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Building Management System

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Abstract: In the busy life of human beings all people want to reduce their works and it is possible with the help of the technology. Likewise technology is becoming one of the greatest support to the human being. The common and small works are like controlling the home appliances. If we do not manage to control the usage of power today then in future the problems will be faced by us or our upcoming generation. So, there is a need to manage the electricity with help of technology. In this paper we address an IoT(Internet of Things) based Building Management System. There are many works are done on this issue using different methodology. Our method is using the NodeMCU and relay which would be controlled by a mobile application, using this the user can easily manage and control the appliances without the physical presence on the exact location. Our method is easy to control and it is also at a very low cost. This inquire about article guarantees back for the poor individuals with respect to a toll compelling and control sparing who are involved with their works. The paper concludes with summarized dialog on the inquire about.

Index words: Internet of Things, NodeMCU, Relay module, Building Management System(BMS)

I. INTRODUCTION

In the era of technology, human beings are also very busy in their respective works. No one are bothering about the sustainable development. One of the common need of human is the electricity which should be used as much our need not more than that or never try to waste. Using Iot we can overcome this problem. But some time cost is also becoming a limitation for the upgradation of technology. BMS is a computer based controlling system through which we can easily control the electrical appliances of the building. BMS can also be called Building Automation System. According to the history previously there was home automation system, first such system was ECHO IV. This system invented on 1966 by Jim Sutherland ECHO(Electronic Computing Home Operator)but it was not sold commercially. This method is easy to use, more efficient and best thing is it is at low cost. In this paper we proposed the IoT based BMS which is very easy to operate. The main part is the NodeMCU and relay module. Elderly people can also use this system very easily. This model is efficient at affordable price. This method can installed easily in different institutions, offices etc.

II. RELATED WORKS

Technologies are emerging these days due to this it plays a vital role in making human life easy and automated.

One of the work presented in that they used the NodeMCU for the home automation and security system[1]. In this they have used different sensors like DHT-11(Digital Humidity Temperature) which was mainly consist of humidity sensor and thermistor(used for measuring the temperature and moisture), ultrasonic sensors for the object sensing and distance measurement, PIR(Passive Infrared), this sensors is used to detects and measure the infrared radiation generated by the human body and the Blynk app. This is like a interface where users can enables the device status and regulations by them.

One of the latest work which was based on speech controlled home automation using google assistant[2]. This model was based on voice-based speech recognition through a mobile phone using the google infrastructure known as google assistant. In this all the electrical appliances are controlled by the voice and they used a Raspberry PI 3 model.

Another work was where the proposed system an intelligent way for controlling the home appliances[3]. It mainly uses three components ESP8266 WI-FI module, router and relay. Where ESP8266 WI-FI module plays the key role because all appliances, router, relay, power supply connected to it.

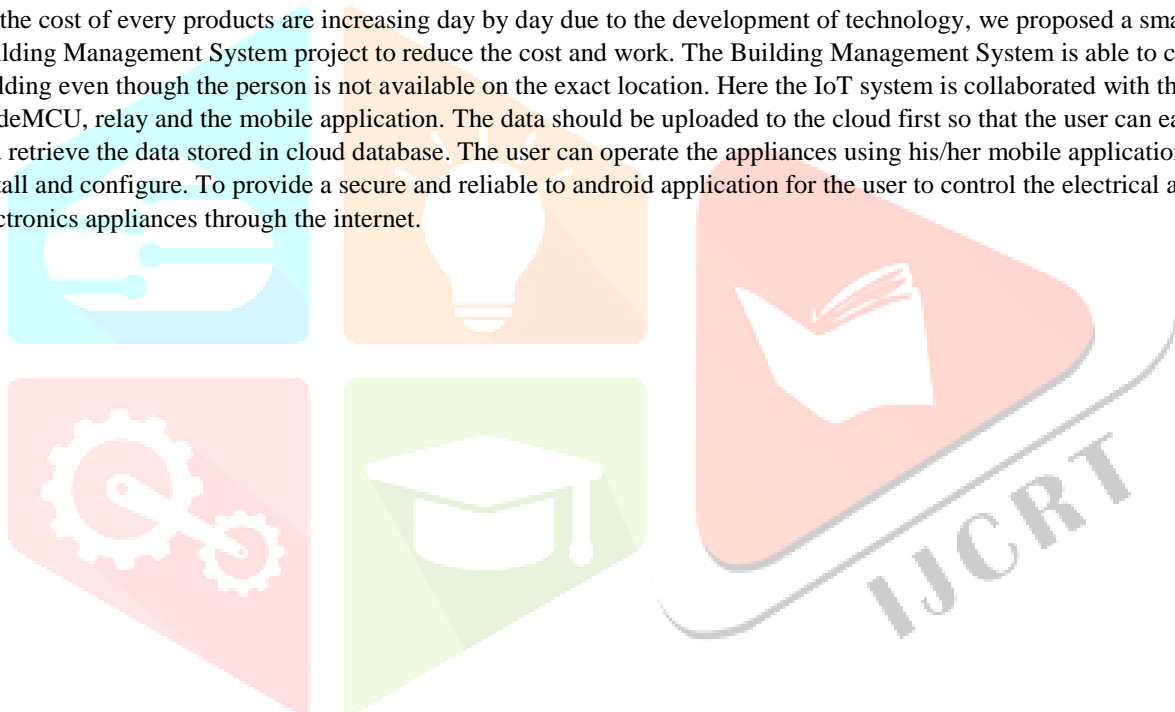
One of the latest methodology proposed for building energy management system will remotely control and manage the energy loads and plug loads[4]. This system is using IoT and machine learning. This mainly focus on two thing i.e. the hardware which will control the air conditioner and the plug loads and the other thing will focus on the prediction of future loads which is possible with machine learning.

Another article presents smart home controller which is a prototype[5]. This model offers a price effective and highly secure way for controlling the home appliances with the help of a android mobile application. This also provides a feature for automatic monitoring and controlling of energy loads by replacing web servers with dedicated local server.

Another article was proposed where the model has used extra sensors like occupancy sensor, smoke sensor, flame sensor[6]. This can also prevent the disaster to be happen in the building. This proposed model is also focused on the saving the energy and the power consumption.

III. PROPOSED MODEL

As the cost of every products are increasing day by day due to the development of technology, we proposed a small idea on Building Management System project to reduce the cost and work. The Building Management System is able to control the building even though the person is not available on the exact location. Here the IoT system is collaborated with the NodeMCU, relay and the mobile application. The data should be uploaded to the cloud first so that the user can easily send and retrieve the data stored in cloud database. The user can operate the appliances using his/her mobile application. It is to install and configure. To provide a secure and reliable to android application for the user to control the electrical and electronics appliances through the internet.



A. BLOCK DIAGRAM

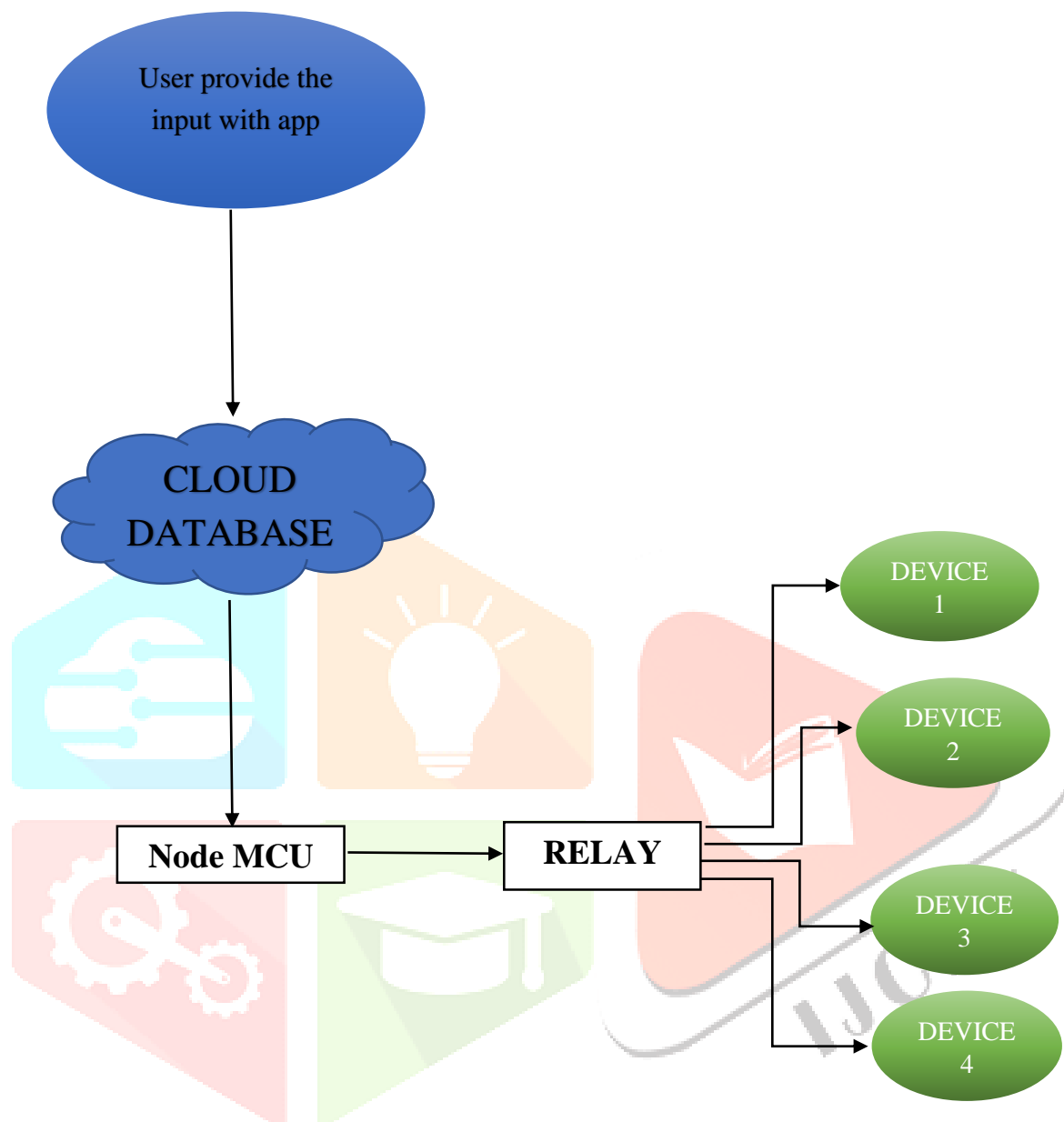


Figure1 block diagram of the proposed model

B. DETAILS OF COMPONENTS

i. NODE MCU

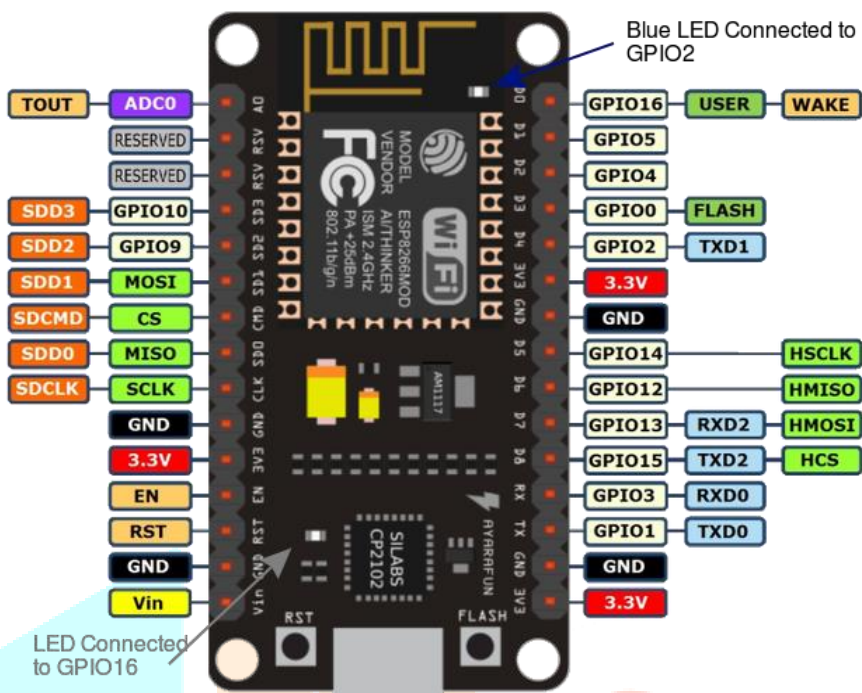


Figure2 pin diagram of NodeMCU

NodeMCU pin description

- **Power pins**

There are four different power pins :

- One VIN
VIN pin is used to give supply to NodeMCU board.
- Three 3.3V pins
3.3V pins are used to give power to the external peripherals

- **Control pins**

There are three different control pins:

- Enable pin(EN)
An enable pin is used to enable the microcontroller
- Reset pin(RST)
A reset pin is used to reset the microcontroller.
- Wake pins
Wake pins are used to wake up the microcontroller from sleep.

- **I2C pins**

I2C stands for Inter-Integrated Circuit , these pins are used to work with all I2C sensors and peripherals.

- **SPI pins**

SPI stands for Serial Peripheral Interface. There are four different SPI pins i.e. SD1,CMD,SD0,CLK. These pins are used for SPI communications. It is mostly used in embedded systems and it is a serial communication interface used for short distance communication.

- **GND pins**

GND stands for ground. On the NodeMCU development board there three different ground pins.

- **ADC channel**

ADC stands for Analog to Digital Converter. It is used to convert analog signals into digital form. NodeMCU board has an in build 10-bit ADC with only one ADC pin on board.

- **GPIO pins**
GPIO stands for General Purpose Input-Output pins. There are 17 different GPIO pins on the NodeMCU board from GPIO0 to GPIO16. These pins can be used for either input or output, whose behavior can be controlled at run time.
- **UART pins**
UART stands for Universal Asynchronous Receiver-Transmitter. It is used for asynchronous communication and can be communicated at 4.5Mbps. on the NodeMCU board two different UART pins:
 - i. UART0(TXD0,RXD0,RST0 and CTS0 pins)
It can be used for communication.
 - ii. UART1(TXD1 pin)
It is used for data transmit a signal only i.e., used for printing log.
- **PWM pins**
It stands for Pulse Width Modulation. There are four different PWM pins on the NodeMCU board. PWM is a technique by which the width of the pulse can be varied while keeping the frequency of the wave constant. It's range is adjustable from 100Hz to 1KHz.

ii. 4 Channel Relay

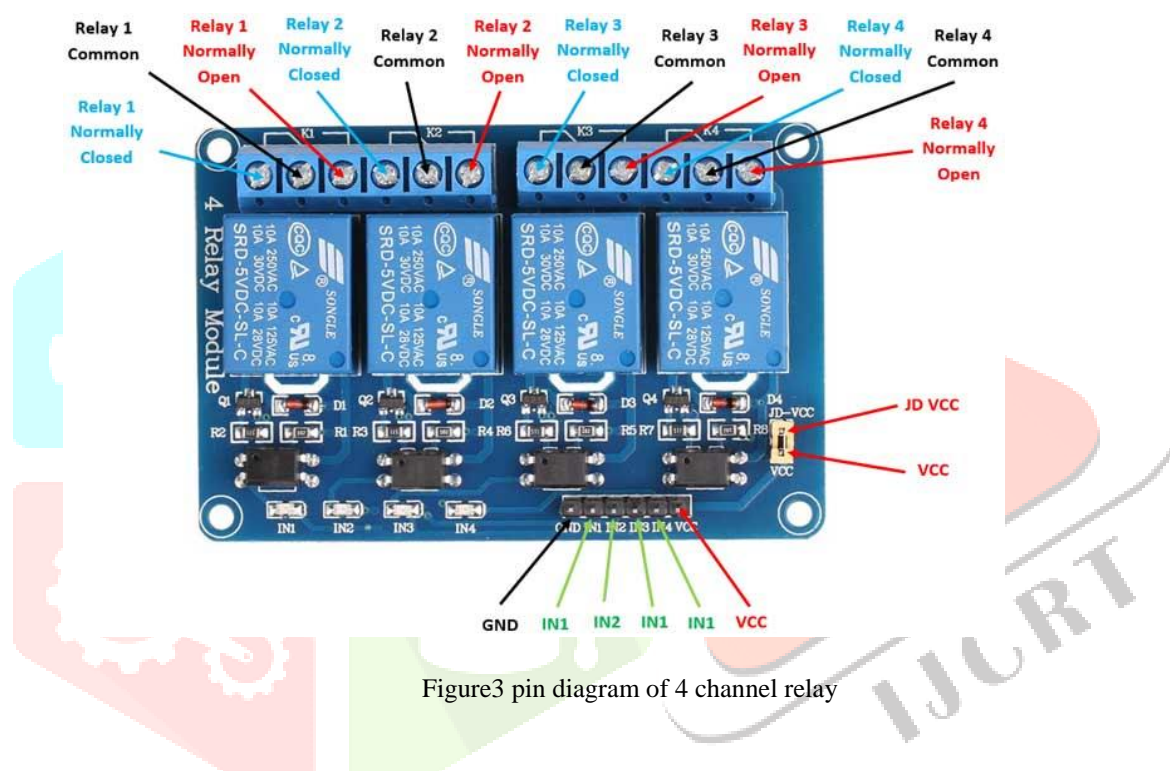


Figure3 pin diagram of 4 channel relay

The **four-channel relay module** contains four 5V relays and the associated switching and isolating components, which makes interfacing with a microcontroller or sensor easy with minimum components and connections. The contacts on each relay are specified for 250VAC and 30VDC and 10A in each case, as marked on the body of the relays.

- **Four Channel Relay Module Pinout**

PIN Number	Pin Name	Description
1	GND	Ground reference for the module
2	IN1	Input to activate relay 1
3	IN2	Input to activate relay 2
4	IN3	Input to activate relay 3
5	IN4	Input to activate relay 4
6	Vcc	Power supply for the relay module
7	Vcc	Power supply selection jumper
8	JD-Vcc	Alternate power pin for the relay module

- **Four-Channel Relay Module Specifications**

- Supply voltage – 3.75V to 6V
- Trigger current – 5mA
- Current when the relay is active - ~70mA (single), ~300mA (all four)
- Relay maximum contact voltage – 250VAC, 30VDC
- Relay maximum current – 10A

iii. FIREBASE DATABASE

Google Firebase **helps developers build real-time applications for the Internet of Things**. Realtime Database is a cloud-hosted database in which data is stored as JSON. The data is synchronized in real-time to every connected client.

iv. MIT 2 Application developer

It is a web based application building tool where user can easily design their application as per their need.

C. IMPLEMENTATION MODEL

- a. **Hardware interfaces**
 - NodeMCU
 - Relay module
 - Connectors
 - Switch
 - 5v power adapter
 - Bulb
- b. **Software interface**
 - MIT 2 application developer
 - Arduino IDE
 - Firebase

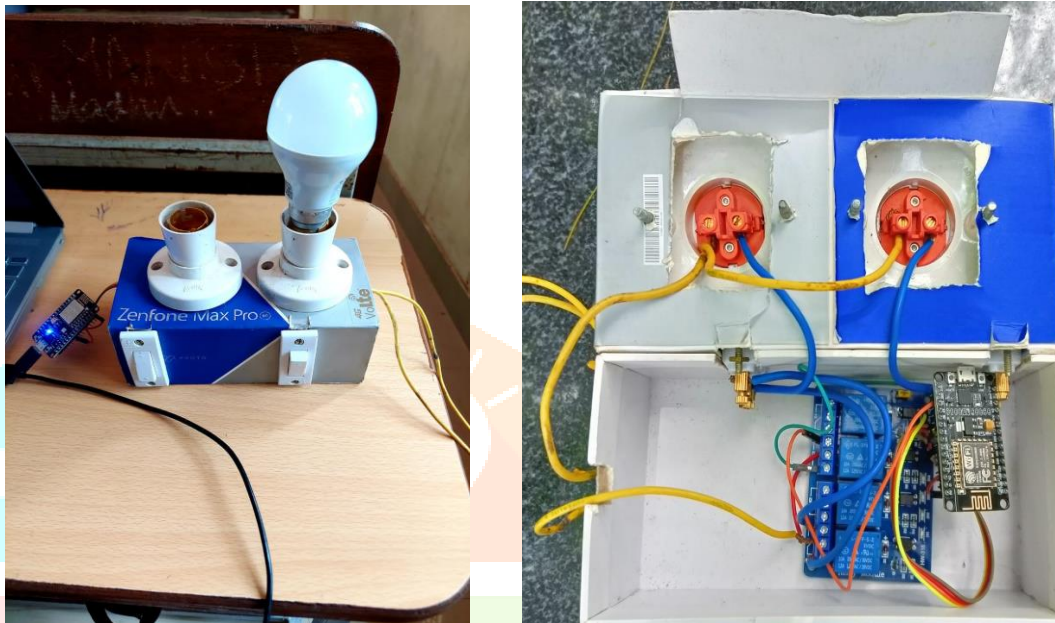


Figure4. Prototype model



Figure5 BMS App

Above figure is the page that open up when the user will use the application.

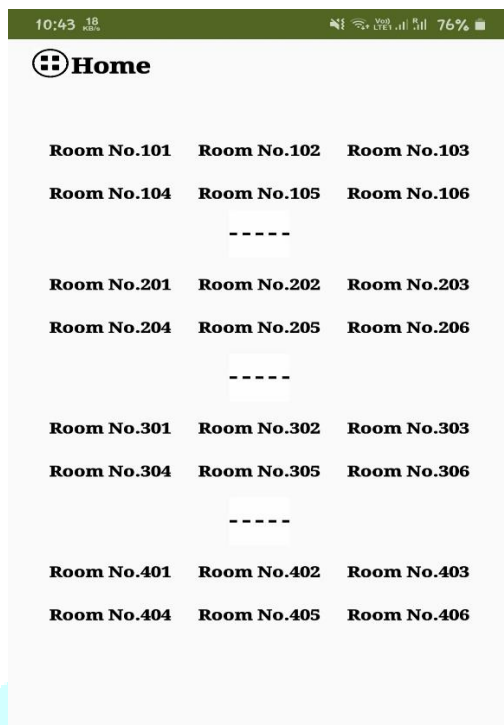


Figure6 Home page of the BMS app

Figure 6 is the home page of the BMS app where all the room numbers are given in which the fans and lights switch has to be controlled. This page contains all the rooms of the building so that the automation can be easy.

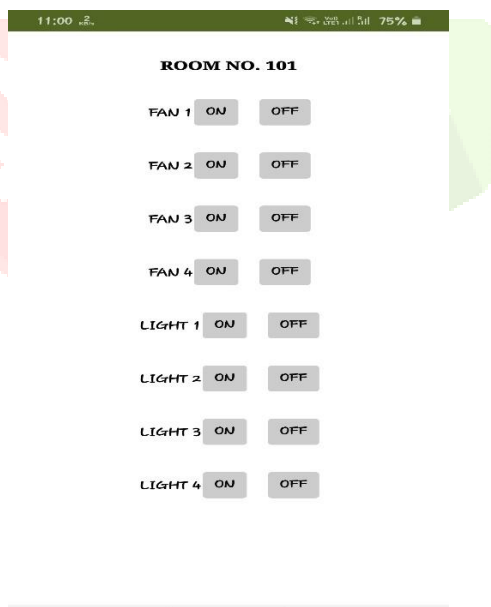


Figure7 Single room of the building

From the home page select one room where we want to ON or OFF the switches of the fans and lights.

IV. RESULTS

In our work, we have reviewed various studies on research papers based on IoT based home automation and building management system from 2017 to 2021. published in conference proceedings and journals of high repute nationally and internationally.

Our proposed model is controlled by the BMS automation application. Using the mobile application we can control each and every room of the building without the our presence and without taking the time from our respective works. Internet is needed while operating the application. If we click ON then the respective appliances will ON and if we click OFF then then the respective appliances will be OFF. Like this energy will also be saved.



Figure8 Bulb glows

The above figure shows our respective result of our proposed prototype.

V. CONCLUSION

In this paper, we used the NodeMCU and relay module for the hardware source and a mobile application **BMS Automation** for controlling the switches of each room of the building. It is affordable and efficient. It can be used by different users in a very easy manner. Users can operate from anywhere but they should be connected to the internet and the prototype should also has enough electricity. For future scope we can do this using the artificial intelligence, add more sensors to it and voice recognition also enabled in the model.

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