A

Project Report

On

VOICE BASED HOME AUTOMATION SYSTEM

Submitted to

RAJIV GANDHI UNIVERSITY OF KNOWLEDGE TECHNOLOGIES, KADAPA

In partial fulfillment of the requirements for the award of the Degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

Submitted by

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(RGUKT KADAPA is approved by UGC, AICTE, established in 2008, provide Education opportunities for rural people)

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that the project report entitled "VOICE BASED HOME AUTOMATION SYSTEM "a bonafide record of the project work done and submitted by

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DECLARATION

We hereby declare that the project report entitled **"VOICE BASED HOME AUTOMATION SYSTEM"** submitted to the Department of **ELECTRONICS AND COMMUNICATION ENGINEERING** in partial fulfilment of requirements for the award of the degree of **BACHELOR OF TECHNOLOGY**. This project is the result of our own effort and that it has not been submitted to any other University or Institution for the award of any degree or diploma other than specified above.

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Abstract:

The main objective of this project is to develop a VOICE BASED HOME AUTOMATION SYSTEM using an ESP32 Microcontroller. As technology is advancing so houses are also getting smarter. Modern houses are gradually shifting from conventional switches to sensing control system and using voice applications. Presently, conventional wall switches located in different parts of the house makes it difficult for the user to go near them to operate.

Even more it becomes more difficult for the elderly or physically handicapped people to do so. Voice controlling Home automation system provides a most modern solution by recognizing the person. Even it is more efficient than remote controlling system in the case of damage/lost of remote.

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Chapter-1
INTRODUCTION

1.1 RELATED WORK

Nowadays, we are mostly using Internet of Things everywhere which have made our lives easy. Have you ever wondered about Home automation which would give the facility of controlling tube lights, fans and other electrical appliances at home using voice? Off-course, yes! But, the available options are not cost-effective, we have found a solution to it with a new system called Arduino based Home automation system using GOOGLE ASSISTANT. This is cost effective design. Time is a very valuable thing everybody wants to save time as much as they can. New technologies are being introduced to save our time. By implementing the Home automation system we can save the power.It is very helpful to control your home appliances easily. With this home automation project, you can control & monitor the real-time feedback of the relays in the Google Home and Alexa App from anywhere in the world. If the Wi-Fi is available, the ESP32 will automatically connect with the Wi-Fi.

In this IoT project, I will see how to make an **IoT-based Smart Home** with Google Assistant & Alexa using **ESP32** to control 3 home appliances with voice commands. If the internet is not available, then you can control the home appliances from manual switches.

This complete Home Automation system has the following features:

1. Control appliances with **Google Assistant**
2. Control appliances with **Alexa**
3. Control appliances manually with **switches.**
4. Monitor real-time feedback in the **Google Home** and **Amazon Alexa App.**
5. Control home appliances manually without internet.
6. For this project, I have used a **FREE Sinric Pro** account

For this project, I have used all the FREE tools. So if you follow all steps, you can easily make this Smart Home System with Google Home and Amazon Alexa to control the appliances with voice commands.

1.2 Objective

Home automation gives you access to control devices in your home from a mobile device anywhere in the world. Home automation more accurately describes homes in which we control nearly everything like smart light switches, appliances, heating and cooling systems connecting to a remotely controllable network. Home automation can works using the Bluetooth controlled application or wifi controlled application. We control the home appliances like Lights,Fans,ACs etc. with the voice based applications like Google Assistant ,Alexa and Siri.

1.3 Problem Statement

The goal of this project is to create a model that will be able to recognize and determine the human voice and operate devices according to the instructions given by the person . Though the goal is to create a model which can act with a bluetooth module, it can be extended by using wifi module too . The major goal of the proposed system is understanding human language and making the device act according to the instructions given by the person .

1.4 Working Principle

Here we will control four different home appliances by voice Command. The key components of this project are Arduino, Bluetooth module, Relay module, LCD display, a smartphone, and Android App. At first, we need to install the app on our smartphone, which is easily available in the play store. This app receives our Voice command and sends it to the Bluetooth module wirelessly. The Arduino decodes this command from the Bluetooth module. Then Arduino sends a command to the Relays to control the home appliances. These four home appliances are switched on/off by eight different voice commands. The LCD module will display the status of the home appliances on or off.

Chapter-2

LITERATURE SURVEY

2.1 INTRODUCTION

Automation plays a key role in human life. Home automation allows us to control household electrical appliances like light, door, fan, AC etc. It also provides home security and emergency system to be activated. Home automation not only refers to reduce human efforts but also energy efficiency and time saving. The main objective of home automation and security is to help handicapped and old aged people who will enable them to control home appliances and alert them in critical situations. This project put forwards the implementation of home automation and security system using Arduino microprocessor and Android smartphone.

Home appliances are connected to the microprocessor and communication is established between the Arduino and Android mobile device or tablet via Bluetooth module. We would develop an authentication to the system for authorized person to access home appliances. The device with low cost and scalable to less modification to the core is much important. It presents the design and implementation of automation system that can monitor and control home appliances via android phone or tablet Voice controlled wireless smart home system has been presented for elderly and disabled.

voice recognition system, and wireless system. This system to control home appliances uses a voice controlled android application. By the increasing use of PC (personal computers), internet, mobile phone and wireless technology, it makes it easy for a user to remotely access and control the appliances. A lot of research has been done and many solutions have been proposed to remotely access the appliances. Some of them used internet, wireless technology to communicate and control home appliances, others used Bluetooth and GSM technology for controlling the home appliances.

The main aim of our system is to build a perfect companion for someone to be at home. Generally, home automation research targeted many needs like applications that provide the luxury smart requirements while some threw light on the special needs for elderly and disabled etc. our system is a computer based system that can accept voice to direct commands and process them. The system provides us switching.

All that the user needs is an android smartphone, which is present in almost everybody's hand nowadays, and a control circuit. When the first computers came around, achieving the level of sophistication so as to narrate commands using voice to a machine was only realized in science fiction. However with tremendous breakthrough in the field, we are at the precipice of truly using voice to interface with devices.

2.2 PROJECT OVERVIEW

There are many types of Home automation systems like Bluetooth controlled, Internet Controlled, Remote Controlled(IR Remote) etc. Each type has its own advantages and disadvantages. In this project, we have designed a voice activated home automation system, where different appliances are controlled by sending a voice command. The voice activated home Automation project is implemented using arduino UNO, Bluetooth, and a smartphone. We are showing a voice control home automation system to control appliances with their own voice command.

2.2.1 BLUETOOTH BASED HOME AUTOMATION:

In Bluetooth based home automation systems the home appliances are connected to the ESP32 board at input output ports using relay. The program of the ESP32 board is based on the high level interactive C language of microcontrollers. The connection is made via Bluetooth. The password protection is provided so only authorized users are allowed to access the appliances.

The Bluetooth connection is established between ESP32 board and phone for wireless communication. In this system the python script is used and it can install on any of the Symbian OS environments, it is portable. One circuit is designed and implemented for receiving the feedback from the phone, which indicates the status of the device.

2.2.2 WIFI BASED HOME AUTOMATION:

Wi-Fi based home automation systems mainly consist of three modules, the server, the hardware interface module, and the software package. The figure shows the system

model layout. Wi-Fi technology is used by servers, and hardware Interface modules to communicate with each other. The same technology is used to login to the server web based application. The server is connected to the internet, so remote users can access server web based applications through the internet using a compatible web browser.

Software of the latest home automation system is split to server application software, and Microcontroller firmware. This software, built using C language, using IDE comes with the microcontroller itself. Arduino software is culpable for gathering events from connected sensors, then applies action to actuators and pre-programed in the server. Another job is to report the and record the history in the server DB. The server application software package for the proposed home automation system, is a web based application built using asp.net.

The server application software can be accessed from an internal network or from the internet if the server has real IP on the internet using any internet navigator that supports asp.net technology. Server application software is culpable for maintaining the whole home automation system, setup, configuration. Server uses a database to keep log of home automation system components, we choose to use XML filesto save system log.

2.3 EXISTING METHOD

IoT stands for the internet of things. it means to control things over the internet or in simple language the instruction is to be given through the internet, we can use the mobile applica application, web page, or a computer system in this technology. Generally, we use a Mobile phone application like Blink App etc. that is connected to the internet or wifi. and the device we used is the wifi module to control the connected devices like TV, fan, AC.

We generally uses an application known as the Blynk app and there we made some buttons as per our requirement. we made only four button top make the 4 channel device and the application is to be connected to the internet every time when we want to operate our smart home project. our device which we made with the wifi module also needs to connect to the wifi network continuously. wifi device can’t be directly connected to the electronic appliances so that we will use the relay module to connect the electronic appliances.

Now ,In our project we use Dual core Bluetooth and wifi enabled microcontroller called ESP32 which is very high performanced and works better than Arduino and we use Google Assisstant to connect directly to home appliances through our voice.

Chapter-3
METHODOLOGY

3.1. PROPOSED METHOD

As the existing method i.e., Using Android Application like Blink and Arduino, Wifi Module, Bluetooth Module circuit becomes complex and it is not reliable and fast. Failure with this implementation is more. To overcome this problem we go for an another alternative method i.e., Home Automation using ESP32 and Google Assisstant.

BLOCK DIAGRAM OF HOME AUTOMATION USING ESP32

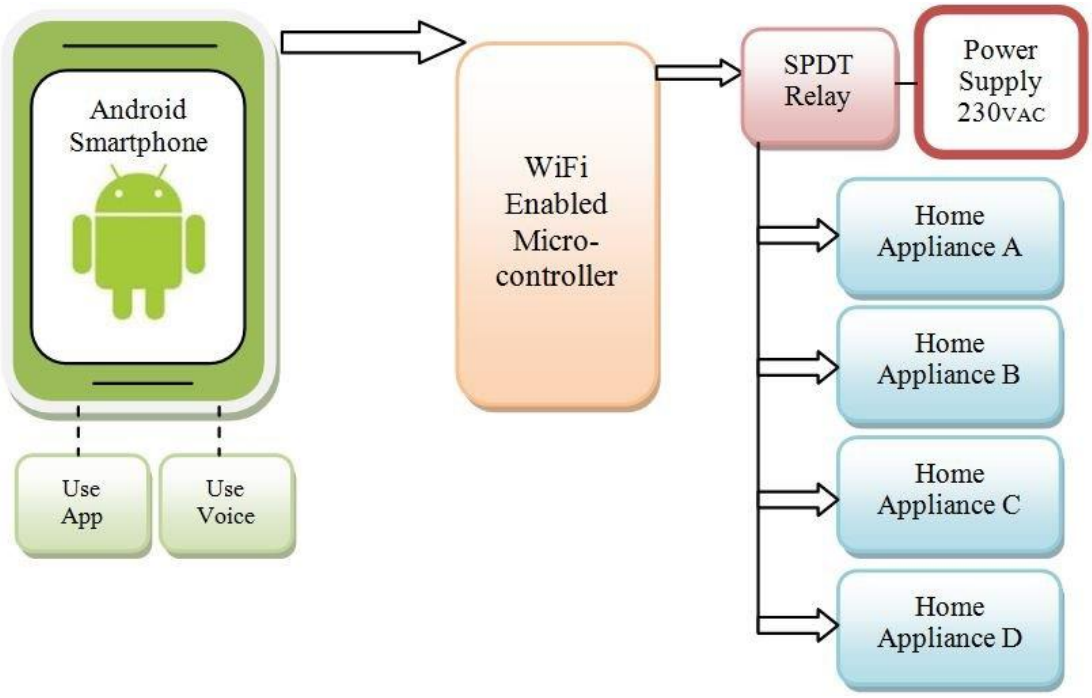


Fig 1: Block diagram of Home Automation System

3.2 METHODOLOGY:

In this modern era, the concept of home automation is growing at great speed. Smart systems are being installed in almost every place. Smart Home Systems is a concept in which all the electrical appliances or the devices are controlled using a single remote control. In these systems, most of the time, the remote control is a mobile application. As an android mobile is the most common among the people, so an android application is the best option to control all these devices.

So in this project, we are going to connect some of the home's electrical appliances to the Relay module and control it through ESP32 Microcontroller. We will make a firebase realtime database and connect it from the android app. This android app will send the data to the cloud and then it will be sent to the microcontroller to switch the electrical appliance on or off.

The best part is that you can have full control over the switching of your appliances from anywhere in the world. You just need an internet connection to operate the android application.In our project we are work with Google Assistant in real time i.e., Monitoring our home.

This project is only applicable upto a limited range.Here we use power supply to supply power. Home Automation systems that are already available in the market, are very costly. We can use an ESP32 board to connect different home appliances and control them using an Android App. This will be very low in cost and an efficient way to automate the house.

Hence the main idea was to monitor the real time water level of the Bridge so that bridge height raises or falls automatically according to the water level.In this ESP32 project, I have explained how to make IoT based projects using ESP32 with Google Home & Alexa. With this internet of things project, you can control 3 home appliances with Google Assistant, Alexa, and manual switches. You can also control the relays from Google Home and Amazon Alexa App from anywhere in the world

I have used the INPUT_PULLUP function in Arduino IDE instead of using the pull-up resistors with each push button. As per the source code, when the control pins of the relay module receive a LOW signal the relay will turn on and the relay will turn off for the HIGH signal in the control pin. I have used a 5V 5Amp mobile charger to supply the circuit.

CHAPTER -4
DESCRIPTION OF HARDWARE COMPONENTS

4.1 ESP32 MICROCONTROLLER

ESP32 is a series of low-cost, low-power system on a microcontroller chip with integrated Wi-Fi and dual-mode Bluetooth, The ESP32 series employs either a Tensilla Xtensa LX6 microprocessor in both dual-core and Single-Core variations, Xtensa LX7 dual-core microprocessor or a single-core microprocessor and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power-management modules. ESP32 is created and developed by Espressif Systems, a Shanghai-based Chinese company, and is manufactured by TSMC using their 40 nm process. It is a successor to the ESP32 microcontroller.

Fig 2: ESP32 microcontroller

• ESP32 is a dual core, this means it has 2 processors.

• It has Wi-Fi and bluetooth built-in. • It runs 32 bit programs.

• The clock frequency can go up to 240MHz and it has a 512 kB RAM.

• This particular board has 30 or 36 pins, 15 in each row.

• It also has wide variety of peripherals available, like: capacitive touch, ADCs, DACs, UART, SPI,I2C and much more.

4.1.1 FEATURES

Features of the ESP32 include the following:

- Processors:
    - CPU: Xtensa dual-core (or single-core) 32-bit LX6 microprocessor, operating at 160 or 240 MHz and performing at up to 600 DMIPS
    - Ultra low power (ULP) co-processor
- Memory: 320 KiB RAM, 448 KiB ROM

- Wireless connectivity:
    - Wi-Fi: 802.11 b/g/n
    - Bluetooth: v4.2 BR/EDR and BLE (shares the radio with Wi-Fi)

- Peripheral interfaces:
    - 34 × programmable GPIOs
    - 12-bit SAR ADC up to 18 channels
    - 2 × 8-bit DACs
    - 10 × touch sensors (capacitive sensing GPIOs)
    - 4 × SPI
    - 2 × I²S interfaces
    - 2 × I²C interfaces
    - 3 × UART
    - host controller
    - SDIO/SPI slave controller
    - Ethernet MAC interface with dedicated DMA and planned IEEE 1588 Precision Time Protocol support
    - CAN bus 2.0
    - Infrared remote controller (TX/RX, up to 8 channels)
    - Pulse counter (capable of full quadrature decoding)
    - Motor PWM
    - LED PWM (up to 16 channels)
    - Ultra low power analog pre-amplifier

- Security:
    - IEEE 802.11 standard security features all supported, including WPA, WPA2, WPA3 (depending on version) and WLAN Authentication and Privacy Infrastructure (WAPI)
    - Secure boot
    - Flash encryption
    - 1024-bit OTP, up to 768-bit for customers
    - Cryptographic hardware acceleration: AES, SHA-2, RSA, elliptic curve cryptography (ECC), random number generator (RNG)

- Power management:
    - Internal low-dropout regulator
    - Individual power domain for RTC
    - 5 μA deep sleep current
    - Wake up from GPIO interrupt, timer, ADC measurements, capacitive touch sensor interrupt

ESP32 Module Features and Technical Specs		
No.	Parameter Name	Parameter Value
1	Maximum Operating Frequency	240MHz
2	Microprocessor	Tensilica Xtensa LX6
3	Operating Voltage	3.3V
4	DAC Pins	8-bit, 2 Channel
5	Analog Input Pins	12-bit, 18 Channel
6	DC Current on I/O Pins	40 Ma
7	Digital I/O Pins	39 (34 are normal GPIO pins)
8	DC Current on 3.3V Pin	50 mA
9	Communication	SPI(4), I2C(2), I2S(2), CAN, UART(3)
10	SRAM	520 KB
11	Bluetooth	V4.2 – Supports BLE and Classic Bluetooth
12	Wi-Fi	802.11 b/g/n

4.1.2 ESP32 Peripherals and I/O

Although the ESP32 has 48 GPIO pins in total, only 25 of them are broken out to the pin headers on both sides of the development board. These pins can be assigned a variety of peripheral duties, including:

15 ADC channels	15 channels of 12-bit SAR ADC with selectable ranges of 0-1V, 0-1.4V, 0-2V, or 0-4V
2 UART interfaces	2 UART interfaces with flow control and IrDA support
25 PWM outputs	25 PWM pins to control things like motor speed or LED brightness
2 DAC channels	Two 8-bit DACs to generate true analog voltages

SPI, I2C and I2S interface	Three SPI and one I2C interfaces for connecting various sensors and peripherals, as well as two I2S interfaces for adding sound

4.1.3 ESP32 Pinout

The ESP32 DevKit V1 development board has 30 pins in total. For convenience, pins with similar functionality are grouped together. The pinout is as follows:

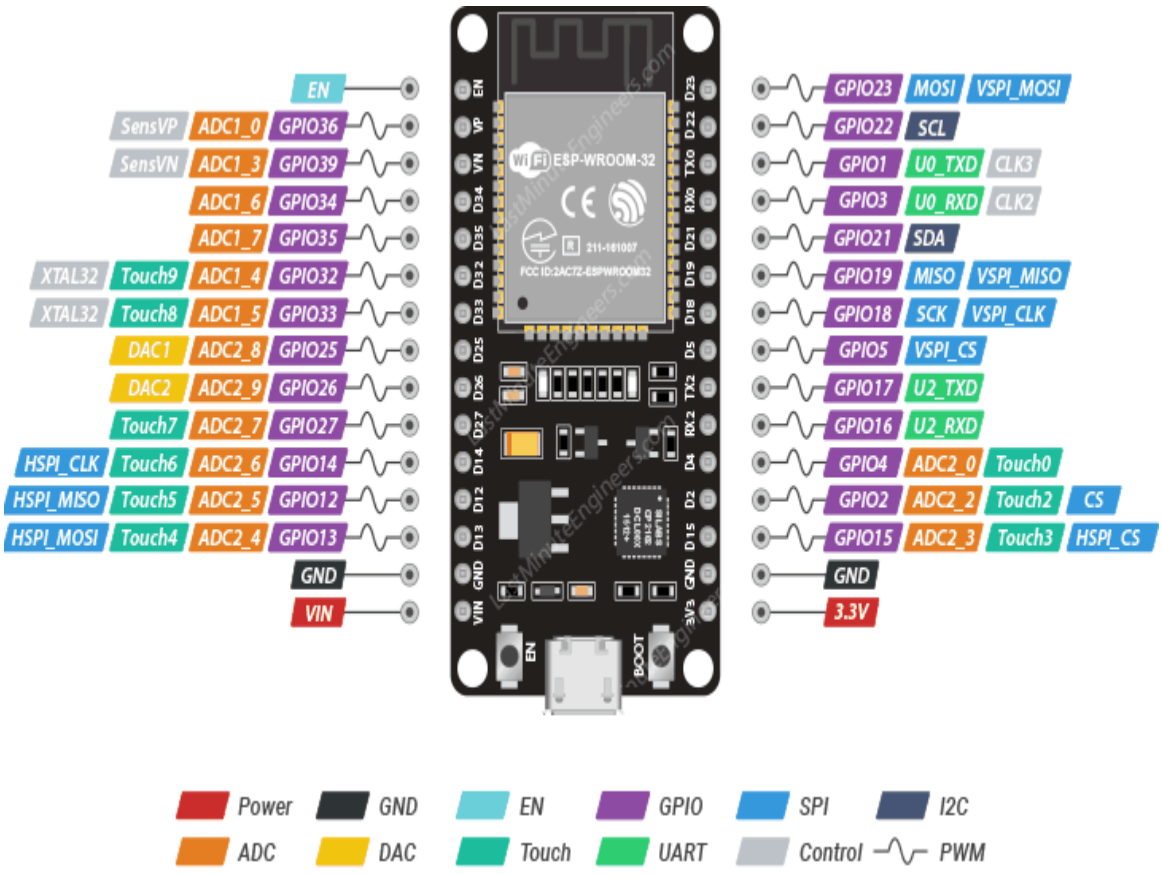


Fig 3 ESP32 Pinout

4.1.4 GPIO PINS

The ESP32 development board has 25 GPIO pins that can be assigned different functions by programming the appropriate registers. There are several kinds of GPIOs: digital-only, analog-enabled, capacitive-touch-enabled, etc. Analog-enabled GPIOs and Capacitive-touch-enabled

GPIOs can be configured as digital GPIOs. Most of these digital GPIOs can be configured with internal pull-up or pull-down, or set to high impedance.

Although the ESP32 has a lot of pins with various functions, some of them may not be suitable for your projects. The table below shows which pins are safe to use and which pins should be used with caution.

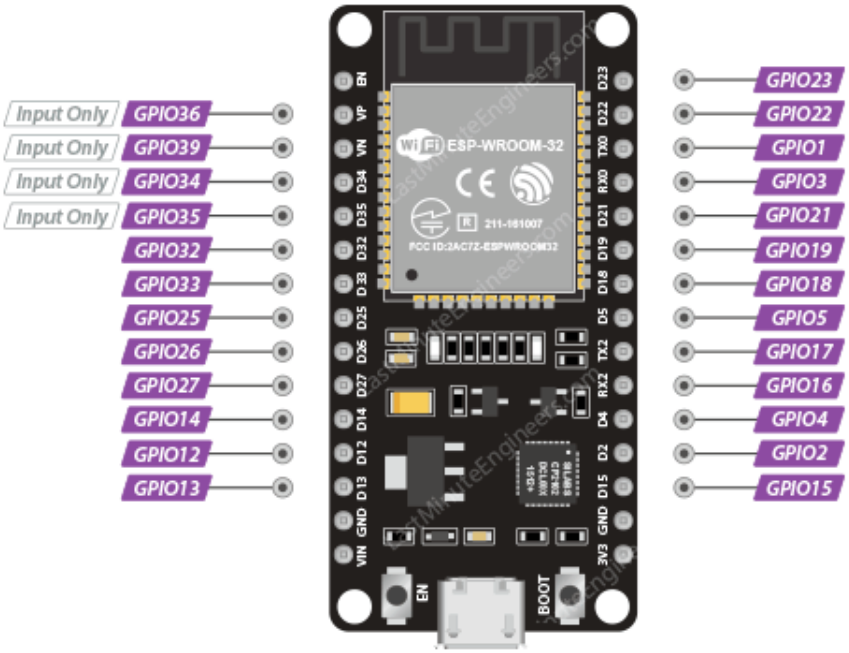


Fig 4 GPIO Pins

The **ESP32 Wi-Fi module specifications or features** are given below:

- It is a powerful Wi-Fi module available in a compact size at a very low price.
- It is based on the L106 RISC 32-bit microprocessor core and runs at 80 MHz
- It requires only 3.3 Volts power supply
- The current consumption is 100 m Amps
- The maximum Input/Output (I/O) voltage is 3.6 Volts.
- It consumes 100 mA current
- The maximum Input/Output source current is 12 mA
- The frequency of built-in low power 32-bit MCU is 80 MHz
- The size of flash memory is 513 kb

- It is used as either an access point or station or both
- It supports less than 10 microAmps deep sleep
- It supports serial communication to be compatible with several developmental platforms such as Arduino
- It is programmed using either AT commands, Arduino IDE, or Lua script
- It is a 2.4 GHz Wi-Fi module and supports WPA/WPA2, WEP authentication, and open networks.
- It uses two serial communication protocols like I2C (Inter-Integrated Circuit) and SPI (Serial Peripheral Interface).
- It provides 10- bit analog to digital conversion
- The type of modulation is PWM (Pulse Width Modulation)
- UART is enabled on dedicated pins and for only transmission, it can be enabled on GPIO2.
- It is an IEEE 802.11 b/g/n Wi-Fi module with LNA, power amplifier, balun, integrated TR switch, and matching networks.
- GPIO pins – 17
- Memory Size of instruction RAM – 32 KB
- The memory size of instruction cache RAM – 32 KB
- Size of User-data RAM- 80 KB
- Size of ETS systems-data RAM – 16 KB

The **applications of the ESP32 Wi-Fi module** are given below:

- Access points portals
- IoT projects
- Wireless data logging
- Used in learning the networking fundamentals
- Sockets and smart bulbs
- Smart home automation systems

The **ESP32 is an alternative ESP8266 Wi-Fi module**. It is a standalone and most powerful module.Thus, this is all about an overview of the ESP8266 Wi-Fi module datasheet – definition, pin configuration, specifications, circuit diagram/How to use, where to use/applications, and its alternatives. The ESP8266 Wi-Fi module is a User-friendly module because it can be programmed with the help of Arduino IDE. This module can also be used to build ESP8266 wifi module projects. The other standalone modules like ESP-12 and ESP-32 are also commonly used for IoT applications development and to achieve internet connection to the project. Here is a question for you, "What are the advantages of the ESP8266 Wi-Fi module? "

4.2-channel 5V SPDT Relay Module :

Relay modules (or power relay modules) are ubiquitous electronic components. They are an exceedingly significant component of any home automation project. You will require a relay module if you use a low voltage microcontroller such as an Arduino to control motors or lighting circuits.

Relay modules are straightforward components. Essentially, they work as switches. Your average relay module comprises two internal metal contacts. Usually, these contacts do not connect or touch each other. However, relays include an internal switch connecting these contacts to complete an electrical circuit that allows current flow.

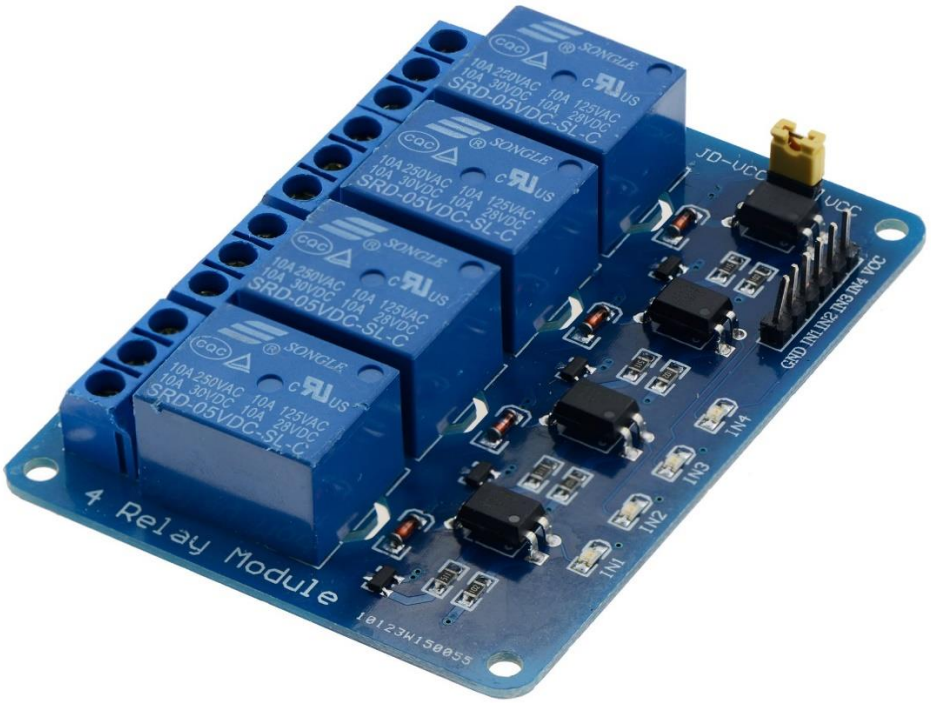


Fig 5: RELAY MODULE

Relay modules do not work like manual light switches. To illustrate, when you switch on a light, you must press a button to connect the two metal contacts within it. Inversely, a relay switch uses electric pulses to turn its internal switch on and off.

You power a voltage power current on one side of the circuit that powers an electromagnetic coil which pulls the metal contacts together. Consequently, this allows the current to flow on the other side of the relay. Your Arduino Uno or Raspberry Pi can send a digital signal to the relay, which can then power whatever application you need. As you may expect, there are different relay module types. We will cover that further down this guide.

4.2.1 How Do Relay Modules Work?

Firstly, we need to distinguish between relay and relay modules. A relay module is an array of one or more relays. While it is possible to purchase individual relays separate from the module, we recommend that you purchase them in a module format. This is because it comes with a few advantages.

On the input side of your standard single-channel relay module, you will find that you can access the relay's input through three jumper pin connectors. You'll find that the output connectors are wires suitable for a hardware connection. This makes it easier to attach whatever your single digital output load is. Most modules also have an LED at the bottom of the module. It turns on when you activate the relay and off when you deactivate it.

Additionally, there is a diode that goes across the electromagnetic coil that's inside the relay. Essentially, it is what is known as a flyback diode. When we energize the coil and the relay reaches deactivation, it needs to discharge that count somewhere. This flyback diode prevents input voltage from going back into the output pin.

4.2.2. Relay Module Applications

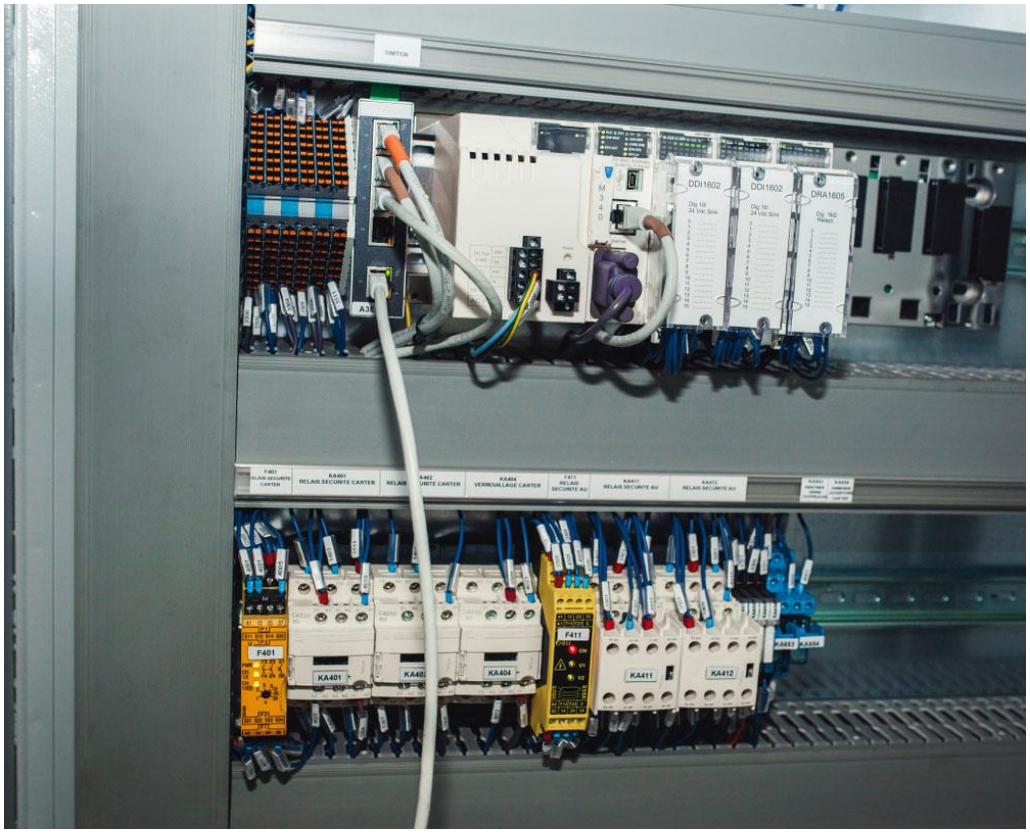


Fig 6: Relays, circuit-breakers, motor protections, and controllers extension modules

relay module in the following applications:

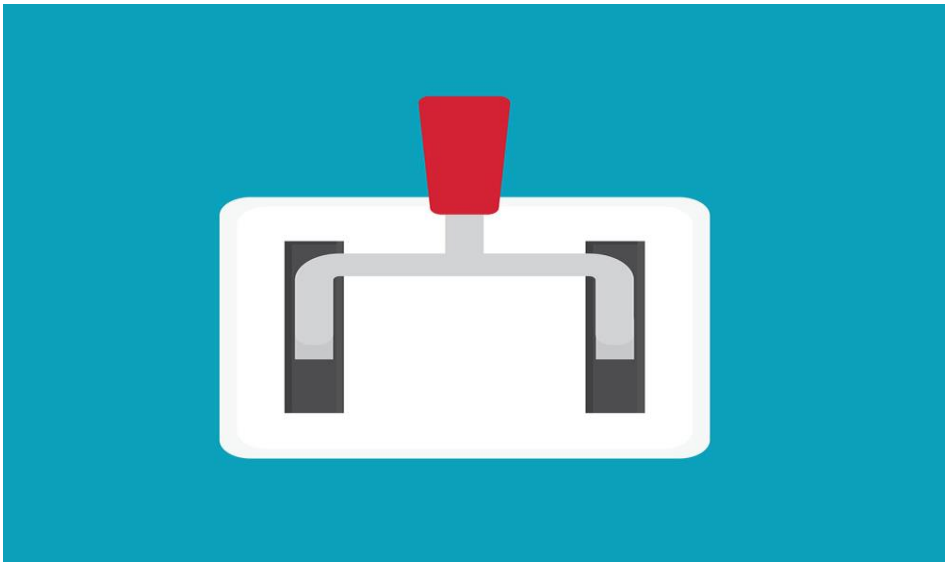


Fig 7: Mains Switching

- Automating electrical appliances and lights in your home
- Isolated power delivery
- High Current switching

4.2.3. Relay Module Circuit

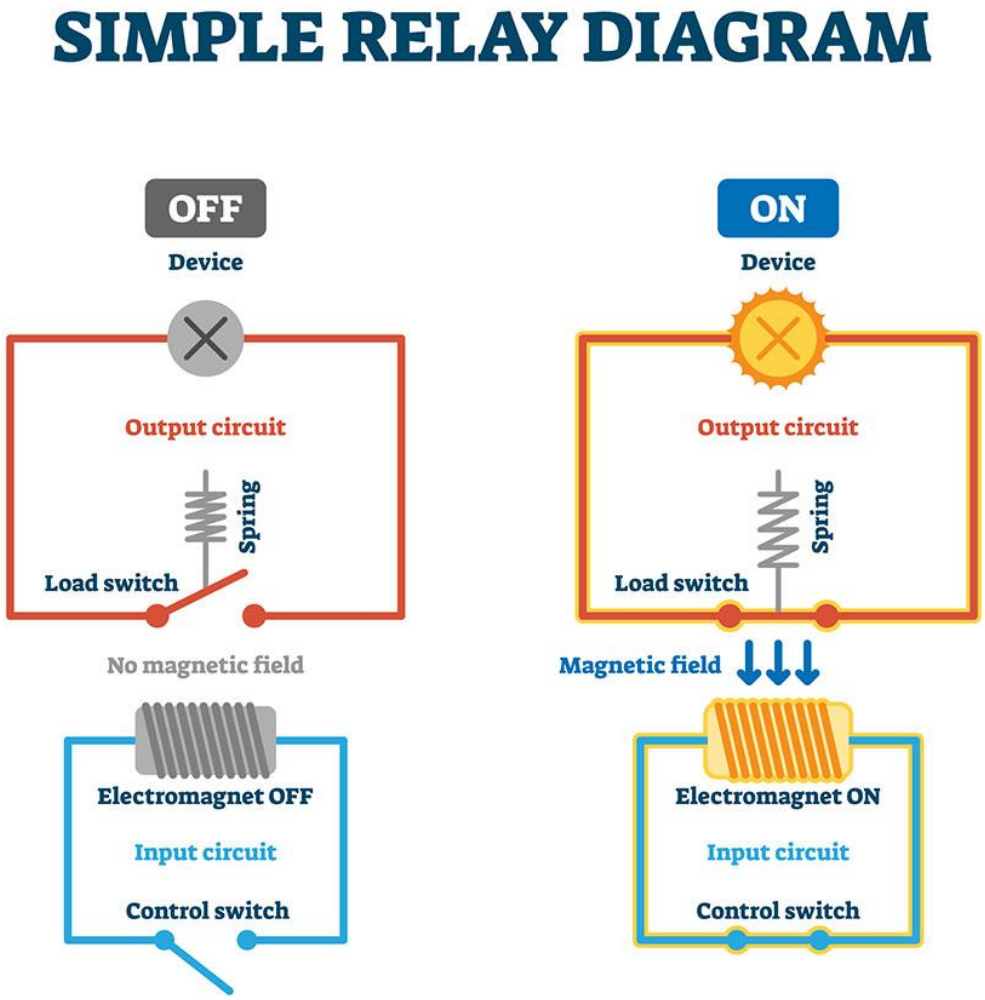


Fig8:Simple Relay Diagram

Markings on the relay module usually serve as an illustration for the inner circuitry. What you need to know most about a relay is the voltage and current it needs on the input side. Additionally, you will need to know the voltage that the relay can accept on the digital output side.

When we discuss 5V relays, we refer to the input it requires to energize the electromagnetic coil. For instance, your relay may have a number at the bottom that reads SRD-05VDC-SL-C. Essentially, this indicates that it is a 5-volt relay. Accordingly, it can control either an AC circuit at ten amps or a DC circuit at 30-volts and ten amps.

4.2.4. Types of Relay Modules

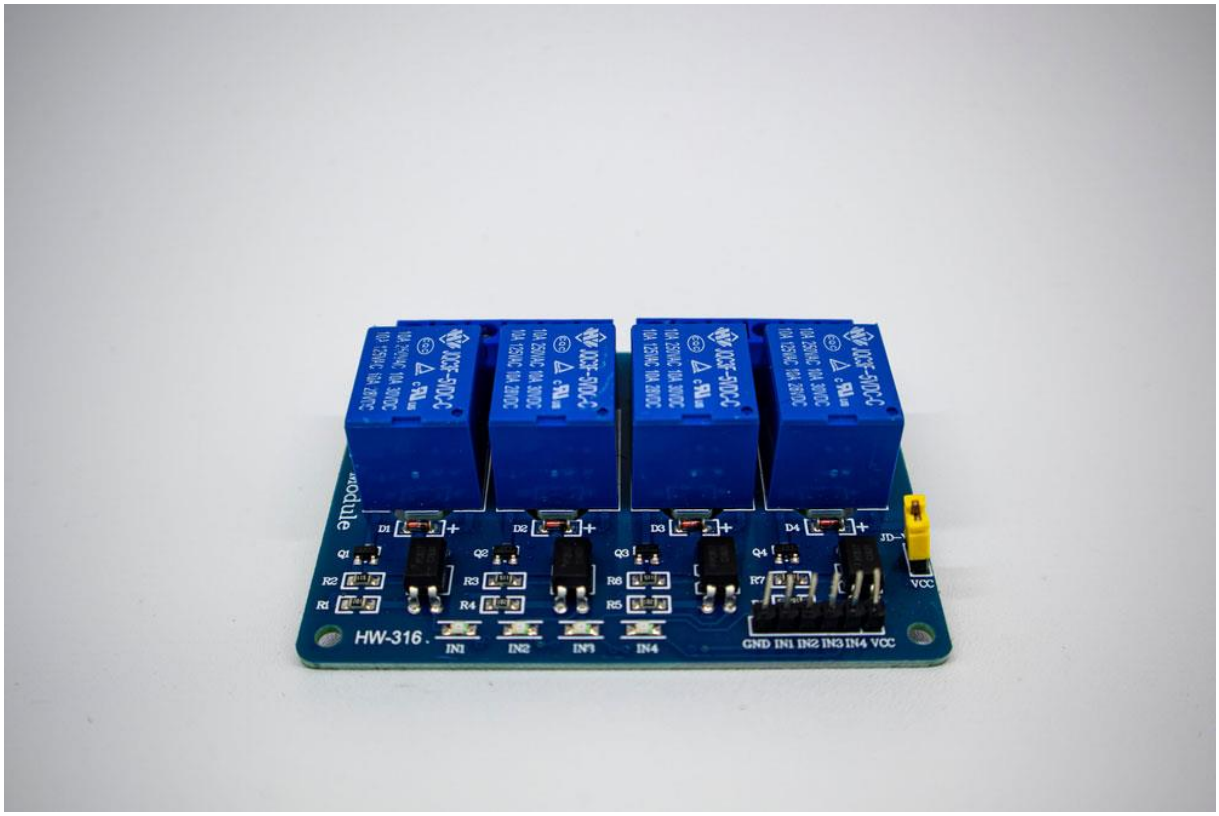


Fig9: Horizontal relay 4-channel relay module

You can generally find a relay as either an electromechanical relay or a solid-state relay. Furthermore, electromechanical relays are the most common. The types of relay modules are

Types of Electromechanical Relays

- General Purpose Relays
- Reed Relays
- Machine Control Relays

Types of Solid-State Relays

- Zero-Switching Relays
- Instant On Relays
- Peak Switching Relays
- Analog Switching Relays

Channel Types

- Single/One Channel Relays
- 2-Channel SPDT Relay/Dual-Channel Relay Module
- 4-Channel SPDT Relay/Four-Channel Relay

- 8-Channel Relay Module

4.3 Breadboard

An electronics breadboard (as opposed to the type on which it has made by the main sandwiches are made) is actually referring to a solderless breadboard. These are great units for making temporary circuits and prototyping, and they require absolutely no soldering. Prototyping is the process of testing out an idea by creating a preliminary model from which other forms are developed or copied, and it is one of the most common uses for breadboards. If you aren't sure how a circuit will react under a given set of parameters, it's best to build a prototype and test it out.For those new to electronics and circuits, breadboards are often the best place to start. That is the real beauty of breadboards--they can house both the simplest circuit as well as very complex circuits. As you'll see later in this tutorial, if your circuit outgrows its current breadboard, others can be be attached to accommodate circuits of all sizes and complexities.Another common use of breadboards is testing out new parts, such as Integrated circuits (ICs). When you are trying to figure out how a part works and constantly rewiring things, you don't want to have to solder your connections each time.As mentioned, you don't always want the circuit you build to be permanent. When trying to duplicate a customer's problem, SparkFun's Technical Support team will often use breadboards to build, test, and analyze the circuit. They can connect the parts the customer has, and once they've gotten the circuit setup andf igured out the problem, they can take everything apart and put it aside for the next time they need to do some troubleshooting.

A breadboard (sometimes called a *plugblock*) is used for building temporary circuits. It is useful to designers because it allows components to be removed and replaced easily. It is useful to the person who wants to build a circuit to demonstrate its action, then to reuse the components in another circuit.A breadboard consists of plastic block holding a matrix of electrical sockets of a size suitable for gripping thin connecting wire, component wires or the pins of transistors and integrated circuits (ICs). The sockets are connected inside the board, usually in rows of five sockets. A row of five connected sockets is filled in at the top right of the figure. The rows are 2.54 mm apart and the sockets spaced 2.54 mm apart in the rows, which is the correct spacing for the pins of ICs and many other components.

On some designs of board, longer rows of sockets occur along the edges of the board, usable for power supply rails. On the board illustrated above, the sockets on the extreme right, although spaced in vertical groups of five are all connected together. The figure shows how a simple circuit is built up on the board. For example, the + 3V supply is connected to R1, to VR1

and (through a wire link) to pin 7 of IC1. Pin 6 of IC1 is connected to the LED (Dl), which is connected through R3 to the –3 V supply.

Fig10:BreadBoard

Note the gap in the centre of the board, bridged by the IC. This ensures that opposite pins of the ICs are not connected.Once a circuit is assembled on the breadboard, it is tested. If its performance is found to be less than perfect, it is easy to substitute resistors or capacitors of different values.

It is also easy to replace components suspected of being faulty. If sections of the circuit need to be isolated to investigate faulty operation, this may readily be done by removing one of the component terminal wires from its socket. Breadboards are ideal for building and testing relatively simple circuits. Although they can, in theory, be used for complicated circuits, the board soon becomes covered with a nest of wires so that it becomes very difficult to trace the connections. If one of the wires is accidentally removed from its socket, it is often difficult to find the correct socket in which to replace it. A breadboard is used to make up temporary circuits for testing or to try out an idea. No soldering is required so it is easy to change connections and replace components. Parts are not damaged and can be re-used afterwards. Almost all the Electronics Club website projects started life on a breadboard to check that the circuit worked as intended.

4.4. Push Button Switch

push-button (also spelled pushbutton) or simply button is a simple switch mechanism to control some aspect of a machine or a process. Buttons are typically made out of

hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. Buttons are most often biased switches although many un-biased buttons (due to their physical nature) still require a spring to return to their un-pushed state.

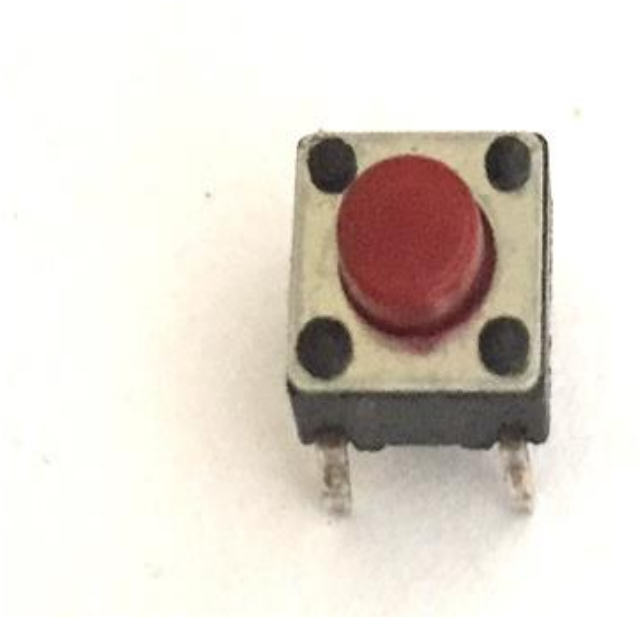


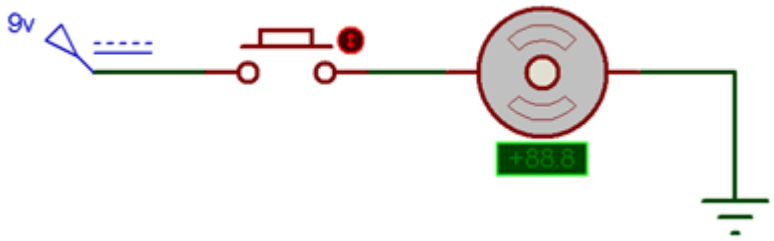
Fig11:PushButton

4.4.1: Where to use push button?

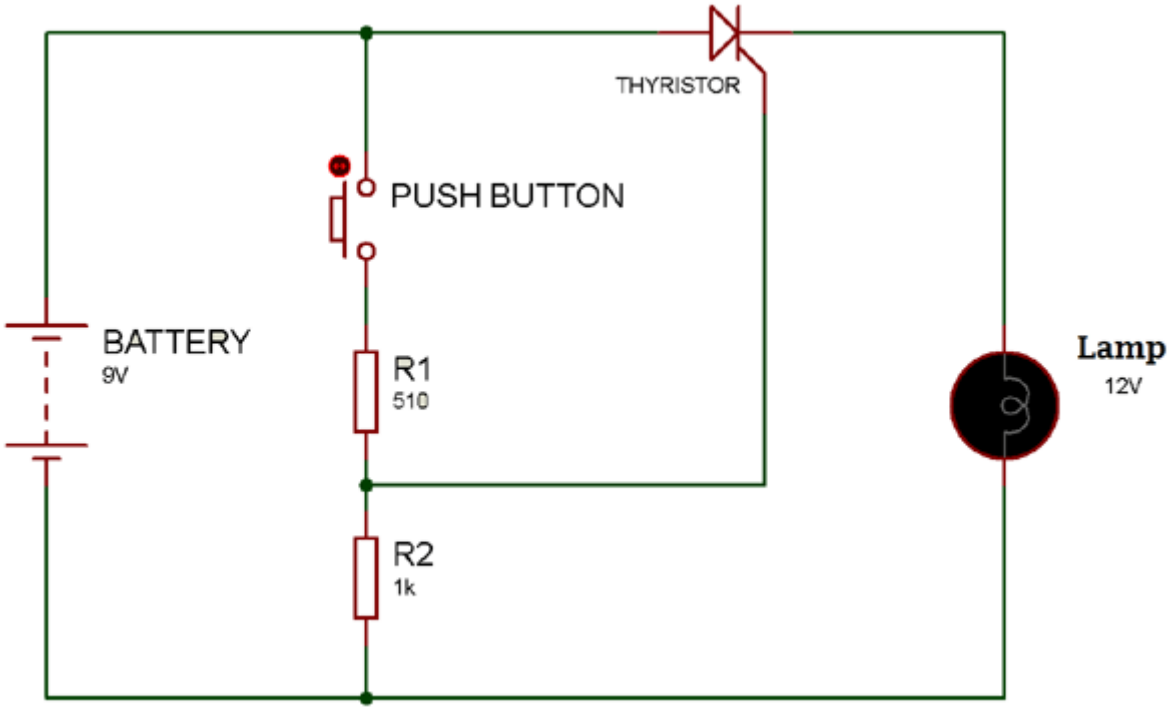
Push Buttons are normally-open tactile switches**.** Push buttons allow us to power the circuit or make any particular connection only when we press the button. Simply, it makes the circuit connected when pressed and breaks when released. A push button is also used for triggering of the SCR by gate terminal. These are the most common buttons which we see in our daily life electronic equipment's. Some of the applications of the Push button are mentioned at the end of the article.

4.4.2: How to use a push button?

When connecting in between of supply and the circuit we should only connect the wires with both the legs of the Push-Button as shown in the circuit below:



A Push-Button can also be used for the triggering purpose like of SCR. An SCR is a gate controlled Switch which needs a triggering pulse. So, for this we can add a Push button in the circuit.



4.4.3: Push Button Features

- Prevent flux rise by the insert-molded terminal
- Snap-in mount terminal
- Contact Bounce: MAX 5mS
- Crisp clicking by tactile feedback
- Dielectric Withstanding Voltage 250V AC for 1 minute

4.4.4: Technical Specifications

- Mode of Operation: Tactile feedback
- Power Rating: MAX 50mA 24V DC
- Insulation Resistance: 100Mohm at 100v
- Operating Force: 2.55±0.69 N
- Contact Resistance: MAX 100mOhm
- Operating Temperature Range: -20 to +70 ℃
- Storage Temperature Range: -20 to +70 ℃

4.4.5: Applications

- Calculators
- Push-button telephones
- Kitchen appliances
- Magnetic locks
- Various other mechanical and electronic devices, home and commercials.

4.5. Bulb:

An incandescent bulb gives us light and an incandescent lamp or incandescent light globe is an electric light with a filament wire that is heated until it glows. The current is supplied to the filament by the means of wire or the terminals embedded in the glass. A socket bulb generally provides mechanical support and electrical connections as well.

The bulbs which are incandescent are manufactured in a wide range of sizes. That is the output of light and voltage ratings that is from 1.5 volts to about 300 volts. As a result, we can say that the incandescent bulb became widely used in household and commercial lighting that is for portable lightings such as lamps on tables and the car headlamps and flashlights and for advertising and decorative lighting.

Fig12:Bulb

4.5.1. Types of Bulbs:

A) Light Bulb:

A bulb that generally gives out or we can say it emits light. There are different types of bulb in varieties. The bulb which is the filament one is used, for example, in a car headlight or for lighting in houses purpose as well. There are also lights that are fluorescent and they are energy saving in nature. Another type is an LED is a light-emitting diode. These are getting more popular nowadays in the day to day life. For example, we can see an array of LEDs in brake lights of vehicles.

A simple traditional light is an incandescent bulb. This is such a basic technology that we take this almost for granted but if we delve into the quantum physics that is behind it we find that something amazing is happening with it.

The principle that is operating behind the light bulb is very simple: we run an electric current through a thin filament which causes it to get hot. The objects that are hot generally emit light so the bulb glows. The higher the temperature the more intense the glowing of the bulb happens and the more "white" the light that comes out. So we can say that if we get the filament hot enough then we get a bright source of light at wavelengths through the whole visible region of the spectrum.

B) LED Light Bulbs

As we have seen that the high temperature is the reason for the lighting of the bulb. The Heating of a filament to the temperature that is necessary for air will cause chemical reactions that quickly

destroy the filament. This can be avoided by usually putting the filament in a glass bulb with the air either pumped in it away or in a higher-wattage bulb replaced with an inert gas for example like argon. This is why if we put a light bulb in a microwave oven sometimes it produces cool flickering colours that represent the gas inside makes a plasma.

The light which is emitted by a hot object is known as "blackbody radiation," and has some interesting properties which are simple. The colour of the light does not strongly depend on the properties of the material being heated that are just its temperature. And the spectrum of light or the intensity of the light emitted at various wavelengths usually takes the form of a broad peak whose wavelength changes location in a fairly simple way.

This makes the spectrum surprisingly difficult to explain though. As we have mentioned when writing about Sir Einstein's truly radical contribution to Physics, the most obvious approach to this problem generally produces disastrous results. Sir Max Planck was able to explain the spectrum in 1900 but he had to resort to maths for a desperate trick that is assigning an energy characteristic to the light-emitting material. This is the idea Sir Einstein picked up in 1905, which is introducing what we now call photons in order to explain the photoelectric effect. These LED models are inevitable to the development of quantum mechanics in all its glory.

C) Halogen Bulbs

A lamp of halogen is also sometimes called a halogen of the tungsten that is quartz-halogen or we can say quartz iodine lamp is a lamp that is incandescent. That consists of a filament of tungsten which is sealed into a compact transparent envelope. The envelope is filled with a mixture of a gas that is inert and a small amount of a halogen gas such as bromine or iodine. This allows the filament to operate at a temperature that is higher than a standard incandescent lamp of similar power and life operating. This is also said to produce light with higher luminous efficacy and temperature colour.

4.5.2: Uses Of Electronic Bulb

- It is used in portable lighting such as table lamps
- It is used in vehicle lights and car headlights.
- It is used in household and commercial lighting
- It is used in decorative and advertising lighting

4.5.3: Advantages and Disadvantages of Electronic Bulb

Advantages

- Bulbs offer longer life than any other light source.
- The working time ranges from 8000 to 15000 hours.
- It is affordable and economical.
- It is easy to install.
- It comes in various sizes and shapes.
- Produces relatively high output.

Disadvantages

- It is energy inefficient.
- A short lamp lifetime is about 1000 hours typically.
- It produces warm light.
- Requires higher operating cost.
- Since it is made of glass, it is fragile and should be handled with care.
- Bulb generates low lumen per watt.

4.6: Batteries

A battery is a source of electric power consisting of one or more electrochemical cells with external connections[1] for powering electrical devices. When a battery is supplying power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox reaction converts high-energy reactants to lower-energy products, and the free-energy difference is delivered to the external circuit as electrical energy. Historically the term "battery" specifically referred to a device composed of multiple cells; however, the usage has evolved to include devices composed of a single cell.

Fig13:Battery

Primary (single-use or "disposable") batteries are used once and discarded, as the electrode materials are irreversibly changed during discharge; a common example is the alkaline battery used for flashlights and a multitude of portable electronic devices. Secondary (rechargeable) batteries can be discharged and recharged multiple times using an applied electric current; the original composition of the electrodes can be restored by reverse current. Examples include the lead–acid batteries used in vehicles and lithium-ion batteries used for portable electronics such as laptops and mobile phones.

Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wristwatches to, at the largest extreme, huge battery banks the size of rooms that provide standby or emergency power for telephone exchanges and computer data centers. Batteries have much lower specific energy (energy per unit mass) than common fuels such as gasoline. In automobiles, this is somewhat offset by the higher efficiency of electric motors in converting electrical energy to mechanical work, compared to combustion engines.

4.7: Connecting wires

Connecting wire conducts electricity. Connecting wires which allows us in like allows an electrical current to travel from one point on a circuit to another, because electricity needs a medium through which to move. In the case of computers, wires are embedded into circuit boards, carrying pulses of electricity that are interpreted as binary signals of zeros and ones. Most wires in computers and electronic components are made of copper or aluminum. Copper is cheap and electrically conductive. Silver has higher conductivity but is far more expensive. In a basic circuit, the wire comes from one terminal of a power source, such as a battery. It then connects to a switch that determines whether the circuit is open or closed. The wire then connects to the device that is drawing power, allowing it to draw electricity and perform its taskS.

Fig14:Connecting Wires

Finally, the wire connects the load back to the opposite terminal of the power source.Before a current can travel through the wire, the circuit has to be closed; in other words, there cannot be any breaks in the path. Electricity cannot easily travel through air, and if it does there is a risk of stray current leaking into the surroundings and causing damage or failing to power the appliance.

CHAPTER -5
PROGRAMMING CODE

// Arudino code //

```
#ifdef ENABLE_DEBUG
      #define DEBUG_ESP_PORT Serial
      #define NODEBUG_WEBSOCKETS
      #define NDEBUG
#endif

#include <Arduino.h>
#include <WiFi.h>
#include "SinricPro.h"
#include "SinricProSwitch.h"

#include <map>

#define WIFI_SSID         "Wifi 404"
#define WIFI_PASS         "Lavs@111"
#define APP_KEY           "912f5aad-4122-4960-9b1f-528da7bb2586
#define APP_SECRET        "4ae9d7ae-9cd0-4b5d-9965-eee7c2af6c6a-2fe4a3d8-de91-
4186-a8ba-93785031f4e9"   // Should look like "5f36xxxx-x3x7-4x3x-xexe-
e86724a9xxxx-4c4axxxx-3x3x-x5xe-x9x3-333d65xxxxxx"

//Enter the device IDs here
#define device_ID_1   "6320214536b44d06d4ba29b7"//Incandescent
#define device_ID_2   "6322d61436b44d06d4bbf90a"//Kitchen
#define device_ID_3   "63202127fa69c39e7cc8c40f"//HAll
//#define device_ID_4   "SWITCH_ID_NO_4_HERE"

// define the GPIO connected with Relays and switches
#define RelayPin1 23  //D23
#define RelayPin2 22  //D22
#define RelayPin3 21  //D21
//#define RelayPin4 19  //D19
```

```
#define SwitchPin1 13  //D13
#define SwitchPin2 12  //D12
#define SwitchPin3 14  //D14
//#define SwitchPin4 27  //D27

#define wifiLed   2   //D2

// comment the following line if you use a toggle switches instead of tactile buttons
#define TACTILE_BUTTON 1

#define BAUD_RATE   115200

#define DEBOUNCE_TIME 250

typedef struct {      // struct for the std::map below\

  int relayPIN;
  int flipSwitchPIN;
} deviceConfig_t;



std::map<String, deviceConfig_t> devices = {
    //{deviceId, {relayPIN,  flipSwitchPIN}}
    {device_ID_1, {  RelayPin1, SwitchPin1 }},
    {device_ID_2, {  RelayPin2, SwitchPin2 }},
    {device_ID_3, {  RelayPin3, SwitchPin3 }},
//    {device_ID_4, {  RelayPin4, SwitchPin4 }}
};

typedef struct {      // struct for the std::map below
  String deviceId;
  bool lastFlipSwitchState;
  unsigned long lastFlipSwitchChange;
} flipSwitchConfig_t;
```

```
std::map<int, flipSwitchConfig_t> flipSwitches;

void setupRelays() {
  for (auto &device : devices) {           // for each device (relay, flipSwitch combination)
    int relayPIN = device.second.relayPIN; // get the relay pin
    pinMode(relayPIN, OUTPUT);             // set relay pin to OUTPUT
    digitalWrite(relayPIN, HIGH);
  }
}

void setupFlipSwitches() {
  for (auto &device : devices)  {
    flipSwitchConfig_t flipSwitchConfig;

    flipSwitchConfig.deviceId = device.first;
    flipSwitchConfig.lastFlipSwitchChange = 0;
    flipSwitchConfig.lastFlipSwitchState = true;

    int flipSwitchPIN = device.second.flipSwitchPIN;

    flipSwitches[flipSwitchPIN] = flipSwitchConfig;
 // save the flipSwitch config to flipSwitches map
    pinMode(flipSwitchPIN, INPUT_PULLUP);
// set the flipSwitch pin to INPUT
  }
}

bool onPowerState(String deviceId, bool &state)
{
  Serial.printf("%s: %s\r\n", deviceId.c_str(), state ? "on" : "off");
  int relayPIN = devices[deviceId].relayPIN;
  digitalWrite(relayPIN, !state);            // set the new relay state
  return true;
}
```

```
void handleFlipSwitches() {
  unsigned long actualMillis = millis();
    unsigned long lastFlipSwitchChange = flipSwitch.second.lastFlipSwitchChange;

    if (actualMillis - lastFlipSwitchChange > DEBOUNCE_TIME) {
   // if time is > debounce time...

      int flipSwitchPIN = flipSwitch.first;                                  // get the flipSwitch pin
from configuration
      bool lastFlipSwitchState = flipSwitch.second.lastFlipSwitchState;          // get
thelastFlipSwitchState
      bool flipSwitchState = digitalRead(flipSwitchPIN);                        // read the
current flipSwitch state
      if (flipSwitchState != lastFlipSwitchState) {              // if the flipSwitchState has
changed...
#ifdef TACTILE_BUTTON
        if (flipSwitchState) {                                      // if the tactile button is
pressed
#endif
          flipSwitch.second.lastFlipSwitchChange = actualMillis;   // update
lastFlipSwitchChange time
          String deviceId = flipSwitch.second.deviceId;                // get the deviceId from
config
          int relayPIN = devices[deviceId].relayPIN;                          // get the relayPIN
from config
          bool newRelayState = !digitalRead(relayPIN);                        // set the new
relay State
          digitalWrite(relayPIN, newRelayState);                             // set the trelay to
the new state

          SinricProSwitch &mySwitch = SinricPro[deviceId];           // get Switch device
frSinricPro
          mySwitch.sendPowerStateEvent(!newRelayState);                  // send the event
#ifdef TACTILE_BUTTON
```

```
        }
#endif
        flipSwitch.second.lastFlipSwitchState = flipSwitchState;                // update
lastFlipSwitchState
      }
    }
  }
}

void setupWiFi()
{
  Serial.printf("\r\n[Wifi]: Connecting");
  WiFi.begin(WIFI_SSID, WIFI_PASS);

  while (WiFi.status() != WL_CONNECTED)
  {
    Serial.printf(".");
    delay(250);
  }
  digitalWrite(wifiLed, HIGH);
  Serial.printf("connected!\r\n[WiFi]: IP-Address is %s\r\n",
WiFi.localIP().toString().c_str());
}

void setupSinricPro()
{
  for (auto &device : devices)
  {
    const char *deviceId = device.first.c_str();
    SinricProSwitch &mySwitch = SinricPro[deviceId];
    mySwitch.onPowerState(onPowerState);
  }

  SinricPro.begin(APP_KEY, APP_SECRET);
  SinricPro.restoreDeviceStates(true);
```

```
}

void setup()
{
  Serial.begin(BAUD_RATE);

  pinMode(wifiLed, OUTPUT);
  digitalWrite(wifiLed, LOW);

  setupRelays();
  setupFlipSwitches();
  setupWiFi();
  setupSinricPro();
}

void loop()
{
  SinricPro.handle();
  handleFlipSwitches();
}
```

CHAPTER -6
RESULTS AND ANALYSIS

6.1: Advantages:

- When people are tired and not willing to go to the switch board to ON the device --- this Home automation gives more convience to people.
- This Home automation System helps to control all the devices from one place
- It helps to save power consumption.
- Having greater control over your home's energy usage and costs
- Improving the safety and security of your home
- Making your life more convenient by automating tasks like turning lights off/on or locking doors
- Increasing the comfort of your home with features like programmable thermostats
- Advantage of smart devices is that they can often save you money.

6.2: Disadvantages:

- Home automation requires internet to connect with the devices.It cannot be work properly when there is a internet issues.
- It works only within the limited wifi range.
- disadvantage is that they can be hacked. If someone were to hack into your home's system, they could control the lights, temperature, and even the locks on your doors.
- This could lead to everything from your lights being turned off unexpectedly to your doors being unlocked without your knowledge.

6.3: Applications:

Home robots and security: a household security system integrated with a home automation system can provide additional services such as remote surveillance of security cameras over the Internet, or access control and central locking of all perimeter doors and windows.

- Leak detection, smoke and CO detectors.
- Laundry-folding machine, self-making bed
- Indoor positioning systems (IPS).
- Home automation for the elderly and disabled.
- Pet and baby care, for example tracking the pets and babies' movements and controlling pet access rights.
- Air quality control (inside and outside). For example, Air Quality Egg is used by people at home to monitor the air quality and pollution level in the city and create a map of the pollution.
- Smart kitchen, with refrigerator inventory, premade cooking programs, cooking surveillance, etc.
- Voice control devices like Amazon Alexa or Google Home used to control home appliances or systems.

6.4: Results:

Fig15:Initial State

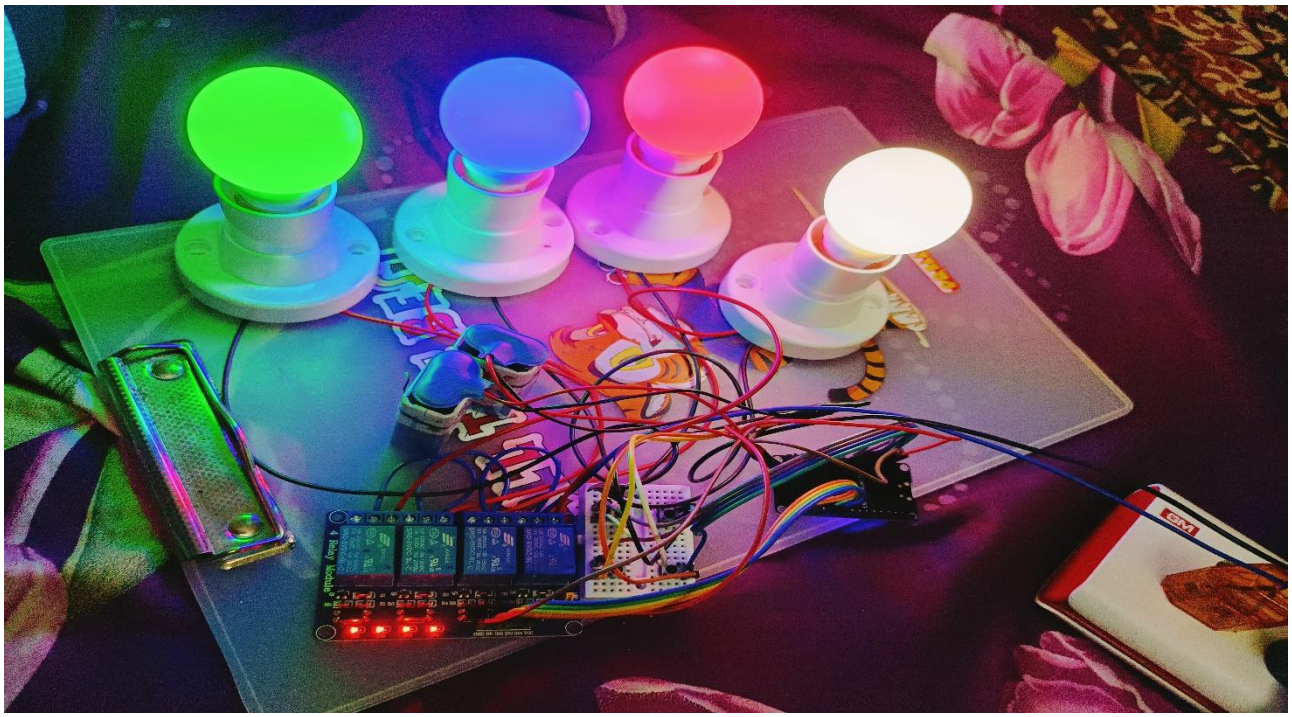


Fig16:Final Result

6.5: Conclusion:

The system as the name indicates ,'Home Automation System' makes the system more flexible and provides attractive user interface compared to other home automation systems. The system consists of mainly three components they are ESP32 microcontroller, and relay circuits. A smart home contains a connection between wireless communication they are huge systems with multiple technologies and applications involved that can provide security and control of home easily. In this project an efficient approach for smart homes was proposed and implemented. By activating the GOOGLE ASSISSTANT ,automatically we can turn on and off the electronic devices like light bulbs and fans.

6.6: Future Scope:

Historically a Smart Home was perhaps considered a luxury item and would be classed as more of a "want" rather than a "need". After all, people have been getting up off the sofa to turn their lights on and off manually for many years! Nowadays though, Home Automation systems bring all manner of benefits to you and your family - security, safety, comfort, convenience, energy efficiency and moneysaving.

Fig17 : Future Smart Home Devices

Smart devices are already available to suit most requirements, so in terms of the type (sensors, actuators, etc) we don't believe that there will be much development in that respect. Instead, evolution will take over, with existing products being improved in terms of technological advancements in the protocols that they use (WiFi, Z-Wave, Zigbee, etc) and in terms of the features and functionality that they offer.

CHAPTER -7
REFERENCES

[1]. IoT based Projects using ESP32 (Google + Alexa) - IoT 2023 (iotcircuithub.com)

[2]. Smart Home Automation System Based on IoT using Chip Microcontroller | IEEE Conference Publication | IEEE Xplore