy by only illuminating areas when they are in use.

1.2 OVERVIEW OF SMART STREET LIGHT WITH AUTOMATIC LIGHT SENSING :

This street lighting is one of the largest energy expanses of a city. A street lighting system can cut municipal street lighting cost is 50% to 70%. The smart street lighting system is a system that adjusts light output based on the usage and occupancy, i.e., automatic classification of pedestrian versus cyclist, versus automotive. The project is mainly implemented to track the intensity of the light using sensors and it is done using the wireless system to

control the energy consumption and uses reduction measures through power conditioning and control. The street light (ON/OFF Status) will be accessed from anytime, anywhere through internet based on the real time system. The street controller should be installed on the pole light which consists of NodeMcu ESP8266. The data from the street light controller can be transfer to base station by using wireless technology to monitor the system. The operation of the system can be conducted using auto mode and manual mode the control system will switch on-off the lights are required timings and can also vary the intensity of the street light according to requirement.

Lamp unit : Does it consist of a power-adjustable? LED? array,? the brightness sensor, the motion sensor, the communication device, such as the ZigBee module,? and the controller. It turns on for several minutes under the conditions that a motion is detected in the defined area by the sensors including its own sensor. Then, it sends the message to other units. It turns off or reduced power under the condition that any motion is not detected in the defined area.

Sensor unit : It consists of the motion sensor, the communication device, and the controller. It sends out the message to other units under the condition that motion is detected. This unit is placed in many locations, such as at electric poles, at house gates, at house fences, and inside or outside of the door, to ensure that every street light turns on before pedestrians notice that. As for power supply, the solar battery can be a good option.

Interconnecting : Both units can be interconnected through the MQTT protocol. MQTT is a machine-to-machine (M2M)/”Internet of Things”

connectivity protocol. It was designed as an extremely lightweight publish/subscribe messaging transport. It is useful for connections with remote locations where a small code footprint is required and/or network bandwidth is at a premium.

FLOWCHART

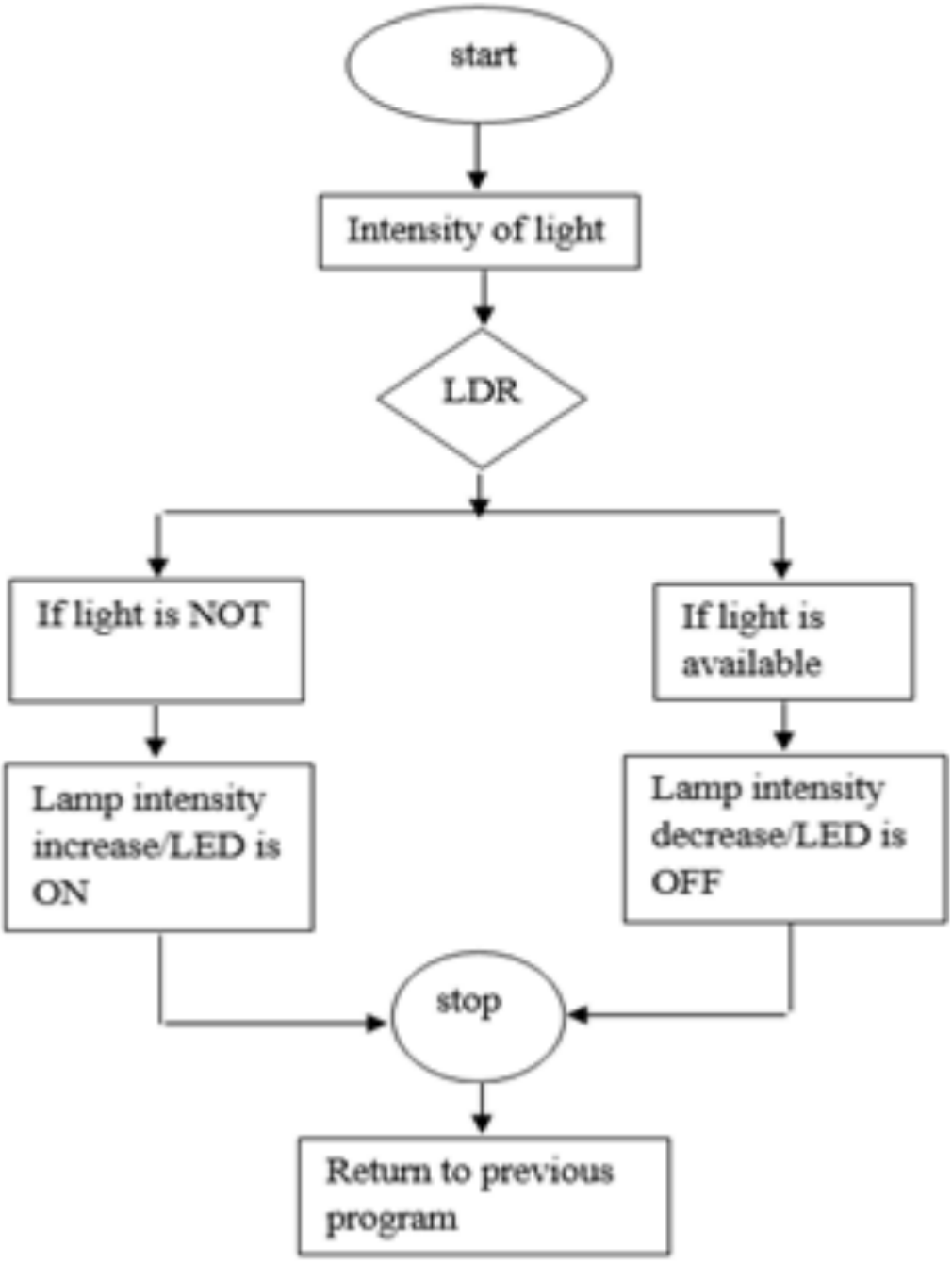


Fig1.1: flowchart of working system

The flowchart and table of component

Component	Specification
Node MCU	ESP8266
PIR sensor	ZRD 09
LDR sensor	BC547
LED	-
Micro USB cable	-
Jumper Wires	-

1.3 DIRECT BENEFITS :

1. The role of smart lighting solutions in the intelligent transformation of cities and buildings has gained momentum in the past years. This development will continue in the coming years based on increased connectivity and industrial internet of things (IIoT) solutions

becoming a key element in most smart city strategies around the globe.

2. The opportunities that cities can seize with the installation of smart lighting solutions go far beyond value creation through energy (cost) and maintenance savings (which are huge considering that as much as 40 percent of a city's energy budget is consumed by street lighting and new efficient lighting can save up to 50% of these costs as a result of increased energy efficiency) or the improvement of the environmental impact.

3. By reducing the amount of time that the lights are on, smart street lights using motion sensing technology can extend the lifespan of the bulbs and reduce the need for maintenance.

4. Motion sensors can detect the presence of people and vehicles, triggering the street lights to turn on and provide illumination. This can help to improve safety and security in public areas, especially in low-visibility situations.

5. Smart street lights using motion sensing technology can be easily adjusted to suit the needs of different areas, such as increasing the brightness level during peak hours or reducing it during off-peak hours.

1.4 INDIERCT BENEFICTS:

1. The installation of smart lighting solutions can play a key role in a smart city strategy, in which street and other exterior lighting installations serve as the backbone of a network in which services are delivered to the benefit of citizens, businesses, and the city government.

2. Today, most cities that install new smart lighting or retrofit existing fixtures choose systems that already are equipped with sensor technology or that can be upgraded easily to utilize the advantages of IoT applications.

3. Modern smart lighting products can help cities in monitoring the environment, increase public- and traffic safety, upgrade connectivity as WiFi hotspots or deliver location-based services like smart parking and smart navigation.

4. Improved lighting and safety in public areas can help to attract tourists and enhance the overall experience of the city.

5. The presence of well-lit areas can deter criminal activity, and motion sensing technology can help to provide illumination in areas where it is needed most, such as in alleys or parking lots.

6. By providing illumination only when needed, smart street lights using motion sensing technology can help to reduce glare and improve visibility for drivers, cyclists, and pedestrians.

CHAPTER 2

2.LITERATURE REVIEW

2.1 RELATED BACKGROUNDS

- The project is usually a multi-functional model capable of eliminating the manual operation of old street lightning with an automatic switching technique [1]. It aims to design and implement improved improvements to embedded energy-efficient street lighting systems and their maintenance at a reduced cost with modern development. The Street Lightning system has a feature as two sensors, the Light Dependent Resistor (LDR), are used to mark day/night time and therefore the passive infrared sensor (PIR) to detect movement on the road.
- In this IoT context, among all the wi-fi chips included, the ESP8266 is one of the best and is the least expensive wi-fi module. A small 32bit TensilicaXtensa L106 controller is integrated into it. Inside a small RB balun PCB area, a low-noise amplifier, power amplifier, filters and small external power management modules are included in the front module [3].
- In [4] Automatic Street Light Control System is not only simple but also powerful. Relay uses automatic switching on this system. It frees up almost 100% manual labor. As soon as sunlight penetrates the visible surface of our eyes this system automatically changes LIGHT lights. The Light Dependent Resistor (LDR) is a type of sensor that performs this function and senses light as does our eyes. As soon as the light from the sun comes on, our eyes automatically turn off the lights. Such a system is also useful in reducing energy consumption.

- In [5] this project is designed to detect vehicle movement on highways so that you ONLY turn on the traffic light in front of it and SWITCH off the rear light to save energy. At night all the headlights on the highways are always ON in the car, but a LOT of energy is wasted when there is no car movement on the highways.

- The Wi-Fi ESP8266 MODULE is employed to upload to the important time information on the cloud through IOT panel [6].

- Providing a street lightning is one in every of the foremost important and expensive responsibilities of a city. Lightning can account for 10-38% of the overall energy bill in typical cities world-wide [7].

CHAPTER 3

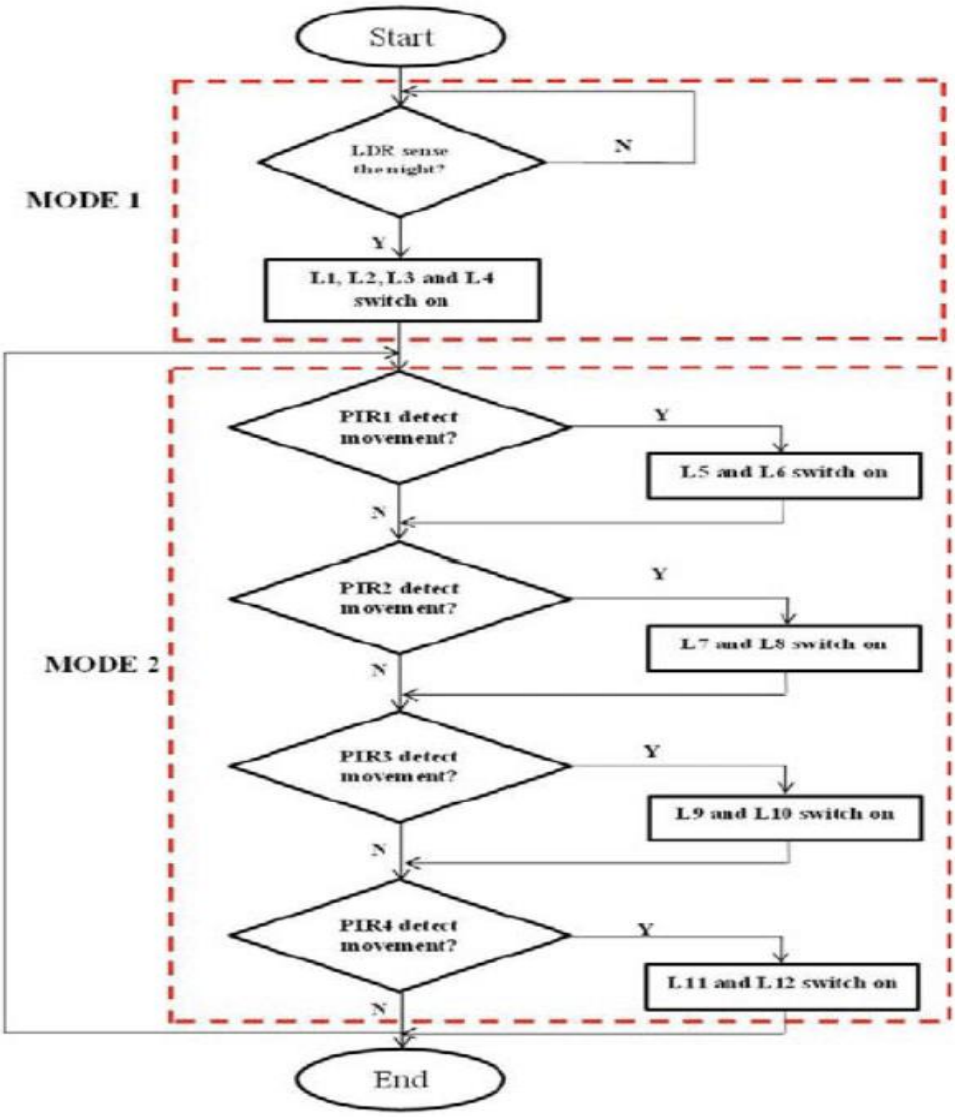
3. SYSTEM IMPLEMENTATION

3.1 PROBLEM IDENTIFICATION

- Each year, in the world, several **trillion kWh** are expended onstreet lighting. According to the International Energy Agency,the overall demand for public lighting will be 80% higher by2030 than in 2005.
- On an average, **18%-38%** of the **total energy bill** goestowards street lighting. Another name for public lighting is “unmetered load”.
- So a management system is needed for taking autonomousdecisions to ensure **efficient power management** in public lighting is proposed.
- Once the system is deployed, it is monitored and maintained to ensure that it continues to function properly. This includes regular inspections, software updates, and repairs as needed.

3.2 METHODOLOGY INVOLVED

The idea of this project is to give information about the IOT SMART STREET LIGHT SYSTEM. So, we have chosen the THING SPEAK technology to get more control over the street lighting. In this project we are interfacing NODEMCU ESP8266, RELAY &LDR SENSOR. India facing one of the major Problem is maintenance of street lights. In India street lights are maintained manually, it is found that there is wastage of power by operating the street lights due to manual operations like switch on the light at day time. To reduce the manual errors by controlling, implementation is done using Thingspeak for effective communication.

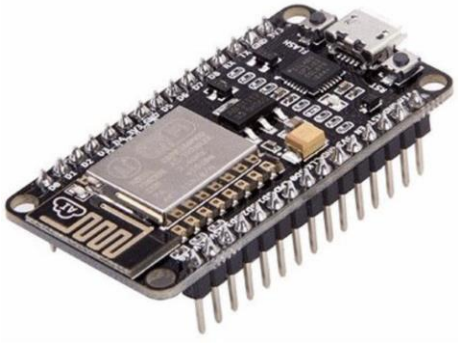


Internet of Things is a term of opening new possibilities of interacting with electronic devices by digitally interfacing them possibly providing information in a very simple userfriendly format to a smart device and connected to the same network as the rest of the system. In this system, every device is required to be operate in the basis of IoT, are connected to each other on the same network. The system architecture is adaptive system and it consists LDR sensors, NODEMCU ESP8266, relay, Bulb. In this system

NODEMCU microcontroller acts as the brain of the entire system. All the sensors used in this system are connected to micro controller. LDR is light dependent resistor. When the day time sunlight falls on it, its resistance decreases and makes the light to switch off. When the night time, light do not fall on the sensor, so its resistance increases and triggers the light to switch On. Relay acts an automatic switch and electromagnetic switch it is connected to the micro controller by relay driver. It is highly reliable and automatically switches ON and OFF the lights.

ESP8266 NodeMCU

ESP8266 NodeMCU is an open source IoT platform. It includes firmware which runs on the low cost Wi-Fi enabled ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. It has GPIO, SPI, I2C, ADC, PWM AND UART pins for communication and controlling other peripherals attached to it. On board NodeMCU has CP2102 IC which provides USB to TTL functionality.



The ESP8266 chip can be programmed using a variety of programming languages, including C, C++, Python, and Lua. It is also compatible with

many development platforms and tools, such as the Arduino IDE and the NodeMCU firmware.

Some of the key features of the ESP8266 chip include:

1. Low power consumption
2. Built-in Wi-Fi connectivity
3. GPIO pins for controlling devices and sensors
4. Support for a wide range of programming languages and development platforms
5. Small size and low cost

LDR Sensor

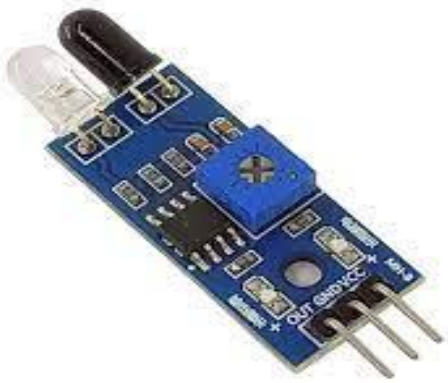
LDR stands for **Light Dependent Resistor** also known as photo-resistor. LDR is sensitive to light and its resistance changes according to the intensity of light falling on it. It is made up of high resistance semiconductor and its resistance increases in darkness and decreases in light. When light incident on the LDR exceeds some threshold, it absorbs the photons and allows electrons to jump into the conduction band. LDR generates a variable resistance which depends on the intensity of light falling on it. It is mainly used in electric circuits like street light, alarm clock, automatic brightness and contrast control etc. In street lighting systems, LDR sensors can be used to detect the level of ambient light and adjust the brightness of the street lights accordingly. When the ambient light level is low, the LDR sensor detects this and triggers the

street lights to turn on. As the ambient light level increases, the LDR sensor detects this and triggers the street lights to dim or turn off.

Overall, LDR sensors are a useful tool for detecting the presence or absence of light and can be used in a wide range of applications. They are easy to use, affordable, and widely available.

IR Sensor

IR sensor can detect animal/human movement in a requirement range. IR is made of a pyroelectric sensor, which is able to detect different levels of infrared radiation. The detector itself does not emit any energy but passively receives it.



IR sensors can be a cost-effective solution for street lighting systems, as they only turn on the lights when needed, reducing energy consumption and

lowering costs. Additionally, they can improve safety for pedestrians and drivers by providing better lighting in areas where it is needed most.

IR sensors can also be used in street light systems to detect the presence of vehicles or pedestrians and trigger the street lights to turn on or adjust their brightness accordingly. When a vehicle or pedestrian enters the range of the IR sensor, it detects the presence and triggers the street lights to turn on or increase their brightness. As the vehicle or pedestrian moves away from the sensor, the street lights can be set to dim or turn off.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 EXPERIMENT RESULTS

- In this section, the setup of the whole research work is depicted in a step by step manner. Sample screenshots are displayed once the components are fixed and connected to each other. All the components are connected to each other and thus completes the system setup which helps one to understand the steps in a simple and easy way. With these steps, even when a person who is trying to implement the same, it makes it simple, clear and easy.

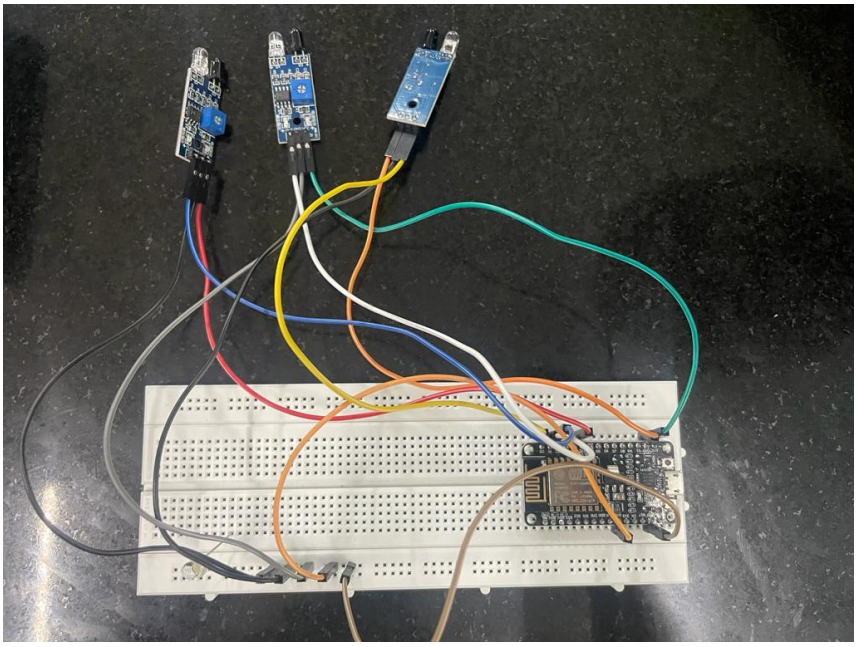
- All the components are in accordance to every other component. The five IR sensors are placed next to each other. The Arduino board is about to be mounted and connected to the external power supply for the flow of current. All the five IR sensors are going to be connected to the Arduino board. All the wirings with the breadboard are installed.

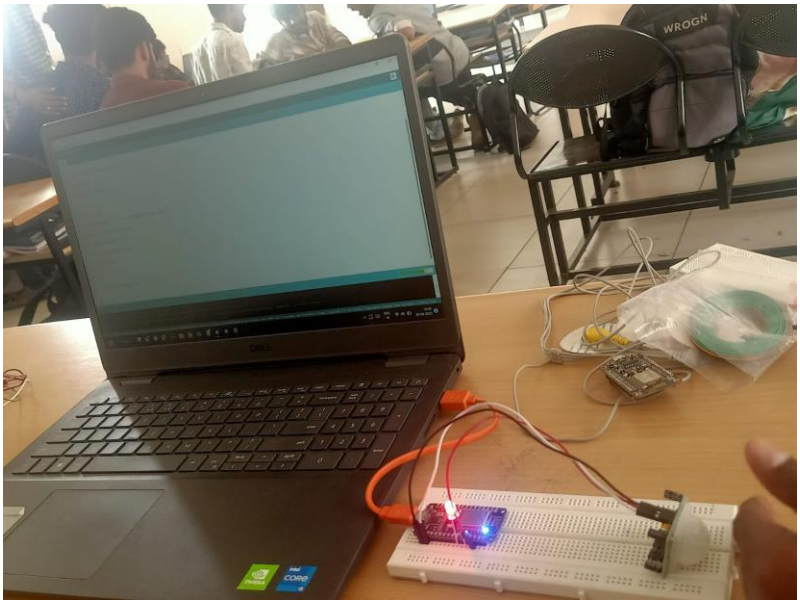
- All the LEDs are connected with the Arduino 23 and Arduino is mounted. All the connections are completed, as soon as the 5V power supply is fed to the input Arduino, circuit will start to work perfectly.

- Thus, LDR circuit detects light and LDR works as an insulator, does not allow the current to pass through the circuit. Hence, LEDs are remained turn off. LDR is hidden by finger tip, to create natural dark condition. Due to no light, the resistance of LDR becomes very low,

allowing current to pass through the LDR circuit. Thus, LEDs glow dimly.

- when any object is detected by the first sensor first two adjacent LEDs glow with its full intensity keeping rest of the LEDs lit dimly.





CHAPTER 5

CONCLUSION AND FUTURE TRENDS

5.1 CONCLUSION

By using Smart Street light, one can save surplus amount of energy which is done by replacing sodium vapor lamps by LED and adding an additional feature for security purposes. It prevents unnecessary wastage of electricity, caused due to manual switching of streetlights when it's not required. It provides an efficient and smart automatic streetlight control system with the help of IR sensors. It can reduce the energy consumption and maintains the cost. The system is versatile, extendable and totally adjustable to user needs.

- The system is now used only for One way traffic in highways.
- Continuous uses of LDR and IR sensors even in day time.
- Not switched on before the sunset. The Smart light system can be further extended to make the current system in twoway traffic, making the system more flexible in case of rainy days and introduction of ways to control the lights through GSM based service.

5.2 FUTURE TRENDS

- This system can be used for only one way traffic. A highway might be covered by this system on dual system installation on both side. The system does not have any automatic fault detector. Pole damage detection with the addition of suitable sensor can be implemented.
- The street light control circuit can be used in normal roads, highways, express ways etc.

- The project can also be used in parking areas of malls, hotels, industrial lighting, etc.
- If the lighting system implements all LED lights, the cost of the maintenance can be reduced as the life span and durability of LEDs is higher than Neon based lights which are normally used as street lights.
- As the lights are automatically turned ON or OFF, huge amount of energy can be saved.
- This system less costly, less installation and maintenance cost and more efficient as compared to the others system

APPENDIX - 1

SOURCE CODE

```
#include <ESP8266WiFi.h>;
#include <WiFiClient.h>;
#include <ThingSpeak.h>;

const char* ssid = "CircuitLoop";
const char* password = "circuitdigest101";

WiFiClient client;

unsigned long myChannelNumber = 795820;
const char * myWriteAPIKey = "FZTOUARV558GRZ8J";
const char * myReadAPIKey = "T52GT3QQOQBVPG4V";

int led_1;
int led_2;
int led_3;

int ir1 = D0;
int led1 = D5;
```

```
int ir2 = D1;
int led2 = D6;

int ir3 = D2;
int led3 = D7;

int ldr = A0;
int val =0;

void setup() {
  Serial.begin(9600);
  delay(10);
  pinMode(ir1,INPUT);
  pinMode(led1,OUTPUT);

  pinMode(ir2,INPUT);
  pinMode(led2,OUTPUT);

  pinMode(ir3,INPUT);
  pinMode(led3,OUTPUT);

  WiFi.begin(ssid, password);
```

```
  ThingSpeak.begin(client);
}

void loop() {
  int s1 = digitalRead(ir1);
  int s2 = digitalRead(ir2);
  int s3 = digitalRead(ir3);
  s3 = not(s3);

  val = analogRead(ldr);

  Serial.print(s1);
  Serial.print(":");
  Serial.print(s2);
  Serial.print(":");
  Serial.print(s3);
  Serial.print("   ");
  Serial.println(val);
  if(val<800)
  {
    if(s1==0)
    {
      digitalWrite(led1,LOW);
```

```
  }
  else
  {
    digitalWrite(led1,HIGH);
  }
  if(s2==0)
  {
    digitalWrite(led2,LOW);
  }
  else
  {
    digitalWrite(led2,HIGH);
  }

  if(s3==0)
  {
    digitalWrite(led3,LOW);
  }
  else
  {
    digitalWrite(led3,HIGH);
  }
}
```

```
else
{
  digitalWrite(led1,LOW);
  digitalWrite(led2,LOW);
  digitalWrite(led3,LOW);
}

ThingSpeak.writeField(myChannelNumber, 1,val, myWriteAPIKey);
ThingSpeak.writeField(myChannelNumber, 2,s1, myWriteAPIKey);
ThingSpeak.writeField(myChannelNumber, 3,s2, myWriteAPIKey);
ThingSpeak.writeField(myChannelNumber, 4,s3, myWriteAPIKey);
ThingSpeak.writeField(myChannelNumber, 5,led1, myWriteAPIKey);
ThingSpeak.writeField(myChannelNumber, 6,led2, myWriteAPIKey);
ThingSpeak.writeField(myChannelNumber, 7,led3, myWriteAPIKey);

led_1 = ThingSpeak.readIntField(myChannelNumber, 5, myReadAPIKey);
led_2 = ThingSpeak.readIntField(myChannelNumber, 6, myReadAPIKey);
led_3 = ThingSpeak.readIntField(myChannelNumber, 7, myReadAPIKey);

if(led_1==1)
{
  digitalWrite(led1,HIGH);
}
```

```
  else
  {
    digitalWrite(led1,LOW);
  }

  if(led_2==1)
  {
    digitalWrite(led2,HIGH);
  }
  else
  {
    digitalWrite(led2,LOW);
  }

  if(led_3==1)
  {
    digitalWrite(led3,HIGH);
  }
  else
  {
    digitalWrite(led3,LOW);
  }
}
```

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