PROJECT REPORT

CSE- 3009- INTERNET OF THINGS

2018

AUTOMATIC STREET LIGHT

SUBMITTED TO:

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ABSTRACT

Automatic Street Light Control System is a simple yet powerful concept, which uses transistor as a switch. By using this system manual works are 100% removed. It automatically switches ON lights when the sunlight goes below the visible region of our eyes. This is done by a sensor called Light Dependant Resistor (LDR) which senses the light actually like our eyes. It automatically switches OFF lights whenever the sunlight comes, visible to our eyes. By using this system energy consumption is also reduced because nowadays the manually operated street lights are not switched off even the sunlight comes and also switched on earlier before sunset. In this project, no need of manual operation like ON time and OFF time setting. And in addition to this if there is defect in the light sensor then automatically it sends information to the nearest light traffic administration and if a person at night try to cross zebra crossing the red light appears and the driver gets to know there is a person crossing the road that will be helpful when the nearest automated light is not working.

INDEXED TERMS Automation, Switching, Energy conservation, Arduino, Sensors.

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 . Among all exciting applications, street lights play a vital role in our environment and also plays a critical role in providing light for safety during night-time travel. In this scenario, when the street lights are in working functionality over the whole night that consumes a lot of energy and reduces the lifetime of the electrical equipment such as electric bulb etc. Especially in cities' streetlights, it is a severe power consuming factor and also the most significant energy expenses for a city. In this regard, an intelligent lighting control system can decrease street lighting costs up to 70% and increase the durability of the equipment.

The traditional lighting system has been limited to two options ON and OFF only, and it is not efficient because this kind of operations meant power loss due to continuing working on maximum voltage. Hence, wastage of power from street lights is one of the noticeable power losses, but with the use of automation, it leads to many new methods of energy and money saving. In this regard, controlling lighting system using Light Dependent Resistor (LDR), IR obstacle detector sensor and Arduino together is proposed. It automatically switches OFF lights whenever the sunlight comes, visible to our eyes but this system is not so efficient for the energy consumptions. In order to minimize the energy consumption, we use IR (infrared ray sensor) which glow the light only when it detects the objects. Since LDR sensor is used only as a switch for IR sensor functioning. On detecting the darkness by the LDR sensor, only then IR sensor start functioning. 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 objects detections or day-time, 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. Most importantly, a counter is set to count the number of vehicles/objects passing through the road, which will be displayed on the serial monitor of Arduino UNO. 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.

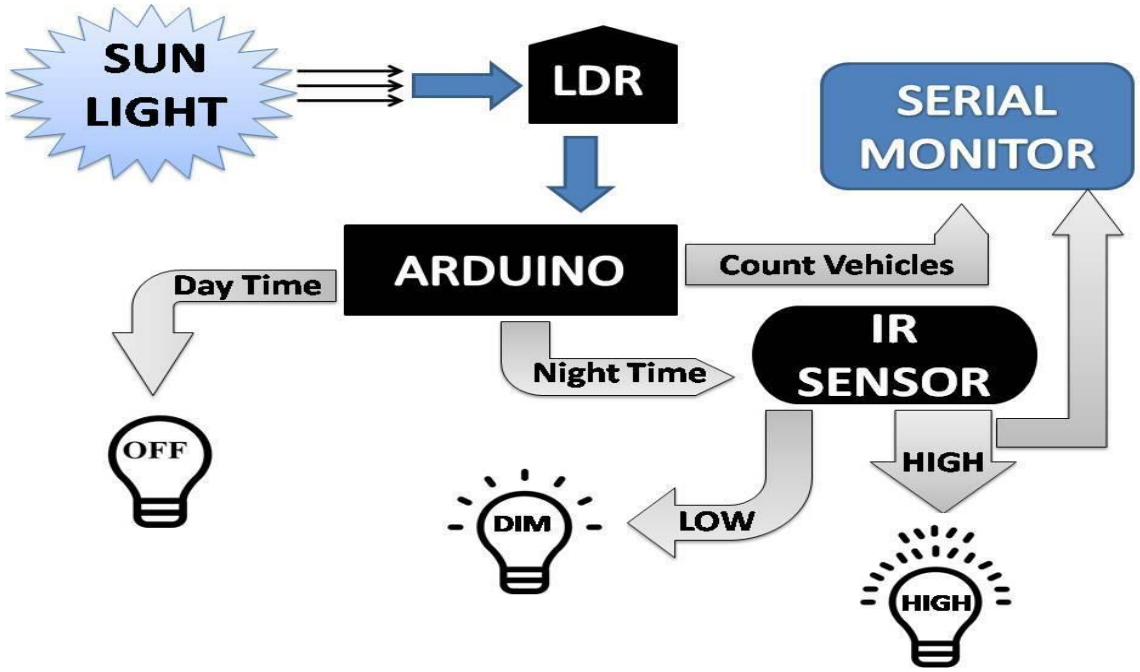


Figure 1. The architecture design of automatic street light control system.

For the simplicity of discussion, 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.

Multiple electronic components are used for building electronic circuits. Our proposed circuit designs contain these components that are described below in table 1

Components	**Specifications**
1. LDR [3]	Voltage: DC 3-5V, 5mm,1.8 gm.
2. Arduino Uno [5]	22 pins, operating voltage 6-20V
3. LEDs [6]	5 mm, operating voltage 5V
4. IR obstacle avoidance sensor [4]	Voltage: DC 3-5V, Range 2-30cm, Angle 35
5. Resistors [25]	100-ohm, 220 ohms

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

LIGHT DEPENDENT RESISTOR (LDR)

LDR is a Light Dependent Resistor (Fig. 2a) whose resistance is dependent on the light impinging on it. 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, as shown in Fig. 2b. These are very beneficial, especially in light/dark sensor circuits and help in automatically switching ON /OFF the street lights.

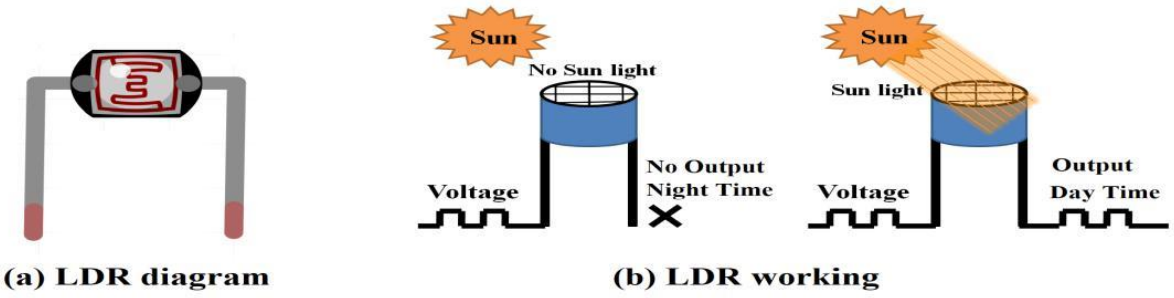


Figure 2. LDR symbol and its working phenomenon [4].

ARDUINO UNO

As shown in Fig. 3, the Arduino Uno [6] 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).

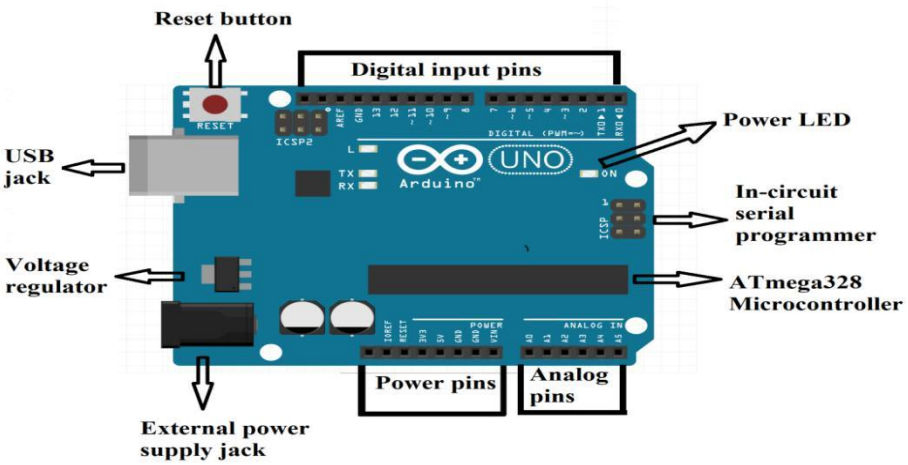


Figure 3. Arduino Uno board description [6].

LEDs

A LED (light-emitting diode) is a PN junction diode which is used for emitting visible light when it is activated, as presented in Fig. 4. 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.

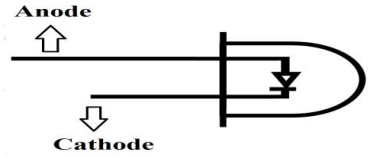
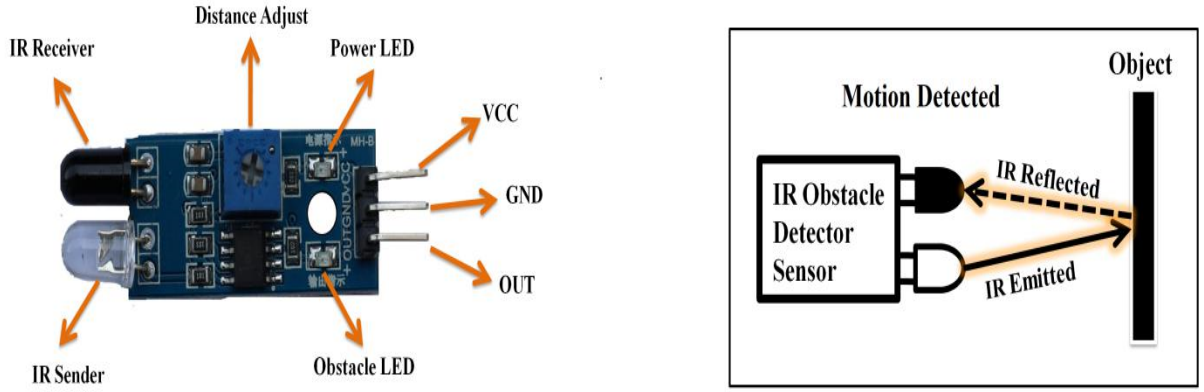


Figure 4. LED circuit diagram [7].

IR OBSTACLE AVOIDANCE SENSOR

An obstacle avoidance sensor consists of an infrared-transmitter, an infrared-receiver and a potentiometer for adjusting the distance, shown in Fig. 5a. 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 (as shown in Fig. 5b). It is a heat sensitive sensor and used for detection of motion.



(a) IR board diagram

(b) Working of IR sensor

Figure 5. IR obstacle detector sensor diagram and working.

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 as illustrated in Fig. 6. It works on the principle of Ohm's law which prevent overflow of voltage.

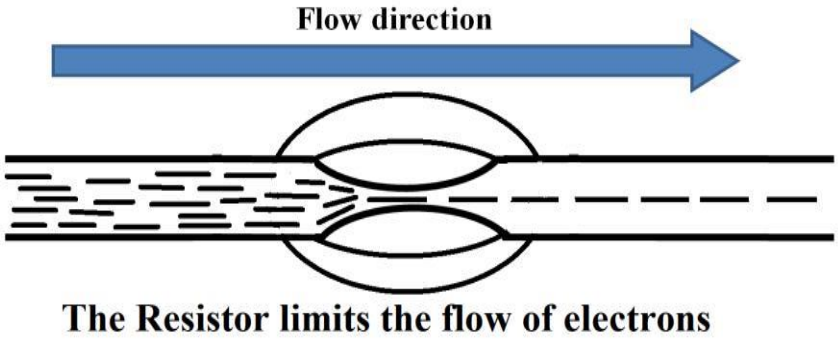


Figure 6. Working principle of resistor [26].

DESIGNING METHODOLOGY

OBJECT INDEPENDENT AUTOMATION SYSTEM

Fig. 7 shows the circuit design of automatic street light control system based on vehicle detection using Arduino Uno having feature of Dim light capability. In this task, 01 LDR sensor, 12 LEDs, 13 resistors, 03 IR obstacle detector sensors and 01 Arduino UNO have been used.

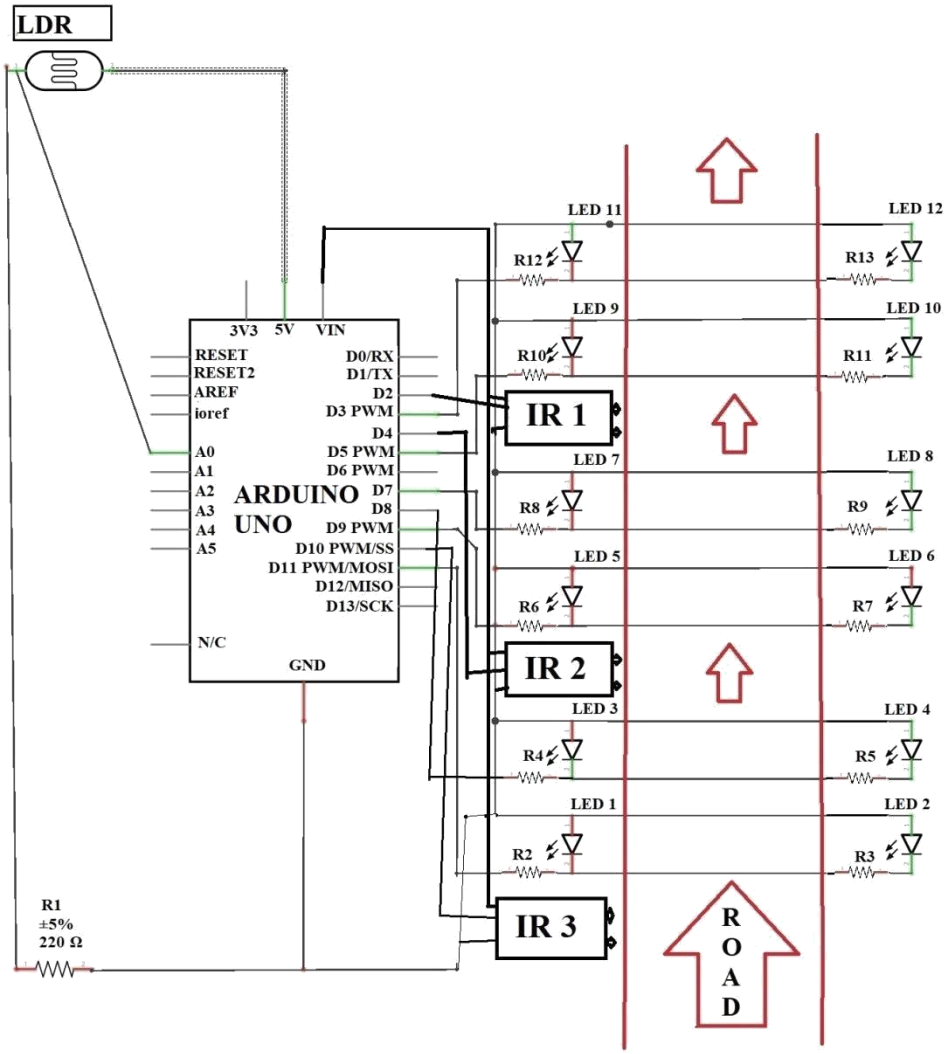


Figure 7. Circuit design of automatic street light control system with the Dim light capability.

One leg of LDR sensor is connected to Arduino analog pin number A0 and another leg to VCC pin and same with a resistor to the ground port of Arduino. In addition, the threshold value is adjusted to 10 from the discrete values (0-1023) for understanding whether it is day or night. After that, all the positive terminals of the LEDs are connected with resistors to pin number 3, 5, 7, 8, 9 and 11, depicting the streetlights as the outputs of the Arduino signals. Furthermore, connected the ground of all the LED's to Ground port as per the circuit diagram shown in Fig. 7. The IR obstacle avoidance sensors are connected to the Arduino port from pin number 2, 4 and 10, respectively, which is the input signal to the Arduino board. Similarly, the ground of all the IR obstacle avoidance sensors are connected to GND port and all VCC of IR obstacle avoidance

sensors are attached to Arduino 5V pin. Initially, set the IR obstacle avoidance sensors to HIGH at the start if there is no motion.

After connecting all these devices to the corresponding pins in Arduino according to Fig. 7, the Arduino Software from the official website "www.arduino.cc" is downloaded and installed. Then Arduino Uno is connected to the computer using the USB cable and installed the driver software on the computer to write, compile and run the software code on Arduino software.

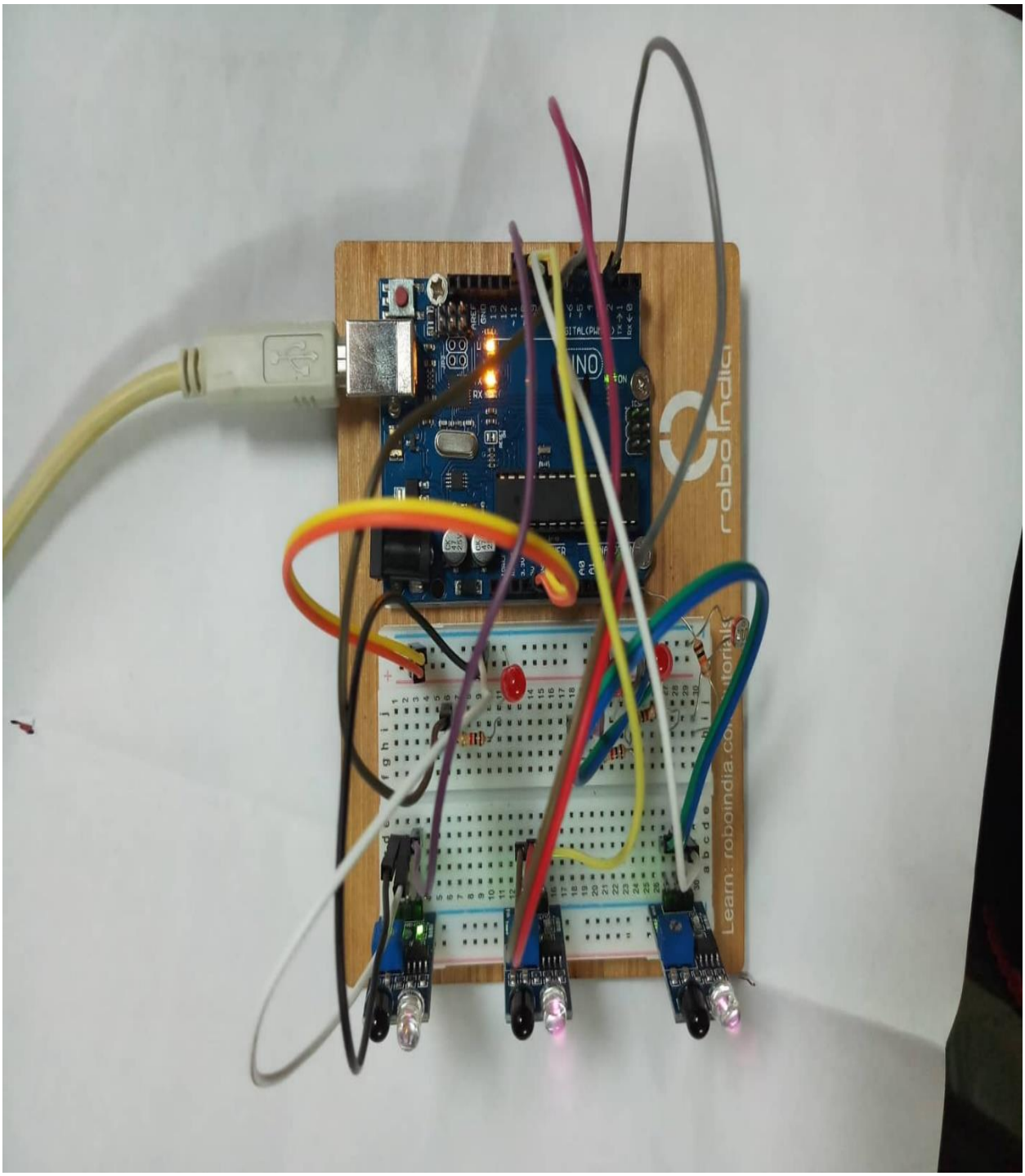
RESULTS & DISCUSSIONS

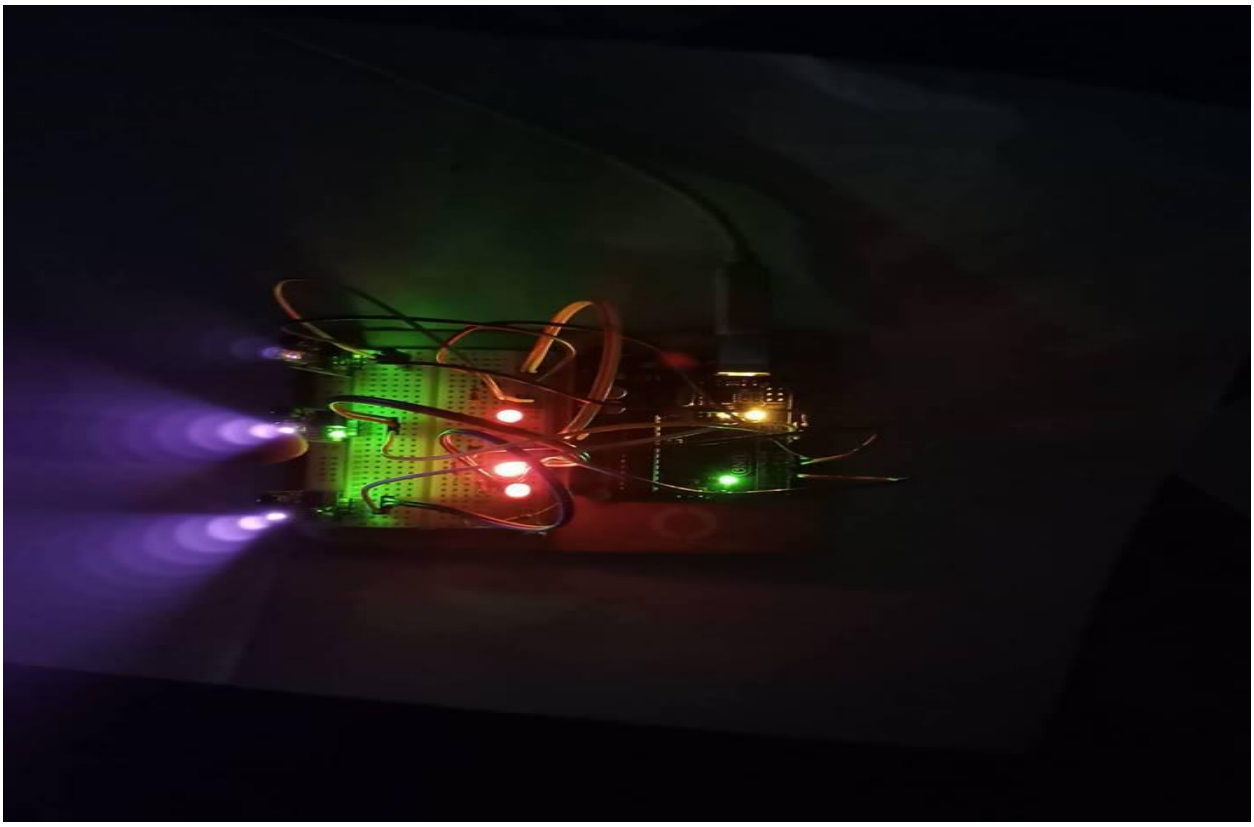
In the beginning, the LDR sensor will sense the light intensity in the atmosphere at that time and consequently sends the data to Arduino. After receiving the data, Arduino will convert it into different discrete values from 0 to 1023 (In which 0 represents maximum darkness and 1023 represents maximum brightness) and then it will adjust the output voltage accordingly from 0 to 2.5v/5v (Dim/High) depending upon the received value (0-2023) by comparing with threshold value. So, the output will be 2.5v in the complete darkness (night time) if the received value is less than the threshold value. As a result, Dim LEDs will glow that is the half of maximum brightness, and when there is completely shine (daytime), the received value will be higher than the threshold value, and the output voltage would be 0v resulting the LEDs to be entirely switched OFF.

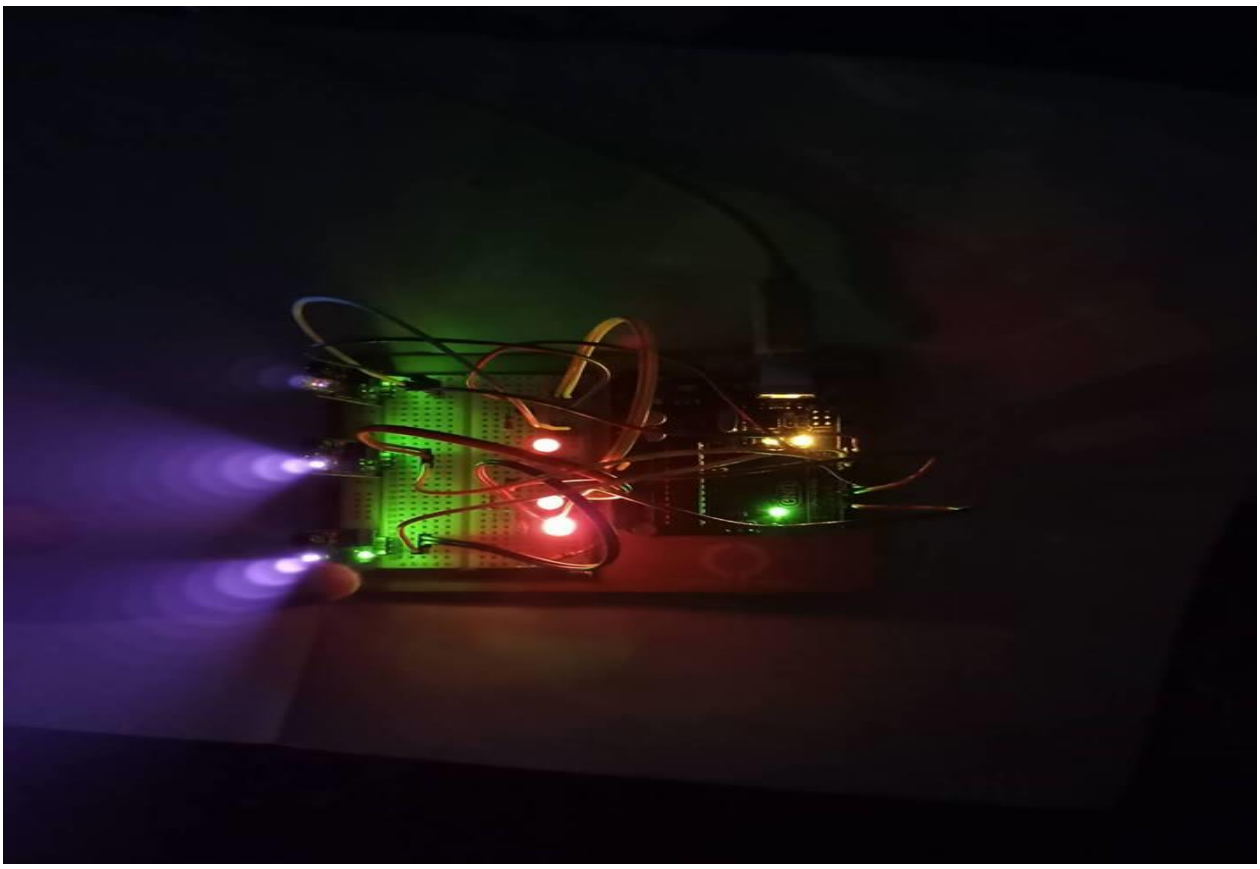
Initially, the IR obstacle detection sensor will be HIGH. So, when there is no vehicle/obstacle in-front of the sensor, IR Transmitter does continuously transmit the IR light. Whenever, a car or any other object blocks any of the IR sensors, then the emitted rays will reflect the IR receiver after hitting 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 LEDs will be turned from DIM to HIGH (5v) by the microcontroller. As the object moves forward and blocks the next IR sensor, the next three LEDs will be turned to HIGH from DIM, and the LEDs from the previous set is switched to DIM from HIGH. The process continues this way for the entire IR obstacle detector sensors and LEDs. These kinds of application can be implemented in the headlights of vehicles, street lights, parking lights of hotels, malls and homes, and it can be very beneficial.

Fig. 8 shows the result diagrams of automatic streetlights that turn to DIM at night and HIGH on vehicle movement using Arduino Uno. Fig. 8a represents the daytime with no LEDs are glowing after measuring the sensed intensity value of sunlight with the threshold value by the LDR sensor. In the meanwhile, Fig. 8b shows the night time because the sensed intensity value of sunlight by LDR is below than the threshold value (10) and there is no motion detected by any of IR sensors, so as a result, the DIM LEDs are glowing. Moreover, the beauty of the proposed model can be seen in Fig. 8(c-d) with the motive that only those LEDs will glow higher whose will detect the object's presence and the remaining LEDs will keep maintain their DIM state. As an example, in Fig. 8c, the first set of LEDs are glowing HIGH and remaining are in DIM mode because the sensed intensity value of sunlight by LDR is below then the threshold value so, it considered night-time and, there is an object detected by the first IR sensor. Moreover, when the object moved to the second IR obstacle detector sensor, the second set of High LEDs are glowing and the first set again turns to DIM state (Fig. 8d). These results show the efficiency of proposed idea and gives the immediate validation of the proposed model.

In addition, Fig. 9 illustrates the total number of objects / vehicles passed through the road and the derived results of Fig. 8 are summarized in table 2







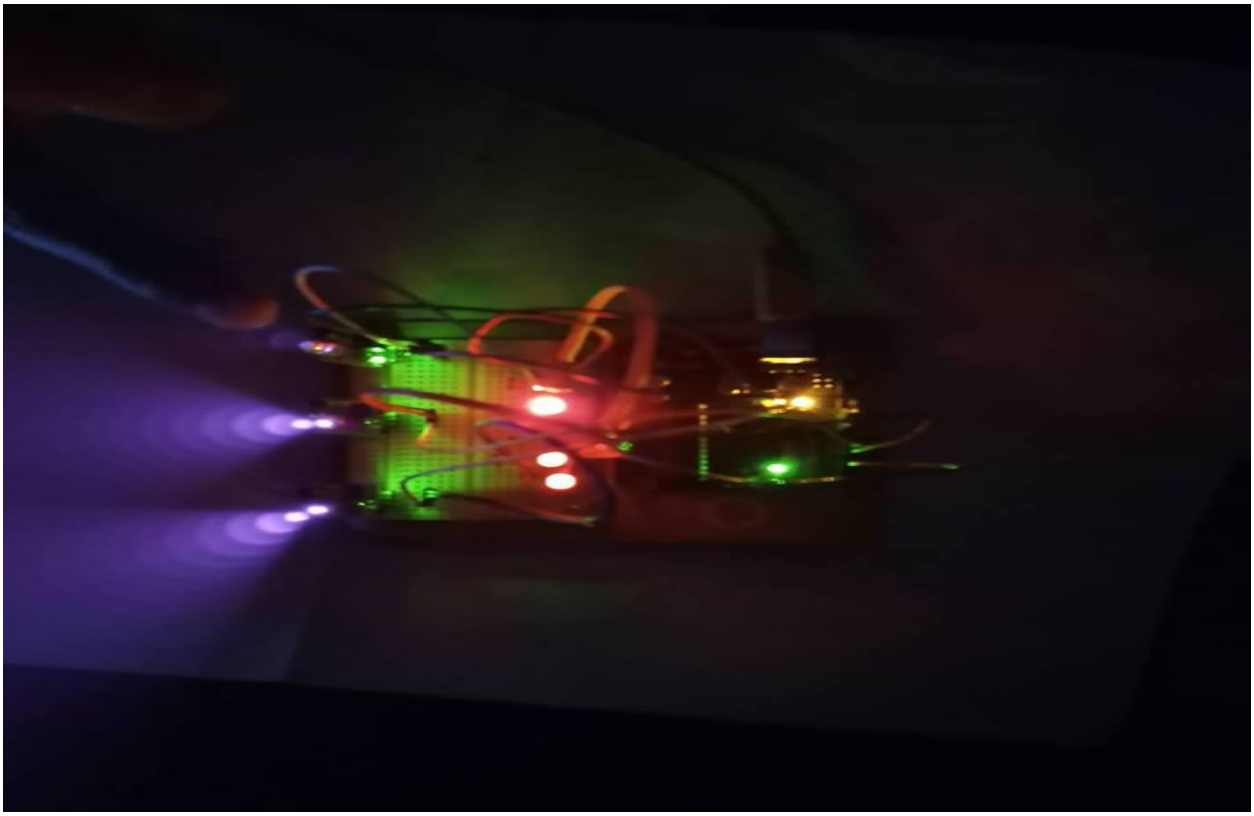


Figure 8. Result diagrams of automatic streetlight control system that turn to DIM at night and HIGH on object detection. (a) Shows it is a day-time, so LEDs are not glowing. (b) Shows it is a night-time and Dim LEDs are glowing. (c) Shows object in-front of first IR sensor and first set of High LEDs are glowing while remaining are in DIM mode. (d) Shows motion in-front of second IR sensor so, only second set of LEDs are glowing HIGH and others are in DIM state.

CODE:

```
const int led_1 = 3;
const int led_2 = 5;
const int led_3 = 6;
const int ir_1 = 9;
const int ir_2 = 10;
const int ir_3 = 11;
const int ldr = A5;
int b = 0;
int c = 0;
int d = 0;

void setup() {
  // put your setup code here, to run once:
  pinMode(led_1,OUTPUT);
  pinMode(led_2,OUTPUT);
  pinMode(led_3,OUTPUT);
  pinMode(ir_1,INPUT);
  pinMode(ir_2,INPUT);
  pinMode(ir_3,INPUT);
  pinMode(ldr,INPUT);
  Serial.begin(9600);
}

void loop() {
  // put your main code here, to run repeatedly:
int a = 40;//analogRead(ldr);
b = digitalRead(ir_1);
c = digitalRead(ir_2);
d = digitalRead(ir_3);
int threshold = analogRead(ldr);
```

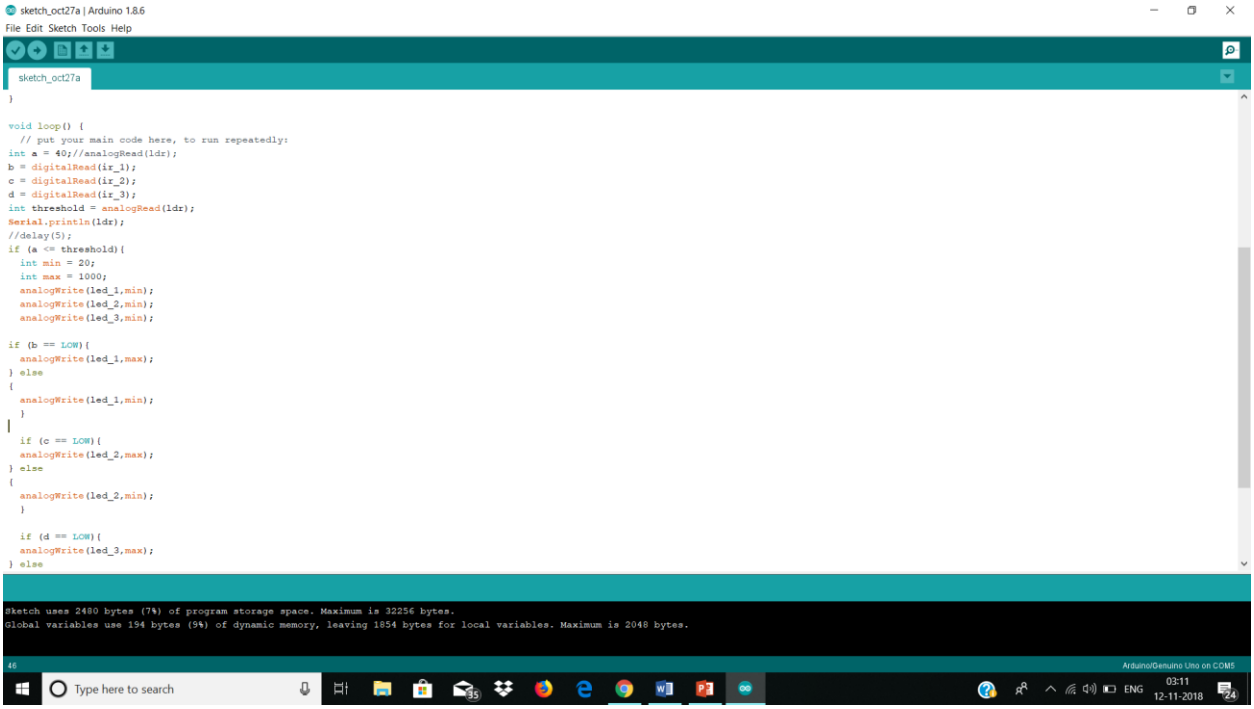
```
Serial.println(ldr);
//delay(5);
if (a <= threshold){
  int min = 20;
  int max = 1000;
  analogWrite(led_1,min);
  analogWrite(led_2,min);
  analogWrite(led_3,min);

if (b == LOW){
  analogWrite(led_1,max);
} else
{
  analogWrite(led_1,min);
  }

  if (c == LOW){
  analogWrite(led_2,max);
} else
{
  analogWrite(led_2,min);
  }

  if (d == LOW){
  analogWrite(led_3,max);
} else
{
  analogWrite(led_3,min);
  }

}else
```

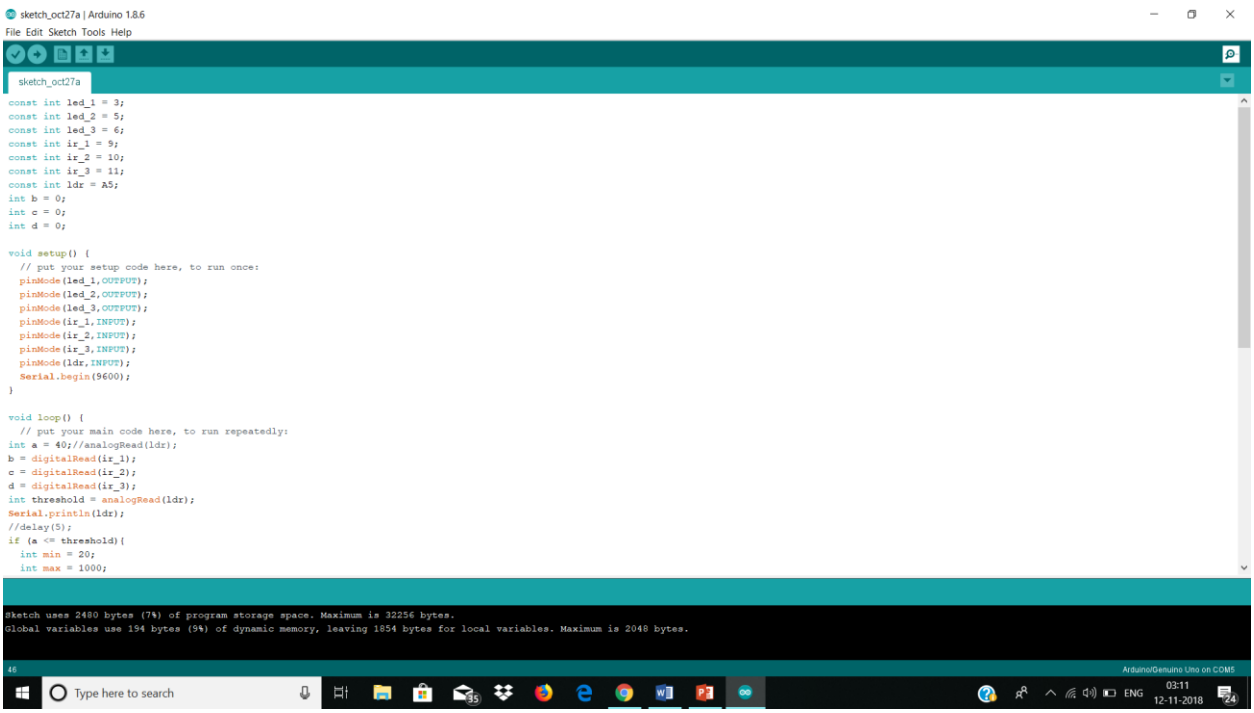
{digitalWrite(led_1,LOW);

digitalWrite(led_2,LOW);

digitalWrite(led_3,LOW);}

}





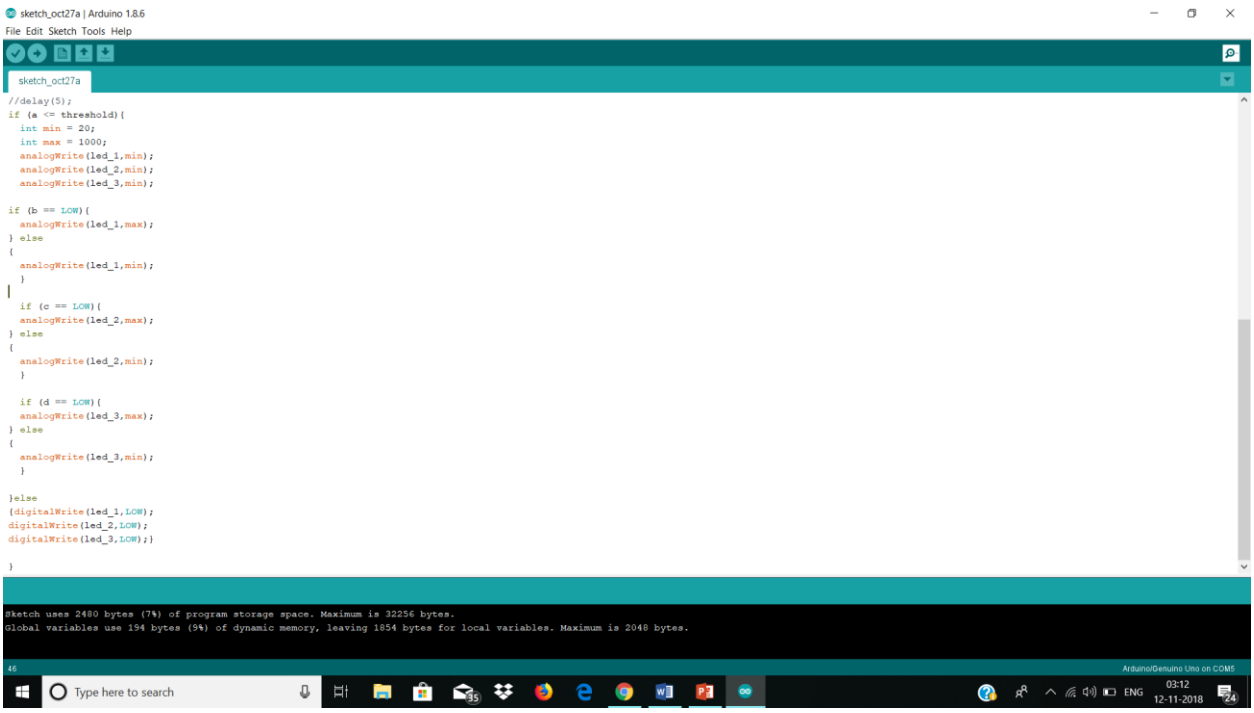


Figure 9. Serial monitor output according to traffic flow.

Device Name	**Input Data**	**Verified Results**	**Remarks**
Arduino Board testing	Digital Signal	Switching of LEDs at different intervals	Hardware is accurate
Light Dependent Resistor testing	Outside light intensity values	Dim/High LEDs glows according to light intensity and noted on the Serial monitor	Hardware is accurate
IR Obstacle Senor testing	Sense Motion	High LEDs glows whenever it detects motion	Hardware is accurate

Table 2. Derived results after implementation.

APPLICATION AND ADVANTAGES:

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.

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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