A

PROJECT REPORT

on

IOT BASED HOME AUTOMATION SYSTEM

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B. Tech Sixth Semester

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ASPIRE TO EXCEL

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DECLARATION BY THE STUDENT

We the undersigned solemnly declare that the project report titled **'IOT BASED HOME AUTOMATION SYSTEM'** is based on our own work carried out during the course of our study under the supervision of **Mr. Mousam Sharma, Assistant Professor**.

We assert that the statements made and conclusions drawn are an outcome of our work. We further certify that

i. The work contained in the report is original and has been done by us under the general supervision of our supervisor.

ii. We have followed the guidelines provided by the University in writing the report.

iii. Whenever we have used materials (data, theoretical analysis, and text) from other sources, we have given due credit to them by citing them in the text of the report and giving their details in the references.

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CERTIFICATE FROM THE SUPERVISOR

This is to certify that the work incorporated in the project report entitled **'IOT BASED HOME AUTOMATION SYSTEM'** is a record of work carried out by Lipika Dewangan (Enrollment No.:BK2504), Akansha Ghritlahare (Enrollment No.:BK2331), Ujjwal Kumar Puri (Enrollment No.:BK2550) under my guidance and supervision as a fulfillment of a curriculum of autonomous course in B.Tech 6th semester in the Faculty of Department of Electrical and Electronics Engineering of Bhilai Institute of Technology, Durg (CG).

To the best of my knowledge and belief the project report

i) Embodies the work of the candidates themselves,

ii) Has duly been completed,

iii) Fulfills the requirement B.Tech 6th semester and

iv) Is up to the desired standard both in respect of contents and language for being referred to the examiners.

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ABSTRACT

This project presents the overall design of Home Automation System (HAS) with low cost and wireless system. It specifically focuses on the development of an IOT based home automation system that is able to control various components via internet or be automatically programmed to operate from ambient conditions. In this project, we design the development of a firmware for smart control which can successfully be automated minimizing human interaction to preserve the integrity within whole electrical devices in the home. We used Node MCU, a popular open source IOT platform, to execute the process of automation. Different components of the system will use different transmission mode that will be implemented to communicate the control of the devices by the user through Node MCU to the actual appliance. The main control system implements wireless technology to provide remote access from smart phone. We are using a cloud server-based communication that would add to the practicality of the project by enabling unrestricted access of the appliances to the user irrespective of the distance factor. We provided a data transmission network to create a stronger automation. The system intended to control electrical appliances and devices in house with relatively low cost design, user-friendly interface and ease of installation. The status of the appliance would be available, along with the control on an android platform. This system is designed to assist and provide support in order to fulfill the needs of elderly and disabled in home. Also, the smart home concept in the system improves the standard living at home.

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LIST OF ABBREVIATION

GSM	Global System for Mobile communication
BT	Bluetooth
IP	Internet Protocol
UID	Unique Identifiers
HAS	Home Automation System
MCU	Micro-Controller Unit
PDA	Personal Digital Assistant
IDE	Integrated Development Environment
PCB	Printed Circuit Board
SPDT	Single Pole Double Throw
SPIFFS	Serial Peripheral Interface Flash File System
SDK	Software Development Kit
DIP	Dual Inline Package
ADC	Analog to Digital Converter
SPI	Serial Peripheral Interface
SDIO	Secure Digital Input/Output
PWM	Pulse Width Modulation
LDO	Low Dropout Regulator
GPIO	General Purpose Input/Output
RTC	Real Time Clock
EEPROM	Electrically Erasable Programmable Read Only Memory
LDR	Light Dependent Resistor
PIR	Passive Infrared
DHT-11	Digital Temperature and Humidity Sensor

CHAPTER-1

INTRODUCTION

1.1 INTRODUCTION :

Nowadays, we have remote controls for our television sets and other electronic systems, which have made our Internet of Things (IOT) is a concept where each device is assign to an IP address and through that IP address anyone makes that device identifiable on internet. The mechanical and digital machines are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. Basically, it started as the "Internet of Computers." Research studies have forecast an explosive growth in the number of "things" or devices that will be connected to the Internet. The resulting network is called the "Internet of Things" (IoT). The recent developments in technology which permit the use of wireless controlling environments like, Bluetooth and Wi-Fi that have enabled different devices to have capabilities of connecting with each other. Using a WIFI shield to act as a Micro web server for the Arduino which eliminates the need for wired connections between the Arduino board and computer which reduces cost and enables it to work as a stand alone device. The Wi-Fi shield needs connection to the internet from a wireless router or wireless hotspot and this would act as the gateway for the Arduino to communicate with the internet. With this in mind, an internet based home automation system for remote control and observing the status of home appliances is designed.

Due to the advancement of wireless technology, there are several different type of connections are introduced such as GSM, WIFI, and BT. Each of the connection has their own unique specifications and applications. Among the four popular wireless connections that often implemented in Home Automation System project, WIFI is being chosen with its suitable capability. The capabilities of WIFI are more than enough to be implemented in the design. Also, most of the current laptop/notebook or Smartphone come with built-in WIFI adapter. It will indirectly reduce the cost of this system. lives real easy. The concept of "Home Automation" has been in existence for several years. "Smart Home", "Intelligent Home" are terms that followed and is been used to introduce the concept of networking appliance within the house. Home Automation Systems (HASs) includes centralized control and distance status monitoring of lighting, security system, and other appliances and systems within a house. HASs enables energy efficiency, improves the security systems, and certainly the comfort and ease of users.

1.2 OBJECTIVE :

1. Design of an independent HAS

To formulate the design of an interconnected network of home appliance to be integrated into the Home Automation System. The objective to account for every appliance and its control to be automated and integrated into the network further formulated into the Home Automation System. Develop design criteria (green, sustainable, remotely, mobility, smart, security).

2. 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.

3. Monitoring status of appliances

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

4. 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.

5. 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.

6. 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.

7. Power saving

Energy savings can be realized by automating thermostats, lights, and other environmental system such as garden sprinklers and fountains. Integrated all of these into one environmental system can help ensure a minimum waste of energy in your home.

1.3 PROBLEM IDENTIFICATION :

The field of Automation has well advanced in Industries, as majority of automobile industry plants as well as bottling plants have Automated assembly lines. But automation has not yet penetrated in the homes especially in India. If automation was to be used in homes than everyday life would be get eased. Simple example of use of automation in home can be seen in the transfer of water from the under-ground water tank to the over-head water tank, by sensing the level of water in both the tanks. This process eases the every time effort the user has to put in for filling the tank and also helps in saving water. Also people are getting more acquainted daily with the use of Smartphone and tablets which are capable of doing much of PC's work handy.

Home mechanization framework confront four primary difficulties, these are high cost of proprietorship, poor sensibility, energy consumption and trouble in accomplishing security. The proposed framework has an incredible adaptability by utilizing Wi-Fi innovation to interconnect its circulated sensors to home mechanization server. This will diminish the organization cost and will expand the capacity of overhauling and framework reconfiguration. The idea of home computerization has been around for quite a while and items have been available for a considerable length of time, however nobody arrangement has gotten through to the standard yet. Home computerization for the elderly and handicapped can give expanded personal satisfaction to people who may somehow or another require parental figures or institutional care. It can likewise give a remote interface to give control and observing by means of a PDA or web program. Energy consumption can be measured through its environmental impact and usage. When the load requires more energy than what the sources can provide, this becomes a major issue, which results in load shedding and blackouts. Energy consumption is a major issue in the modern world. Inefficient power monitoring and controlling techniques in the households, businesses and institutions are the main cause of power consumption.

So we have decided to make a low cost Embedded System in which the smart phones can be used to help automate entire home. In this System the user will have remote access and control over all the subsystems present in the house.

CHAPTER-2

LITERATURE REVIEW

2.1 MICROCONTROLLER SELECTION FOR HOME APPLIANCES :

In this project we will chose the microcontroller to be used is either Arduino, NODEMCU, wifi module or GSM and other. The Arduino Uno is an open source microcontroller board based on the microchip ATmega328P microcontroller. NodeMCU is an open source development board and firmware based in the widely used ESP8266-12E Wi-Fi module. It allows us to program the ESP8266 Wi-Fi module with the simple and powerful LUA programming language or Arduino IDE. A GSM modem or GSM module is a device that uses GSM mobile telephone technology to provide a wireless data link to a network. GSM modems are used in mobile telephones and other equipment that communicates with mobile telephone networks. They use SIMs to identify their device to the network.

Table 2.1 : Difference between microcontrollers

NODEMCU	ARDUINO UNO
128KB RAM	2KB RAM
4MBytes of ROM(flash) can store more code compare to UNO	32KB
Comes with micro USB port	Comes with USB type B connector
Small in size	Bigger than NODEMCU

2.2 CONTROL SYSTEM :

The Home automation system that uses Wi-Fi technology . System consists of three maincomponents; web server, which presents system core that controls, and monitors users' home and hardware interface module(Arduino PCB (ready-made), Wi-Fi shield PCB, 3 input alarms PCB, and 3 output actuators PCB.), which provides appropriate interface to sensors and actuator of home automation system. The System is better from the scalability and flexibility point of view than the commercially available home automation systems. The User may use the same technology to login

to the server web based application. .If server is connected to the internet, so remote users can access server web based application through the internet using compatible web browser.

The application has been developed based on the android system. An interface card has been developed to assure communication between the remote user, server, raspberry pi card and the home Appliances. The application has been installed on an android Smartphone, a web server, and a raspberry pi card to control the shutter of windows.

Microcontroller -A microcontroller is a computer present in a single integrated circuit which is dedicated to perform one task and execute one specific application. It contains memory, programmable input/output peripherals as well a processor. Microcontrollers are mostly designed for embedded applications and are heavily used in automatically controlled electronic devices such as cellphones, cameras, microwave ovens, washing machines, etc.

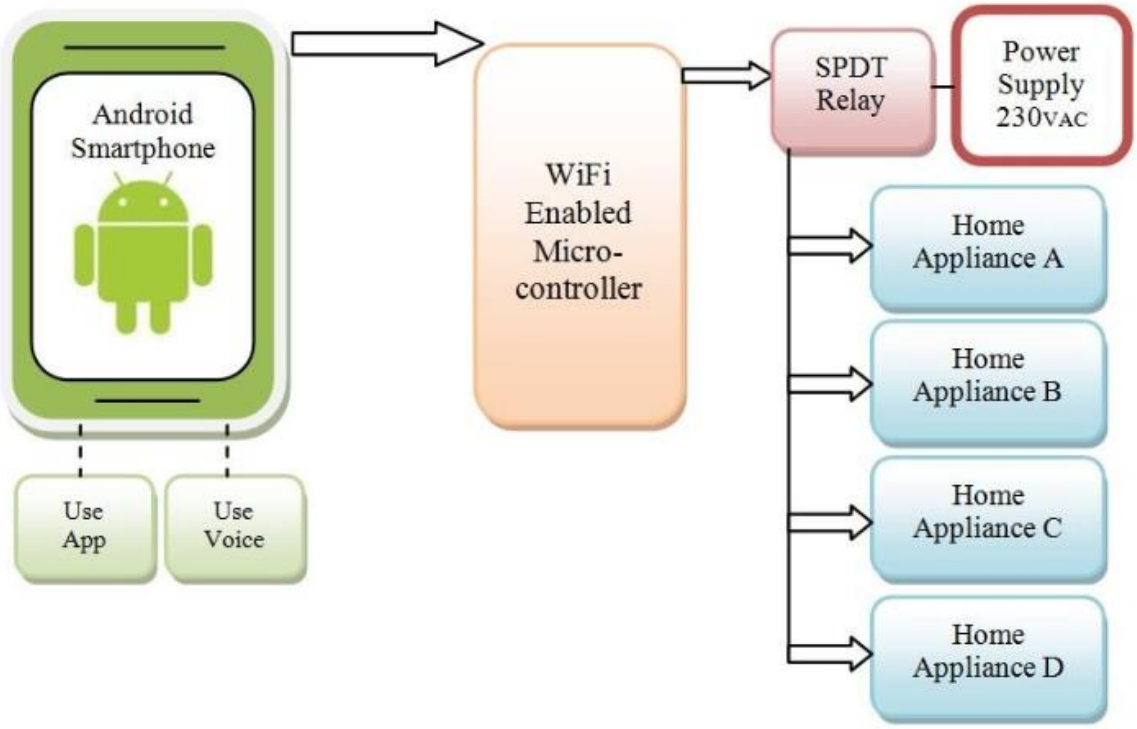

Fig 2.1 : Block diagram of home automation system

NODEMCU -NodeMCU is an open source IoT platform.It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS.

CHAPTER-3

METHODOLOGY

3.1 PROJECT DESIGN AND OVERVIEW :

As mention in previous chapter, the design home controller with NODEMCU as the main controller. The design of the controller circuit using NODEMCU is realize using Blynk IoT application to run the system. The following describes the process of creating an account in Blynk application and generating unique ID against a particular device. This ID acts as an identifier for the particular device on the Blynk server.

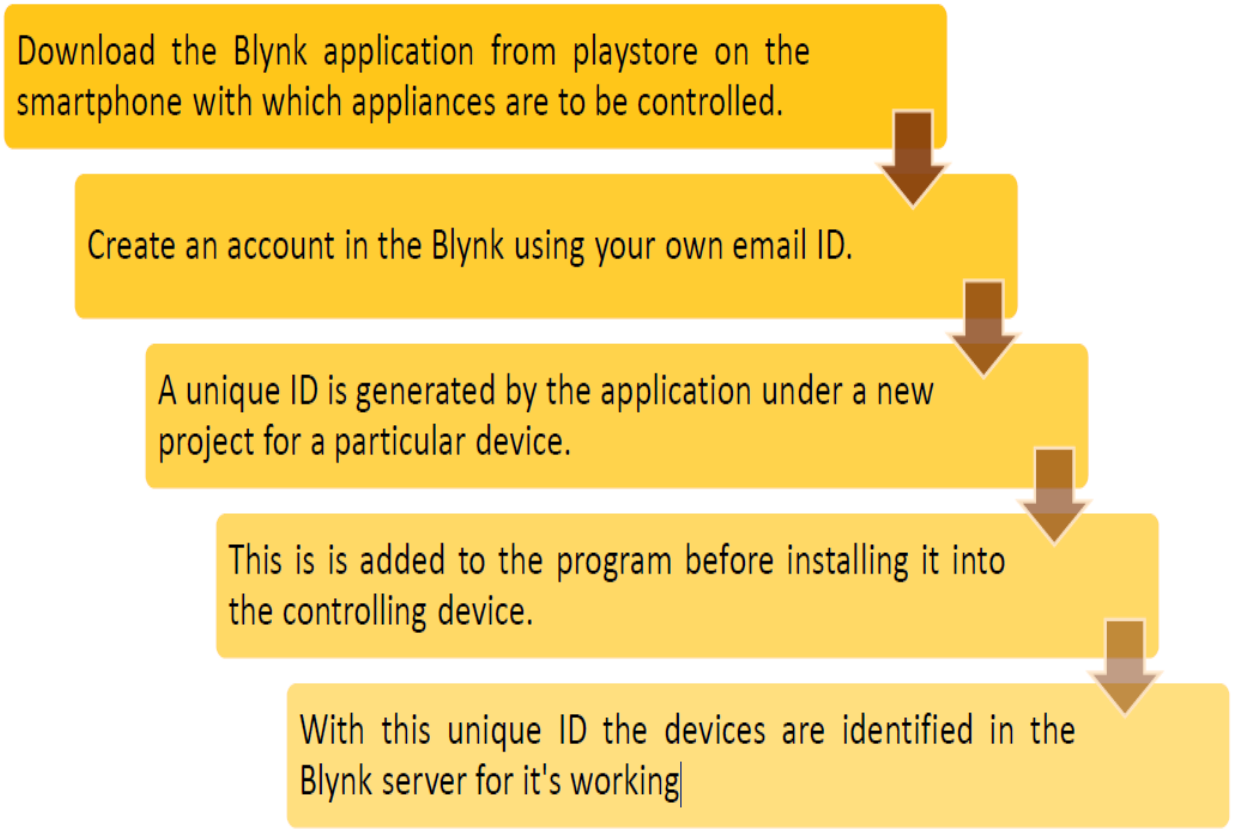

Fig. 3.1 : Creating an account and generating unique ID in Blynk Server

Once the unique Id is generated the next step would be to include this key into the coding written in embedded C to establish communication between Node MCU and Blynk Server. The following describes this process.

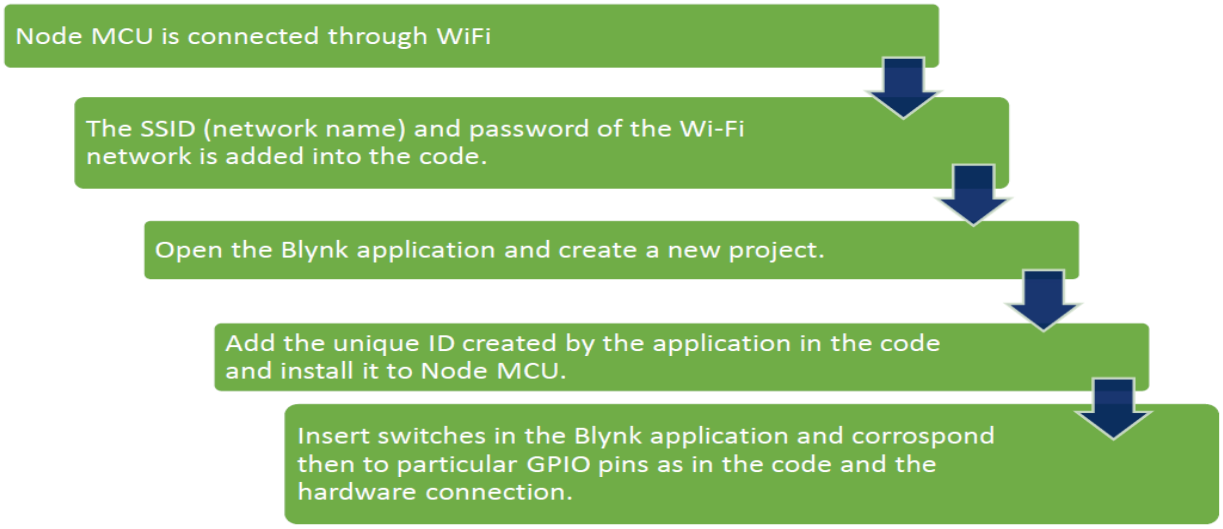

Fig. 3.2 : Setup to control Node MCU from Blynk application

3.2 LIST OF COMPONENT :

Table 3.1 : List of Component

S. No.	Name of Component	Number of Component
1.	NodeMCU ESP8266	1
2.	4 Channel 5V Relay	1
3.	BULB	2
4.	DC Fan	1
5.	Power Adapter	1
6.	Smart Phone	1
7.	Connecting Wires	-

3.3 DESCRIPTION OF COMPONENT

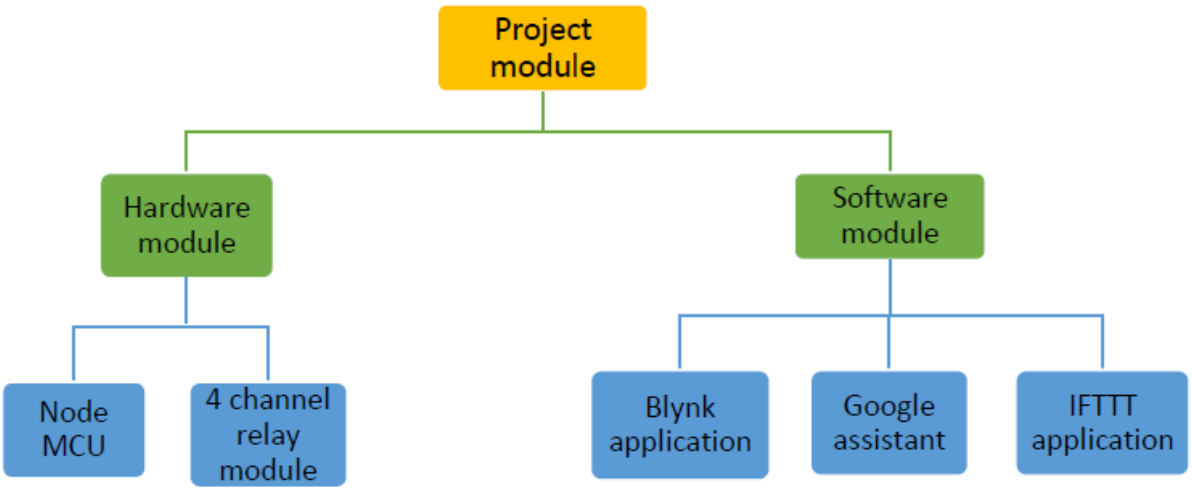

Fig. 3.3 : Project Layout

3.3.1 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.

Fig 3.4 : Node MCU Development Board

NodeMCU is an open source firmware for which open source prototyping board designs are

available. The name “NodeMCU” combines “node” and “MCU” (micro-controller unit). The term “NodeMCU” strictly speaking refers to the firmware rather than the associated development kits. Both the firmware and prototyping board designs are open source. The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as luacjson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented. 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. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially was based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Tensilica Xtensa LX106 core, widely used in IOT applications.

NodeMCU pin configuration :

The ESP8266 Node MCU has total 30 pins that interface it to the outside world. The pins are grouped by their functionality as:

Power pins: There are four power pins viz. one VIN pin & three 3.3V pins. The VIN pin can be used to directly supply the ESP8266 and its peripherals, if you have a regulated 5V voltage source. The 3.3V pins are the output of an on-board voltage regulator. These pins can be used to supply power to external components.

GND: is a ground pin of ESP8266 Node MCU development board.

12 IC Pins: are used to hook up all sorts of I2C sensors and peripherals in your project. Both I2C Master and I2C Slave are supported. I2C interface functionality can be realized programmatically, and the clock frequency is 100 kHz at a maximum. It should be noted that I2C clock frequency should be higher than the slowest clock frequency of the slave device.

GPIO Pins: ESP8266 Node MCU has 17 GPIO pins which can be assigned to various functions such as I2C, I2S, UART, PWM, IR Remote Control, LED Light and Button programmatically. Each digital enabled GPIO can be configured to internal pull-up or pull-down, or set to high impedance. When configured as an input, it can also be set to edge-trigger or level-trigger to generate CPU interrupts.

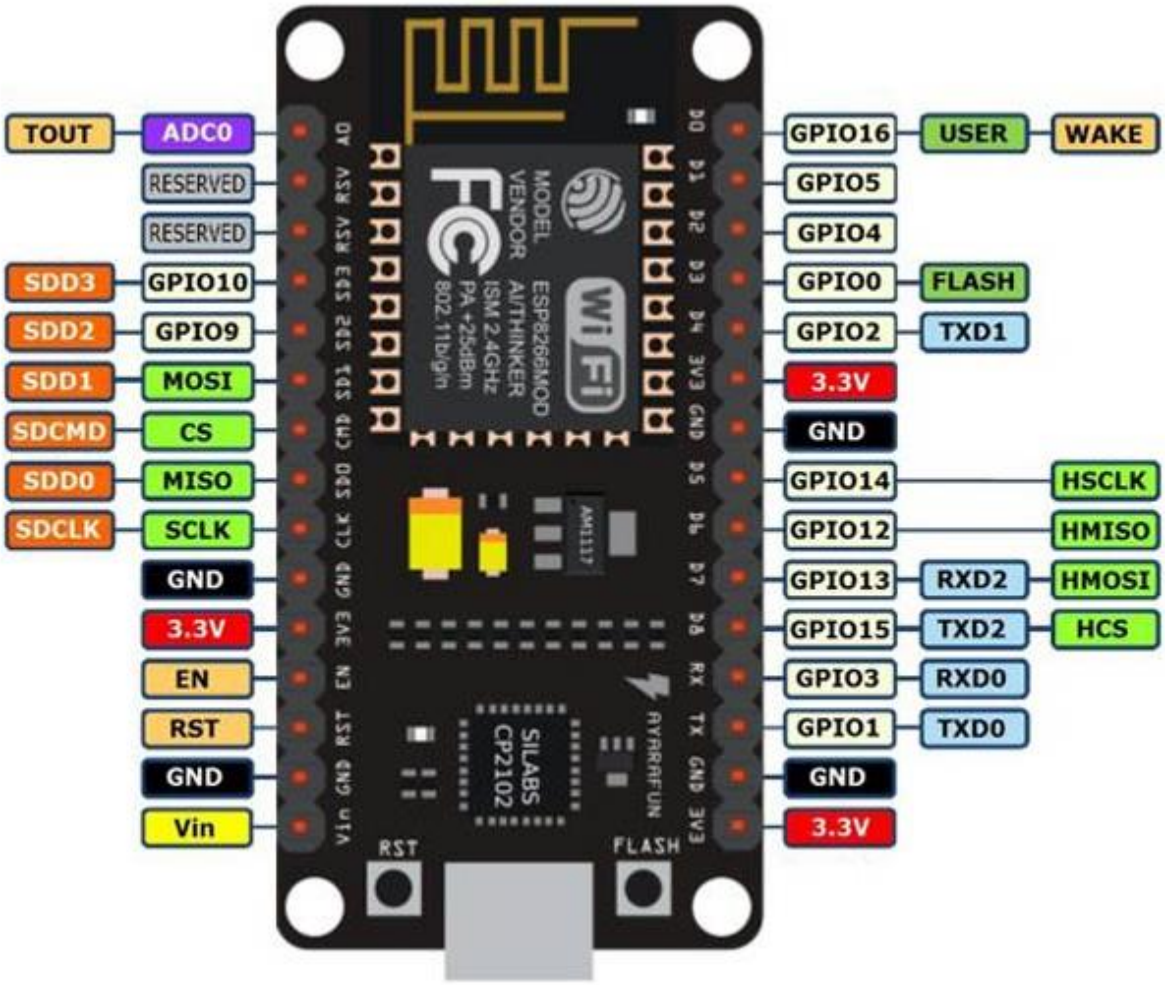

Fig 3.5 : ESP8266 Node MCU pinout

ADC Channel: The Node MCU is embedded with a 10-bit precision SAR ADC. The two functions can be implemented using ADC viz. Testing power supply voltage of VDD3P3 pin and testing input voltage of TOUT pin. However, they cannot be implemented at the same time.

UART Pins: ESP8266 Node MCU has 2 UART interfaces, i.e. UART0 and UART1, which provide asynchronous communication (RS232 and RS485), and can communicate at up to 4.5 Mbps. UART0 (TXD0, RXD0, RST0 & CTS0 pins) can be used for communication. It supports fluid control. However, UART1 (TXD1 pin) features only data transmit signal so, it is usually used for printing log.

SPI Pins: ESP8266 features two SPIs (SPI and HSPI) in slave and master modes. These SPIs also support the following general-purpose SPI features:

1. 4 timing modes of the SPI format transfer

2. Up to 80 MHz and the divided clocks of 80 MHz

3. Up to 64-Byte FIFO

SDIO Pins: ESP8266 features Secure Digital Input/output Interface (SDIO) which is used to directly interface SD cards. 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are supported.

PWM Pins: The board has 4 channels of Pulse Width Modulation (PWM). The PWM output can be implemented programmatically and used for driving digital motors and LEDs. PWM frequency range is adjustable from 1000 μs to 10000 μs, i.e., between 100 Hz and 1 kHz.

Control Pins: are used to control ESP8266. These pins include Chip Enable pin (EN), Reset pin (RST) and WAKE pin.

1. EN pin – The ESP8266 chip is enabled when EN pin is pulled HIGH. When pulled LOW the chip works at minimum power.

2. RST pin – RST pin is used to reset the ESP8266 chip.

3. WAKE pin – Wake pin is used to wake the chip from deep-sleep.

Table 3.2 : Node MCU index and GPIO mapping

PIN NAME ON NODE MCU DEVELOPMENT KIT	ESP8266 INTERNAL GPIO PIN NUMBER	PIN NAME ON NODE MCU DEVELOPMENT KIT	ESP8266 INTERNAL GPIO PIN NUMBER
0 [*]	GPIO16	**7**	GPIO13
1	GPIO5	**8**	GPIO15
2	GPIO4	**9**	GPIO3
3	GPIO0	**10**	GPIO1
4	GPIO2	**11**	GPIO9
5	GPIO14	**12**	GPIO10
6	GPIO12		

Parts of Node MCU Development Board

ESP 12-E Module

The development board equips the ESP-12E module containing ESP8266 chip having Tensilica Xtensa® 32-bit LX106 RISC microprocessor which operates at 80 to 160 MHz adjustable clock frequency and supports RTOS. There's also 128 KB RAM and 4MB of Flash memory (for program and data storage) just enough to cope with the large strings that make up web pages, JSON/XML

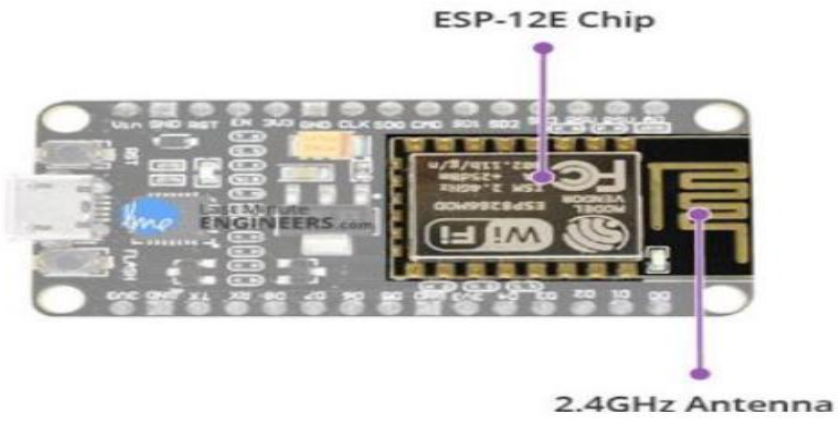

Fig. 3.6 : ESP 12E module in Node MCU Development board

data, and everything we throw at IOT devices nowadays. The ESP8266 Integrates 802.11b/g/n HT40 Wi-Fi transceiver, so it can not only connect to a Wi-Fi network and interact with the Internet, but it can also set up a network of its own, allowing other devices to connect directly to it. This makes the ESP8266 Node MCU even more versatile.

Power Requirements

As the operating voltage range of ESP8266 is 3V to 3.6V, the board comes with a LDO voltage regulator to keep the voltage steady at 3.3V. It can reliably supply up to 600mA, which should be more than enough when ESP8266 pulls as much as 80mA during RF transmissions. The output of the regulator is also broken out to one of the sides of the board and labelled as 3V3. This pin can be used to supply power to external components. Power to the ESP8266 Node MCU is supplied via the on-board Micro B USB connector. Alternatively, if you have a regulated 5V voltage source, the VIN pin can be used to directly supply the ESP8266 and its peripherals.

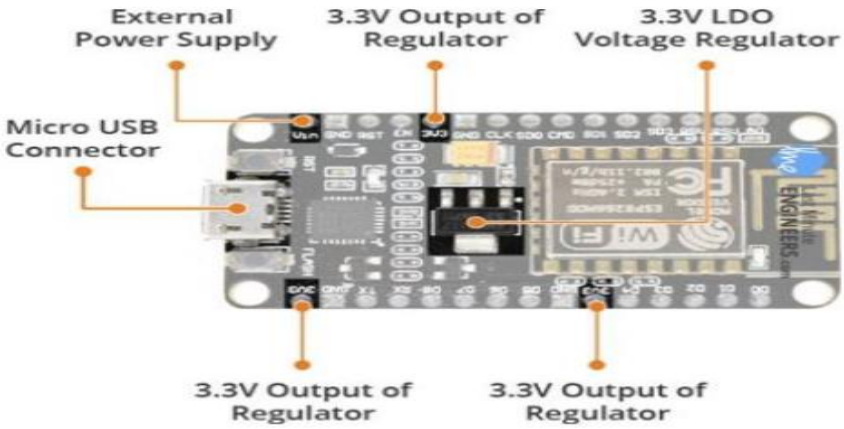

Fig. 3.7 : Power module on a Node MCU development board

Peripheral I/O

The ESP8266 Node MCU has total 17 GPIO pins broken out to the pin headers on both sides of the development board. These pins can be assigned to all sorts of peripheral duties, including:

1. ADC channel – A 10-bit ADC channel.
2. UART interface – UART interface is used to load code serially.
3. PWM outputs – PWM pins for dimming LEDs or controlling motors.
4. SPI, I2C & I2S interface – SPI and I2C interface to hook up all sorts of sensors and peripherals.
5. I2S interface – I2S interface if you want to add sound to your project.

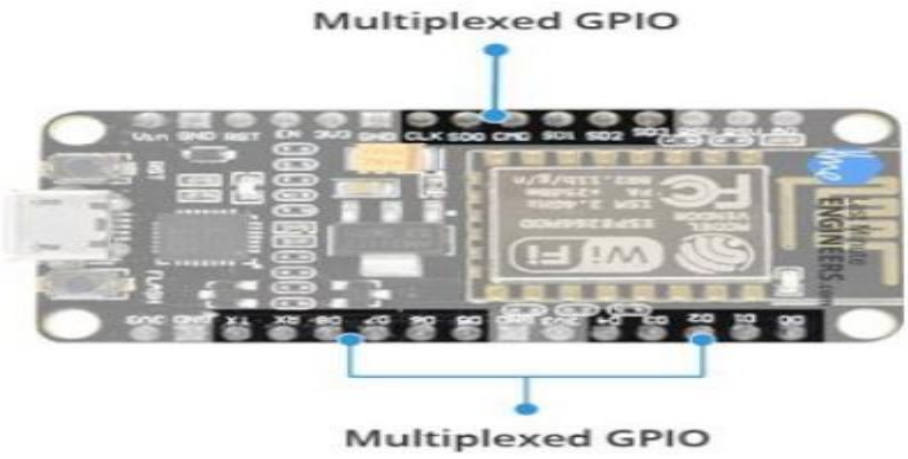

Fig. 3.8 : GPIO pins on Node MCU development board

On Board Switches and LED Indicators

The ESP8266 Node MCU features two buttons. One marked as RST located on the top left corner is the Reset button, used of course to reset the ESP8266 chip. The other FLASH button on the bottom left corner is the download button used while upgrading firmware. The board also has a LED indicator which is user programmable and is connected to the D0 pin of the board.

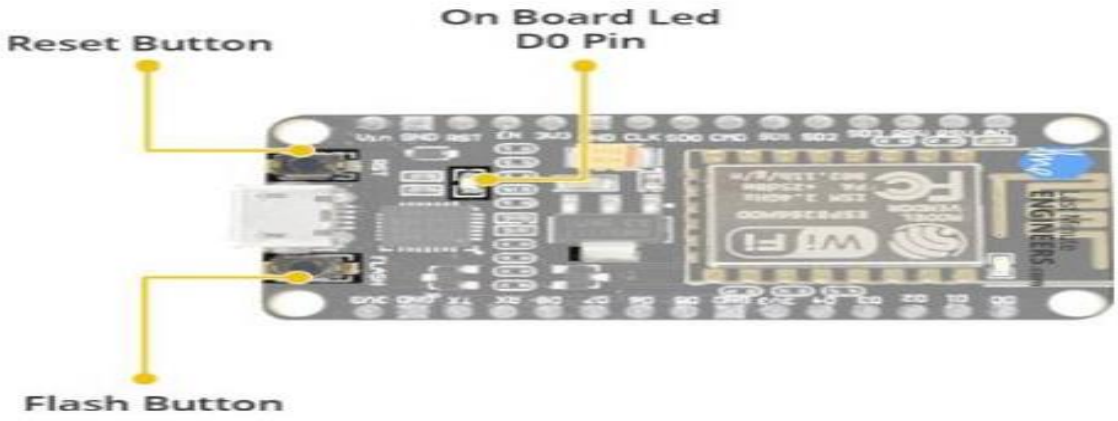

Fig. 3.9 : On board switches and LED indicators on Node MCU development board

Serial Communication

The board includes CP2102 USB-to-UART Bridge Controller from Silicon Labs, which converts USB signal to serial and allows your computer to program and communicate with the ESP8266 chip.

Fig. 3.10 : CP2120 on Node MCU development board

Table 3.3 : Comparison chart of Wi-Fi with other wireless communication protocols

STANDARD	BLUETOOTH	UBW	ZIGBEE	WI-FI
IEEE specification	802.15.1	802.15.3a	802.15.4	802.11a/g/b
Frequency band	2.4 GHz	3.1-10.6 GHz	868/915 MHz; 2.4 GHz	2.4 GHz; 5 GHz
Maximum signal rate	1 Mb/s	110 Mb/s	250 Kb/s	54 Mb/s
Nominal range	10 m	10 m	10-100 m	100 m
Nominal TX power	0-10 dBm	-41.3 dBm/MHz	(-25) -0 dBm	10-20 dBm
RF channels	79	1-15	1/10; 16	14 (2.4 GHz)
Channel bandwidth	1 MHz	500 MHz- 7.5 GHz	0.3/0.6 GHz; 2 MHz	22 MHz
Modulation type	GFSK	BPSK, QPSK	BPSK (+ASK), O-QPSK	BPSK, QPSK, COFDM, CCK, M-QAM
Spreading	FHSS	DS-UBW, MB-OFDM	DSSS	DSSS, CCK, OFDM
Co-existence mechanism	Adaptive frequency hopping	Adaptive frequency hopping	Dynamic frequency selection	Dynamic frequency selection, transmit power control
Basic cell	Piconet	Picomet	Star	BSS
Extension of basic cell	Scattemet	Peer-to-peer	Cluster tree, Mesh	ESS
Maximum cell nodes	8	8	>65000	2007
Encryption	E0 Stream chipper	AES block cipher (CTR, counter mode)	AES block cipher (CTR, counter mode)	RC4 stream cipher (WEP), AES block cipher
Authentication	Shared secret	CBC-MAC (CCM)	CBC-MAC (extention of CCM)	WPA2 (802.11i)
Data protection	16-bit CRC	32-bit CRC	16-bit CRC	32-bit CRC

3.3.2 RELAY:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

Magnetic latching relays require one pulse of coil power to move their contacts in one direction, and another, redirected pulse to move them back. Repeated pulses from the same input have no effect. Magnetic latching relays are useful in applications where interrupted power should not be able to transition the contacts.

Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and will reset when the polarity is reversed. On a dual coil device, when polarized voltage is applied to the reset coil the contacts will transition. AC controlled magnetic latch relays have single coils that employ steering diodes to differentiate between operate and reset commands.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

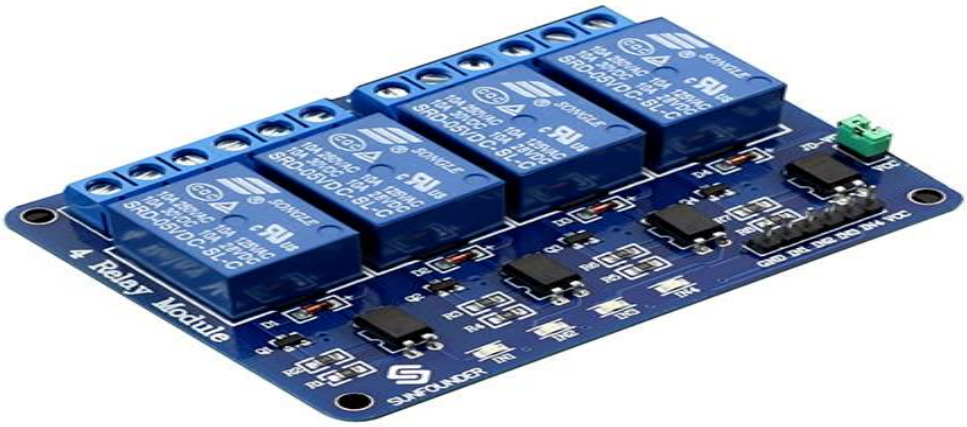

Fig. 3.11 : 4 Channel relay module

This is a 5V 4-channel relay interface board, and each channel needs a 15-20mA driver current. It can be used to control various appliances and equipment with large current.

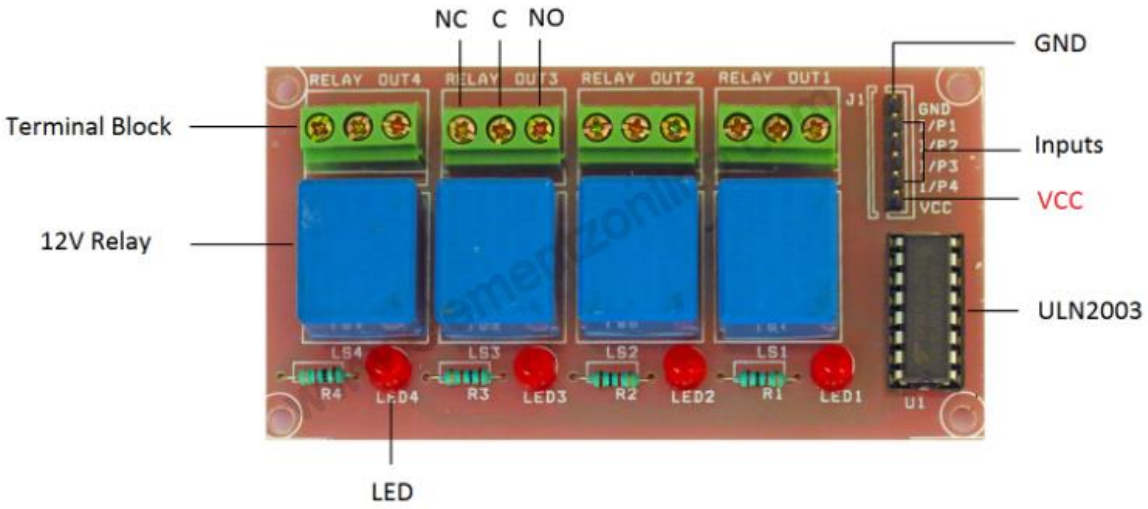

Fig. 3.12 : Pin description of 4 Channel relay module

PIN DESCRIPTION :

Input: **VCC:** Positive supply voltage
GND: Ground
IN1--IN4: Relay control port

Output: Connect a load, DC 30V/10A, AC 250V/10

3.3.3 BLYNK APPLICATION

The Blynk application was designed for the primary purpose of Internet of Things. Blynk is a platform with IOS and Android apps to control Arduino, Raspberry Pi and the likes over the Internet. It's a digital dashboard where graphic interface for a prototype can be built by simply dragging and dropping widgets. It can control hardware remotely, it can display sensor data, can store and visualize data and possessed a lot more functionality. There are three major components in the platform:

Blynk Application: allows to you create amazing interfaces for your projects using various widgets we provide.

Blynk Server: responsible for all the communications between the smartphone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. It's an open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.

Blynk Libraries: for all the popular hardware platforms – enable communication with the server and process all the incoming and outgoing commands.

Every time a radio button is accessed in the Blynk application, the message travels to the Blynk Cloud, where it finds the specific hardware by the unique generated authentication token. It works in the same way for the opposite direction. The prototype primarily uses Blynk application to sense commands from user.

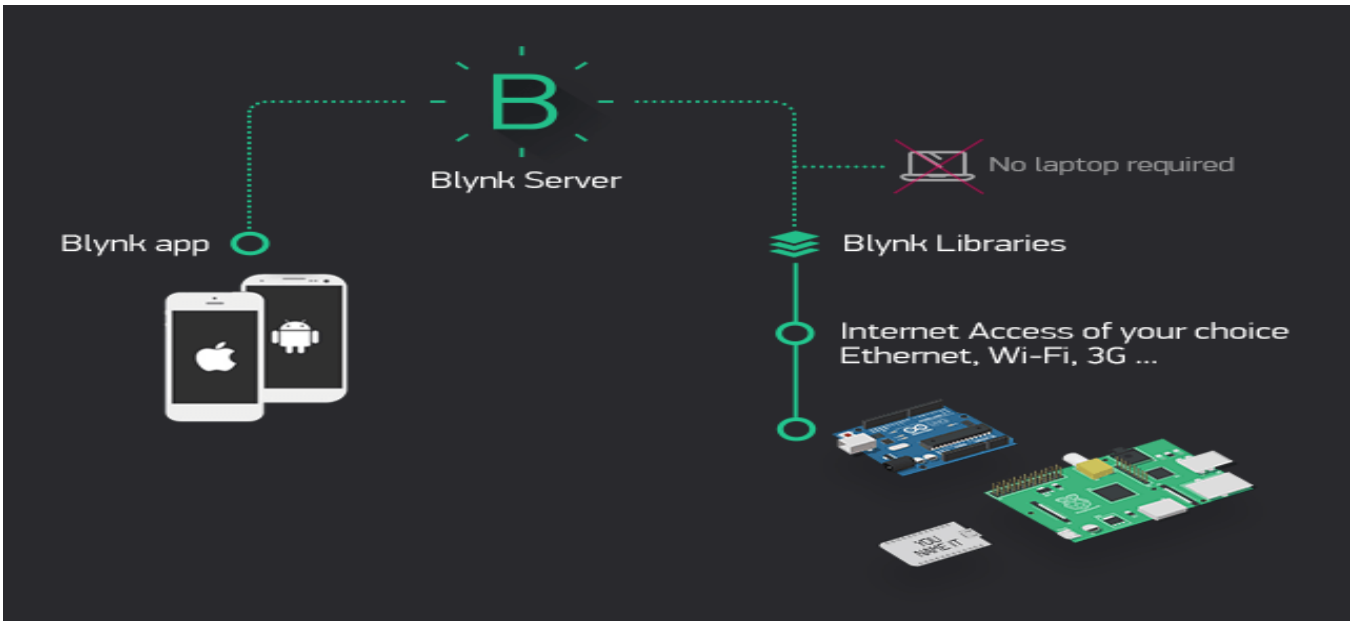

Fig. 3.13 : Working principle of Blynk application

3.3.4 VOICE MODE CONTROL

The prototype works in both switch mode and voice mode of control. The switch mode is simply be accessing the radio buttons on the Blynk application, and the process of control has been discussed earlier in this chapter in the section before. Here we will discuss the voice mode control of the prototype. We use application IFTTT and Google assistant on smart phone to achieve control by voice commands.IFTTT stand for 'If This Then That', is an interface that provides web based service in which devices are connected to mobile application.

We cannot connect the Google Assistant to the Node MCU directly, and that is the only reason we are using the Blynk app. Blynk app can directly connect to the Node MCU and send data to it. So, if we can send the voice commands interpreted by Google assistant directly to the Blynk app, the Blynk app can then forward those commands to the NodeMCU. But the problem is Google Assistant cannot directly understand foreign commands like "turn on the fan" or "turn on relay one" etc. on its own. So, to solve this we use another intermediate application/website called 'IFTTT'.

Simply, to control our home appliances over the internet we are using Node MCU and to connect Node MCU with the home appliances we use a relay board. Now to send on or off signals to the Node MCU we use our smartphone, and we do this using the Blynk app. But we want to send the on or off signals using voice commands. To do this we use google assistant in our smartphone and an app called IFTTT. So, in the end what will happen is, when we say a voice command like "ok google turn on the light" to the Google Assistant, Google Assistant sends that this foreign command to IFTTT. IFTTT interprets this command and sends an on or off signal to the Blynk app via the Blynk Server. Blynk will then send this signal to the Node MCU and then to our electrical appliances.

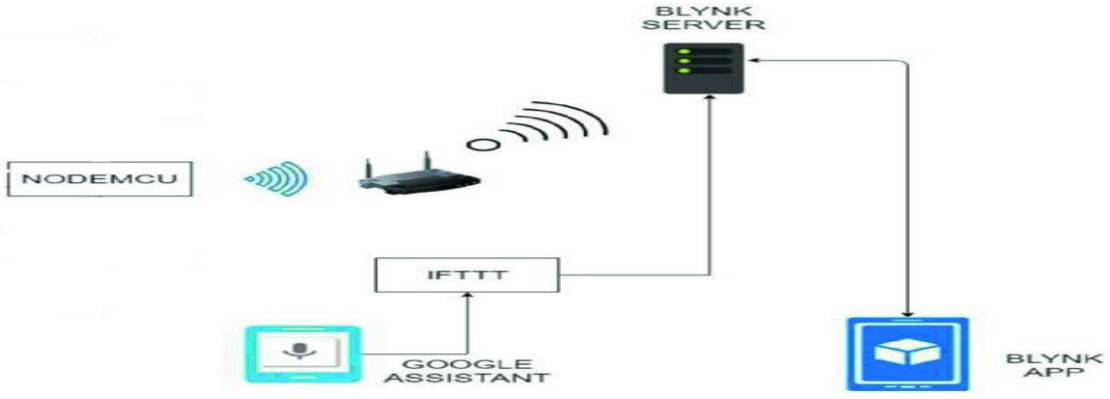

Fig. 3.14 : Voice and switch mode control

CHAPTER-4

WORKING

4.1 WORKING :

All the home appliances will be controlled by mobile app. The appliances in the industry or home will be interfaced with centralized micro controller NODE MCU for the systematic working. The inbuilt RTC and EEPROM technology present the controller will be activated for the operation. The controller is interfaced with WIFI devices to received the control commands from Wi-Fi shield material (Wi-Fi hotspot).

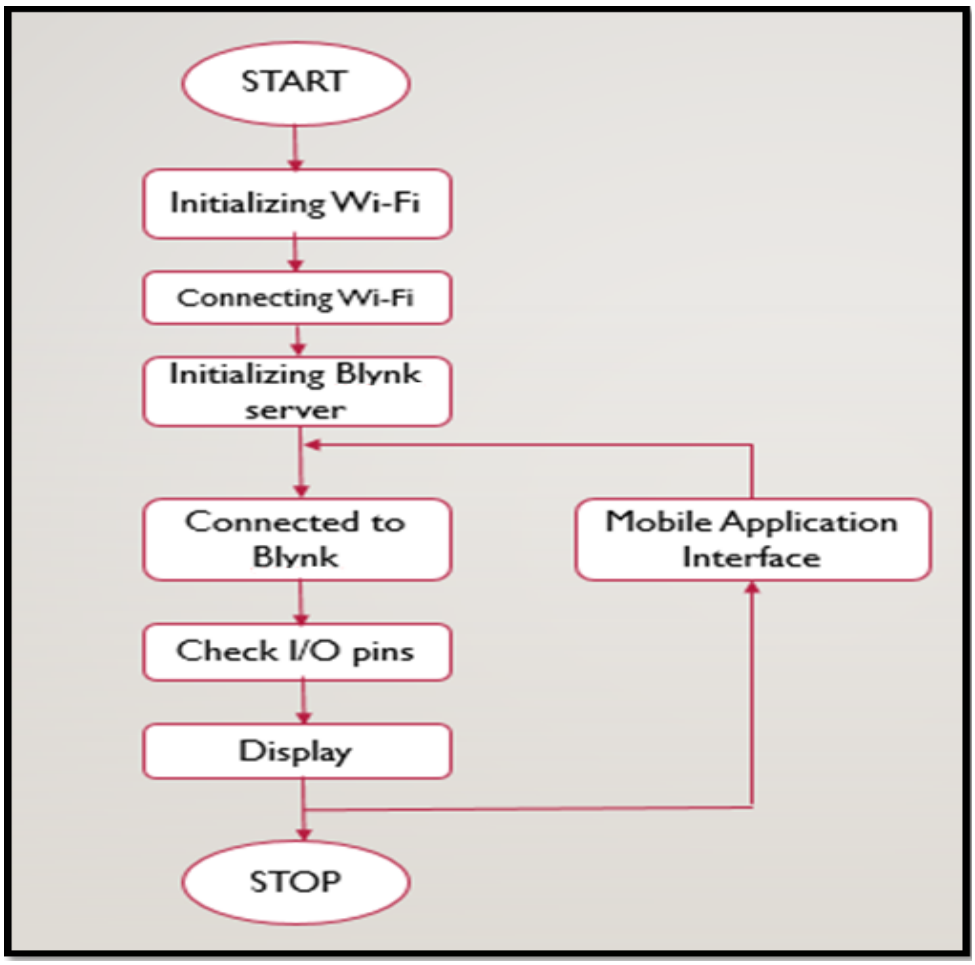

Fig. 4.1 : Flowchart of NodeMCU based HAS

To demonstrate the possibility and effectiveness of this system, the devices such as light switches, power plug, temperature sensor, gas sensor and motion sensors, etc., have been integrated with the proposed home control systems. It employs an embedded micro – web server in NODE MCU microcontroller, with IP connectivity for accessing and controlling devices and appliances Remotely.

A cloud based home automation generally uses a Wi-Fi protocol to communicate with other devices. The user register himself on the app, and then he can access all the smart home devices such as lightning, alarm

systems, thermostats, etc. This flow chart shows the working of the project. The process starts by initializing the Wi-Fi, the network name and password are written in the code and uploaded to Node MCU. The android device is connected to Node MCU over Wi-Fi. The Blynk server is set up and connection is made, the devices is identified in the Blynk server using the generated authentication token. The command for controlling the load is given to the application, and this command, over Wi-Fi network is sent to the Node MCU. The prototype aims to wireless control over home appliances with the technology of IOT. This is because Wi-Fi has its own advantages over other wireless communication protocols. These devices can be controlled through web-applications or via Bluetooth Android based Smart phone using applications. The future system does not require a dedicated server PC with respect to similar systems and offers a protocol communication to monitor and control the home switching functionality. The operator will be done with Mobile app having Wi-Fi in that enough.

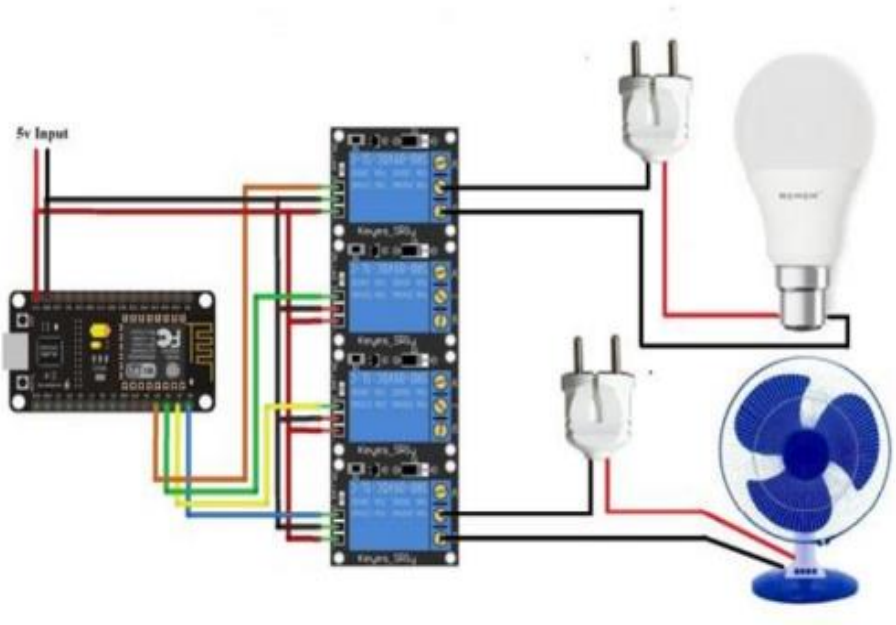

Fig. 4.2 : Circuit diagram

If operator wants to switch the Light to turn on or off he needs to switch control button provided in app. Once the Wi-Fi will send the data to Wi-Fi present at microcontroller. As and when the requested was received the microcontroller activates through RTC and EEPROM and as per request received action will be done. In the same way all other appliances can be controlled.

4.2 APPICATION :

1. Health care

IOT applications have turned reactive medical based system into proactive wellness based system. IOT creates a future of medicine and healthcare which exploits a highly integrated network of sophisticated medical devices. The integration of all elements provides more accuracy, more attention to detail, faster reactions to events, and constant improvement while reducing the typical overhead of medical research and organizations.

2. Agriculture

A greenhouse farming technique enhances the yield of crops by controlling environmental parameters. However, manual handling results in production loss, energy loss, and labour cost, making the process less effective. A greenhouse with embedded devices not only makes it easier to be monitored but also, enables us to control the climate inside it. Sensors measure different parameters according to the plant requirement and send it to the cloud. It, then, processes the data and applies a control action.

3. Government and Safety

IOT applied to government and safety allows improved law enforcement, defence, city planning, and economic management. The technology fills in the current gaps, corrects many current flaws, and expands the reach of these efforts. For example, IOT can help city planners have a clearer view of the impact of their design, and governments have a better idea of the local economy.

4. Industrial Automation

For a higher return of investment this field requires both fast developments and quality of products. This vitality thus coined the term IIOT. This whole schematic is re-engineered by IOT applications. Following are the domains of IOT applications in industrial automation

1. Factory Digitalization
2. Product flow Monitoring
3. Inventory Management
4. Safety and Security
5. Quality Control
6. Packaging optimization
7. Logistics and Supply Chain Optimization

CHAPTER-5

RESULT AND CONCLUSION

5.1 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. The project Home Automation System is working properly with proper range coverage and can be operate automatically.

5.2 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 a number of 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.

5.3 FURTHER ENHANCEMENT AND FUTURE SCOPE :

Looking at the current situation we can build cross platform system that can be deployed on various platforms like iOS, Windows. Limitation to control only several devices can be removed by extending automation of all other home appliances. The prototype can include sensors to implement automatic control of the home appliances like; an LDR that can sense daylight and switch lamp accordingly, a PIR to detect motion and be used for security purposes making an alarm buzz, or a DHT11 sensor that’s senses ambient temperature and humidity of atmosphere and switch fan/air conditioner accordingly. Scope of this project can be expanded to many areas by not restricting to only home, but to small offices.

REFERENCE

1. Shardha Somani, Parikshit Solunke, Shaunak Oke, Parth Medhi, Prof. P. P. Laturkar, 2015. "IOT Based Smart Security and Home Automation".
2. Tui-Yi Yang, Chu-Sing Yang, Tien-Wen Sung, 2016. Third International Conference on Computing Measurement Control and Sensor Network research about "A Dynamic Distributed Energy Management Algorithm of Home Sensor Network for Home Automation System".
3. Tushar Churasia and Prashant Kumar Jain, 2019, in Proceedings of the Third International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC 2019) research about "Enhance Smart Home Automation System based on Internet of Things", IEEE Xplore Part Number:CFP19OSV-ART; ISBN:978-1-7281-4365-1.
4. Suraj, Ish Kool, Dharmendra Kumar, Shovan Barman, 2011."Visual Machine Intelligence for Home Automation".
5. Vikram.N, Harish.K.S, Nihaal.M.S, Raksha Umesh, Shetty Aashik Ashok Kumar; in 2017 IEEE 7th International Advance Computing Conference. "A Low Cost Home Automation System Using Wi-Fi based Wireless Sensor Network Incorporating internet of Things".
6. Wikipedia(2009).Home Automation. From https ://en.wikipedia.org/wiki/Home_automation
7. Theory of IOT from :https://internetofthingsagenda.techtarget.com/definition/Internet-of-Things-IoT
8. About Node MCU from: https://lastminuteengineers.com/esp8266-nodemcu-arduino-tutorial/
9. Satyendra K. Vishwakarma, Prashant Upadhyaya, Babita Kumari, Arun Kumar Mishra, 2010."Smart Energy Efficient Home Automation System using IOT".

APPENDIX

SOURCE CODE :

```
#include <ESP8266WiFi.h>
Software Serial SwSerial(10, 11);         // RX, TX
#include <BlynkSimpleStream.h>
char auth[] = "d0e68eae86a3446995a256415bd6cfc4";
Widget Terminal terminal(V1);
BLYNK_WRITE (V1)
{
 // We start by connecting to a WiFi network
Serial.println();
Serial.println();
Serial.print("Connecting to ");
Serial.println(ssid);
WiFi.begin(ssid, password);
while (WiFi.status() != WL_CONNECTED) {
delay(500);
Serial.print(".");
}
Serial.println("");
Serial.println("WiFi connected");
Serial.println("IP address: ");
Serial.println(WiFi.localIP());
}
int value = 0;
void loop() {
delay(5000); ++value;
Serial.print("connecting to ");
Serial.println(host);
// Use WiFiClient class to create TCP connections WiFiClient client;
const int httpPort = 80;
if (!client.connect(host, httpPort)) { Serial.println("connection failed"); return;
 }
// We now create a URI for the request String url = "/projects/index.html";
Serial.print("Requesting URL: ");
Serial.println(url);
// This will send the request to the server
client.print(String("GET ") + url + " HTTP/1.1\r\n" + "Host: " + host + "\r\n" + "Connection:
close\r\n\r\n");
delay(500);
// Read all the lines of the reply from server and print them to Serial
while(client.available())
{
String line = client.readStringUntil('\r');
Serial.print(line);
```

```
}
Serial.println();
  Serial.println("closing connection");
//the relays connect to
int RelayControl1 = 4;       // Digital Arduino Pin used to control the motor
 int RelayControl2 = 5;
 int RelayControl3 = 6;
 int RelayControl4 = 7;
void setup()
 {
 Serial.begin(9600);
pinMode(RelayControl1, OUTPUT);
pinMode(RelayControl2, OUTPUT);
 pinMode(RelayControl3, OUTPUT);
 pinMode(RelayControl4, OUTPUT);
 }
void loop()
{
digitalWrite(RelayControl1,HIGH);          // NO1 and COM1 Connected (LED on)
 delay(1000);
 digitalWrite(RelayControl1,LOW);          // NO1 and COM1 disconnected (LED off)
delay(1000); digitalWrite(RelayControl2,HIGH);
delay(1000);
digitalWrite(RelayControl2,LOW);
delay(1000);
digitalWrite(RelayControl3,HIGH);
delay(1000);
digitalWrite(RelayControl3,LOW);
delay(1000);
digitalWrite(RelayControl4,HIGH);
delay(1000);
digitalWrite(RelayControl4,LOW);
delay(1000);
}
```