**Angular Emission Profile**

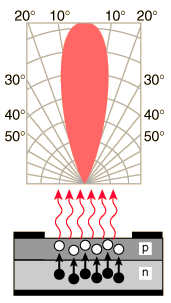
**of a Light Emitting Diode (LED).**

**Aim:**

To study the angular profile of a light emitting diode(LED) using Arduino and Stepper motor module

**Theory:**

An LED is a directional light source, with the maximum emitted power in the direction perpendicular to the emitting surface. The typical radiation pattern shows that most of the energy is emitted within 20° of the direction of maximum light. Some packages for LEDs include plastic lenses to spread the light for a greater angle of visibility.



**To study Angular Profile of LED Arduino and Scilab are used:**

**Arduino Code for rotating Stepper motor and reading the data at different angles and serially communicate with Scilab:**

**CODE:**

int sensorPin = A0;

int sensorValue=0,val=0;

int drd[4096];

int x=10;

void setup() {

//Initialize serial and wait for port to open:

Serial.begin(9600);

while (!Serial) {

; // wait for serial port to connect. Needed for native USB

}

DDRB=B00001111;

}

void loop() {

if (Serial.available()>0){

int x=Serial.readString().toInt();

int i=256;

while(i>0){

PORTB = B00001000;

delay(x);

sensorValue = analogRead(sensorPin);

Serial.print(sensorValue);

Serial.print(",");

PORTB = B00001100;

delay(x);

sensorValue = analogRead(sensorPin);

Serial.print(sensorValue);

Serial.print(",");

PORTB = B00000100;

delay(x);

sensorValue = analogRead(sensorPin);

Serial.print(sensorValue);

Serial.print(",");

PORTB = B00000110;

delay(x);

sensorValue = analogRead(sensorPin);

Serial.print(sensorValue);

Serial.print(",");

PORTB = B00000010;

delay(x);

sensorValue = analogRead(sensorPin);

Serial.print(sensorValue);

Serial.print(",");

PORTB = B00000011;

delay(x);

sensorValue = analogRead(sensorPin);

Serial.print(sensorValue);

Serial.print(",");

PORTB = B00000001;

delay(x);

sensorValue = analogRead(sensorPin);

Serial.print(sensorValue);

Serial.print(",");

PORTB = B00001001;

delay(x);

sensorValue = analogRead(sensorPin);

Serial.print(sensorValue);

Serial.print(",");

i--;

}

Serial.print("ended The PROCESS");

int j=256;

while(j>0){

PORTB = B00001001;

delay(x);

PORTB = B00000001;

delay(x);

PORTB = B00000011;

delay(x);

PORTB = B00000010;

delay(x);

PORTB = B00000110;

delay(x);

PORTB = B00000100;

delay(x);

PORTB = B00001100;

delay(x);

PORTB = B00001000;

delay(x);

j--;

}

}

}

**Scilab Code for getting the data from serial port and plotting of Graph of Intensity Vs Angle:**

*//## Setting up a communication protocol between SCILAB and Arduino and using it for data Acquisition.#############*

h = openserial(3,"9600,n,8,1"); *//Establishing Serial communication port*

disp('Please wait for four seconds');

sleep(3000); *// Time to get the serial communication established*

writeserial(h,'5'); *// To Start the rotation of stepper motor connected to arduino time in milliseconds is sent to get the data from Arduino*

q=[0 0];

while q(1)==0

[q,flags]=serialstatus(h); *// Gives the serialstatus of the serial port*

end

sleep(15000) *//Waiting time to get serial to be filled with data*

buff=readserial(h); *// read the data from serial port*

y=tokens(buff,','); *// converting data into a array*

data =strtod(y); *//conversion of the data to double*

x=linspace(0,0.08789,length(data))

plot(x,data)

closeserial(h)

**Observation:**

After plotting the Graph of Intensity v/s Angle it was found that LED is very directional and observed that intensity of LED changes as the angle of observation varies. It was found that it is most intense exactly in the perpendicular direction to the surface of LED and forward in direction and intensity falls off as within +/- 200 and it is evident in the experiment as angle increased on either sides.

**Discussion:**

1. If you connect an LED directly to a battery or power supply it will try to dissipate as much power as possible, and, it will destroy itself almost instantly. use resistors which limits the flow of electrons in the circuit and prevents the LED from trying to draw too much current.
2. For most low-power LEDs, the typical voltage drop is from 1.2V to 3.6V for currents between 10mA to 30mA. The exact voltage drop will of course depend upon the semiconductor material used, colour, tolerance, along with other factors.
3. Various Wavelength LEDs and their Forward voltages and Material used for preparation

|  |  |  |  |
| --- | --- | --- | --- |
| LED Colours | | | |
| Colour | Wavelength (nm) | Forward Voltage (V) | Material |
| Ultraviolet | <400 | 3.1-4.4 | Aluminium nitride(ALN) Aluminium gallium nitride (AIGaN) |
| Violet | 400-450 | 2.8-4.0 | Indium gallium nitride (InGaN) |
| Blue | 450-500 | 2.5-3.7 | Indium gallium nitride (InGaN) Silicon carbide (SiC) |
| Green | 500-570 | 1.9-4.0 | Gallium phosphide (GaP) Aluminium gallium phosphide (ALGaP) |
| Yellow | 570-590 | 2.1-2.2 | Gallium arsenide phosphide (GaAsP) gallium phosphide (GaP) |
| Orange | 590-610 | 2.0-2.1 | Gallium arsenide phosphide(GaAsP) gallium phosphide (GaP) |
| Red | 610-760 | 1.6-2.0 | Aluminium gallium arsenide (AIGaAs) Gallium arsenide phosphide (GaAP) Gallium phosphide (GaP) |
| Infrared | >760 | >1.9 | Gallium arsenide(GaAs) Aluminium gallium arsenide (ALGaAs) |

**References:**

1. [http://hyperphysics.phy-astr.gsu.edu/hbase/Electronic/leds.html#c4](http://hyperphysics.phy-astr.gsu.edu/hbase/Electronic/leds.html%23c4)