# IoT based Real Time Street Lights controlling on Motion Detection

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**Abstract:**

A Street light is raised source of light on the edge of a road or walkway, which is turned ON at ascertain time every night. The System consists of LED, PIR sensor, IR Sensor and LDR sensors which are connected and controlled using Raspberry pi. Three modes of Operation is going to be done in this project by giving commands. PIR Sensor will be placed before certain number of street lights which detect the moving vehicles by automatically turning ON Whole Street lights for a period of time declared. LDR sensor is fixed, which activates during night by turning on the Lights and remain off during day time. An IR sensor is fixed for every street light pole to detect the motion by automatically turning ON the respective Street Light. This is intended with Solar Module which is controlled by Arduino Uno. Here solar power is used as power supply for street lights.

***Keywords:*** *Raspberry Pi, street light, sensors, energy saving.*

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## 1. Introduction

Street Automation plays a very important role in the world economy and in daily life. Automatic systems are being preferred over any kind of manual system. Intelligent light sensing refers to public street lighting that adapts to movement by pedestrians, cyclists and cars. This street lighting System referred as adaptive street lighting, dims when no movement is detected, but brightens when motion is detected [1-2]. This type of lighting is different from traditional and illumination or dimmable street lighting that dims at pre-determined times. Embedded means something that is connected to another thing and a system is an arrangement in which all its unit fabricate work together according to a set of rules. It can also be described as a way of working, organizing or doing one or many tasks according to a fixed plan. An embedded system can be thought as a computer hardware system having

software embedded in it. An embedded system is a microcontroller or microprocessor based system which is designed to perform a specific task. The Internet of Things has developed due to the convergence of multiple technologies, real-time analytics, commodity sensors, machine learning, and embedded systems. Traditional fields of embedded systems, wireless sensor networks, control systems, automation and others all contribute to enabling the Internet of Things [3-4]. The growth of Internet of Things (IoT) has brought about a revolution in our day to day lives. Cheaper and improved sensor technology has provided an impetus to this revolution of IoT. Each and everything can be connected to the internet and synchronized to interact, collaborate and contribute [5-6]. IoT has been responsible for machine-human inter-dependency. The major advantages that IoT offers include improved efficiency, reduced interaction time and human effort. It also provides support to Artificial Intelligence and Data Mining due to the involvement of larger data-sets and the need for extracting useful information in order to improve efficiency to the application and add 'Smartness' to it. IoT has a great potential for Automation and Data research [7-8]. The thing that we are considering in this paper is a Street Light. The main motivation of this research work is derived from the fact that lighting accounts for more than 15 percent of electricity consumption of the world. This also contributes about 1.6 billion tons of carbon emissions (per year) in the atmosphere [9-14]. With the aim to cut-short the energy wastage through the conventional street lighting systems and realizing the growing demand of Automation, it is important to work in this area for making the Street Light smart, we need to define smartness. A 'Thing' is said to be 'Smart' if it is able to sense its immediate surroundings and perform actions that work towards a desired goal [15-20]. If we fit the Smart Street Light to this definition, we can describe the system as composed to things called Street Lights equipped with sensors, illustrated in figure 1, to sense ambient light, motion, temperature, humidity, faults and moving objects, acquire data through the sensors, apply some pre-processing algorithms to compress data, and send it to the Cloud via an IoT gateway [21-28]. From the Cloud which consists of a better Infrastructure and storage and Analytical capabilities, users can retrieve beneficial information including visibility in foggy days, ambient light, temperature and humidity in sunny days, traffic density, etc. and researchers can fetch useful data and analyze those data for further research that includes temperature and humidity characteristics of a particular location, season, etc.

The IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating possibilities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency and accuracy [29-34].

## 2. Literature Review

Street Lightning System is necessary to provide ease to the people for safety measurements on the road during nights. Many authors have worked on this street lightning system [35-39]. It suggested an intelligent management of the lamp posts by sending data to a central station by ZigBee wireless communication. With the suggested system, maintenance can be easily and efficiently planned from the central station, allowing additional savings. Many researchers have proposed a number of methodologies and ideas to reduce the energy wastage of the street lights and also highlighted the ways to make them smarter [40-47]. An innovative literature review in the field of saving energy with the help of electro-technology as well as Information and Communication Technology (ICT) in Street Lights. The state of Smart Street light which consists of monitoring and executive programming [48-53]. The information exchange between lamp nodes and wireless sensor networks (WSN) can be a feasible since it is composed of three parts: Control center, Remote concentrator and Street lighting control terminals. Smart Street Lighting system can be integrated with VANET to reduce the cost and use the rich service and communication feature of VANET [54-61]. An adaptive street lighting control based on energy demand idea and showed that the conventional street lighting regulation system he tested showed that adaptive control provides on an average almost double energy saving. There was an ease of maintenance and high communication rate among the devices in the system [62-67]. A Smart Street Lighting (SSL) system is proposed for switching off the street lights based on the desired level of safety and location of pedestrians. The proposed system consisted of Zigbee enabled motes, a Base Station, a centralized SSL Server, server applications for system configurations and Web-Application for monitoring and controlling the lighting zones and lampposts and smart phones of pedestrians with GPS functionality [68-71]. A street lighting system based on ZigBee has also been proposed. The monitoring of the connected sensors for fault detection, power adjustment and on/off control is done via Zigbee wireless technology. The proposed system gathers the parameters of street light via GPRS and Zigbee communication. It includes three main components: a terminal for street monitoring, concentrator and monitoring centre. The concentrator acts as a repeater and works as a bridge between monitoring center and control terminals [72-75]. Its main task is to forward command and data. The task of the control terminal is to fetch the data and make the required adjustments in the power. An autonomous-distributed-controlled light system was proposed in which lights get turned on before a pedestrian actual arrives at that location and then gets off after a pedestrian leaves a certain location. The proposed system comprised brightness sensor node,

LED lamps, motion sensor and communication network based on short distance [76-78]. There are access points which consist of the controller and the communication device. An Automatic Intensity Varying Smart Street Lighting System is presented in which the initial step was to replace the existing lampposts by LED lights in order to reduce the energy dissipation as LED lights are more energy efficient. Secondly, Light Dependent Resistor (LDR) has been deployed in order to control the lights automatically without any human intervention. In order to control the luminosity of the lights, dimmers are installed. A novel street lighting system is proposed which uses the renewable energy source i.e. solar energy. The luminosity of the street lights is controlled based on the intensity of sunlight which is sensed by LDR [79-80]. In case of low intensity of solar energy, the resistance value of LDR is high and based on this value it is decided that whether the street lights should be on/off. In case of moderate value of resistance, the dimming function of lights is invoked. PIR sensor is also utilized to detect the motion of the pedestrian. A novel fuzzy logic based controller is presented whose main objective is to minimize the wastage of power in street light 4 Sahil Garg, Sahil Ahuja and Sukhchandan Randhawa systems. Solar energy is utilized in order to save electric power. A fuzzy rule base is designed which takes natural intensity and occurrence of vehicles as inputs based on the rule set defined by fuzzy logic. A hybrid street lighting system based on Vehicular Ad-Hoc Networks and traditional street lighting system is proposed. VANET provides various functionalities such as reporting the location, direction, speed of vehicles in real time scenario. Road-Side Units (RSUs) are deployed usually 300-400 m apart. The main task of these RSUs is to report the data to the light controllers to switch on and off a light. A reliable on-demand street lighting model is proposed in which the concept of traffic flow rate forecasting model is utilized. There are number of methods based on 1-h prediction whose results are compared with the model based on ANN which reports the best results [81-82]. As per the above discussed literature, it is clearly concluded that most of the ideas are based on motion detection of a person or a vehicle on a road.

## 3. Objective

The main objective of this Street Lightning System is to control energy efficient LED street lights to turn ON only when needed otherwise to remain OFF. It helps to decrease the wastage of Electricity by controlling the working of street light system.

## 4. Overview of Proposed Scheme

PIR Sensor, LDR Sensor and IR sensor are connected to the Raspberry Pi. There are three modes of Operation in this project by giving manual commands for every mode in putty software. The modes of operation are as follows.

**Mode 1:** If IR Sensor detects an object then the respective street light will turn on, if not it remains off. The process will continue till we exit from the command and then stop.

**Mode 2:** If PIR sensor detects the motion then the whole street lights will be turned ON for period of time declared. If PIR sensor does not detect any motion the street lights remain OFF. The process will continue till we exit from the command and then stop.

**Mode 3:** If LDR sensor module detects darkness i.e., in the night time the whole street lights will turn ON and in the daytime street lights will be turned OFF. The process will continue till we exit from the command.

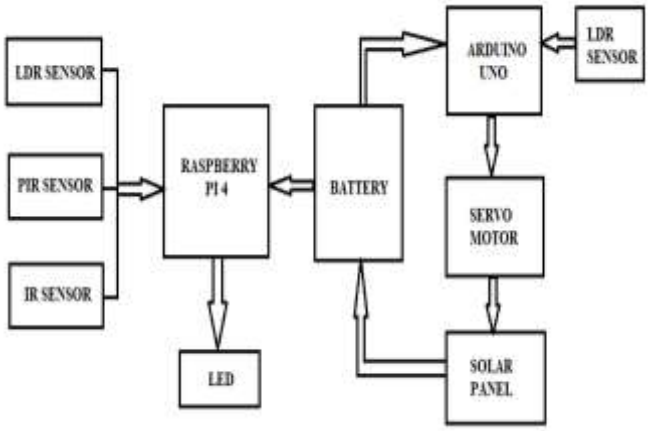


**Fig.1:** System Architecture

This is intended with Solar Module which is controlled by Arduino Uno. Solar panels are used for charging batteries by changing daylight into electricity. The energy which is stored in battery is used as power supply for the street lights. Thus, this technique reduces power wastage and also a manual switch is provided. Servo Motors are used in applications to control rotational speed and position as well as output torque. Servo Motor is connected to Arduino Uno to control the direction of solar panel.

### 4.1 Hardware Requirements

**Raspberry Pi 4:** Raspberry Pi is a small-sized computer used Linux operating system. It is a small size computer used to run larger and smart programs to achieve output quickly. RPi 4 B+(RP4) is the latest model developed by the company, which has all the essential latest wired and wireless communication system used in most of the smart projects. A single

Raspberry Pi 4 comes to a Quad-core Processor but it has three various versions which give three various sizes of RAM.

**Fig.2:** Raspberry Pi 4

**Infrared Sensors:** An IR sensor is an electronic device that is used to sense some aspects of the surrounding environment. An IR sensor can measure the heat of an object as well as detects the movement as well as the presence of an object due to interruption. These type of sensors measure only infrared radiation, rather than emitting it that is called as a passive infrared sensor, an IR sensor is simply a device which detects infrared radiation falling on it.

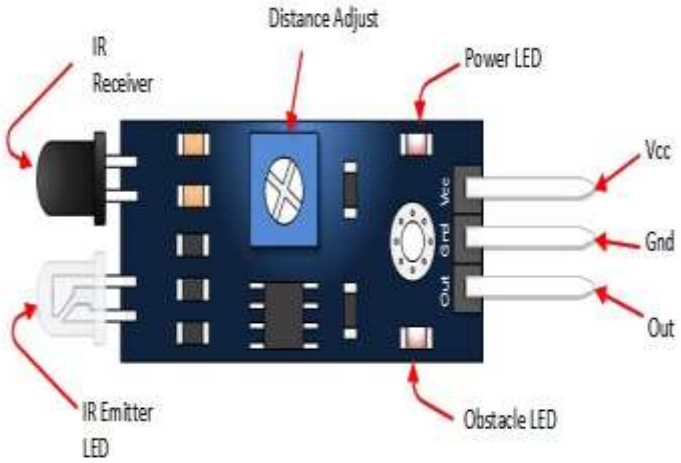


**Fig.3:** IR Sensor

**Light Dependent Resistance:** Light Dependent Resistors are very useful especially in light or dark sensor circuits. Light dependent resistor as the name suggests depends on light for the variation of resistance. Normally the resistance of an LDR is very high, sometimes as high as 1000000 ohms, but when they are illuminated with light resistance drops dramatically. Electronic onto sensors are the devices that alter their electrical characteristics, in the presence of visible or invisible light.

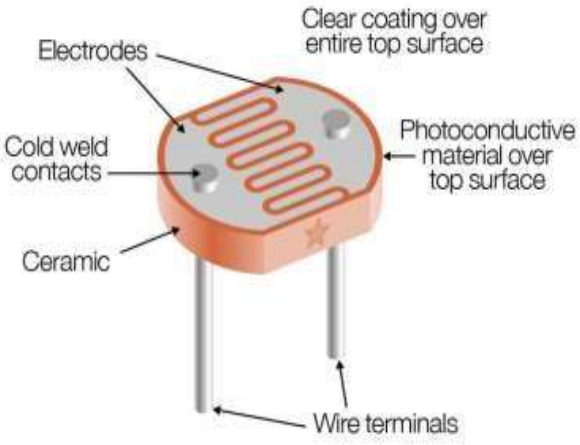


**Fig.4:** LDR Sensor

**Passive Infrared Sensor:** A passive Infrared Sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR based motion detectors. PIR sensors use a pair of piezoelectric sensors to detect heat energy in the surrounding environment. PIR sensors are commonly used in security alarms, motion detection alarms and automatic lighting applications.

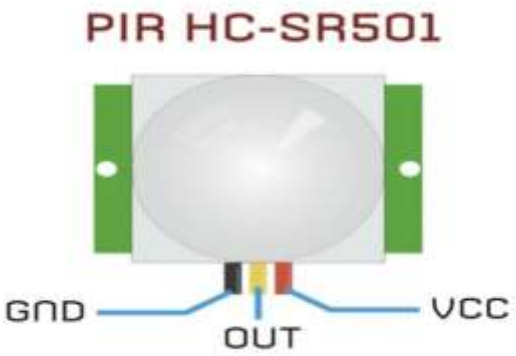


**Fig.5:** PIR Sensor

**Arduino UNO:** Arduino UNO is the microcontroller used in this paper, it is based on ATmega328.It is open source electronic platform based on easy to use software and hardware. It reads input-light on sensor, finger on a button, etc. It has14 input/output and 6 Analog pins. The software used in this microcontroller is Arduino IDE.

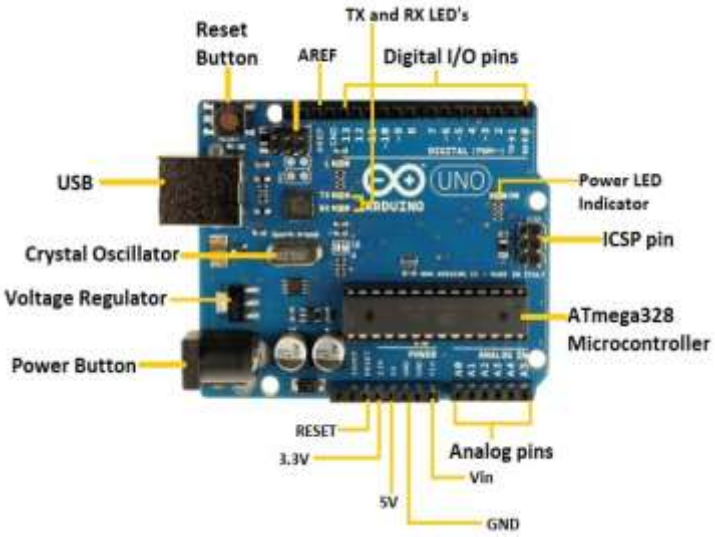


**Fig.6:** Arduino Uno

**Light Emitting Diode:** A light Emitting Diode (LED) is a two-lead semiconductor light source. The long terminal is positive and the short terminal is negative. It is p-n junction diode that emits light when activated. When a suitable current is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the colour of the light is determined by the energy band gap of the semiconductor. LEDs are typically small and integrated optical components may be used to shape the radiation pattern.

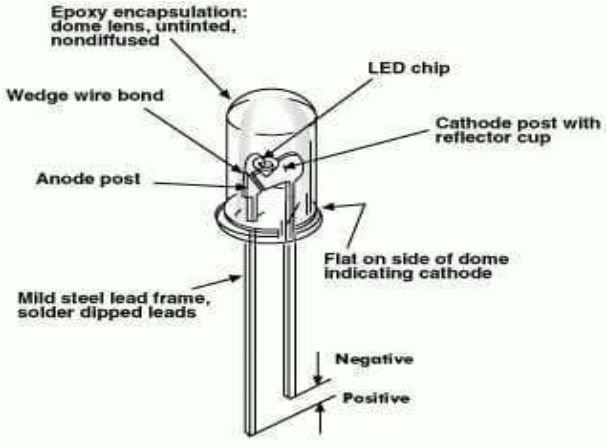


**Fig.7:** Light Emitting Diode

**Solar Panel:** Solar Energy Begins with the Sun. Solar Panels Are Also Known as "PV Panels" Which Are Used to Convert Light from The Sun, which is Composed of Particles of Energy Called "Photons", Into Electricity That Can Be Used to Power Electrical Loads. Solar Panels Can Be Used for A Wide Variety of Applications Including Remote Power

Systems for Cabins, Telecommunications Equipment, And for the Production of Electricity by Residential and Commercial Solar Electric Systems.

**Fig.8:** Solar Panel

**Servo Motor:** Micro Servo Motor SG90 is a tiny and lightweight server motor with high output power. It is an electromechanical device. Servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. It produces torque and velocity based on the supplied current and voltage.

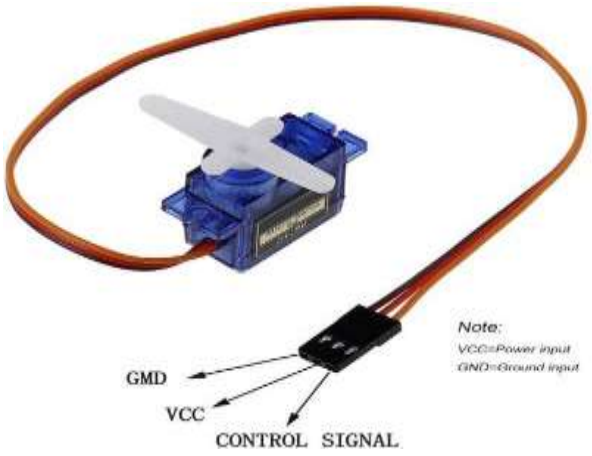


**Fig.9:** Servo Motor

### 4.2 Software Requirements

**Raspbian**

- Installation of Raspbian OS in Raspberry Pi.
- Raspberry Pi Supports C/C++ and Python version 2/3 by default.
- However, These Language Compiler or Interpreter can be installed on Raspbian OS.

**Arduino IDE**

- Downloading Arduino IDE software and then power up Arduino Board.

- Launching Arduino IDE.
- The Arduino integrated development environment is a cross platform Application, that is written in Java programming language and C/C++.

## 5. Implementation of Proposed Scheme

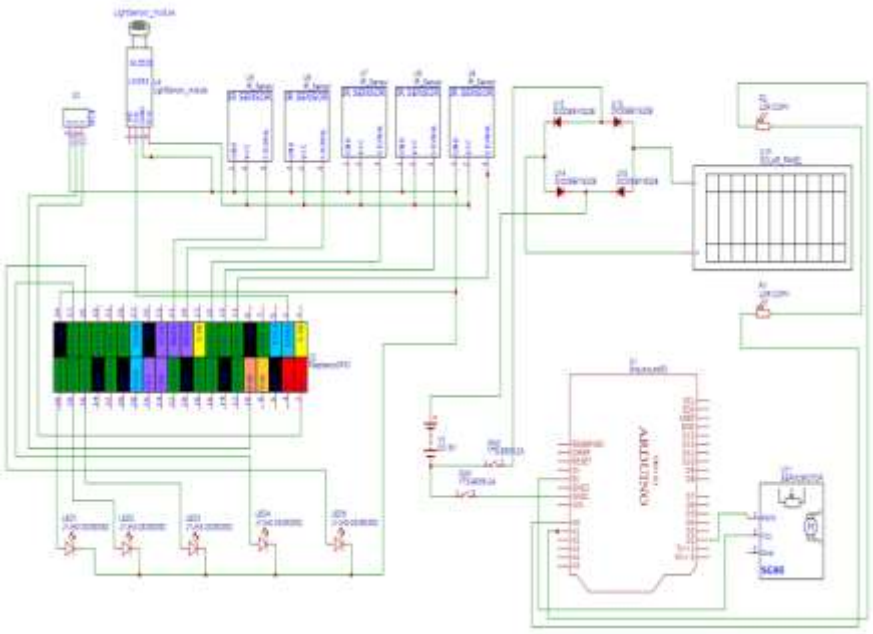

**Fig.10:** Schematic Diagram

Raspberry Pi is connected remotely in a hub for automatic turning ON/OFF the street lights. A person is going to control different streets in that hub. In between 6 and 11'O clock at Night, there are huge vehicles on the Roads. So PIR mode of Operation is used for automatic turning ON the whole street lights when Motion is detected for a period of time declared i.e., for 10 sec. During mid night, there are fewer vehicles on the roads. So IR mode of Operation is used for automatic turning ON the respective street light when the motion is detected. At the time of Festivals, LDR mode of Operation is used i.e., the street lights automatically turned ON at night and turned OFF at day time. Here Manual commands have to be given in the putty software for shifting the mode of Operation. The Solar Module is appended for maintaining less power consumption. There are two manual switches provided to maintain Raspberry pi and Arduino Board. Solar panels are used for charging batteries by changing daylight into electricity. Servo Motor is used to direct the solar panel. The energy which is stored in battery is used as power supply for the street lights. Whenever there is no charge in the battery then the second switch is used to process the Arduino board.

## 6. Results and Discussions

Fig.11 shows PIR mode of Operation, when the motion detected, the whole street lights ON for a period of 10 sec.

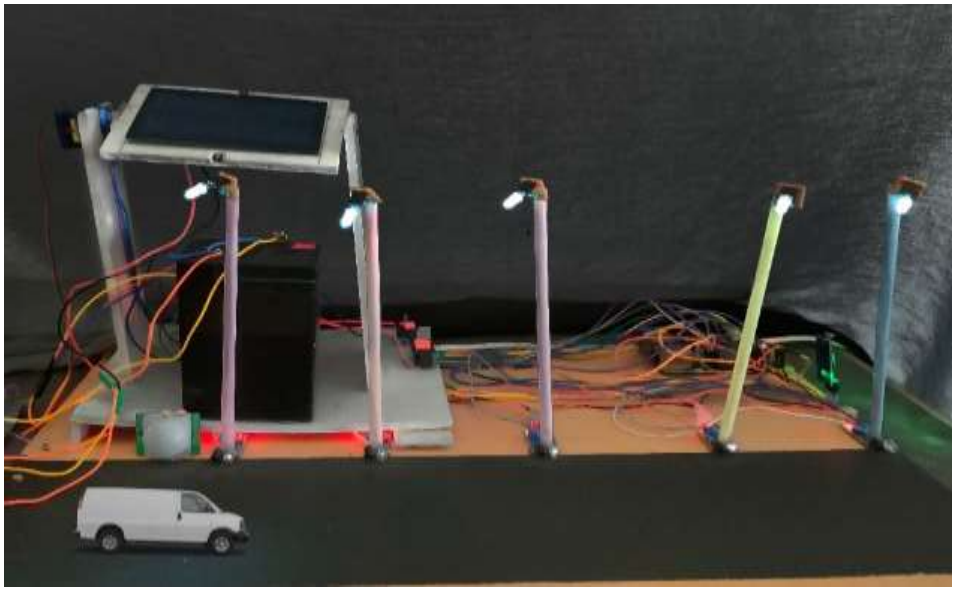

**Fig.11:** PIR Mode

Fig.12 shows IR mode of Operation, whenever there is a movement, the respective street lights turns on.

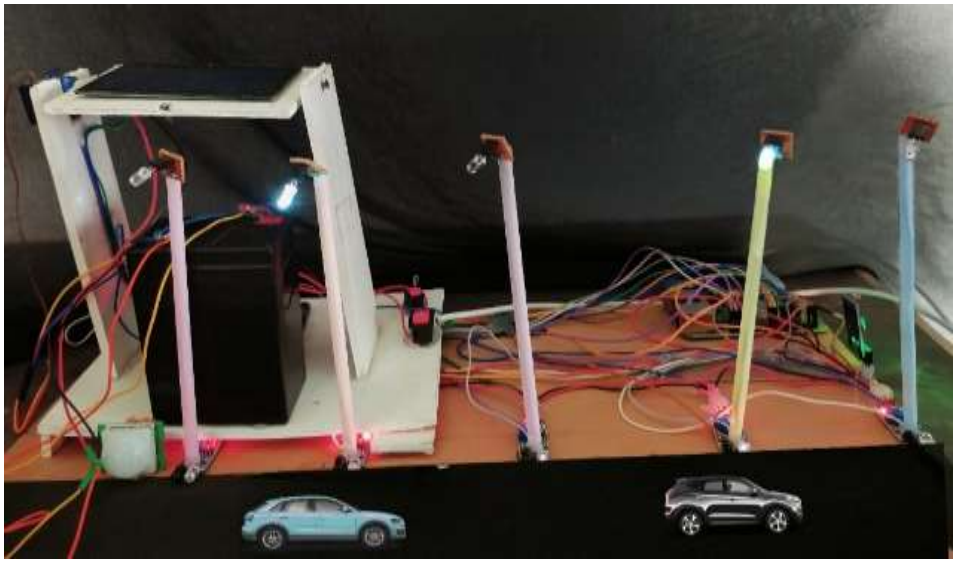

**Fig.12:** IR Mode.

Fig.13 shows LDR mode of Operation, in the dark condition the street lights will turns on.

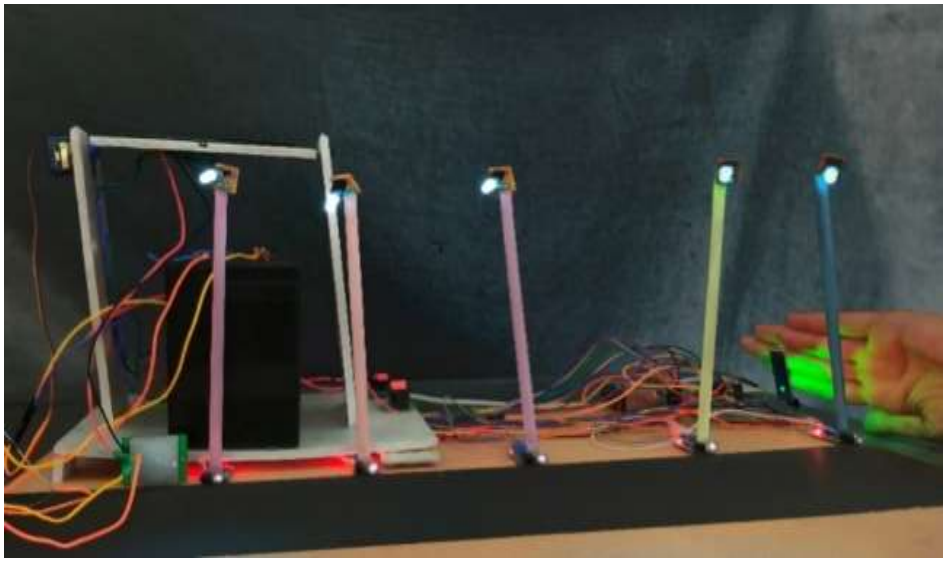

**Fig.13:** LDR Mode.

Fig.14 shows Solar Panel rotation when it hits by lightning which converts light energy into electricity.

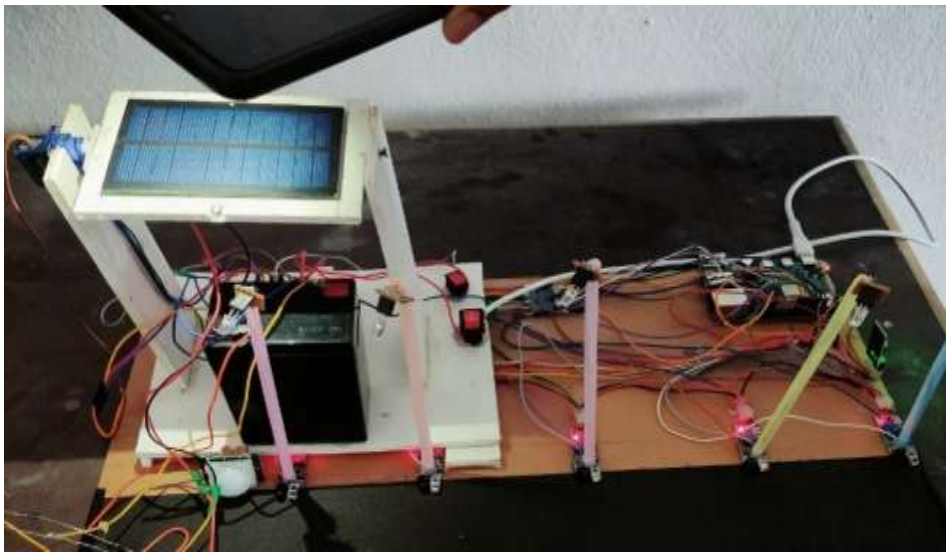

**Fig.14:** Solar Model.

## 7. Conclusion

This Research paper of Real Time Street Lights System has been implemented in order to provide ease to the people for safety measurements on the road during nights. The prototype of this project is build, Raspberry pi is used to control the Street lights by considering the commands in the software by wirelessly. Different Sensors are used in this project to maintain the modes of lightning system. We can control the street lights from the hub where the processor is maintained and can Identity which street light is turned On/Off. Hence, the solar module provides the safety way to save energy.

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