SPEECH AUTOMATED HOME SYSTEM

PROJECT REPORT

TERM I (Year 2)

Submitted by

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ABSTRACT

IoT wants to connect all potential objects to interact with each other on the internet to provide secure, comfortable life for humans.

The Internet of Things makes our world as possible as connected together. Nowadays we almost have internet infrastructure wherever and we can use it whenever. Embedded computing devices would be exposed to internet influence. Common instances of embedded computing devices are MP3 players, MRI, traffic lights, microwave ovens, washing machines and dishwashers, GPS even heart monitoring implants or biochips and etc.

IoT tries to establish advanced connectivity among these mentioned devices or systems or services to little by little makes automation in all areas. The image that all things are connected to gather and all information would interact with each other over standard and different protocol domains and applications.

IoT in different sectors of life:

- Environmental Monitoring
- Infrastructure Management
- Industrial Applications
- Energy Management
- Medical and Healthcare Systems
- Building and Home Automation
- Transport Systems
- Large Scale Deployments

1. INTRODUCTION

Home automation refers to the automatic and electronic control of household features, activities, and appliances. In simple terms, it means you can easily control the utilities and features of your home via the Internet to make life more convenient and secure and even spend less on household bills.

Home automation is a network of hardware, communication, and electronic interfaces that work to integrate everyday devices with one another via the Internet. Each device has sensors and is connected through Wi-Fi, so you can manage them from your smartphone or tablet whether you're at home, or miles away.

For example,

This allows you to turn on the lights, lock the front door, or even turn down the heat, no matter where you are.

The purpose of a home automation system is to streamline how your home functions. Some of these benefits are:
- Remote access
- Comfort
- Convenience
- Increased safety
- Energy efficiency

2.OBJECTIVE

- To exclusively implement the speech recognition module in IoT Device(Raspberry Pi).

Speech Recognition is divided into two variants of voice recognition – **speaker-dependent** and **speaker-independent**.
Speaker-dependent voice recognition relies on the knowledge of the candidate's particular voice characteristics. This system learns those characteristics through voice training (or enrolment).

- The system needs to be trained on the users to accustom it to a particular accent and tone before employing to recognize what was said.
- It is a good option if there is only one user going to use the system.

Speaker-independent systems can recognize the speech from different users by restricting the contexts of the speech such as words and phrases. These systems are used for automated telephone interfaces.
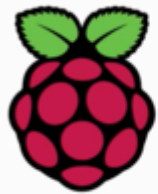
- They do not require training the system on each individual user.
- They are a good choice to be used by different individuals where it is not required to recognize each candidate's speech characteristics.

- To explicitly improve our livelihood by integrating Automation Systems in our houses.

- To experience high-level modern life using simple devices.

3.TECHNOLOGIES USED

➢ RASPBERRY PI OS

Raspberry Pi OS is a Unix-like operating system based on the Debian Linux distribution for the Raspberry Pi family of compact single-board computers. First developed independently in 2012, it has been produced as the primary operating system for these boards since 2013, distributed by the Raspberry Pi Foundation.

Raspberry Pi OS is highly optimized for the Raspberry Pi with ARM CPUs. It runs on every Raspberry Pi except the Pico microcontroller. Raspberry Pi OS uses a modified LXDE desktop environment with the Open box stacking window manager, along with a unique theme. The default distribution is shipped with a copy of the computer algebra system Wolfram Mathematical, and a lightweight version of the Chromium web browser.

➢ PUTTY

PuTTY is an SSH and telnet client, developed originally by Simon Tatham for the Windows platform. PuTTY is open-source software that is available with source code and is developed and supported by a group of volunteers.

PuTTY is a free and open-source terminal emulator, serial console, and network file transfer application.

It supports several network protocols, including SCP, SSH, Telnet, login, and raw socket connection. It can also connect to a serial port.
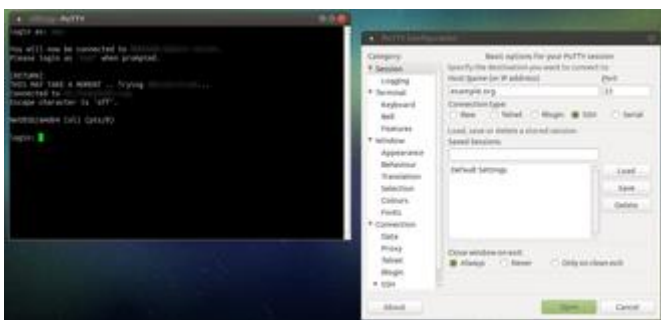
The name "PuTTY" has no official meaning. PuTTY was originally written for Microsoft Windows, but it has been ported to various other operating systems. Official ports are available for some Unix-like platforms, with work-in-progress ports to Classic Mac OS and macOS, and unofficial ports have been contributed to platforms such as Symbian, Windows Mobile and Windows Phone. PuTTY was written and is maintained primarily by Simon Tatham, a British programmer.

➢ VNC VIEWER

VNC viewer is a remote PC software that allows users to instantly and remotely access any computer—be it a Windows PC, Linux machine, or a Mac. Virtual Network Computing (VNC) is a graphical desktop-sharing system that uses the Remote Frame Buffer protocol (RFB) to remotely control another computer. It transmits the keyboard and mouse input from one computer to another, relaying the graphical-screen updates, over a network.

VNC is platform-independent – there are clients and servers for many GUI-based operating systems and for Java. Multiple clients may connect to a VNC server at the same time. Popular uses for this technology include remote technical support and accessing files on one's work computer from one's home computer, or vice versa.

VNC was originally developed at the Olivetti & Oracle Research Lab in Cambridge, United Kingdom. The original VNC source code and many modern derivatives are open source under the GNU General Public License.

➢ VNC SERVER

A VNC server is a piece of computer hardware or software that provides capabilities for other programs called
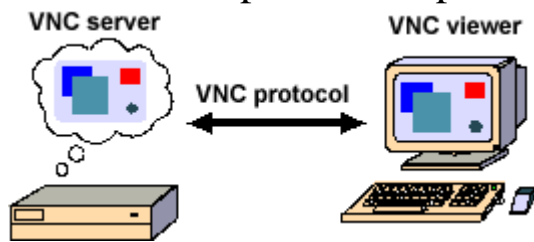
"clients." This is called the client-server model, whereas a server can provide services such as data or resource sharing to one or multiple clients

➢ ADVANCED IP SCANNER

Advanced IP Scanner is a free network scanner that can locate and analyze all computers available on your wireless or wired local network.
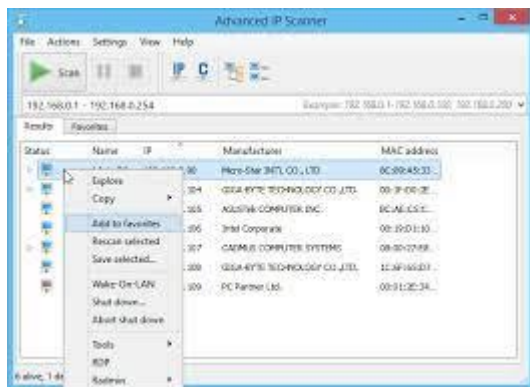
It is fast and free software for network scanning. It will allow you to quickly detect all network computers and obtain access to them. With a single click, you can turn a remote PC on and off, connect to it via Radmin, and much more.

4.DEVICES USED

The important devices used in the making of the project:

➢ Raspberry Pi 4:

Raspberry Pi is a series of small single-board computers (SBCs) developed in the United Kingdom by the Raspberry Pi Foundation in association with Broadcom.

The Raspberry Pi project originally leaned towards the promotion of teaching basic computer science in schools and in developing countries. The original model became more popular than anticipated, selling outside its target market for uses such as robotics. It is widely used in many areas, such as for weather monitoring, because of its low cost, modularity, and open design. It is typically used by computer and electronic hobbyists, due to its adoption of HDMI and USB standards.

➢ Mic:

The mic is the primary input device here we are using wired headphones.

➢ Speaker:

Speaker is the second output device in here we are using in the project.

➢ Relay Module:

A power relay module is an electrical switch that is operated by an electromagnet. The electromagnet is activated by a separate low-power signal from a micro controller. When activated, the electromagnet pulls to either open or close an electrical circuit.

Relay is one kind of electro-mechanical component that functions as a switch. The relay coil is energized by DC so that contact switches can be opened or closed. A single channel

5V relay module generally includes a coil, and two contacts like normally open (NO) and normally closed (NC). This article discusses an overview of the 5V relay module & its working but before going to discuss what is relay module is, first we have to know what is relay and its pin configuration.

Jumper Wires:

A jump wire (also known as jumper, jumper wire, DuPont wire) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

Female To Female Jumper Wires Female to Female jumper wire a highly useful connecting wire. It comes with female connectors at both ends, can be used to make quick connections between header pins, FRC pins, berg pins, etc. Excellent for rapid prototyping.

➢ Bulb:
The primary output device is where the input is converted into electrical energy.

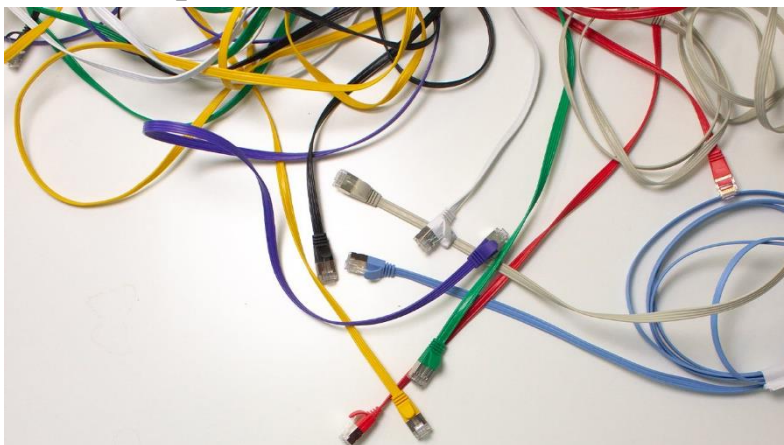We are using 6 watts LED light Bulb Orbit.

➢ SD Card:

Secure Digital, officially abbreviated as SD, is a proprietary non-volatile flash memory card format developed by the SD Association (SDA) for use in portable devices.

The standard was introduced in August 1999 by joint efforts between SanDisk, Panasonic (Matsushita), and Toshiba as an improvement over Multimedia Cards (MMCs), and has become the industry standard. The three companies formed SD-3C, LLC, a company that licenses and enforces intellectual property rights associated with SD memory cards and SD host and ancillary products.

The companies also formed the SD Association (SDA), a non-profit organization, in January 2000 to promote and create SD Card standards.SDA today has about 1,000 member companies. The SDA uses several trademarked logos owned and licensed by SD-3C to enforce compliance with its specifications and assure users of compatibility.

➢ LAN CABLE:
A LAN cable is a conductor that connects devices in a Local Area Network (LAN) with a network connector. The network cable provides communication between several devices (computers, routers, switches…). The term "LAN" is an overtake for Ethernet cable.

It was created in the 1970s by the XEROX company. Universities and laboratories were dependent on the interconnection of their

computers and terminals already at that time. Employee Robert Metcalfe wanted all computers to be able to print from XEROX's new laser printer. The local area network was born.

A lot has happened since the early days of LAN technology. We have already explained in more detail which standards exist today, which categories of cables, and which plug-in technologies are used and what an ethernet cable is.

5.PROBLEMS FACED

Timed Out error waiting for a response:
In Raspberry Pi, this occurs when the VNC server is not able to connect, and the response is not connected properly.

Host Not found:
The Raspberry pi is not connected and the Micro SD card is not connected properly.

Network Error:
The LAN cable not connected and the light of the LAN is not blinking.

Update error:
The Raspberry Pi needs update and the error in groovy is also need to be rectified.

Speech not recognised error:
The speech is not received properly as input and not processed.

Jumper wires not connected properly:
The female and male jumper wires needs to be connected properly.

6. LITERATURE SURVEY

Online References:

> https://www.xfinity.com/hub/smart-home/home-automation

There are three main elements of a home automation system: sensors, controllers, and actuators.

Sensors can monitor changes in daylight, temperature, or motion detection. Home automation systems can then adjust those settings (and more) to your preferences.

Controllers refer to the devices — personal computers, tablets or smartphones — used to send and receive messages about the status of automated features in your home.

Actuators may be light switches, motors, or motorized valves that control the actual mechanism, or function, of a home automation system. They are programmed to be activated by a remote command from a controller.

What features are available through home automation systems? Home automation systems offer a variety of services and functions. Some of the more common features available through these platforms include:

- Fire and carbon monoxide monitoring
- Remote lighting control
- Thermostat control
- Appliance control
- Home automation security systems and cameras
- Live video surveillance
- Alarm systems
- Real-time text and email alerts
- Digital personal assistant integration
- Keyless entry
- Voice-activated control

What are the benefits of home automation?

The purpose of a home automation system is to streamline how your home functions. Consider some of these benefits:

- Remote access: Control your home from mobile devices, including your laptop, tablet, or smartphone.
- Comfort: Use home automation to make your home a more comfortable, livable space. Preprogram your thermostat with your preferred settings so that your home is always at a comfortable temperature, set up smart speakers to play music when you get home from work, or adjust your lights to soften or brighten based on the time of day.
- Convenience: Program devices to turn on automatically at certain times, or access their settings remotely from anywhere with an Internet connection. When you don't have to remember to lock the door behind you or switch off the lights, you can turn your attention to more important things.
- Increased safety: Smart fire detectors, carbon monoxide monitors, pressure sensors, and other home automation security features can help protect your home from disaster.
- Energy efficiency: Home automation allows you to be more mindful of your power usage. For example, you can save on energy bills by reducing the length of time that lights stay on, or by lowering temperatures when you leave a room.

Contact Xfinity Home to get a fully integrated home automation system set up in your home today. After the professional installation of a home automation system is complete, you can enjoy the benefits of living in a safer, smarter home.

- https://www.instructables.com/Iot-Based-Home-Automation-System-With-Speech-Recog/

- https://www.tutorialspoint.com/biometrics/voice_recognition.htm#:~:text=The%20objective%20of%20voice%20recognition,%2C%20voice%20pitch%2C%20and%20accent
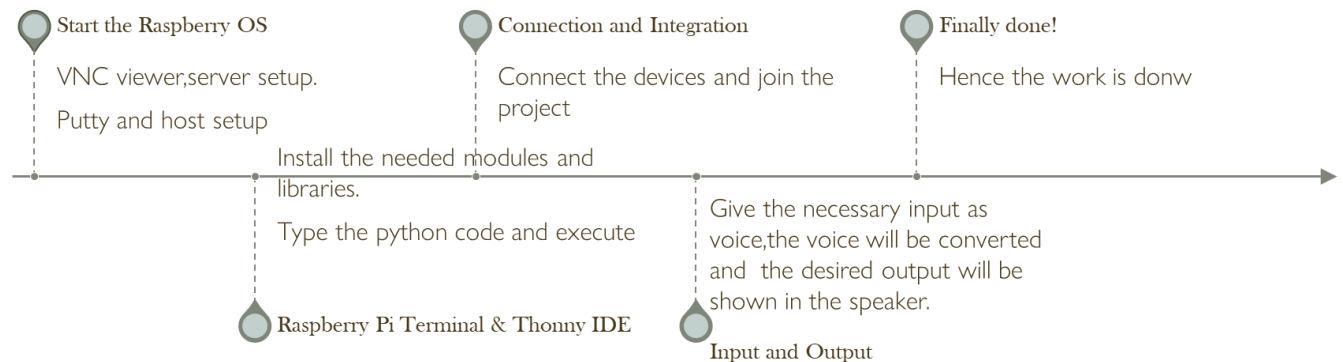
Book References:

- Relay literature 2000 IEEE committee report – Tarlochan Sidhu (Ontario Tech University)
- Overview of the Speech Recognition Technology-Jianliang Meng,Junwei Zhang, Haoquan Zhao
- A Study on Automatic Speech Recognition-(Human Computer Interaction)Saliha Benkerzaz,Youssef Elmir,Abdeslem Dennai
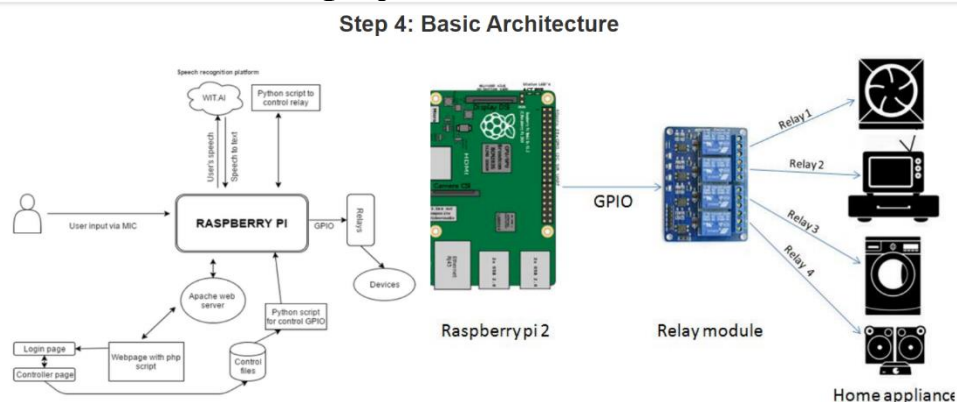
7. IMPLEMENTATION:

The workflow of the project is given below:

Start the Raspberry OS

VNC viewer,server setup.

Putty and host setup

Install the needed modules and libraries.

Type the python code and execute

Raspberry Pi Terminal & Thonny IDE

Connection and Integration

Connect the devices and join the project

Give the necessary input as voice,the voice will be converted and the desired output will be shown in the speaker.

Input and Output

Finally done!

Hence the work is donw

Basic Architecture of the project is shown below:

Step 4: Basic Architecture

The entire system consists of two parts:

1. Speech recognition

The speech recognition uses a python script called speechrecognition.py. This python script uses speech recognition library to record and process speech.
It uses the wit API online Speech-To-Text platform to convert speech to text. When the user provides the speech through the microphone

the speech gets recorded by the python script in WAV format and is send to the wit platform along with an unique API key provided by the wit account.

Once the audio file reaches wit it converts it in to text using their advanced speech recognition algorithm. The text is then send back to the python script. In the python script it is checked with the predefined commands to turn appliances on or off.

If the phrase matches with text received then the corresponding string (ON or OFF) is written to the file of respective relay. A python script is used called iot.py.

It monitors the content of the files for each relays (relay1.txt – relay4.txt). Based on the content of the file ie either "ON" or "OFF" the python scripts turns the GPIO pin high or low for each of the relay connected to it.

2. Web Interface

The Raspberry pi hosts the web pages to control devices through an Apache web server. The web pages include index.html, controller.php, button.php, checklogin.php, logout.php. There file defined for each relay containing the string "ON" or "OFF". The index page acts as the home page.

Once user logs in with a username and password the checklogin page checks the credential with a preset credential. If a match occurs user will be redirected to controller page with after setting a session variable else user will be redirected to login page.

In the controller page user can switch device on or off through buttons. On press of each button a button page is invoked which checks the button id and writes appropriate string to the corresponding relay file.

A python script is used called iot.py. It monitors the content of the files for each relays (relay1.txt – relay4.txt). Based on the content of the file ie either "ON" or "OFF" the python scripts turns the GPIO pin high or low for each of the relay connected to it.

Thus the relay turns on and off based on user input and any appliance can be connected to it to get controlled via internet.

8.FUTURE ENHANCEMENTS:

Further,improvements such as fully giving a full-fledged home automated system.

1. **Smart Homes:** Currently, home automation systems operate on voice commands, but in the future, they could evolve into intelligent systems that know what to do even in the absence of human voice commands. Their smart technology could extend their functionality to a range of actions that offer unmatched convenience.

2**. Home Security:** While advanced home security systems of today have the capability of remote monitoring and safety alerts, with technological advancements, these systems will come with advanced capabilities such as fences with motion sensors that alert homeowners about unusual intrusions (as opposed to false alarms every time the pet jumps over the fence) and drones that automatically activate, based on an alert, to follow the intruders and monitor their actions.

3. **Network Infrastructure:** In the smart home of the future, the increased number of intelligent devices will require improved network infrastructure. Gadgets need to be always connected so that they can work when needed, thereby increasing dependency on a reliable and stable Internet connection. Wi-Fi mesh or other self-configuring networks that allow multiple devices to connect to it and detect and resolve connectivity issues before it reaches the customer complaint stage will provide a more reliable smart home network in the future.

4. **Personal Health & Fitness** :For monitoring health-related needs of every resident within the home, devices such as smartwatches, fitness trackers, smart scales and wearables such as smart clothes can help to track fitness and wellness to improve quality of life by continuously monitoring health information and updating personal fitness benchmarks.

Advantages of Internet of Things (IoT) in Home Automation:

1. *Self-sufficient IoT-enabled home automation* systems can optimize available resources such as energy and water, making the home more self-reliant through water harvesting or harnessing energy from alternative sources such as solar or wind power.

2. ***Cost-effective*** While smart appliances cost significantly higher than conventional ones, by automatically regulating the thermostat or air-conditioning, switching off lights when they aren't needed or even dimming lights based on the time of the day, they help to save energy, thereby contributing to cost savings in the long term.

3. ***Energy-efficient*** Smart homes go beyond mere energy saving to provide an eco-friendly and sustainable alternative to homeowners with features such as intelligent heating, sensor-activated stoves, water-conserving showerheads and other devices that minimize the use of energy within the home.

4. ***Provides Better Quality of Life*** With a higher degree of personalization, smart homes automate several actions, leaving homeowners with a lot more time on their hands to do what they enjoy. Moreover, since they work on voice commands, they can significantly benefit people with disabilities or even older adults or young children who find it challenging to operate appliances.

9. CONCLUSION

Finally conclude, home automated system is better with the IoT device as it is most evolving in this technological era.
With the move of our mouths,we can intensively connect the whole house.
Our voice is the basic need in tech and this is a the next step to evolution.The two main advantages to implementing speech recognition in factories are increased production efficiency and improved workplace ergonomics.

Factory operators are often dealing with heavy objects and machinery. Currently, they must press physical buttons fixed at specific locations to move or manipulate these objects.
Physically reaching and pressing the buttons is slow, and the repetitive actions can also have an ergonomically negative impact on workers' health.
It is much more convenient for the workers to execute the appropriate movements just by using their voice.

APPENDIX:

CODE:

Connecting USB Microphone with Raspberry Pi

```
alsamixer
```

To test the microphone, use the LX-terminal and record your clip. Use the following command to start recording. The recording will be saved in the test.wav file.

```
arecord -D plughw:1,0 test.wav
```

To play the test.wav file, enter the following commands in the terminal.

```
aplay test.wav
```

Libraries required for Speech Recognition on Raspberry Pi

```
sudo apt-get install espeak
sudo pip3 install SpeechRecognition
sudo pip3 install PyAudio
```

Use the following command to test espeak. If it is installed correctly, you will hear 'hello world'.

```
espeak "Hello world"
```

Raspberry Pi Speech Recognition Program

```
from subprocess import call
import speech_recognition as sr
import serial
import RPi.GPIO as GPIO
```

```python
def listen1():
    with sr.Microphone(device_index = 2) as source:
            r.adjust_for_ambient_noise(source)
            print("Say Something");
            audio = r.listen(source)
            print("got it");
    return audio
```

```python
def voice(audio1):
    try:
        text1 = r.recognize_google(audio1)
##       call('espeak '+text, shell=True)
        print ("you said: " + text1);
        return text1;
    except sr.UnknownValueError:
        call(["espeak", "-s140  -ven+18 -z" , "Google Speech Recognition could not understand"])
        print("Google Speech Recognition could not understand")
        return 0
    except sr.RequestError as e:
        print("Could not request results from Google")
        return 0
```

```python
def main(text):
        audio1 = listen1()
        text = voice(audio1);
        text = {}
```

```python
        if 'light on' in text:
            GPIO.output(led , 1)
            call(["espeak", "-s140  -ven+18 -z" , "okay  Sir, Switching ON the Lights"])
            print ("Lights on");
        elif 'light off' in text:
            GPIO.output(led , 0)
            call(["espeak", "-s140  -ven+18 -z" , "okay  Sir, Switching off the Lights"])
            print ("Lights Off");
        text = {}
```

```
if __name__ == '__main__':
 while(1):
     audio1 = listen1()
     text = voice(audio1)
     if text == 'hello':
         text = {}
         call(["espeak", "-s140  -ven+18 -z" ," Okay master, waiting for your command"])
         main(text)
     else:
         call(["espeak", "-s140 -ven+18 -z" , " Please repeat"])
```
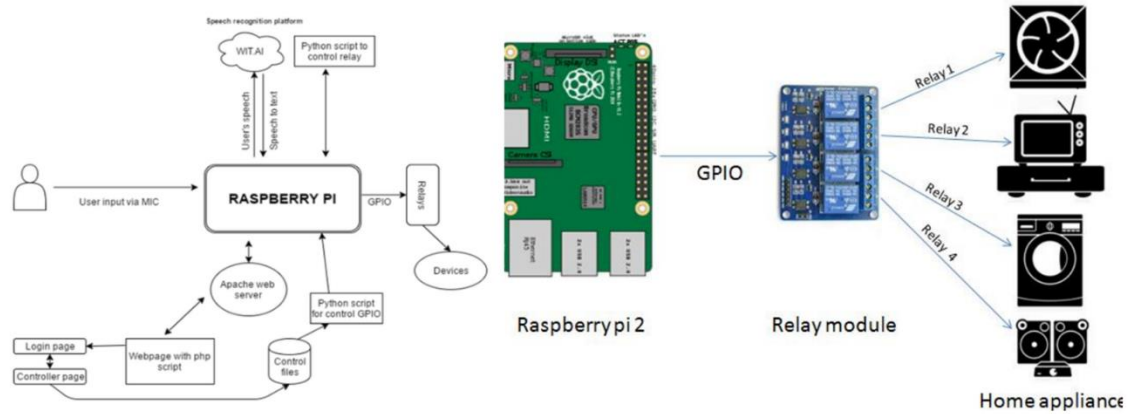
In Thonny IDE,

import speech_recognition as sr
def hear():
  r=sr.Recognizer()
  with sr.Microphone() as source:
    print("Say Now!!")
    r.adjust_for_ambient_noise(source)
    audio=r.listen(source)
    txt=""
    txt=r.recognize_google(audio)
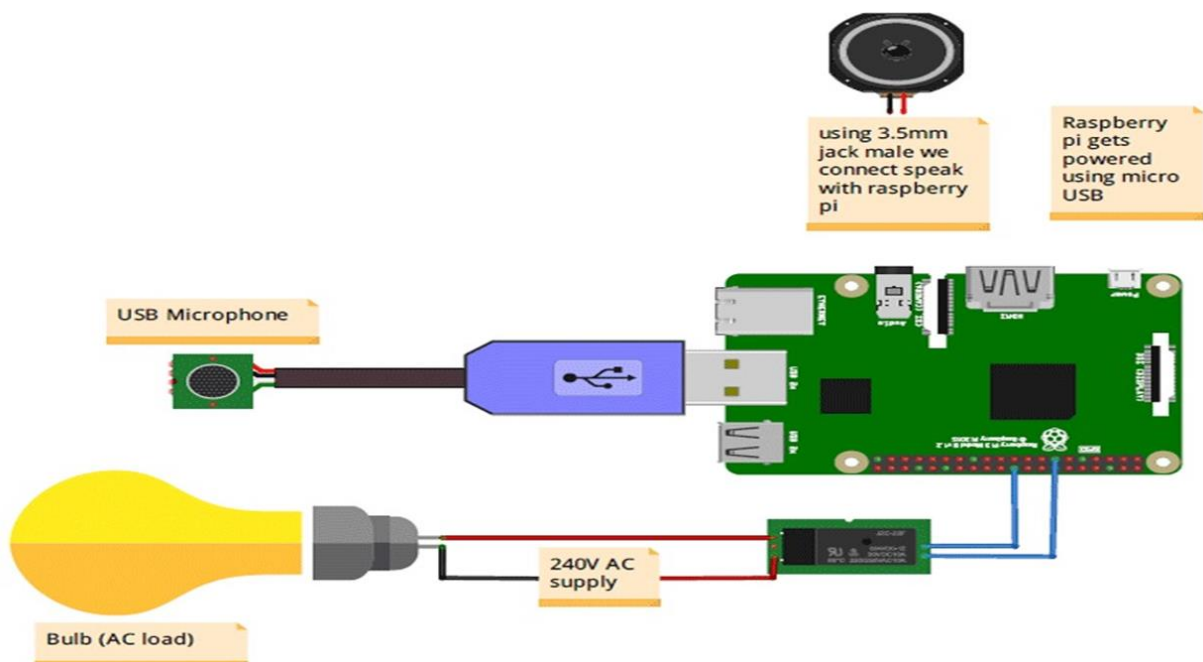   *print("The Given Command Is:",+," ",+txt)*
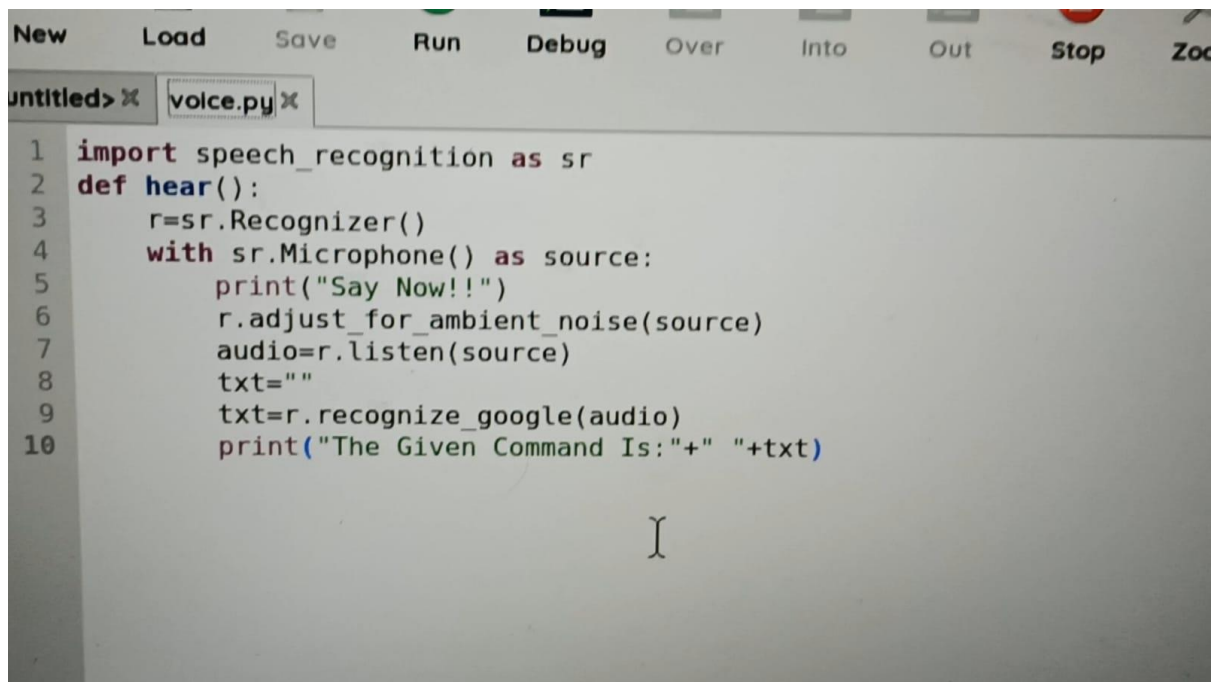
PROJECT SETUP:

Step 4: Basic Architecture

Project Design:

using 3.5mm jack male we connect speak with raspberry pi

Raspberry pi gets powered using micro USB

USB Microphone

Bulb (AC load)

240V AC supply

OUTPUT IMAGES:

In thonny IDE, The python code screen:
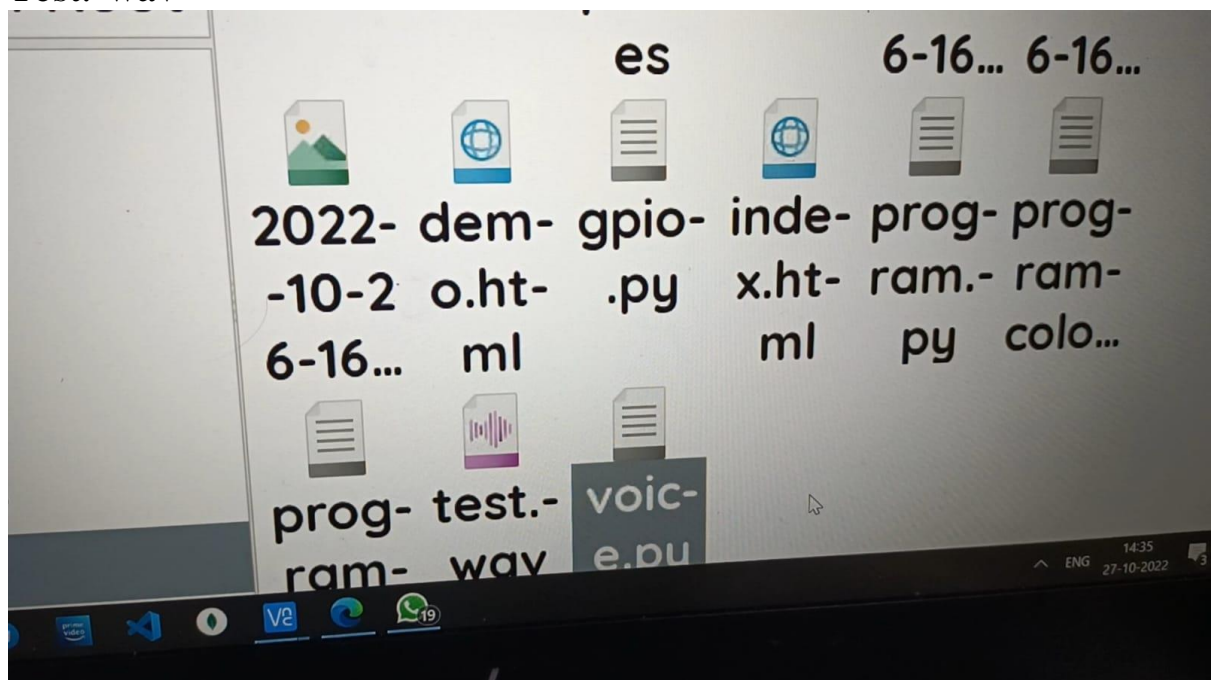
```
New        Load       Save      Run      Debug      Over      Into      Out      Stop      Zoo

untitled> X   voice.py X

1   import speech_recognition as sr
2   def hear():
3       r=sr.Recognizer()
4       with sr.Microphone() as source:
5           print("Say Now!!")
6           r.adjust_for_ambient_noise(source)
7           audio=r.listen(source)
8           txt=""
9           txt=r.recognize_google(audio)
10          print("The Given Command Is:"+" "+txt)
```
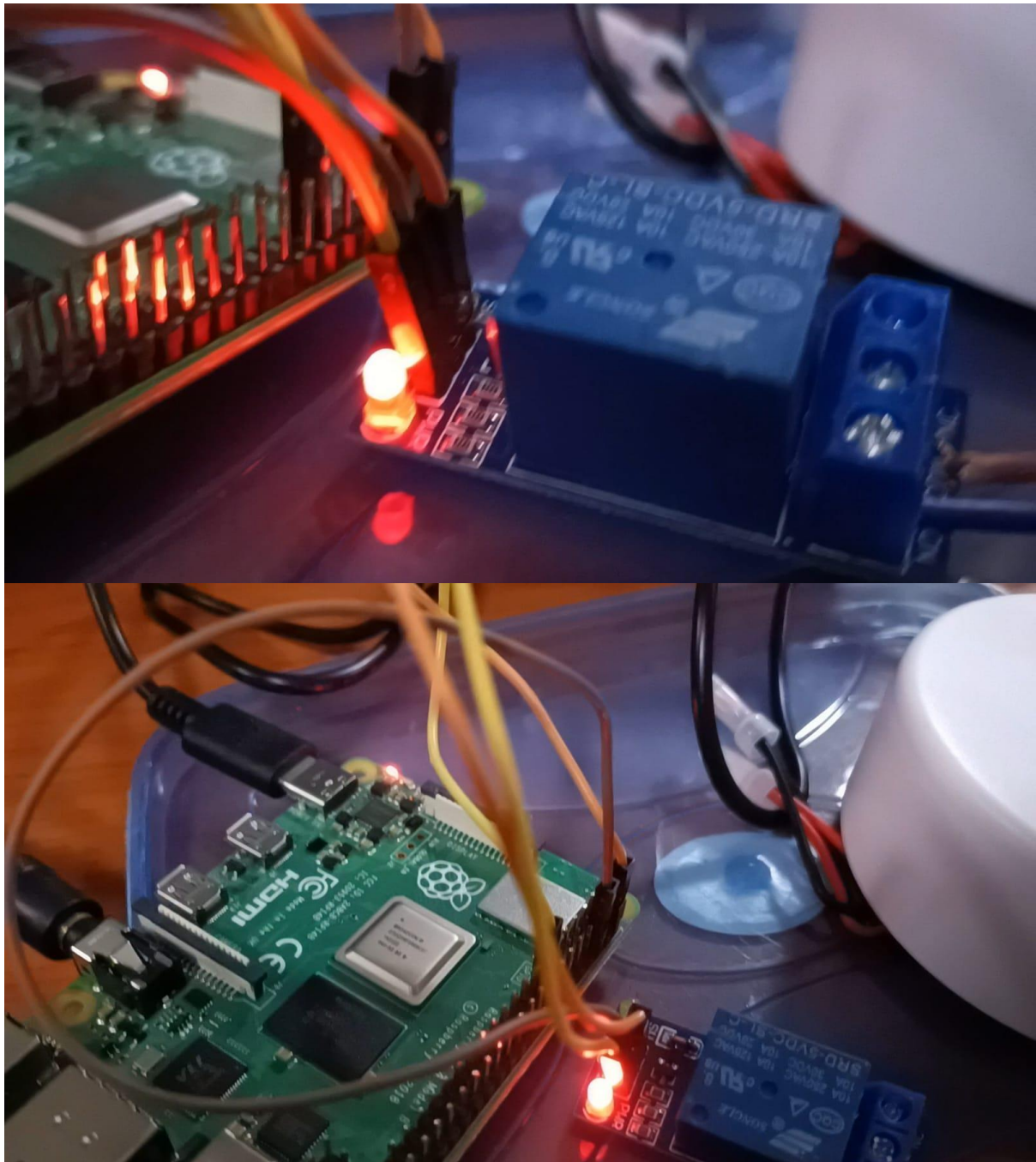
The saved files in raspberry pi os:
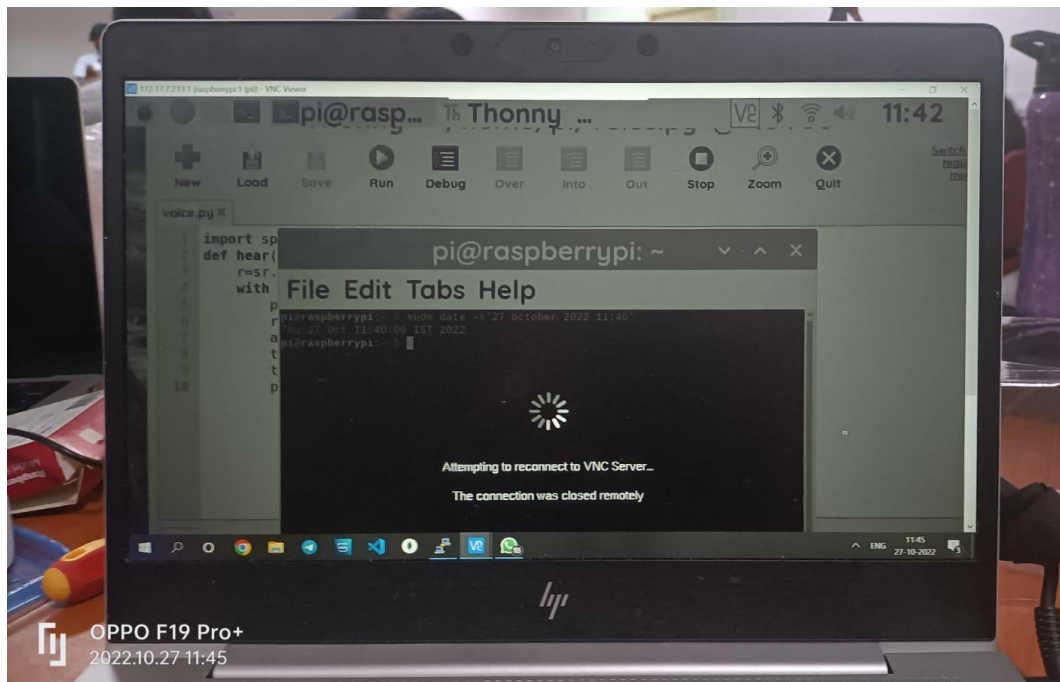Voice.py
Test.-wav

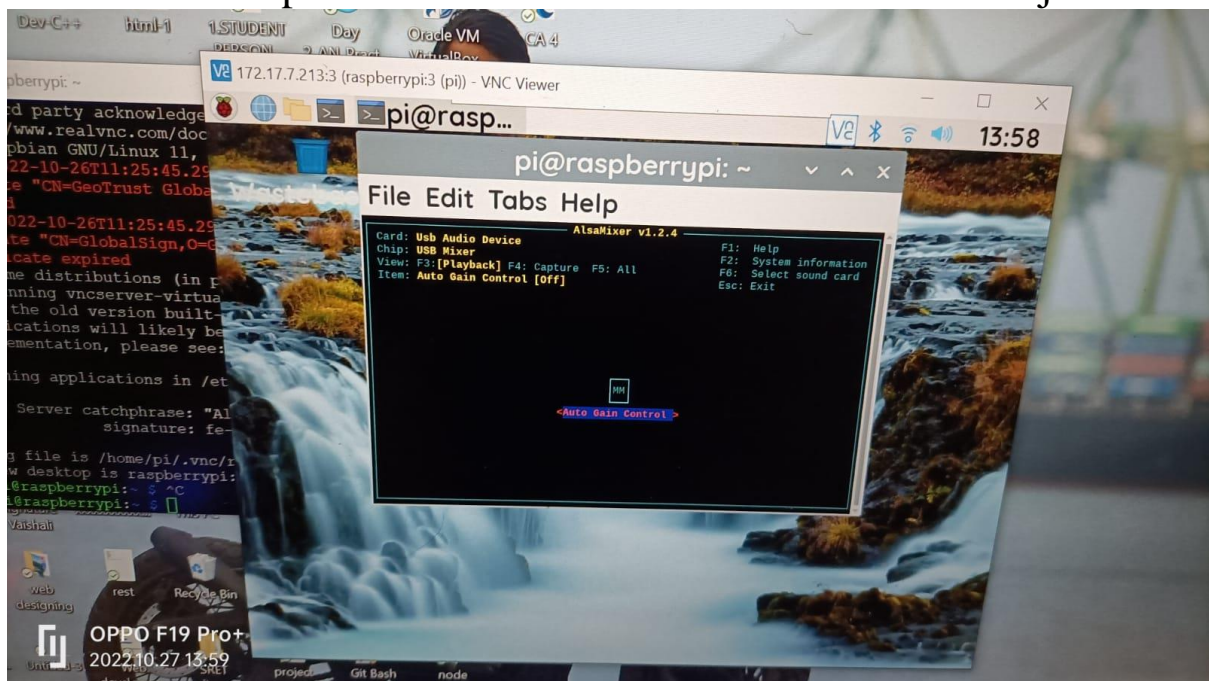The relay module connected to raspberry pi with the LED(white) on the side:

The error encountered screen picture:

The alsamixer opens this screen where the volume can be adjusted:

The project setup with mic speaker led light bulb: