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Home Automation System

CSE3009 Internet of Things

J Component Report

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SCOPE

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1. Introduction

"Smart Home", "Intelligent Home" are terms that followed and has been used to introduce the concept of networking appliances within the house. HASs enables energy efficiency, improves the security systems, and certainly the comfort and ease of users. In the present emerging market, HASs is gaining popularity and has attracted the interests of many users.

1.1 Aim

The aim is to design a prototype that establishes wireless remote control over a network of home appliances. The application is designed to run on android devices providing features like switch mode control, voice command control and a provision to view the status of the devices on the application itself. Considering its wide range of application, following are the scope of this prototype. The system can be implemented in homes, small offices, and malls as well, being in-charge of control of the electrical appliances

1.2 Objective

- Design of an independent HAS

  To formulate the design of an interconnected network of home appliance to be integrated into the HAS. The objective to account for every appliance and its control to be automated and integrated into the network further formulated into the HAS.

- Wireless control of home appliances (Switch and Voice mode)

  To develop the application that would include features of switch and/or voice modes to control the applications.

- Monitoring status of appliances

  Being able to view the status of home appliances on the application, in order have a better HAS.

- Secure connection channels between application and Node MCU

  Use of secure protocols over Wi-Fi so that other devices are prevented to achieve control over the HAS. Secure connections are obtained by SSL over TCP, SSH.

- Controlled by any device capable of Wi-Fi (Android, iOS, PC)

  To achieve flexibility in control of the home appliances, and device capable of Wi-Fi connectivity will be able to obtain a secure control on the HAS.

- Extensible platform for future enhancement

  With a strong existing possibility of adding and integrating more features and appliances to the system, the designed system needs to be highly extensible in nature.

1.3 Benefits

The benefits of an established wireless remote switching system of home appliances include:

- No legal issues

  Obtaining access to or traversing properties with hard lines is extremely difficult.

- Reduced wiring issues

  Considering the increase in price of copper, thus increases the possibility of the wire to be stolen. The use of a wireless remote system to control home appliances means no wire for thieves to steal.

- Extended range

  As the system establishes control over Wi-Fi, it was a generally considered descent range. That is 150 feet indoors. Outdoors it can be extended to 300 feet, but since the application is of a HAS, an indoor range is considered.

- Security

  As the connection of the control of the HAS is established over a secure network the system ensures security to the maximum extent.

- Integrable and extensive nature

  The prototype designed can be integrated to a larger scale. Also it has an extensive nature being able to add or remove the appliances under control according to application.

2. Literature Review

1) Internet of Things based home automation system

Date: 09 January 2017

Publisher: IEEE

Summary and Drawbacks:

This allows the user to automate all the devices and appliances of home and integrate them to provide seamless control over every aspect of their home. The designed system not only monitors the sensor data, but also actuates a process according to the requirement, for example switching on the light when it gets dark, and it allows the user to control the household devices from anywhere. This project takes a greater number of components, and the cost is also high.

2) IoT based monitoring and control system for home automation

Date: 03 December 2015

Publisher: IEEE

Summary and Drawbacks:

This project aims at controlling home appliances via Smartphone using Wi-Fi as communication protocol and raspberry pi as server system. The user here will move directly with the system through a web-based interface over the web, whereas home appliances like lights, fan and door lock are remotely controlled through easy website. This project uses the raspberry pi as execution part so it will be somewhat tough.

3) IoT based smart security and home automation system

Date: 16 January 2017

Publisher: IEEE

Summary And Drawbacks:

This IoT project focuses on building a smart wireless home security system which sends alerts to the owner by using Internet in case of any trespass and raises an alarm optionally. Besides, the same can also be utilized for home automation by making use of the same set of sensors. The leverage obtained by preferring this system over the similar kinds of existing systems is that the alerts and the status sent by the Wi-Fi connected microcontroller managed system can be received by the user on his phone from any distance irrespective of whether his mobile phone is connected to the internet.

4) An IoT based home automation using android application

Date: 26 June 2017

Publisher: IEEE

Summary and Drawbacks:

This paper describes how to control and monitor home appliances using android application over internet. There are number of commercial home automation systems available in market. However, these are designed for limited use. Therefore, home appliances can individually be controlled both from within the home and remotely. This is very helpful to physically challenged people. The practical goal of this paper has been to create a virtual, but practically usable, android home automation system. The android mobile is used to send the commands to the Arduino to control all the home appliances.

5) Home automated system using Bluetooth and an android application

Date: 28 January 2021

Publisher: IEEE

Summary and Drawbacks:

The design comprised an Arduino ATMEGA328 microcontroller board, Bluetooth module (HC-06), and an android application (MIT App Inventor 2). The Arduino controls any connected component and was programmed with C++ programming language by using Integrated Development Environment (IDE). Relays and Triacs are used for the switching mechanism. Once the system is connected, the user controls the electrical appliances connected to the homeautomated system, which can also be controlled using voice prompt with the help of a Google assistant inbuilt with the android smartphone. This system uses the Arduino so it will be a bit expensive as compared to our project

3. COMPONENTS USED

3.1 Sensor & Actuator

1. NodeMCU

NodeMCU (Node Microcontroller Unit) is a low-cost open source IOT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added.

The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna.

NodeMCU

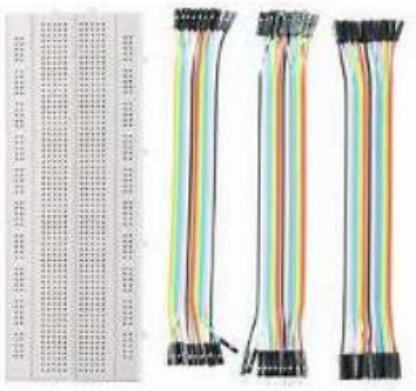
2. Relay(s)

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof.

4-relay module

3. Bread board and Jump wires

A breadboard consists of two areas called STRIPS. One is BUS strips and other TERMINAL strips. At most 5 sensors can be connected. Jump wires are used for connections.



Bread Board and Jump Wires

4. Buzzer and LEDs

The Arduino buzzer is a device that produces sound when an electric current is passed through it. The Arduino buzzer can be directly connected to the Arduino and produce different tones by giving different frequency electric pulses to the buzzer.

LED A light-emitting diode is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons.

Buzzer and LED

3.2 Working Model

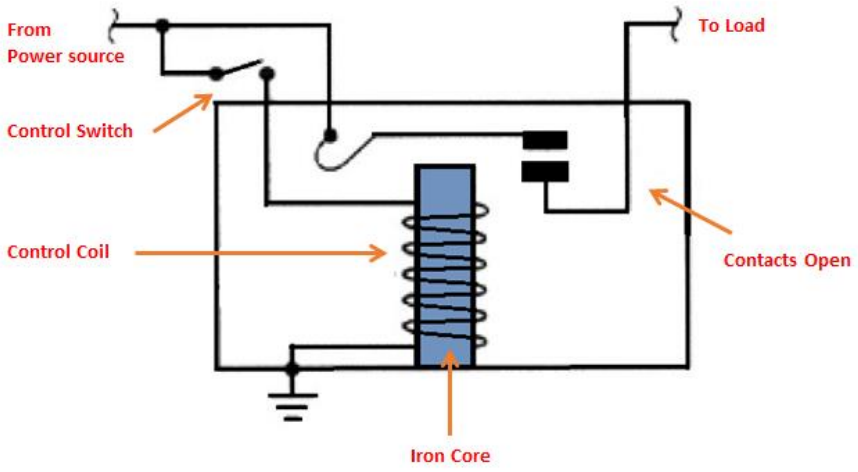
1. ESP8266 Wi-Fi

The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to a Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Wi-Fi uses radio waves to transmit information between a device and a router via frequencies. Two radio-wave frequencies can be used, depending on the amount of data being sent: 2.4 gigahertz and 5 gigahertz. However, ESP8266 uses only 2.4GHz frequency band.

2. Relay (Actuator)

A relay is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current.

The heart of a relay is an electromagnet (a coil of wire that becomes a temporary magnet when electricity flows through it). It can be thought of as a kind of electric lever: switching it on with a tiny current switch on ("leverages") another appliance using a much larger current.



4. Proposed Architecture

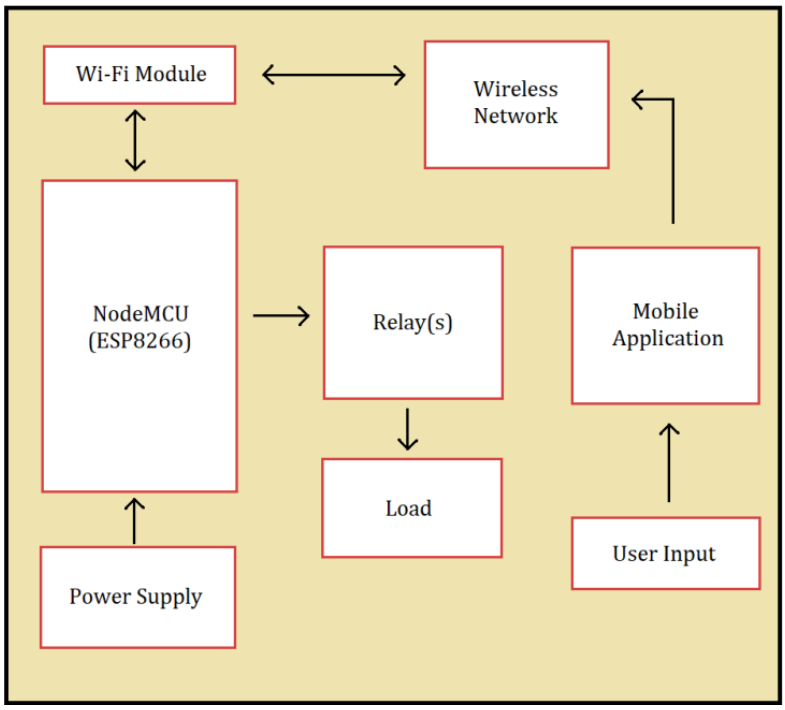
The android OS provides the flexibility of using the open source. The inbuilt sensors can be accessed easily. The application used to control the system has the following features. Android Phone acts as a client and data are sent via sockets programming. The application takes command from user in two different modes.

• Switch mode: Switch mode uses the radio buttons that are used to control the home appliances. The radio button sends the status of the switch.

• Voice mode: Voice Mode is used to control the home appliances using voice command. Using the inbuilt microphone of Smartphone, the application creates an intent that fetches the speech data to the Google server which responds with a string data. The string data are further analysed and then processed.

4.1 Hardware Implementation

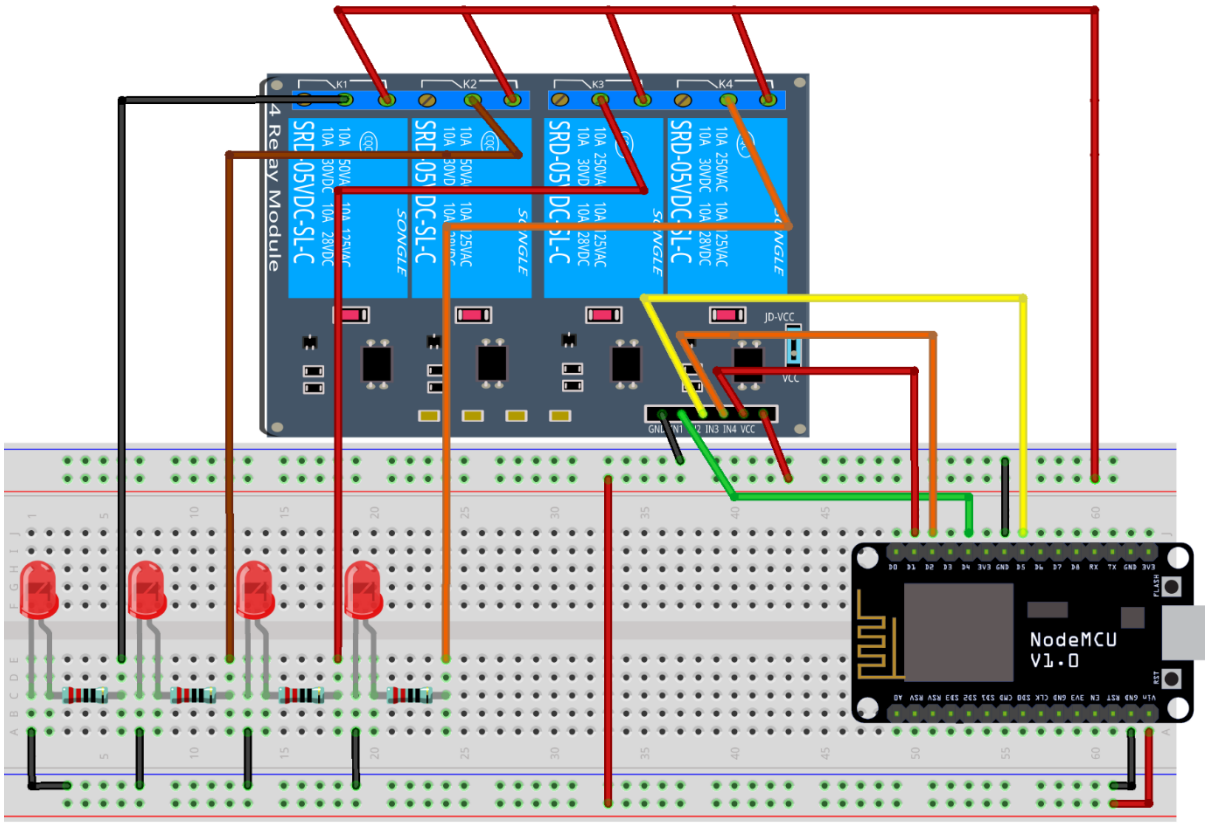
Block Diagram

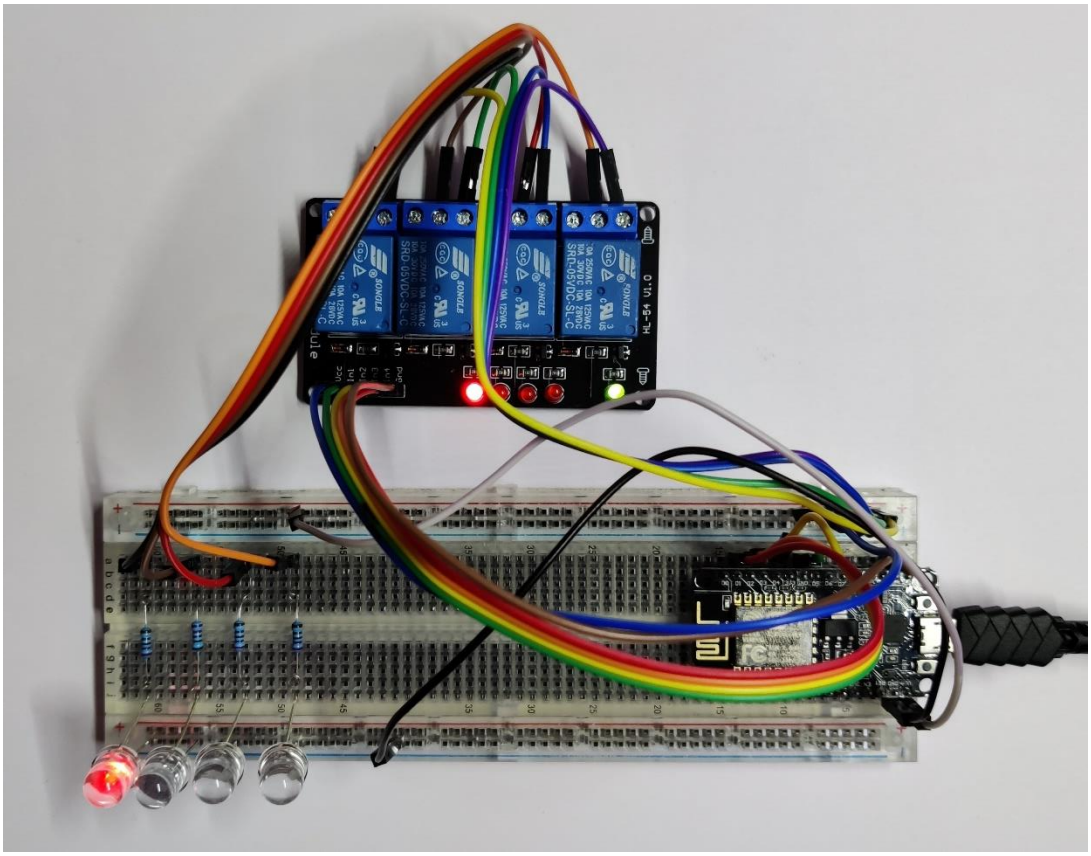


The block diagram gives the functionality of the overall project. The Node MCU unit is the microcontroller or the main controlling unit of the system. The user uses the mobile application in setting commands for functioning of the appliances. The mobile application interprets the command form in user in voice or switch mode and sends signal to the Node MCU unit, over a wireless network established by Wi-Fi communication. Hence the Wi-Fi module (inbuilt into Node MCU), helps the microcontroller establish Wi-Fi communication with a device and take

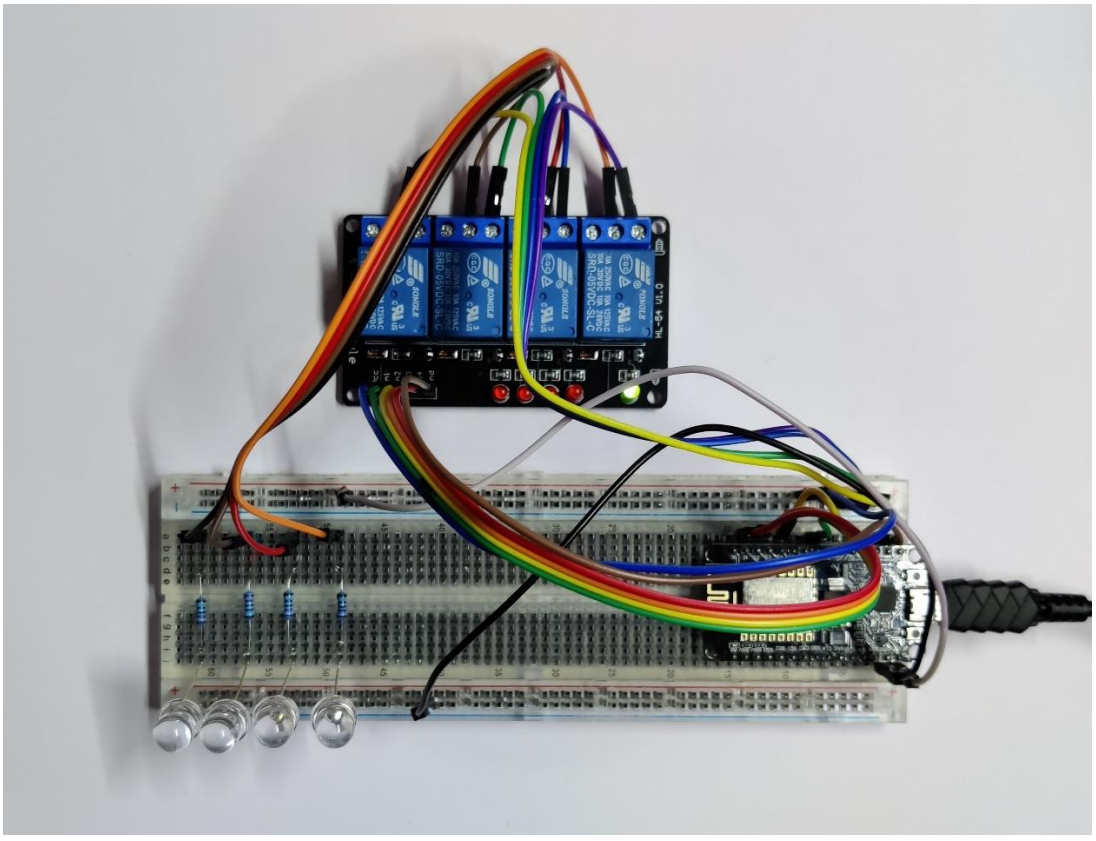
commands from an application over wireless network. The Node MCU on further receiving the signal then turns on/off the appliance with the help of relay. The Node MCU, relay and the final appliances are physically connected. There is a power supply unit that powers the microcontroller, the relay as well as the final appliances.

Schematic Diagram





LED Switched ON



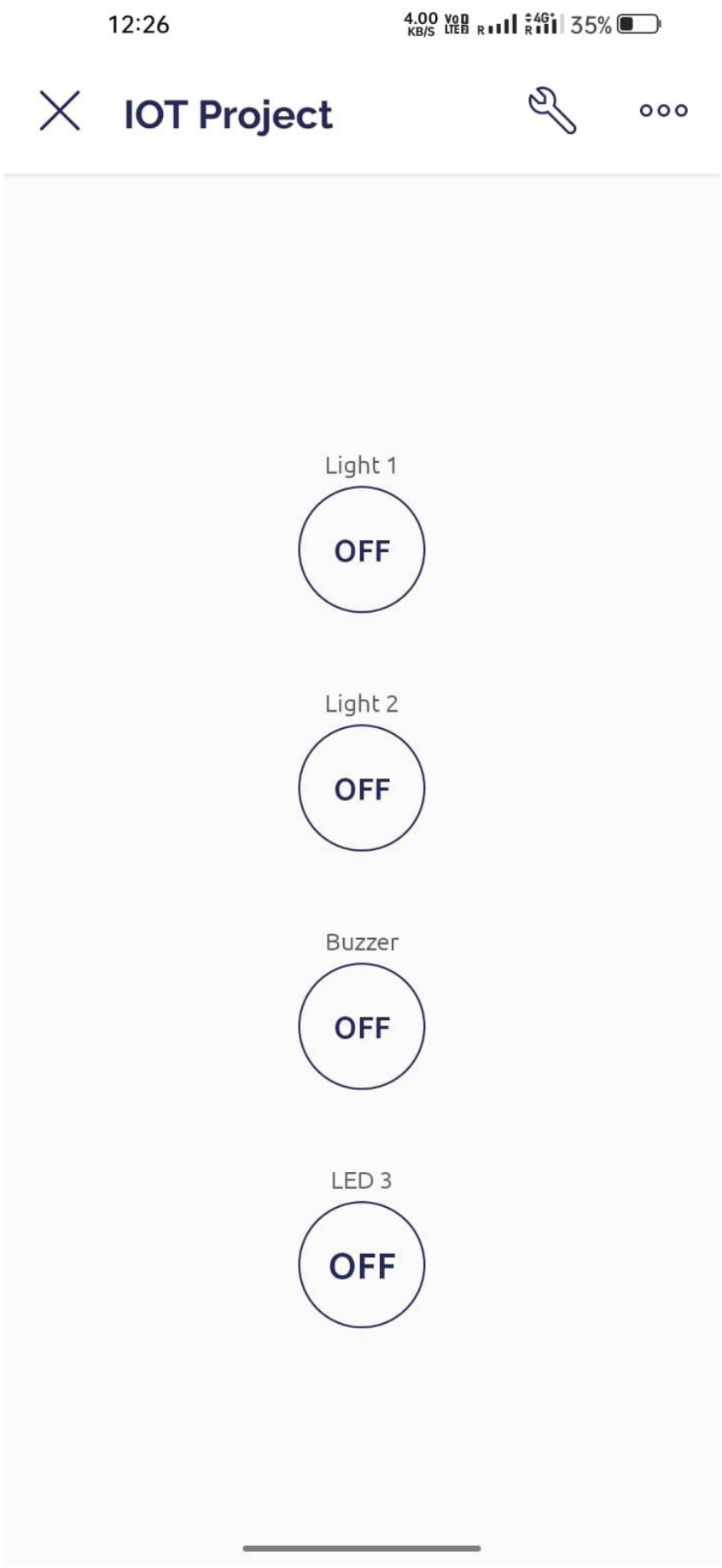
LED switched OFF

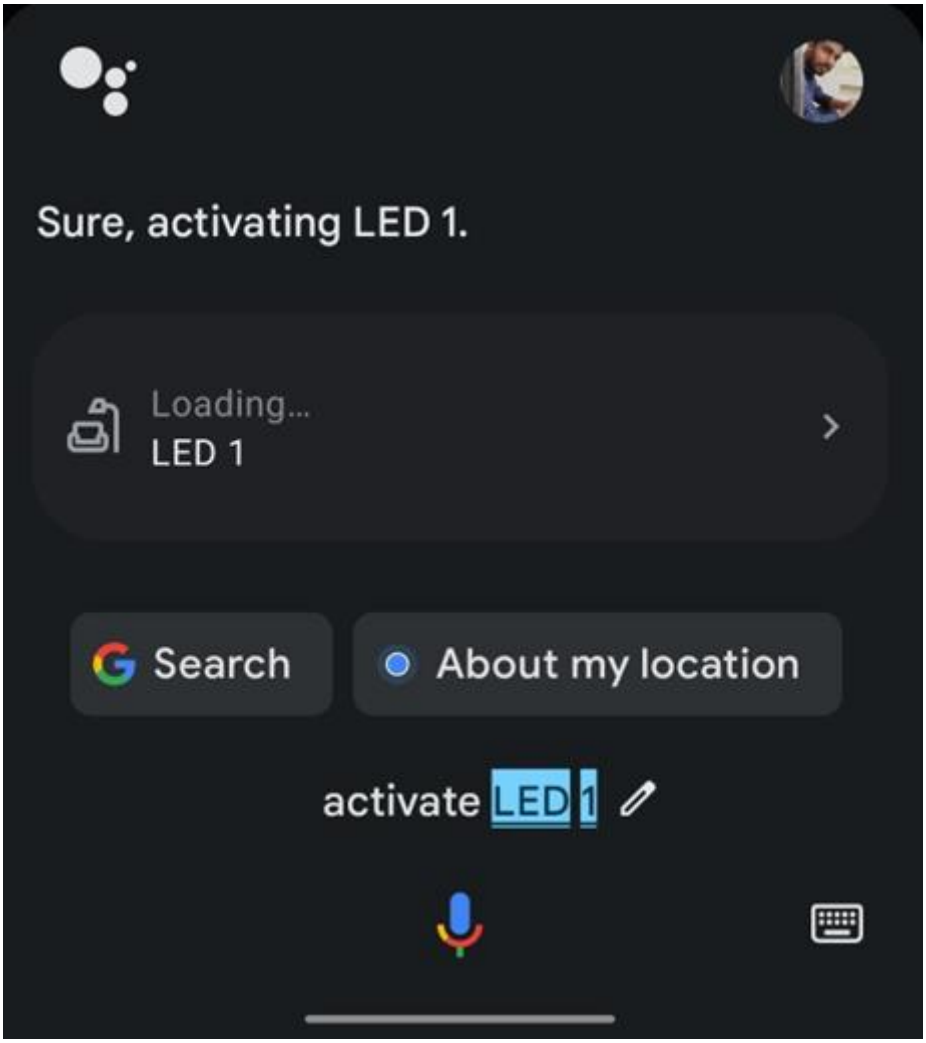
4.2 Software Implementation

```
#define BLYNK_TEMPLATE_ID "TMPLCJwW6vgX"
#define BLYNK_DEVICE_NAME "IOT Project"
#define BLYNK_AUTH_TOKEN "KD3Cv-T179OJUZ9X7pq27LR-176yFlfj"
#define BLYNK_PRINT Serial

#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

int v0 = 0;
int v1 = 0;
int v2 = 0;
int v3 = 0;
int v4 = 0;
int v5 = 0;
int v6 = 0;

char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "Girraj";
char pass[] = "j5i8dh26";

BLYNK_WRITE(V0)
{
  Serial.println("Light 1");
  v0 = param.asInt(); // light_D1
  if (v0 == 1)
  {
    digitalWrite(D1, HIGH);
  }
  else
  {
    digitalWrite(D1, LOW);
  }
}

BLYNK_WRITE(V1)
{
  Serial.println("Light 2");
  v1 = param.asInt(); // light_D2
  if (v1 == 1)
  {
    digitalWrite(D2, HIGH);
  }
  else
```

```
  {
    digitalWrite(D2, LOW);
  }
}

BLYNK_WRITE(V2)
{
  v2 = param.asInt(); // buzz_d4
  if (v2 == 1)
  {
    digitalWrite(D4, HIGH);
  }
  else
  {
    digitalWrite(D4, LOW);
  }
}

BLYNK_WRITE(V3)
{
  Serial.println("Light 1 voice");
  v3 = param.asInt(); // light_D1_VOICE
  Serial.println(v3);
  if (v3 == 1)
  {
    digitalWrite(D1, HIGH);
  }
}

BLYNK_WRITE(V4)
{
  v4 = param.asInt(); // light_D2_VOICE
  Serial.println("Light 2 voice");
  if (v4 == 1)
  {
    digitalWrite(D2, HIGH);
  }
  else
  {
    digitalWrite(D2, LOW);
  }
}

BLYNK_WRITE(V5)
{
  Serial.println(" Buzzer voice");
  v5 = param.asInt(); // BUZZER_VOICE
  if (v5 == 1)
```

```
  {
    digitalWrite(D4, HIGH);
  }
  else
  {
    digitalWrite(D4, LOW);
  }
}

BLYNK_WRITE(V6)
{
  Serial.println("  sevo motor");
  v6 = param.asInt(); // servo
  if (v6 == 1)
  {
    digitalWrite(D5, HIGH);
  }
  else
  {
    digitalWrite(D5, LOW);
  }
}

void setup()
{
  Serial.begin(115200);
  Blynk.begin(auth, ssid, pass);
  pinMode(D1, OUTPUT); // LIGHT1
  pinMode(D2, OUTPUT); // LIGH2
  pinMode(D4, OUTPUT); // BUZZER
  pinMode(D5, OUTPUT); // BUZZER
  digitalWrite(D1, HIGH);
  digitalWrite(D2, HIGH);
  digitalWrite(D4, HIGH);
  digitalWrite(D5, HIGH);
}

void loop()
{
  Blynk.run();
}
```


12:26
4.00 KB/S
35%
IOT Project
Light 1
OFF
Light 2
OFF
Buzzer
OFF
LED 3
OFF



5. RESULT

The experimental model was made according to the circuit diagram and the results were as expected. The home appliances could be remotely switched over Wi-Fi network. Both the switch mode and the voice mode control methodologies were successfully achieved. The Blynk application was also successful in displaying the status of every application.

6. CONCLUSION

It is evident from this project work that an individual control home automation system can be cheaply made from low-cost locally available components and can be used to control multifarious home appliances ranging from the security lamps, the television to the air conditioning system and even the entire house lighting system. And better still, the components required are so small and few that they can be packaged into a small inconspicuous container. The designed home automation system was tested several times and certified to control different home appliances used in the lighting system, air conditioning system, home entertainment system and many more. Hence, this system is scalable and flexible

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