A PROJECT REPORT ON

<< *Automatic Streetlights that glow on detecting Night and Object using Arduino* >>

Submitted in partial fulfilment of the requirements for the award of the degree of

Bachelor of Technology

In

ELECTRONICS&COMMUNICATION ENGINEERING

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Abstract

This paper demonstrates an easy, tough and energy efficient street light intensity system which does not require much maintenance. It is accomplished by using Arduino microcontroller and sensors that will control the electricity based on night and object's detection. LDR sensor is affixed to sense the luminosity in the environment. A cluster of LEDs act as streetlights. The benefits of this proposed work is that the wastage of unused electricity can be reduced, lifetime of streetlights will increase as they do not have to stay ON during the whole night. This proposed idea will surely be beneficial in the future applications of microcontrollers and sensors.

Keywords:

Automation system, Energy conservation, Arduino, Sensors.

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INTRODUCTION

Automation systems are being preferred over the manual mode because it reduces the use of energy to saves energy. These automation systems play an essential role in making our daily life more comfortable and facilitate users from ceiling fans to washing machines and in other applications.

The existing lighting control system was developed uniquely for the target center at the time of construction and is a one of a kind system. Our country is suffering from power crisis for a long time. Although some times because of our ignorance, we see street lights are on in the day. So we always suffer from this electricity crisis. By using automation to our street lights controlling system we can not only save our energy but also save human labor. Here we will show how we can make a controlling system easily by using LDR and sensors, microcontroller and small amount of power supply.
The present system is like, the street lights will be switched on in the evening before the sun sets and they are switched off the next day morning after there is sufficient light on the roads. As a result the electricity waste occurs greatly all over the country. But the actual timings for these street lights to be switched on are when there is absolute darkness. This project gives the best solution for electrical power wastage. Also the manual operation of the lighting system is completely eliminated. In our project we are using LDR, which varies according to the amount of light falling on its surface, this give an indication for us whether it is a day/night time.

Our country is suffering from power crisis for a long time. Although some times because of our ignorance, we see street lights are on in the day. The project Automatic Street Light Control System with LDR and IR sensors has been successfully designed and tested. Here we are saving lot of power without any wastage, by these advanced technologies we can design many more systems which can be done by solar lights and through these solar lights we have a vast usage at the same time we can do automatic systems instead of doing it manually.

The main aim of the project is Automatic street power saving system with LDR; this is to save the power. We want to save power automatically instead of doing manual. So it’s easy to make cost effectiveness. This saved power can be used in some other cases. So in villages, towns etc. we can design intelligent systems for the usage of street lights. The report presents a new and innovative approach to managing street lighting systems. When combining both the sunrise/sunset feature with modern communications intelligent control of the street lighting system will offer significant

cost savings because of reduced energy consumption and lower maintenance and operation cost.

The idea of designing a new system for the streetlight that do not consume huge amount of electricity and illuminate large areas with the highest intensity of light is concerning each engineer working in this field. Providing street lighting is one of the most important and expensive responsibilities of a city. Lighting can account for 1038% of the total energy bill in typical cities worldwide. Street lighting is a particularly critical concern for public authorities in developing countries because of its strategic importance for economic and social stability. Inefficient lighting wastes significant financial resources every year, and poor lighting creates unsafe conditions. Energy efficient technologies and design mechanism can reduce cost of the street lighting drastically.

The most natural solution is to control the street lights according to the outside lighting condition. This is what our paper is aiming for in smart lighting system in which the street lights will be turned OFF when there are no motion detections or daytime, otherwise the lights will be remained Dim/ON. Our proposed design is aimed at efficiently replacing any light systems that are manually controlled, and this is accomplished with the properly arrangements of microcontroller Arduino Uno, IR obstacle avoidance sensor, LDR, and Resistors. In this scenario, when the intensity of sunlight impinges with LDR, street lights can be further controlled as per the desired requirement, automatically. Moreover, the high-intensity discharge street bulbs are replaced with LEDs to further reduce the power consumption. An automatic street light system does not help us in reducing the power consumption only, but also to reduce accidents, criminal activities and maintenance costs.

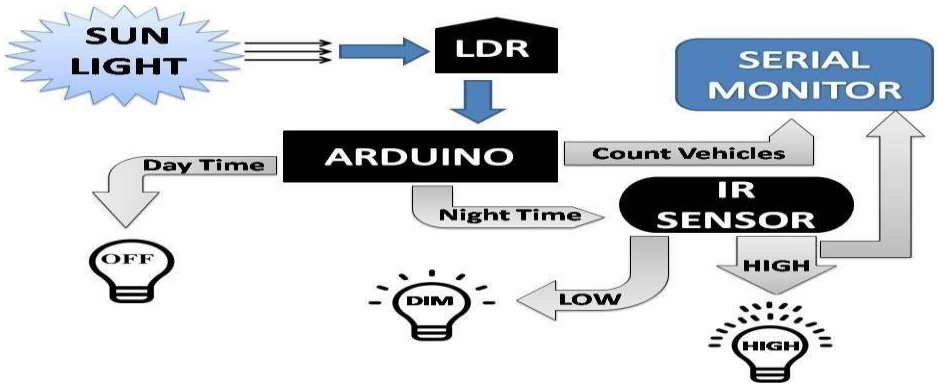

Figure 1. The architecture design of automatic street light control system.

Fig. 1 illustrates the overall working mechanism and the features of the proposed lighting concept. Firstly, LDR will sense the intensity value of sunlight and send it to Arduino. Arduino will judge if the received value is above the threshold level (which is set independently by the user from the discrete value: 0-2023), then it will consider it as day- time and LEDs will remain OFF, or if the received value below the threshold level, Arduino will consider it as a night-time. In the night-time, if the value of IR obstacle detector sensor is LOW and detects no object, then DIM LEDs (half of its maximum voltage) will glow, or if IR obstacle detector value is HIGH and detects any object, then HIGH LEDs (full of its maximum voltage) will glow. Arduino will also count the total number of vehicles that crossed the street in the night- time with the help of IR obstacle detection sensor and will demonstrate it to the serial monitor.

COMPONENTS REQUIRED

Components	Quantity	Specifications	Cost (in Rs.)
LDR	1	Voltage: DC 3-5V, 5mm,1.8 gm.	10
Arduino Uno	1	22 pins, operating voltage 6-20V	450
LEDs	2	5 mm , operating voltage 5V	2
IR obstacle avoidance sensor	2	Voltage: DC 3-5V, Range 2-30cm, Angle 35	60
Resistors	3	100 ohm (12) , 220 ohm (1)	18
Breadboard & jumper wires	1breadboard 20 jumper wires(approx.)	-	130
Cardboard, Paint, Glue, Tape	As per requirement	-	50 (appox)
USB Cable	1	-	30

Table 1. Specification of electronic components used in to design the proposed system.

TOTAL COST* = *Rs. 750 (approx)

COMPONENTS DESCRIPTION

A. Light Dependent Resistor (LDR)

An LDR or light dependent resistor is also known as photo resistor, photocell, and photoconductor. It is a one type of resistor whose resistance varies depending on the amount of light falling on its surface. When the light falls on the resistor, then the resistance changes. These resistors are often used in many circuits where it is required to sense the presence of light. The resistance offered by the sensor decreases with the increase in light strength and increases with the decrease in light strength. This device is used for detection of day-time and night-time because when sunlight falls on it, it will consider as day-time, and when there is no sunlight falls on it, it will be regarded as a night. These are very beneficial, especially in light/dark sensor circuits and help in automatically switching ON /OFF the street lights.

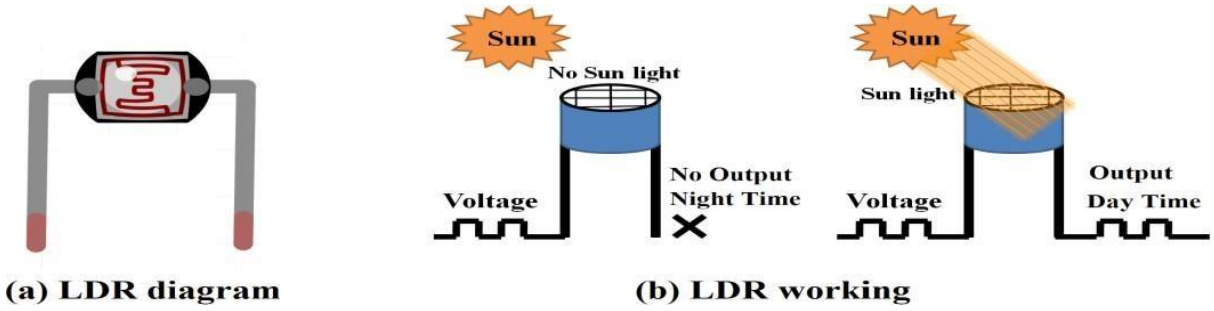

Figure 2. LDR symbol and its working phenomenon

Working Principle of LDR

This resistor works on the principle of photo conductivity. It is nothing but, when the light falls on its surface, then the material conductivity reduces and also the electrons in the valence band of the device are excited to the conduction band. These photons in the incident light must have energy greater than the band gap of the semiconductor material. This makes the electrons to jump from the valence band to conduction.

Figure 3: Working Principle of LDR

These devices depend on the light, when light falls on the LDR then the resistance decreases, and increases in the dark. When a LDR is kept in the dark place, its resistance is high and, when the LDR is kept in the light its resistance will decrease.

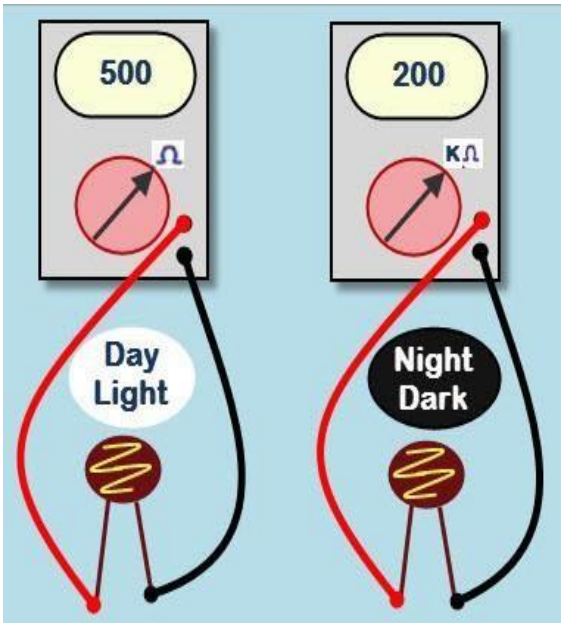

Figure 4: Variation of LDR Resistance with Variation in Light Intensity

If a constant "V' is applied to the LDR, the intensity of the light increased and current increases. The figure below shows the curve between resistance Vs illumination curve for a particular light dependent resistor.

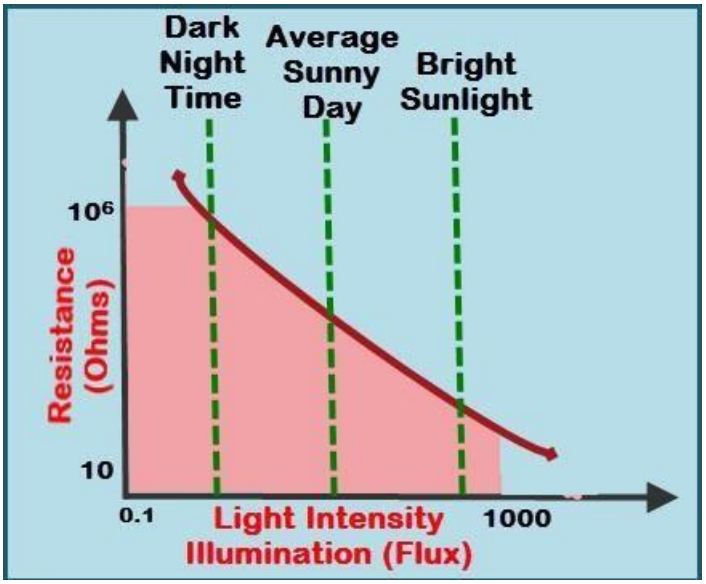

Figure 5: Light Intensity vs. LDR Resistance

B. Arduino Uno

The Arduino Uno is a microcontroller board which is based on the ATmega328 series controllers and has an IDE (Integrated Development Environment) for writing, compiling and uploading codes to the microcontroller. It has 14 digital input and output pins (of which 6 are PWM) and 6 analogue inputs for communication with the electronic components such as sensors, switches, motors and so on. It also has 16 MHz ceramic resonators, a USB connection jack, an external power supply jack, an ICSP (in-circuit serial programmer) header, and a reset button. Its operating voltage is 5v, input voltage 7 to 12v (limit up to 20v).

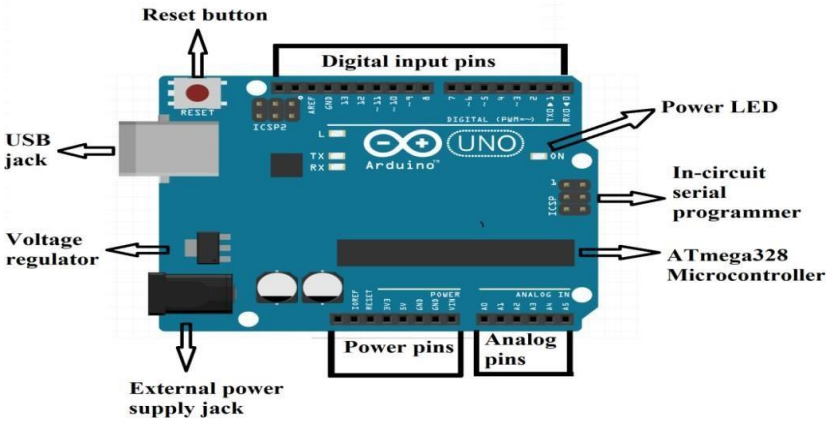

Figure 6: Arduino Uno board description

C. LEDs

A LED (light-emitting diode) is a PN junction diode which is used for emitting visible light when it is activated. When the voltage is applied over its elements, electrons regroup with holes within the LED, releasing energy in the form of photons which gives the visible light. LEDs may have the Dim/full capability.

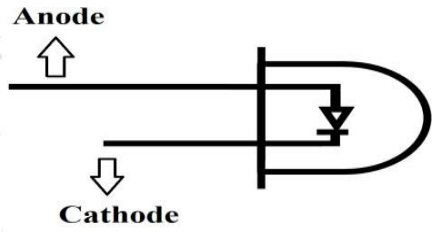

Figure 7. LED circuit diagram

How do LEDs Emit Light?

LEDs (Light Emitting Diodes) are semiconductor light sources that combine a P-type semiconductor (larger hole concentration) with an N-type semiconductor (larger electron concentration). Applying a sufficient forward voltage will cause the electrons and holes to recombine at the P-N junction, releasing energy in the form of light.

Compared with conventional light sources that first convert electrical energy into heat, and then into light, LEDs (Light Emitting Diodes) convert electrical energy directly into light, delivering efficient light generation with little-wasted electricity.

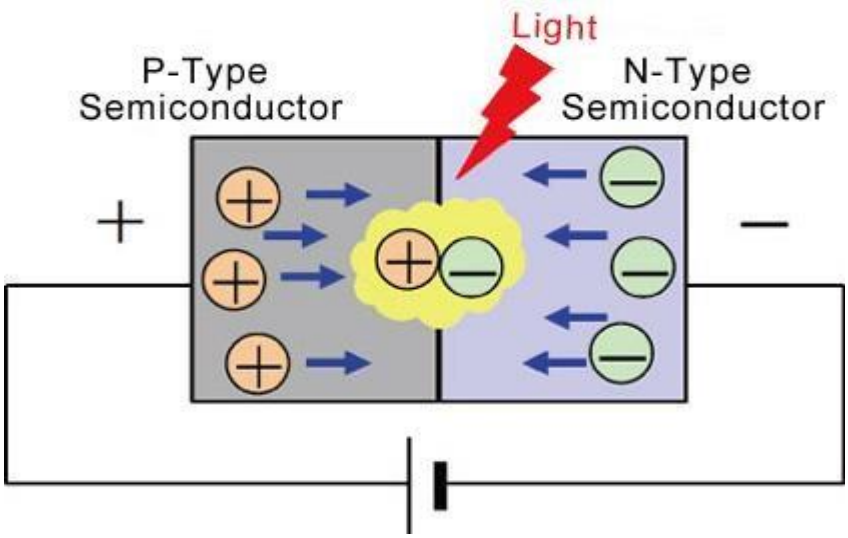

Figure 8. LED diagram

D. IR Obstacle Avoidance Sensor

An obstacle avoidance sensor consists of an infrared-transmitter, an infrared-receiver and a potentiometer for adjusting the distance. The Infrared Obstacle Avoidance Sensor has a pair of infrared transmitting and receiving sensors. The infrared LED emits Infrared signals at certain frequency and when an obstacle appears on the line of infrared light, it is reflected back by the obstacle which is sensed by the receiver. Whenever an object passes in front of a sensor, the emitted rays hit the surface of an object and reflect to the receiver of the sensor so it will consider this as a motion. It is a heat sensitive sensor and used for detection of motion.

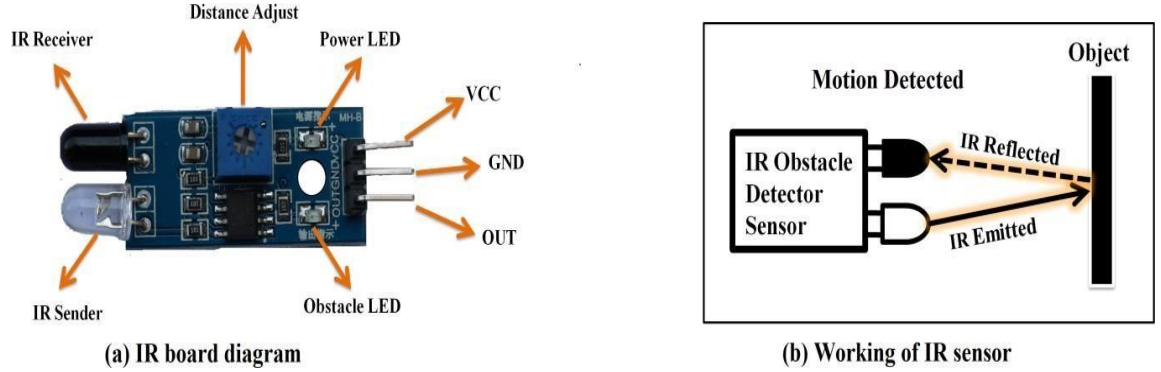

Figure 9. IR obstacle detector sensor diagram and working

E. Resistors

A resistor is a passive electronic component, used with other electronic components such as LEDs and sensors to prevent or limit the flow of electrons through them. It works on the principle of Ohm's law which prevent overflow of voltage.

A **resistor** is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses.

High-power resistors that can dissipate many watts of electrical power as heat, may be used as part of motor controls, in power distribution systems, or as test loads for generators.

Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

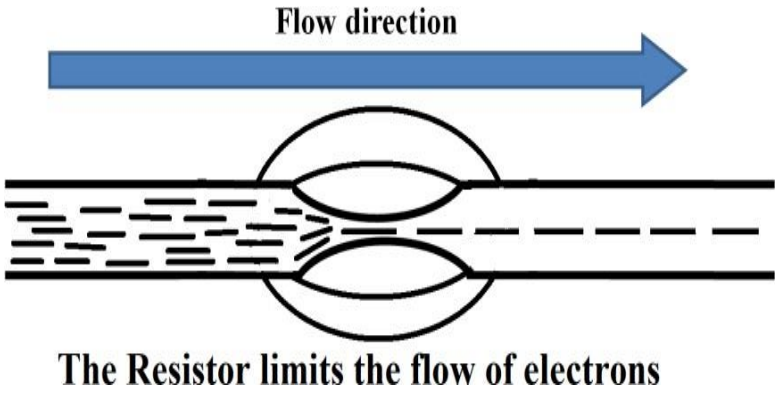

Figure 10. Working principle of resistor

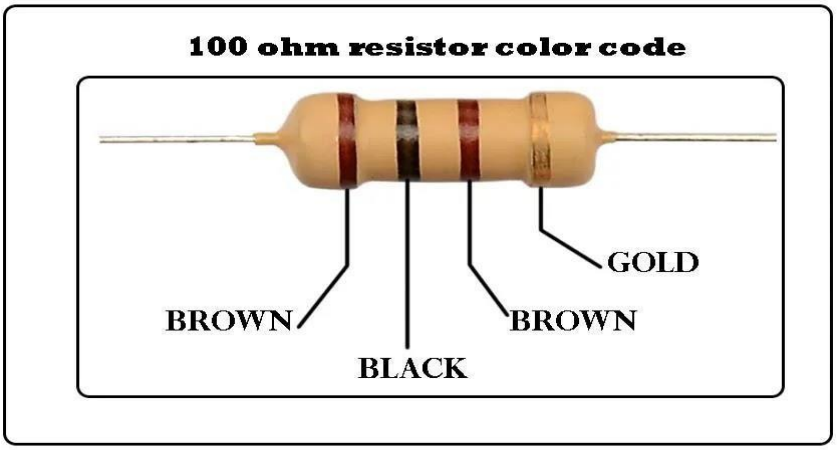

Figure 11: 100 Ω resistor

WORKING PRINCIPLE

Firstly, LDR will sense the intensity value of sunlight and send it to Arduino. Arduino will judge if the received value is above the threshold level (which is set independently by us as 100), then it will consider it as day time and LEDs will remain OFF, or if the received value below the threshold level, Arduino will consider it as a night-time. In the night-time, if the value of IR obstacle detector sensor detects no object, then DIM LEDs will remain switched OFF, or else if IR obstacle detector value detects any object, then LEDs will glow.

DESIGN METHODOLOGY

CIRCUIT DIAGRAM:

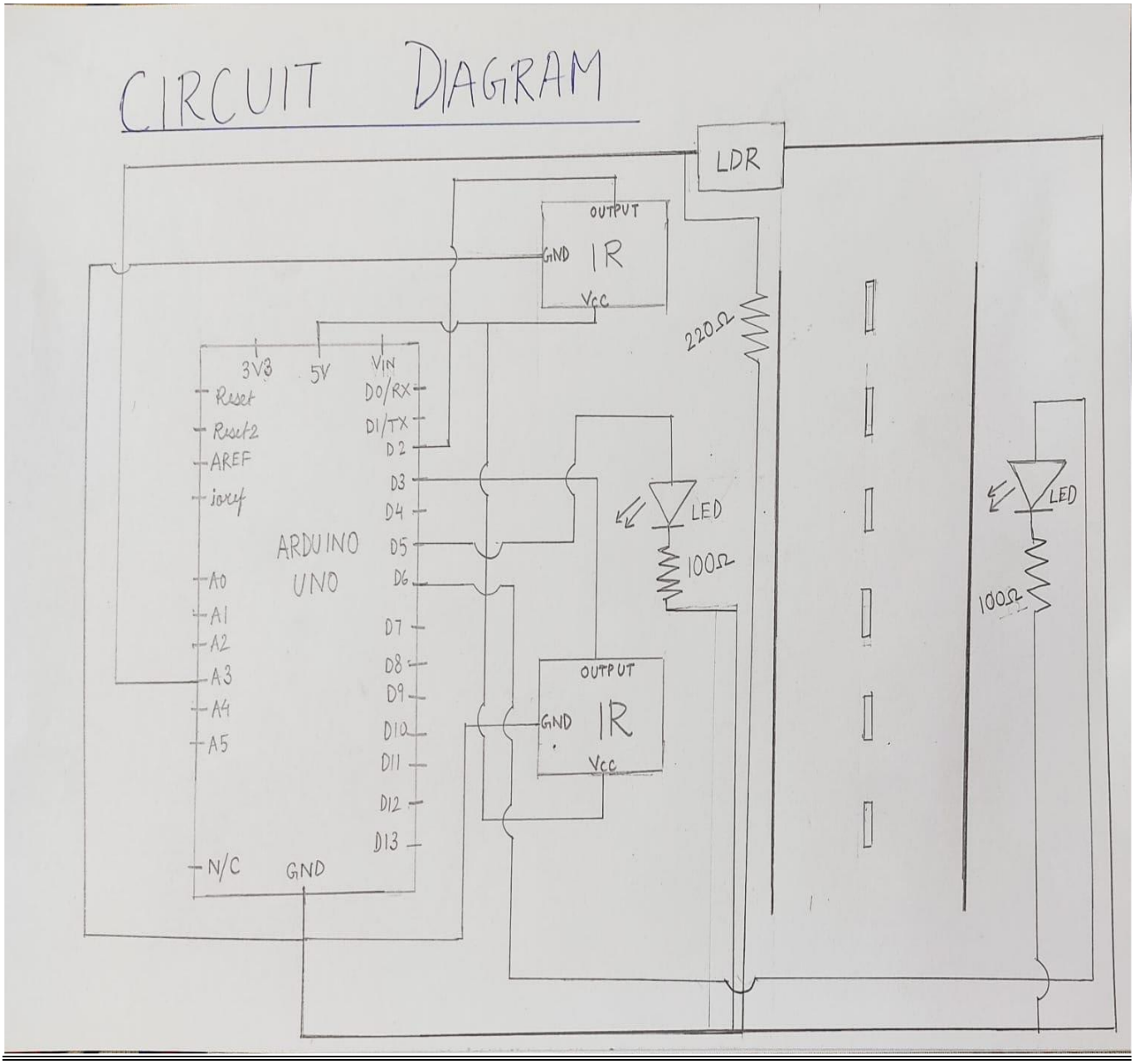

Figure 12: Circuit Diagram

CONNECTIONS:

The IR sensors are interfaced with the Arduino Uno. The input pin of the IR sensors is connected to the positive (5V) of the Arduino. Similarly the ground of the IR sensors is connected to the ground of the Arduino. Next, the output pin of one IR sensor is connected to pin number 2 of the Arduino and the other IR output pin is connected to pin number 3 of the Arduino. The leds are connected to pin number 5 and 6 respectively. To control the glow of LED at night or day, an LDR is used. The LDR produces an analog output which we have given to the A3 pin of the Arduino. One terminal of the LDR is connected to positive (5V) of the Arduino. The other terminal which is connected to the A3 pin is also connected to ground via resistor (220 ohm). This makes a voltage divider. The other terminal of the leds is also grounded via resistors (100 ohm).

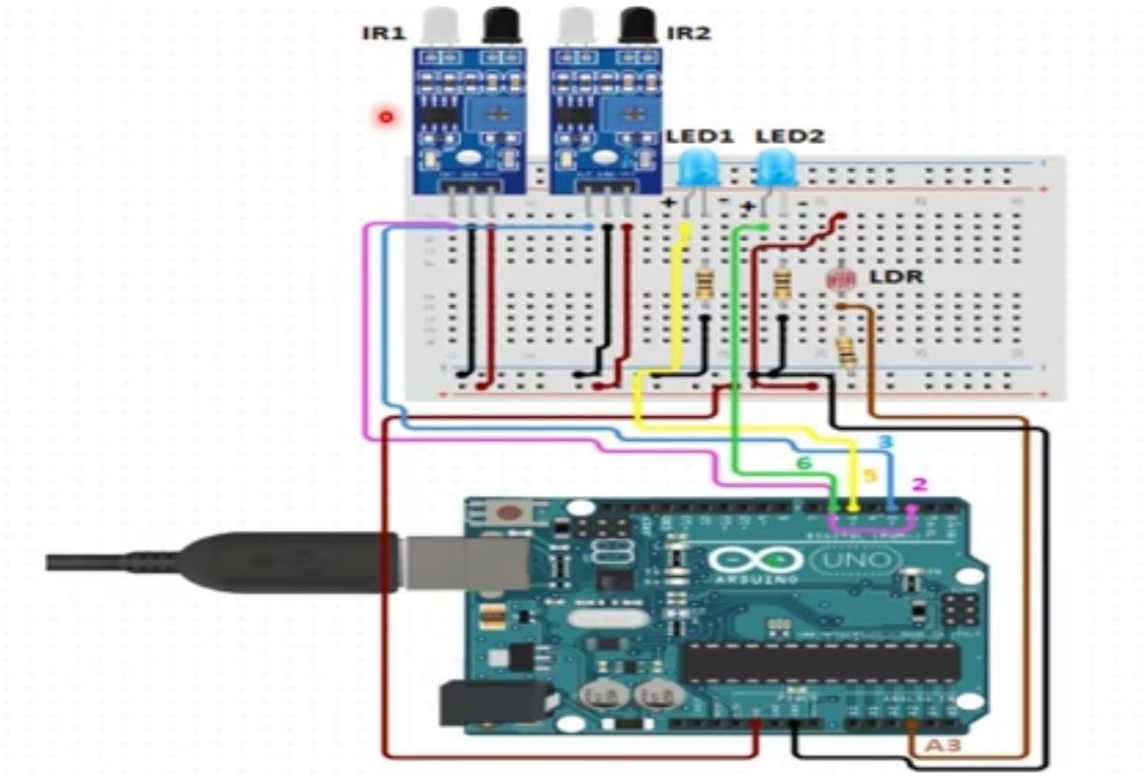

Figure 13: Circuit connections

CIRCUIT PICTURES:

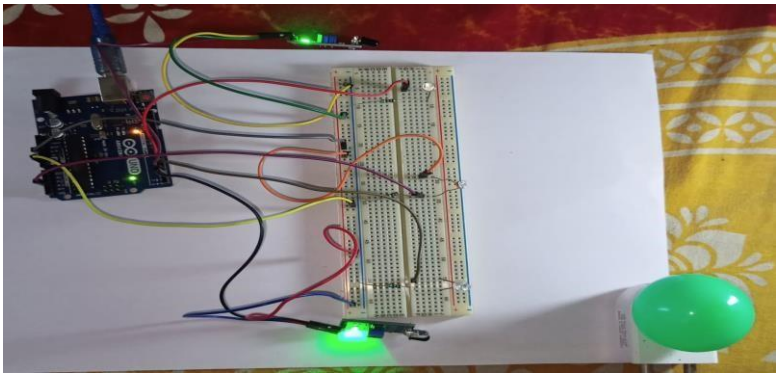

Figure 14: At day LEDs remain OFF.

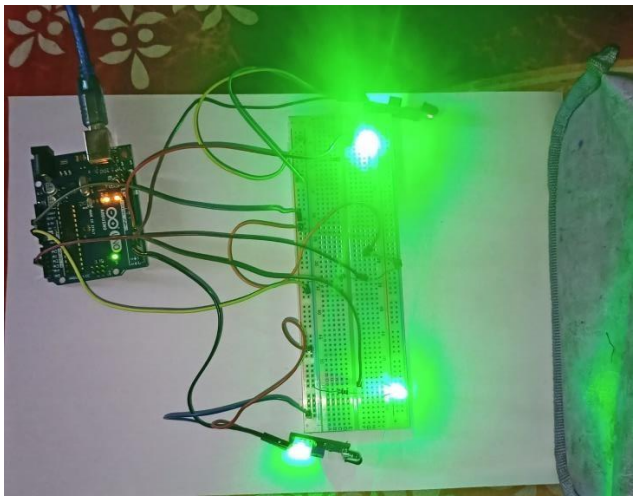

Figure 15: At night when vehicle is detected, LED is ON.

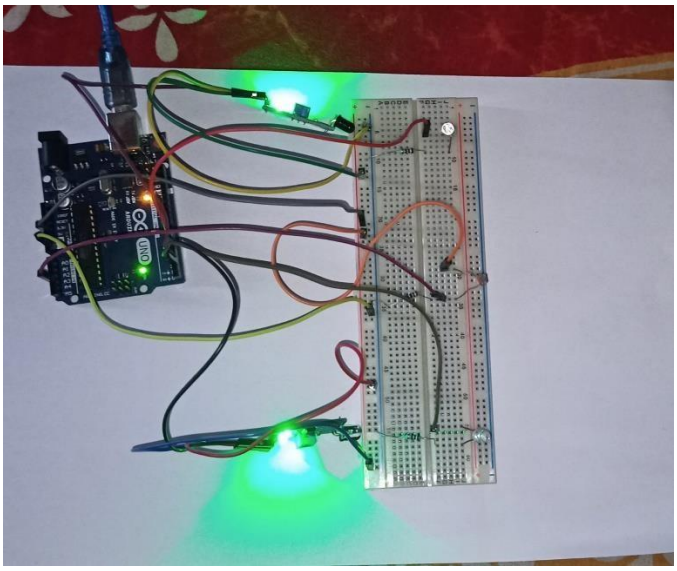

Figure 16: At night when vehicle is not detected, LED is OFF.

WORKING

In the beginning, the LDR sensor will sense the light intensity in the atmosphere at that time and consequently sends the data to Arduino. After receiving the data, Arduino will convert it into different discrete values where 100 is the threshold value (i.e,100 represents brightness).

In the complete darkness (night time), the received value is less than the threshold value so LEDs will glow if a vehicle is detected or else it will not glow. When there is completely shine (daytime), the received value will be higher than the threshold value, resulting the LEDs to be entirely switched OFF.

Initially, the IR obstacle detection sensor will be HIGH. So, when there is no vehicle/obstacle in-front of the sensor, IR Transmitter does continuously transmit the IR light. Whenever, a car or any other object blocks any of the IR sensors, then the emitted rays will reflect the IR receiver after hitting the object, then microcontroller will sense it as a motion. In simple words, when any object passed in front of the first IR sensor, the corresponding LED will be switched ON by the microcontroller. As the object moves forward and blocks the next IR sensor, the next corresponding LED will be switched ON, and the previous LED is switched OFF. The process continues this way for the entire IR obstacle detector sensors and LEDs.

WORKING CODE

```
int IR1 = 2; int
IR2 = 3; int
LED1 = 5; int
LED2 = 6; int
LDR = A3;
void setup()
{
  Serial.begin(9600);
pinMode(LED1,OUTPUT);
pinMode(LED2,OUTPUT);
pinMode(IR1,INPUT);   pinMode(IR2,INPUT);
pinMode(LDR,INPUT);
}
void loop()
{
  int LDRValue = analogRead(LDR);
  Serial.print("sensor = ");
Serial.println(LDRValue);   delay
(500);

  if(LDRValue>=100 && digitalRead(IR1) == LOW)
  {
    digitalWrite(LED1, LOW);
digitalWrite(LED2, LOW);
    Serial.println("It's Bright outside; Lights status: OFF");
  }
  if(LDRValue>=100 && digitalRead(IR2) == LOW)
  {
```

```
   digitalWrite(LED1, LOW);
digitalWrite(LED2, LOW);
   Serial.println("It's Bright outside; Lights status: OFF");
 }
 if(LDRValue<100)
 {
 if(digitalRead(IR1) == HIGH && digitalRead(IR2) == HIGH)
   {
      digitalWrite(LED1, HIGH);
digitalWrite(LED2, HIGH);
      Serial.println("It's Dark outside; LED1 & LED2 lights status: ON");
   }
 else if(digitalRead(IR1) == HIGH && digitalRead(IR2) == LOW)
   {
      digitalWrite(LED1, HIGH);
digitalWrite(LED2, LOW);
      Serial.println("It's Dark outside; LED1 lights status: ON");
   }
 else if(digitalRead(IR2) == HIGH && digitalRead(IR1) == LOW)
   {
      digitalWrite(LED2, HIGH);
digitalWrite(LED1, LOW);
      Serial.println("It's Dark outside; LED2 lights status: ON");
   }
 else
   {
      digitalWrite(LED1, LOW);
digitalWrite(LED2, LOW);
      Serial.println("It's Dark outside; No vehicles; LED2 & LED2 lights status: OFF");
   }
 }
}
```

CONCLUSION

The proposed streetlight automation system is a cost effective and the safest way to reduce power consumption. It helps us to get rid of today's world problems of manual switching and most importantly, primary cost and maintenance can be decreased easily. The LED consumes less energy with cool-white light emission and has a better life than high energy consuming lamps. Moving to the new & renewable energy sources, this system can be upgraded by replacing conventional LED modules with the solar-based LED modules. With these efficient reasons, this presented work has more advantages which can overcome the present limitations. Keep in mind that these long-term benefits; the starting cost would never be a problem because the return time of investment is very less. This system can be easily implemented in street lights, smart cities, home automation, agriculture field monitoring, timely automated lights, parking lights of hospitals, malls, airport, universities and industries etc.

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