Chapter 1: Introduction

1.1 Preamble

Smart device are the part of our day-to-day life from last few years. Consequently, providing facilities and security are becoming increasingly prominent features on smart device. Smart switches is one of the automatic control system which turn ON or OFF room light based on counting how many people are present in the room. If there is no person in the room the lightremains OFF via smart device. Currently, we feel many difficulties in monitoring our home. It's not safe leaving the home alone locked because of theft problem and we don't know whether all the devices in the home are switched off of not like gas, fan, water, light, door security, motor etc., When we are out somewhere and if we have forgotten to switch off some appliances we are able to control it through the concept of IOT (internet of things). Here in this project we use sensors to monitor the level and leakage of gas in home and if there is some leakage and level of gas the alert has been sent to the owner and the security guard. In this homes are able to be controlled using IOT. This project will be more helpful in homes for controlling the devices. The every updated information will inform to the owner. The Temperature sensor is used to sense the room temperature level, if the room temperature exceeds above 40degree then the Ac can be turned ON. When the house owner went outside. They will locked to go for outside, any theft person enter inside message will send to the police station to rescue team will go to the home to safe purpose.

1.2 Literature Review

- Vaishnavi S. Gunge, Pratibha S. Yalagi Walchand Institute of Technology Solapur and Smart Home automation Security about the work focuses on concept of home automation where the monitoring and control operations are facilitating through smart devices.
- Neha Malik1, Yogita Bodwade1 Government College of Engineering, Jalgaon, India1 and Home automation System about the home automation system means to grant the end users to manage and handle the electric appliances.

- RADHIKA , MENAKA and IoT Technologies for Home Automation System This project aims at controlling home appliances via Smartphone using as communication protocol and arduino uno.
- K.Kishore Raju, G.P Saradhi Varma , A Akhil Varma has discussed how IoT allows communication between devices, commonly referred to as Machine -to-Machine communication. With this possibility, physical devices can communicate to people letting them know their temperature and send them mail.[4]
- Homera Durani ,Mitul Sheth, Madhuri Vaghasia,Shyam Kotech in his paper has include functionality of node esp8266 are connected with either of above given house application like fan, light, water pump, gardening with help of coding and hosting online with web server.[5]
- Majid Al-Kuwari, Abdul Rahman Ramadan, Yousef Ismael, Laith Al-Sughair, Adel Gastli in this paper presents and discusses the design of an IoT based home automation which is integrated via Blynk app.[9]
- L. Sanchez et al., describes about the melting point between future internet research and experimentation and the smart cities. [10]

1.3 Problem Statement and Scope of the project

Smart switches is one of the automatic control system which turn ON or OFF room light based on counting how many people are present in the room. If there is no person in the room the lightremains OFF via smart device.

Problem with existing system

To build a web application to control all the electrical light devices connected to switches to provide more flexibility of using energy. The outcome of this project is to efficiently controlling the lights and so the electrical energy will wastage is avoided.

Scope of the Project

The project will be developed using an agile methodology for software model development with the goal of placing where it is actually needed and the programming approach is

bottom-up This IoT application will be using low cost Arduino Uno board which is an open-source electronics platform based on easy-to-use hardware and software.

1.3 Methodology adopted in the project

- The project system works using the smart phone android app/web app, which is the main source for giving the instruction to the Wi-Fi module.
- User have to select option on/off via mobile app/web.
- This command goes to the Wi-Fi module.
- Wi-Fi modules transmitter convert it into signals and send that command to the receiver of the Arduino Uno microcontroller.
- After the controller activates that particular 1/0 pin on the board band send input to the relay.
- Enhance awareness on using efficient equipment.
- Reduce electricity bill and help preserve environment.

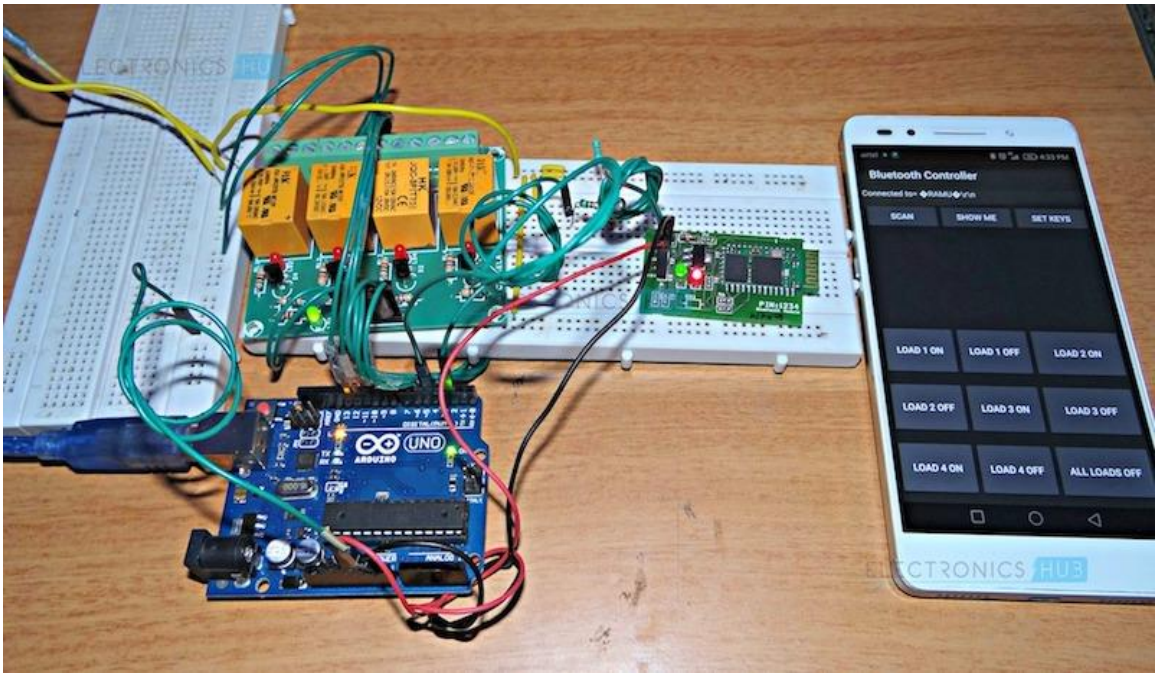

Figure 1.1 Operational Flow of Smart Switch

The Figure 1.1 describes the unified process of incremental development in relation to Internet of Things (IoT).

- To promote efficient lighting,
- Enhance awareness on using efficient equipment
- Reduce electricity bills and help preserve environment.
- Frequent Switching - LEDs Can Be Turned On/Off Many Times
- Reduce the unnecessary wastage of electrical energy.

1.5 Technical Features

Some of the key features of the project are as follows

- Sensing temperature and humidity of various devices
- Real-time temperature & humidity Monitoring
- Notifying end user through push & email notification
- Analysis of sensed temperature & humidity

This IoT application makes use of Arduino Uno is an open source IoT platform. It combined features of WIFI access point and uses simple LUA based programming language. [2]

The use of Relay board is to continuous capture the data from various devices. Blynk app is used for connecting Arduino Uno with internet along with the relay board through which the end user will get the notification of blinking of light in the specific system. It will be built upon an open-source Arduino Software (IDE) which makes easy to write code and upload it to the board. [4]

Chapter 2: Project Description

The project titled “Smart Switches” is based on internet of things (IoT). “Smart Switches” has internet-capable LED light bulb that allows lighting to be customized, scheduled and controlled remotely. Smart switches are among the most immediately successful offerings in the growing category of home automation and Internet of Things (IoT) products.

The system is developed using agile methodology. smart switches can be controlled through a Web Based Application which will be developed using Django framework (python, Bootstrap) or a home/building automation hub and individual bulbs can be programmed to change output in a specific manner.

The bulb's internet connectivity makes it possible for vendors to use edge computing and equip smart bulbs .To design this system we are using Raspberry pi module and relay circuits and jammers. using this we can control light appliances based on internet. The Main Purpose of the project is to control the lights which being switched on unnecessarily so users can get control the lights via even switch boards and web-based application.The outcome of this project will decrease the unnecessary usage of electricity and it is portable as well as convenient so that users can get control over the lights which is unnecessarily switched on.

Chapter 3: Software Requirement Specification

A software requirements specification (SRS) is a description of a software system to be developed, it is defined after business requirements specification also called stakeholder requirements specification.

3.1 Introduction

A smart bulb is an internet-capable Led light bulb that allows lighting to be customized, scheduled and controlled remotely. Smart bulbs are among the most immediately successful offerings in the growing category of home automation and Internet of Things (Iot) products. Smart lighting is lighting that you can control from an app, usually on your Apple or Android phone.

3.2 Hardware and Software Requirements

Software requirements

- **Arduino IDE:** The Arduino integrated development environment is a cross-platform application that is written in the programming language Java. It is used to write and upload programs to Arduino board. The source code for the IDE is released under the GNU General Public License, version 2.6.
- **Django Frame Work:** Django is a Python-based free and open-source web framework, which follows the model-view-template architectural pattern. It is maintained by the Django Software Foundation, an independent organization established as a 501 non-profit. Django's primary goal is to ease the creation of complex, database-driven websites.[7]
- **Python:** Python is an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python has a design philosophy that emphasizes code readability, notably using significant whitespace. It provides constructs that enable clear programming on both small and large scales.[8]

Hardware Requirements

- **Arduino Uno Board**: The Arduino Uno board is a microcontroller based on the ATmega328. It is used to write and upload computer code to the physical board.
- **Relay board:** 5V Relay Module 10A. This small Relay Board works from a 5V signal. It uses a transistor to switch the relay on so can be connected directly to a microcontroller pin.
- **Jummper Wires**: Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering.
- **Led bulbs**: LEDs have been used as indicator lights on myriad products; however, starting in the 2000s, they began to replace incandescent, halogen and fluorescent bulbs.
- **Bluetooth Module**: HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband.

3.3 Functional Requirements

Functional aspects of the system would be the functioning of the Arduino Uno is a microcontroller based on the ATmega328. It is used to write and upload computer code to the physical board.

- **Input:** Readings that are given by Arduino uno and relay board and Bluetooth module. Arduino Uno and relay board and Bluetooth module takes signals as a input for controlling a light
- **Processing:** The readings collected from the Bluetooth is collected by the Arduino Uno and relay directly from device through Bluetooth
- **Output:** Efficiently monitor the light bulbs and efficiently with less power consumption and reduces the problem of heating which leads to short circuits most of the time and bad effects on human body.

- **Module:**
- **Relay Module:** The control circuit functions as the coupling between the input and output circuits. In electromechanical relays, the coil accomplishes this function. A relays Output Circuit is the portion of the relay that switches on the load and performs the same function as the mechanical contacts of electromechanical relays.
- **Arduino Module:** Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.
- **User interface Design using Django and Python:** The required steps for a particular experiment are given in the web page which helps the user to know how to perform a particular task.

3.4 External Interfaces Requirements

Hardware Interface

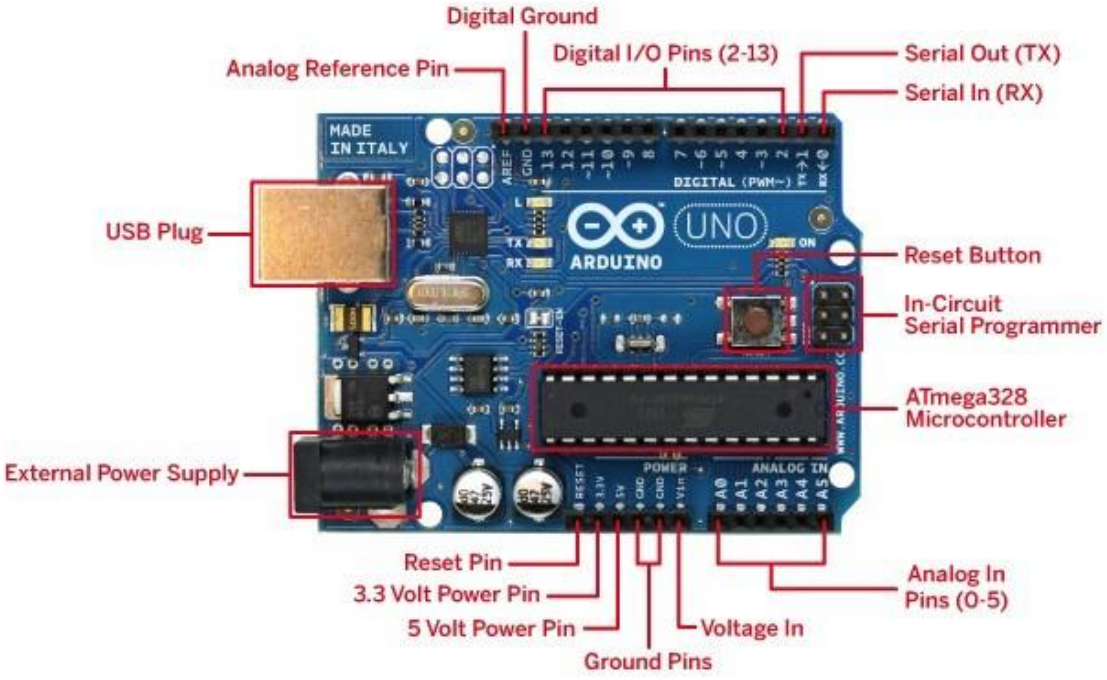

Figure 3.1 Arduino Uno

Software Interface

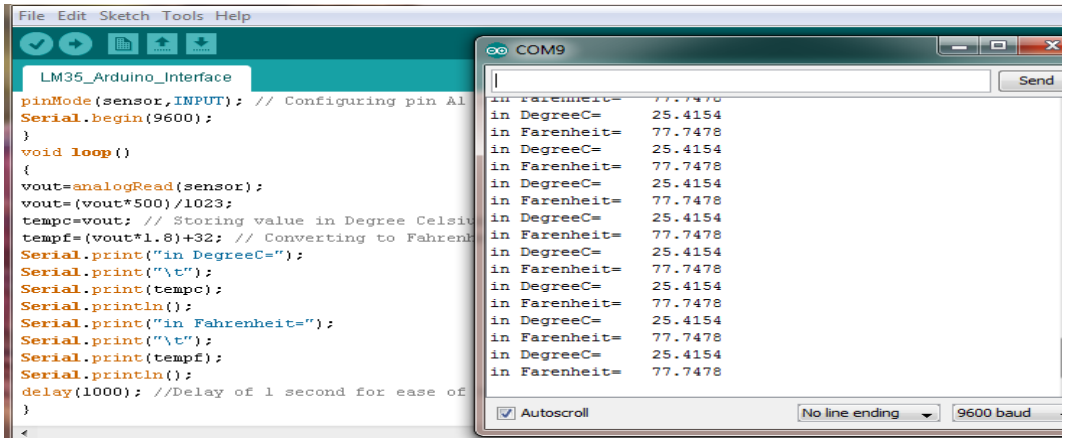

Figure 3.2 Interface Of The Arduino Ide

In Figure 3.2 The Arduino Software (IDE) allows you to write programs and upload them to your board.

User Interface

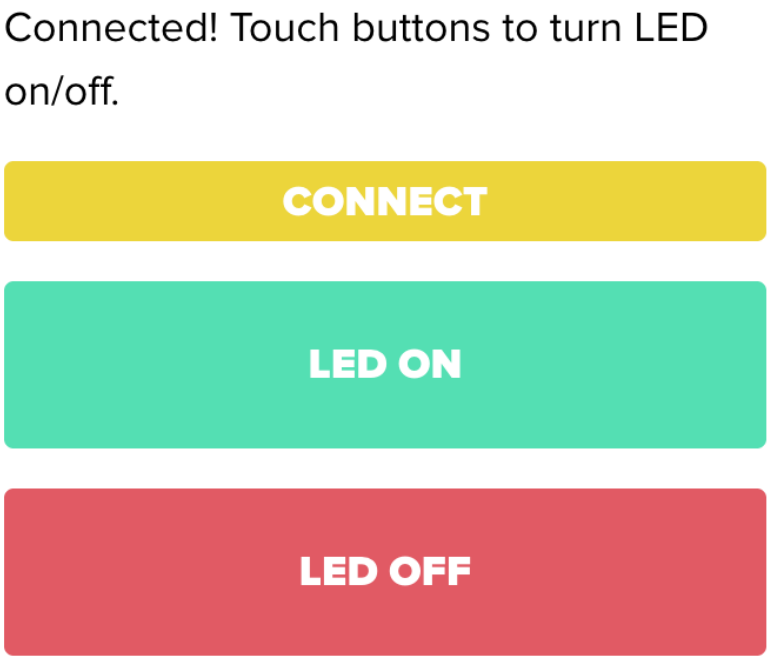

Figure 3.3 ON and Off the LED Bulb

Figure 3.3 shows the user sign up page through user can sign up and log into the application to view the monitored data.

3.5 Performance Requirements

- A stable internet connection
- Browser with good cache management.

3.6 Design Constraints

- Standard Compliance
    - The input and output formats conform to simulation standards.
    - All languages used in the software should comply with current University guidelines for decency and equal opportunities
- Hardware Limitations
    - Constant power supply
    - Uninterrupted internet connection
    - Proper display and pointing device to access the UI

Chapter 4: System Design Specification

4.1 Architectural Design

The software needs the architectural design to represents the design of software. IEEE defines architectural design as "the process of defining a collection of hardware and software components and their interfaces to establish the framework for the development of a computer system." The software that is built for computer-based systems can exhibit one of these many architectural styles.[6]

4.1.1 Problem Specification

A smart bulb is an internet-capable Led light bulb that allows lighting to be customized, scheduled and controlled remotely. Smart bulbs are among the most immediately successful offerings in the growing category of home automation and Internet of Things (IoT) products. Smart lighting is lighting that you can control from an app, usually on your Apple or Android phone.

4.1.2 Block Diagram

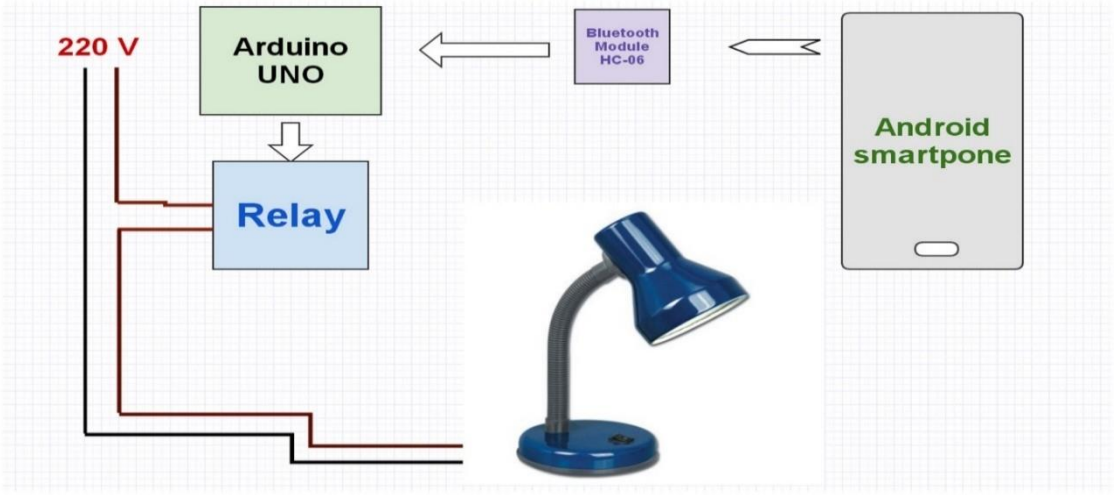

Figure 4.1 Block Diagram showing the arrangement of the module for the system

4.1.3 Module Specification

- **Relay**

  The control circuit functions as the coupling between the input and output circuits. In electromechanical relay, the coil accomplishes this function. A relays Output

Circuit is the portion of the relay that switches on the load and performs the same function as the mechanical contacts of electromechanical relays.

- **Arduino Module**

  Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

- **User interface Design using Django and Python**

  The required steps for a particular experiment are given in the web page which helps the user to know how to perform a particular task.

4.2 System Design

System design is the process of designing the elements of a system such as the architecture, modules and components, the different interfaces of those components and the data that goes through that system. Object-oriented design is the process of planning a system of interacting objects for the purpose of solving a software problem. It is one approach to software design. There are three stages of object-oriented design.[5]

4.2.1 Object Modeling

Object modelling develops the static structure of the software system in terms of objects. It identifies the objects, the classes into which the objects can be grouped into and the relationships between the objects. It also identifies the main attributes and operations that characterize each class.[6]

Class Diagram

The class diagram is the main building block of object-oriented modeling. It is used for general conceptual modeling of the systematic of the application, and for detailed modeling translating the models into programming code. Class diagrams can also be used for data modeling. The classes in a class diagram represent both the main elements, interactions in the application, and the classes to be programmed. In the diagram, classes are represented with boxes that contain three compartments:

- The top compartment contains the name of the class. It is printed in bold and centered, and the first letter is capitalized.
- The middle compartment contains the attributes of the class. They are left-aligned and the first letter is lowercase.
- The bottom compartment contains the functions of the class. They are left-aligned and the first letter is lowercase.

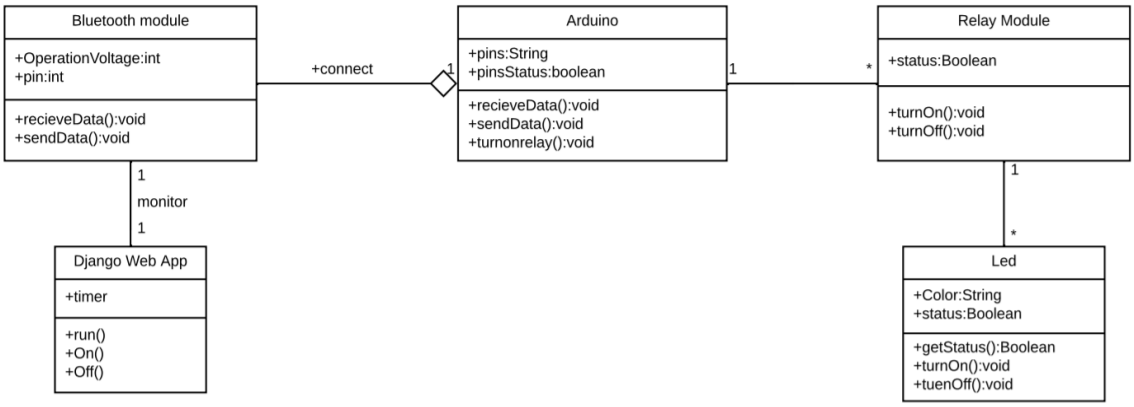

Figure 4.2 Class Diagram showing the structure of the system by showing the attributes involved in the classes

4.2.2 Dynamic Modelling

The dynamic model represents the time–dependent aspects of a system. It is concerned with the temporal changes in the states of the objects in a system.

Use case Diagram

A use case diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases in which the user is involved. A use case diagram can identify the different types of users of a system and the different use cases and will often be accompanied by other types of diagrams as well.[8]

The purpose of a use case diagram in UML is to demonstrate the different ways that a user might interact with a system. Create a professional diagram for nearly any use case using our UML diagram tool.

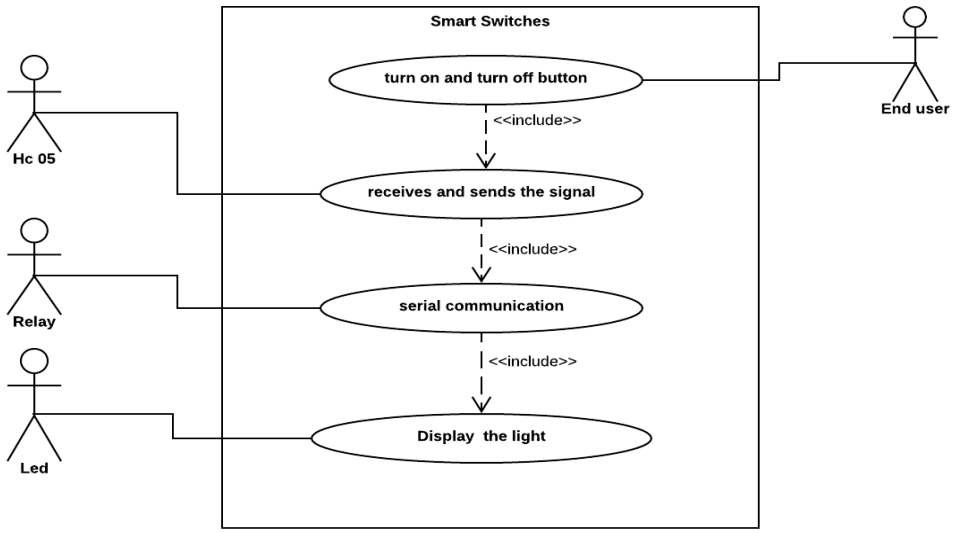

Figure 4.3 Use Case diagram Of Smart Switches

In Figure 4.4 the use case diagram tells us how the user and different component interact with the system.

Sequence Diagram

Sequence diagrams are those which shows interaction between actors and the system and between system components. This diagram describes the interaction between the object that shows how objects operate with one another and in what order.[2]

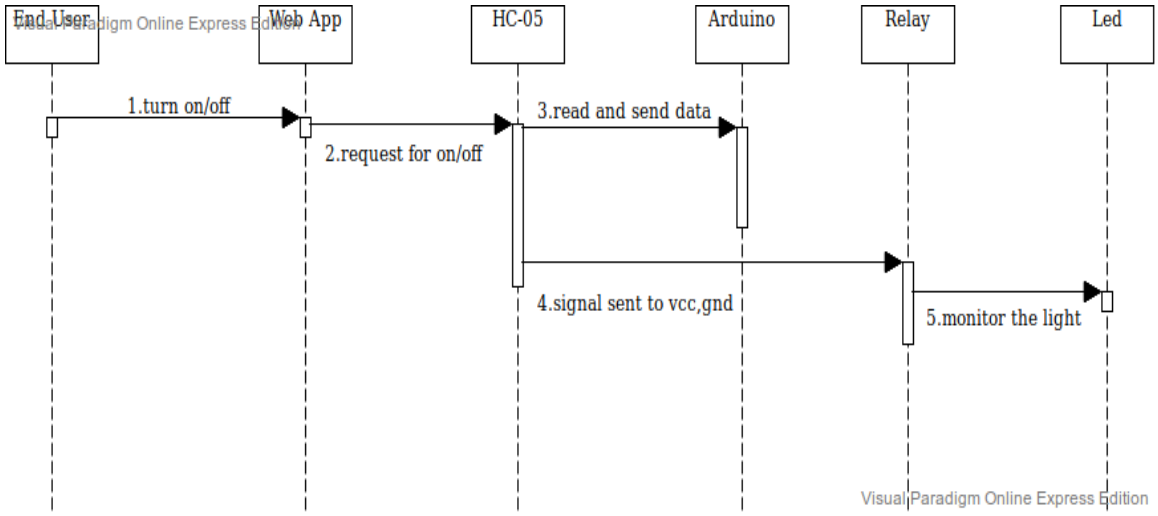

Figure 4.4 Sequence Diagram Of Smart Switches

Figure 4.5 gives us a brief showing interaction between user and the system handled by the project.

Activity diagram

Activity diagrams are graphical representations of workflow of stepwise activities and actions with support for choice, iteration and concurrency. In the Unified Modelling Language, activity diagrams are intended to model both computational and organizational processes (i.e., workflows), as well as the data flows intersecting with the related activities. Although activity diagrams primarily show the overall flow of control, they can also include elements showing the flow of data between activities through one or more data stores.[3]

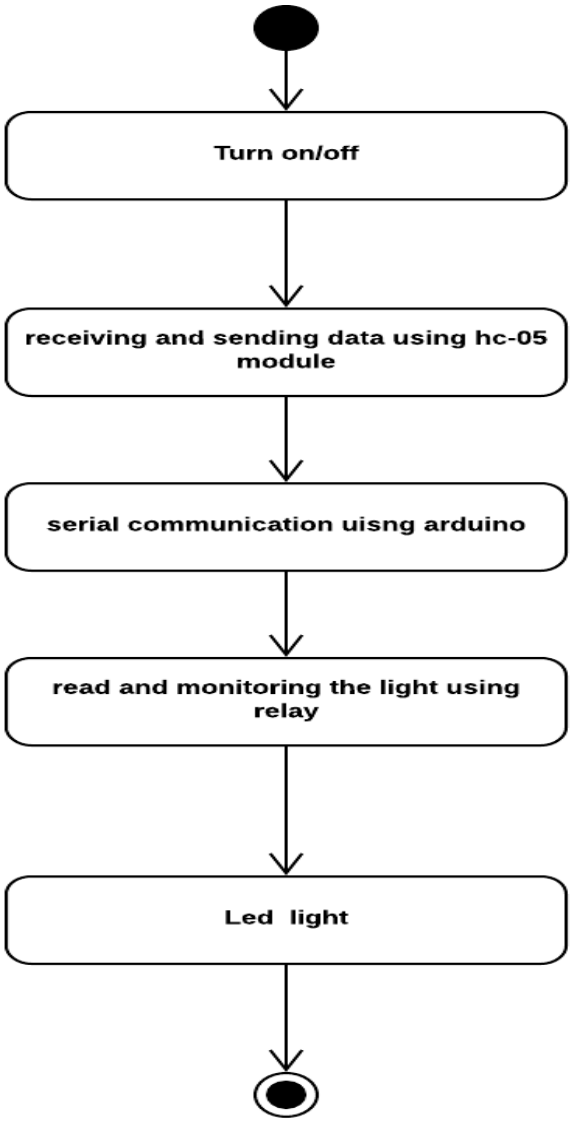

Figure 4.5 Activity Diagram OF Smart Switches

Figure 4.5 shows us how the activity the workflow of stepwise activities

4.2.3 Functional modelling

Data flow diagrams

- DFD Level 0

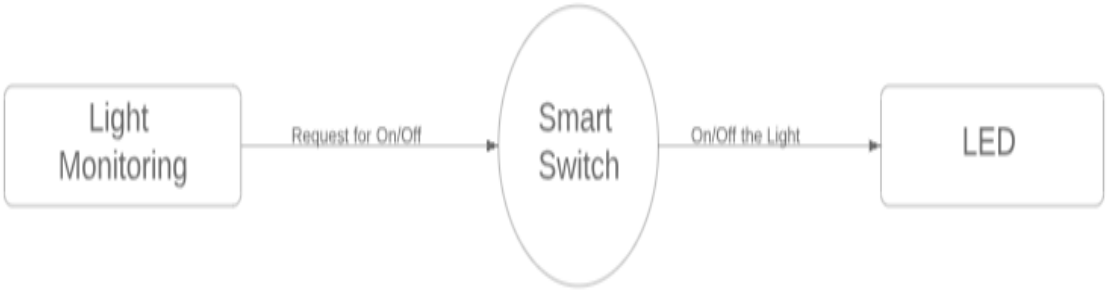

Figure 4.6 Data Flow Diagram for 0 level

- DFD Level 1

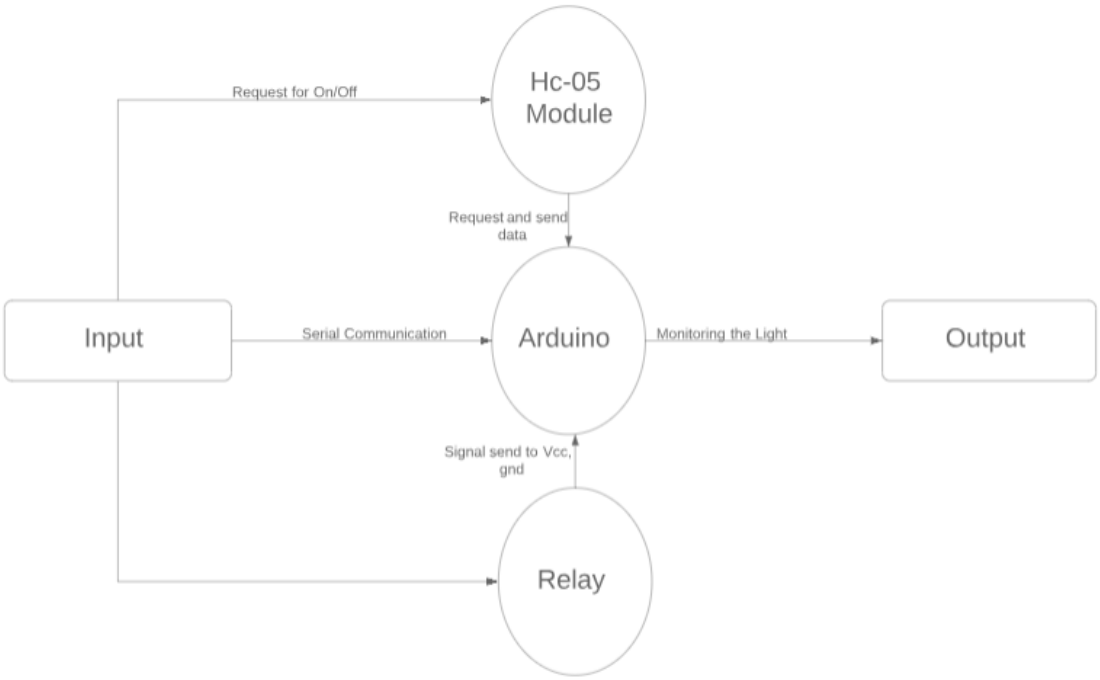

Figure 4.7 Data Flow Diagram for DFD Level 1

Figure 4.7 shows the data flow from one module to the other.

Chapter 5: Implementation

The project's current status is that we are able to fetch the data from the Arduino board. The relay board is able to operated switch that can be turned on or off. Blynk app is been integrated with the system which is controlling the device from the pair of widgets and gauges. The interface of the app let's the end user to interact with system in more simple and friendly manner.

Source Code

```
int switch1=11;
int switch2=12;
int switch3=8;
int switch4=7;
int Received=0;
int switch1_state =0;
int switch2_state =0;
int switch3_state = 0;
int switch4_state = 0;
void setup(){
Serial.begin(9600);
pinMode(switch1,OUTPUT);
pinMode(switch2,OUTPUT);
pinMode(switch3,OUTPUT);
pinMode(switch4,OUTPUT);
  }
void loop(){
 if(Serial.available()>0)
 {
    Received = Serial.read();
    }
if (switch1_state == 0 && Received == '1')
  {
    digitalWrite(switch1,HIGH);
    switch1_state=1;
    Received=0;
  }
if (switch1_state ==1 && Received == '1')
```

```
 {
   digitalWrite(switch1,LOW);
   switch1_state=0;
   Received=0;
  }
if (switch2_state == 0 && Received == '2')
  {
   digitalWrite(switch2,HIGH);
   switch2_state=1;
   Received=0;
  }
if (switch2_state ==1 && Received == '2')
  {
   digitalWrite(switch2,LOW);
   switch2_state=0;
   Received=0;
  }
if (switch3_state == 0 && Received == '3')
  {
   digitalWrite(switch3,HIGH);
   switch3_state=1;
   Received=0;
  }
if (switch3_state ==1 && Received == '3')
  {
   digitalWrite(switch3,LOW);
   switch3_state=0;
   Received=0;
  }
if (switch4_state == 0 && Received == '4')
  {
   digitalWrite(switch4,HIGH);
   switch4_state=1;
   Received=0;
  }
if (switch4_state ==1 && Received == '4')
  {
   digitalWrite(switch4,LOW);
   switch4_state=0;
   Received=0;
```

```
  }
}
```

Screenshots

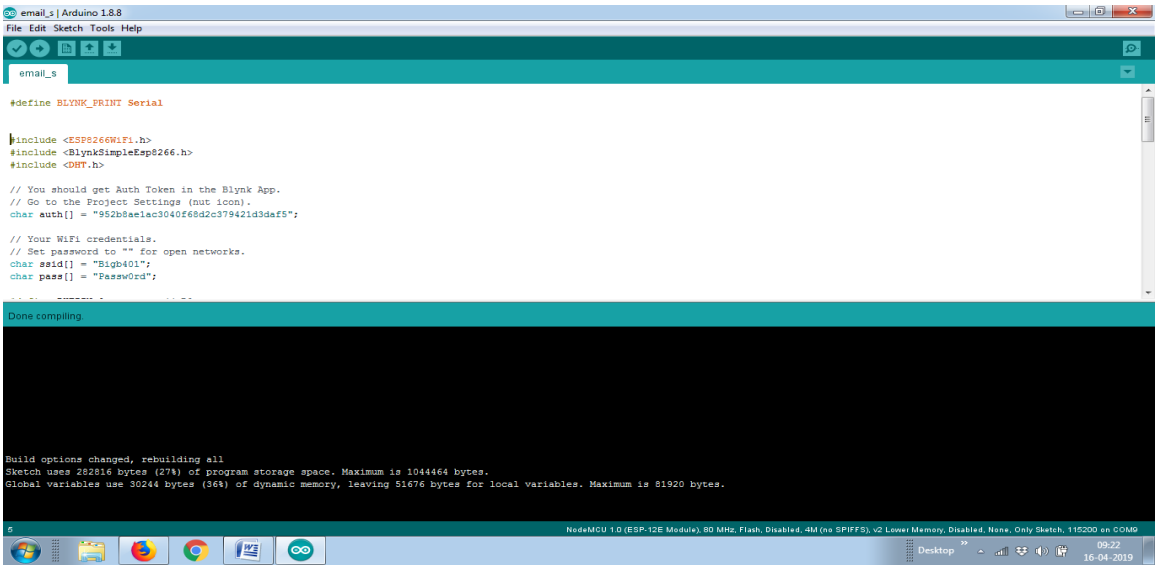

Figure 5.1 Arduino Ide Programming Interface

Figure 5.1 depicts the code when it is build and compiled by the compiler.

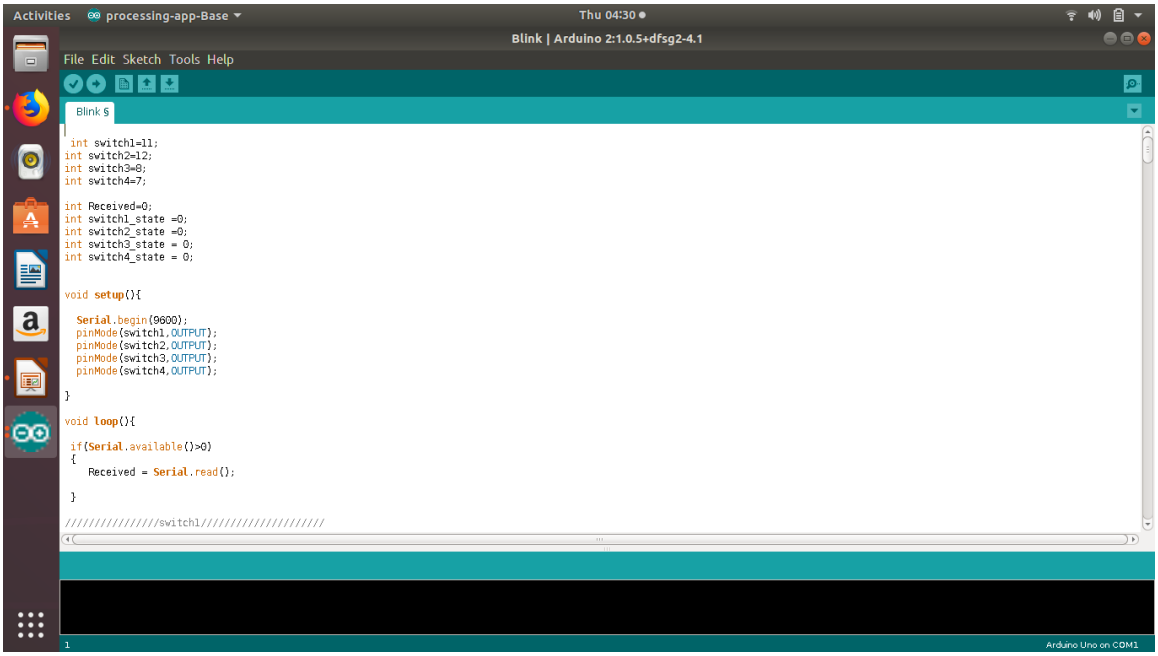

Figure 5.2 Uploading Arduino Code To by Blynk

Figure 5.3 Interface provided by Arduino Bluetooth connectivity

Figure 5.4 Connection Between the Arduino Bluetooth app and other device

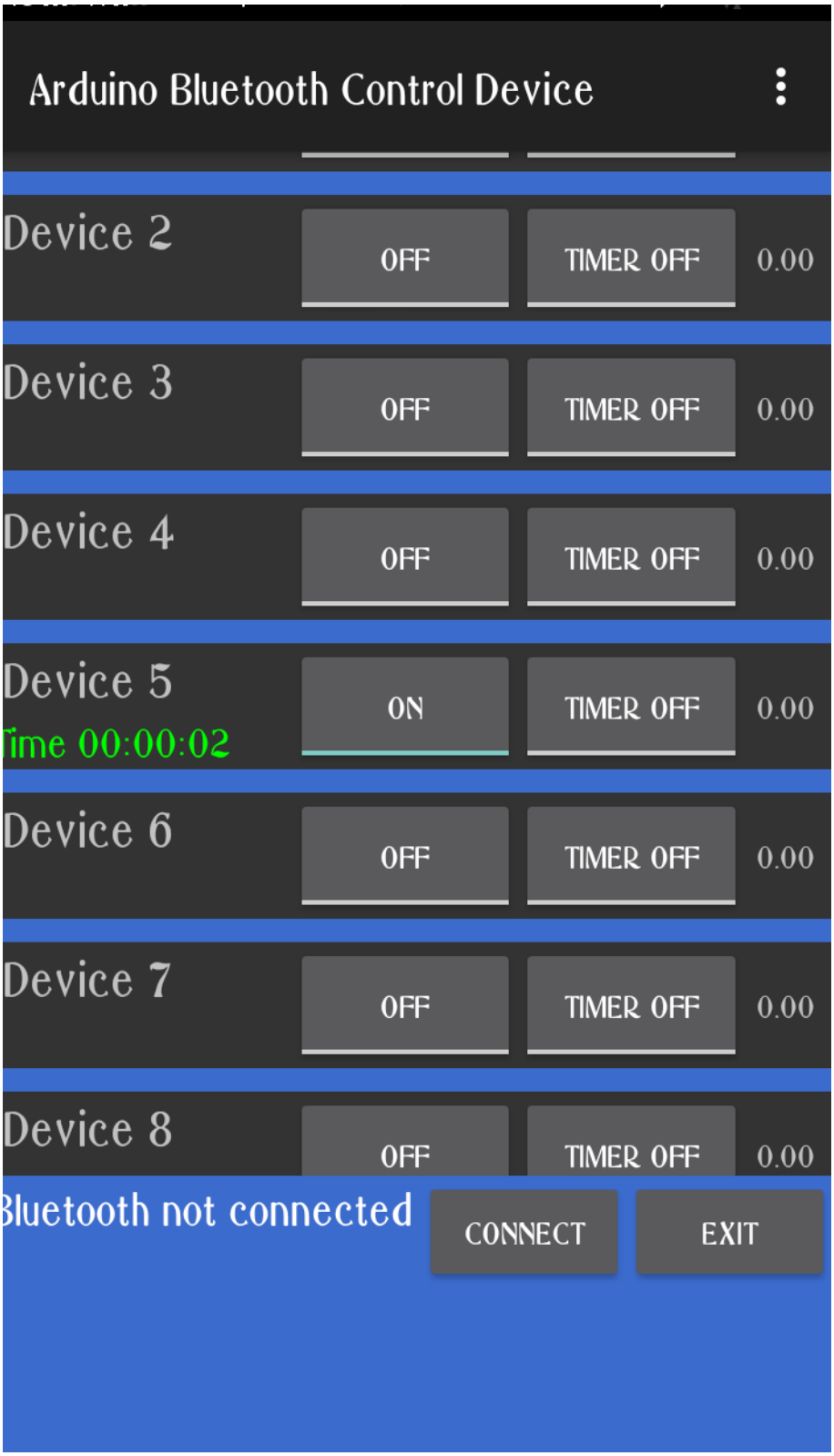

Figure 5.5 Push Notification In Other device

Chapter 6:Testing

6.1 Unit testing

Table 6.1 Unit Test Case Table

Test case id	Description	Input	Expected output	Actual Output	Remarks
u1	Arduino uno connected to the system or not	The cable should be connected to the correct port	Red light should blink if proper connection is done	red light blinks that shows the connection is done	Pass
u2	Relay is working properly or not	Jumper cable is connected to the exact pin board	Continuous red light should relay board	Continuous red light will relay board if connected	Pass
u3	The port is working properly or not	Settings is changed in the arduino IDE	The COM3 port should not give any error message	The code should compile without any errors	Pass
u4	Relay is able to catch the analog data	The pin is correctly connected	The light should blink in the relay board	The light should blink in the relay board	Pass
u5	A relay is an electrically operated switch that can be turned on or off,	On click of on button bulb will blinking	The Button should be displayed in the app.	The Bulb should on/off command	Pass

Test case id	Description	Input	Expected output	Actual output	Remarks
u1	On click of Arduino Bluetooth app the project is opening or not.	On a single click app interface should open	The project dashboard should open	The project dashboard will open	Pass
u2	The dashboard should give proper graph of the humidity and temperature data.	As the power button is pressed in the app the graph should start plotting	The gauge in the app should work properly within 0.5 sec	within 0.5 sec the gauge should start capturing	Pass
u3	The app is able to rectify the and check the threshold value	on click of power button	if it exceeds the threshold value it should send notification to the end user	if it exceeds the threshold value it should send notification to the end user	Pass

Table 6.1 consists of all the unit test case where smallest part of individual unit / component (called unit) is tested to determine if they are fit for use based on the caparison of expected output and actual output.

6.2 Integration Testing

Table 6.2 Integration Test Case Table

Test case id	Description	Input	Expected output	Actual Output	Remarks
I1	In Bluetooth app the project is opening or not	On click of the Bluetooth aap app icon	the project dashboard should open which means the system and app has been integrated	the project dashboard should open which means the system and app has been integrated	Pass
I2	API given to the code should make the app open	The API is correctly written in the code.	the API is correct and the interface of the app is shown	the API is correct and the interface of the app is shown	Pass

Chapter 7: Conclusion and Future Enhancement

The system is developed using agile methodology. smart switches can be controlled through a Web Based Application which will be developed using Django framework (python, Bootstrap) or a home/building automation hub and individual bulbs can be programmed to change output in a specific manner.

The bulb's internet connectivity makes it possible for vendors to use edge computing and equip smart bulbs .To design this system we are using Raspberry pi module and relay circuits and jammers. using this we can control light appliances based on internet. The Main Purpose of the project is to control the lights which being switched on unnecessarily so users can get control the lights via even switch boards and web-based application.The outcome of this project will decrease the unnecessary usage of electricity and it is portable as well as convenient so that users can get control over the lights which is unnecessarily switched on.

Future Enhancement

- The outcome of this project is to efficiently controlling the lights and so the electrical energy will wastage is avoided
- Reduce the unnecessary wastage of electrical energy.
- In other country like Bangladesh this project will be very helpful to reduce unwanted consumption of electricity and it will make life more comfortable.

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