

Secure Vocal Home Appliances Control

EE381-EC Project (Section D)

Vipul Bajaj - 160794
Yogesh Kumar - 160831

Contents

- Problem Definition
 - Materials Used
 - Approach for solving the Problem
 - Prototyping Methodology
 - Results Obtained
 - Possible Future Work
 - References
-

Problem Definition

- The concept of Home Appliance Control is gaining popularity as it helps in reducing human effort also it is really helpful for handicapped people. There are many approaches to do it. In this project we are using vocal commands to achieve automation. In this project different appliances are controlled by sending specific voice messages.
- Here we can control the appliances both by text messages and by voice messages

Problem Introduction

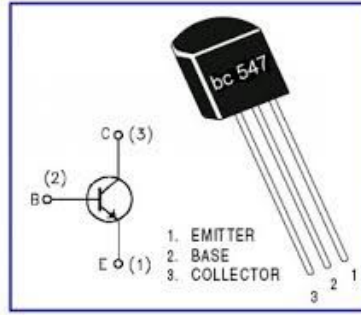
- In this project, we have speech controlled devices, where only the **registered users** can give commands to switch on/off the appliances. We implemented this feature using state of the art machine learning models(ResNet-18) to classify **STFT(Short-Time Fourier Transforms)** of the received audio signal. This makes our product really secure.
- Here we have an app which converts the speech signal into a string which is then sent to the bluetooth module which is received by the microcontroller and it performs the actions according to the message. This project has been implemented using Arduino NANO, Bluetooth and a smartphone.

Materials and softwares used

- Components-
 - Arduino NANO – 1
 - HC – 05 Bluetooth Module – 1
 - NPN Transistor – 4
 - 5V Relay – 4
 - 270 Ω Resistor
 - PN Junction Diode – 4
 - Power Supply
 - DC Motor, 12 V DC Fan, CFL Bulb, LED
- Software-
 - Arduino IDE



12 V DC fan



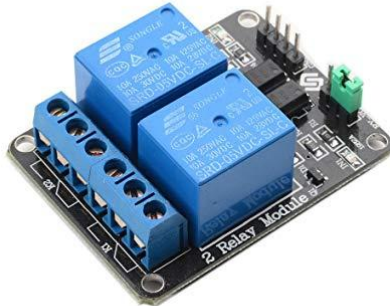
BC 547 BJT



HC-05 Bluetooth Module



DC Motor



2 in 1 Relay



Arduino Nano

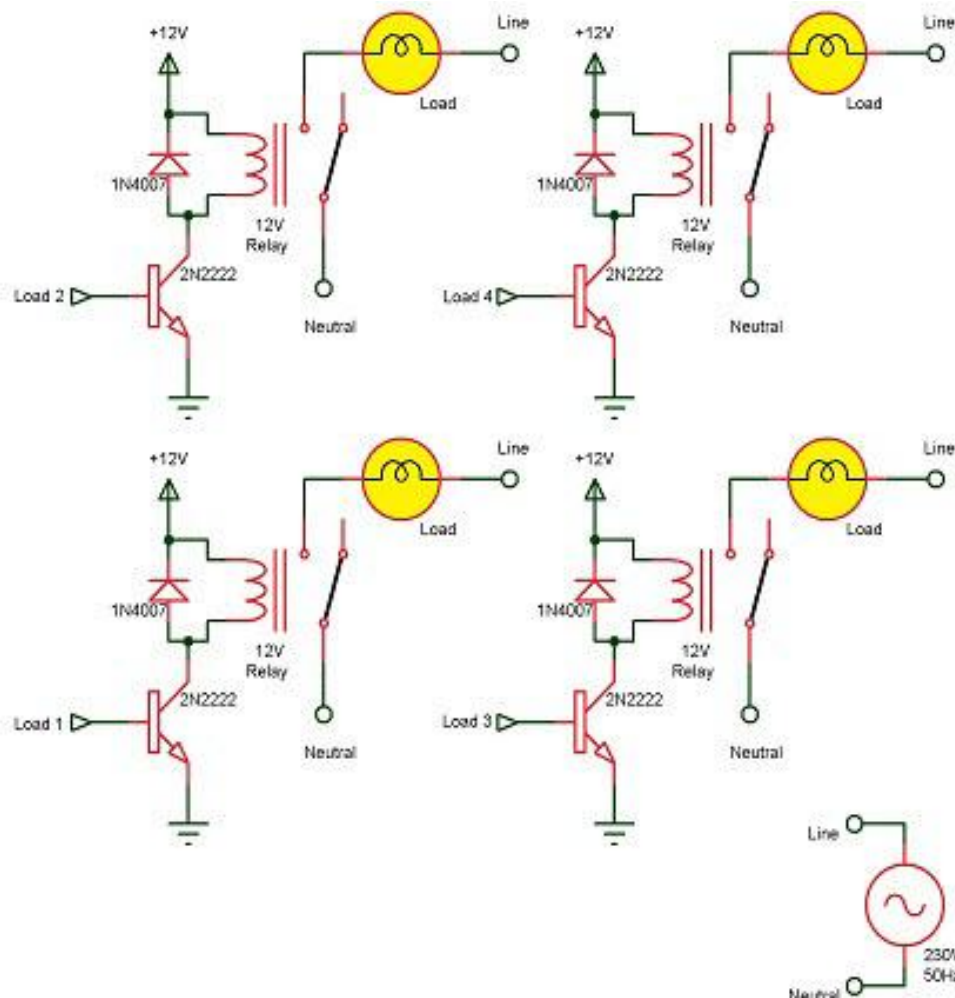
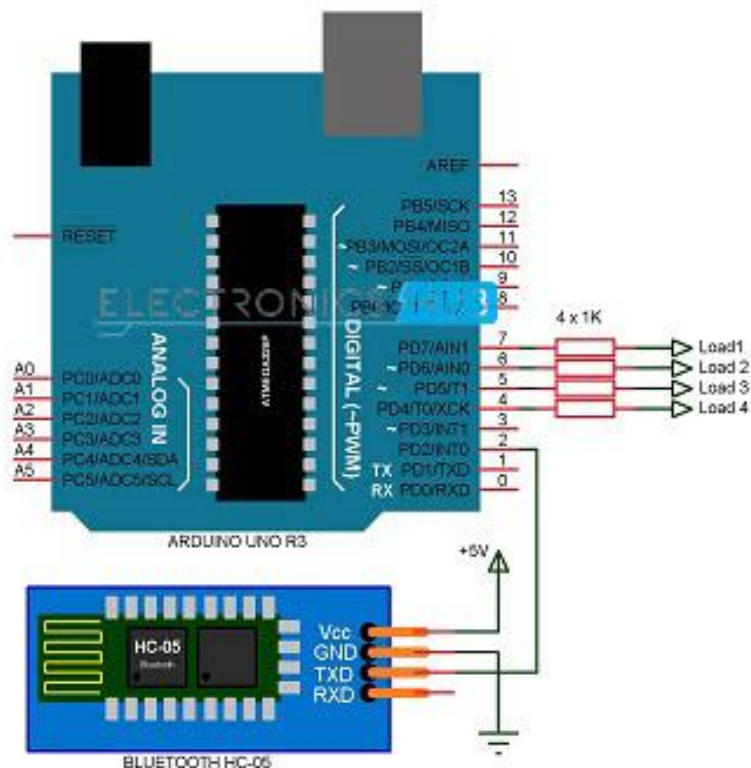


Diode

Approach for solving the Problem

- We pair the Phone's Bluetooth to the HC – 05 Bluetooth Module. We then use an android app to send the voice messages to the bluetooth HC-05 module in text form.
- The message is then transmitted to the arduino by using serial software communication.
- According to the string received by the arduino the corresponding pins are set to a high value.
- Relay are used as to give an output of 5 V

Prototyping Methodology



Arduino - Voice control via Bluetooth


Connect Map

Tap to speak

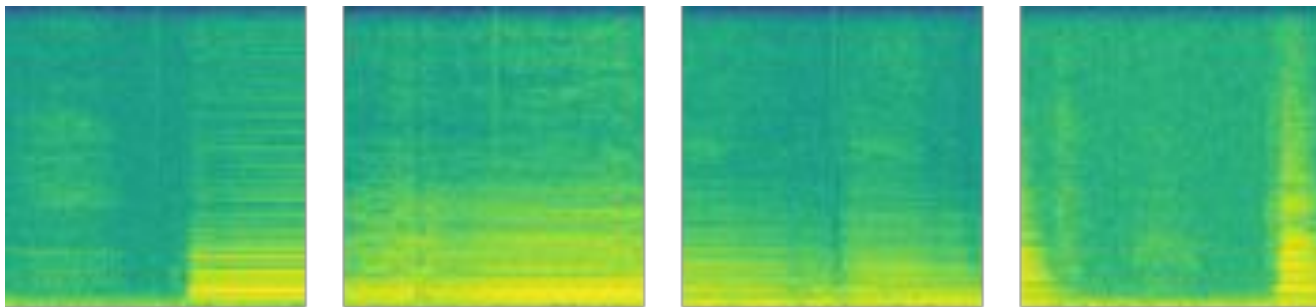
☒ Automatically Send

Repeat Last Command

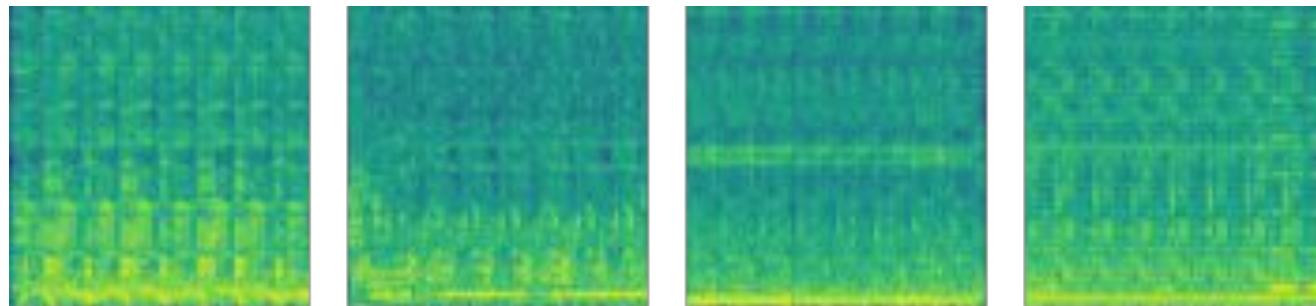
Text To Send Submit

 ARDUINO

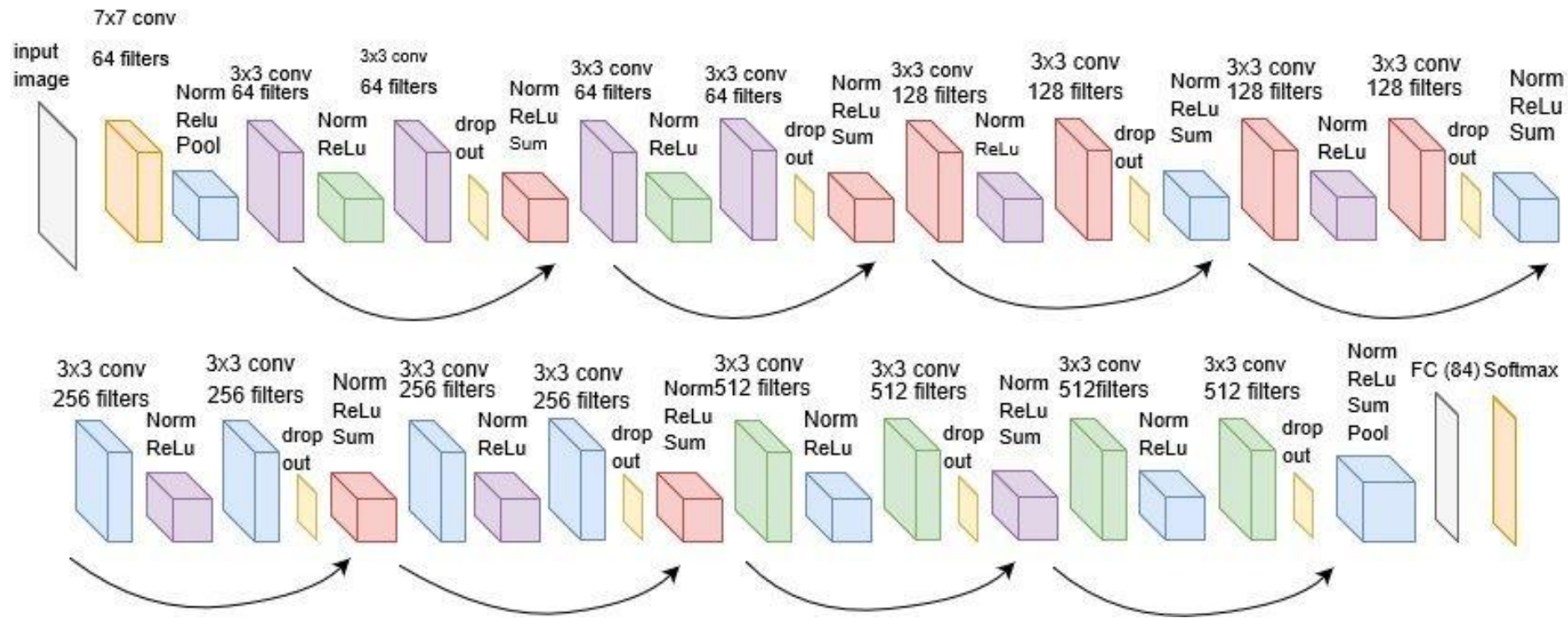
Prototype- App Interface



Audio Spectrograms of registered users



Adversarial Audio Spectrograms of non-registered users and noise



ResNet-18 Architecture(Machine Learning)

Circuit Design

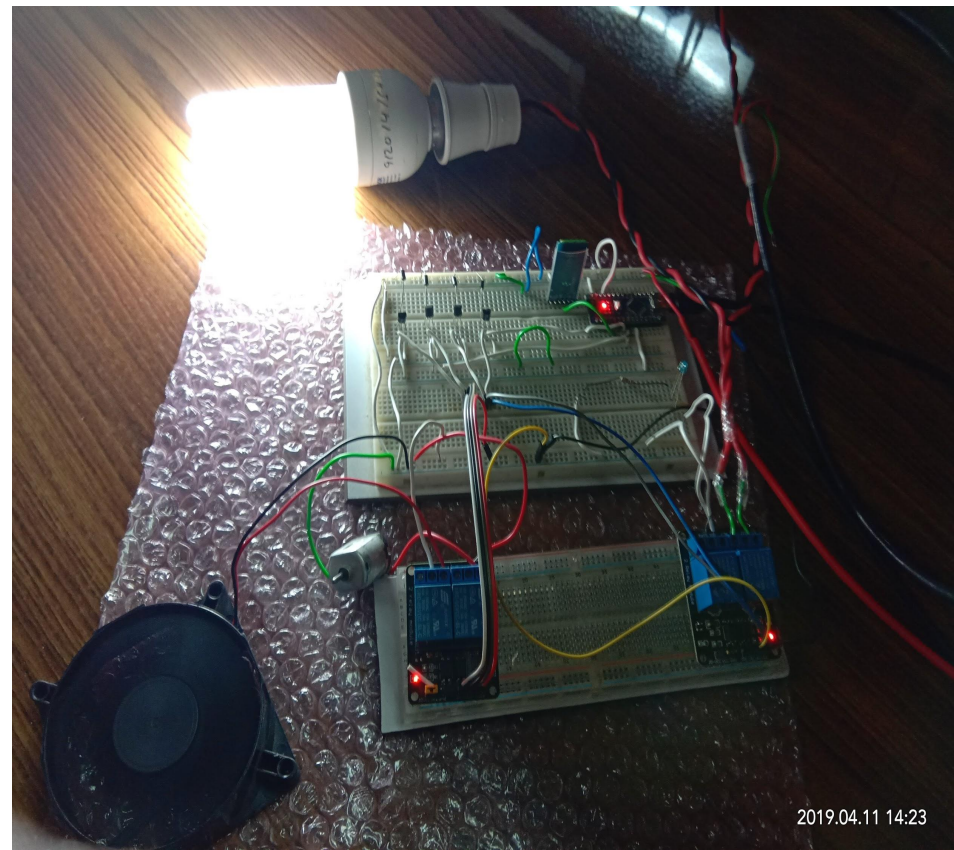
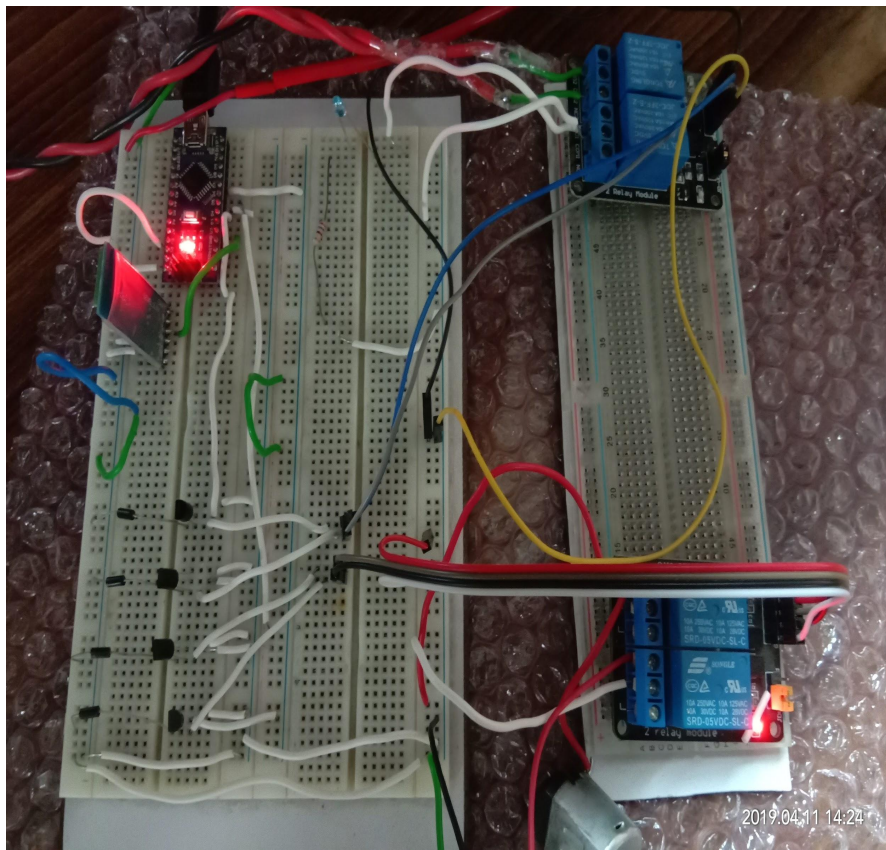
- First, we will connect the Bluetooth Module to the Arduino. Since Bluetooth uses UART protocol, we need to use the RX and TX pins of the Arduino. We will be using “SoftwareSerial” library to define our own RX and TX pins (Pin 2 is RX and Pin 3 is TX)
- Next, we connect the relays to the Arduino. Since we used a readymade relay board with 2 – channels, all we need to do is to connect the inputs of the individual relays to the Arduino. For detailed connection like the resistor, transistor, diode and relay, refer the circuit diagram.

Working of the Android App

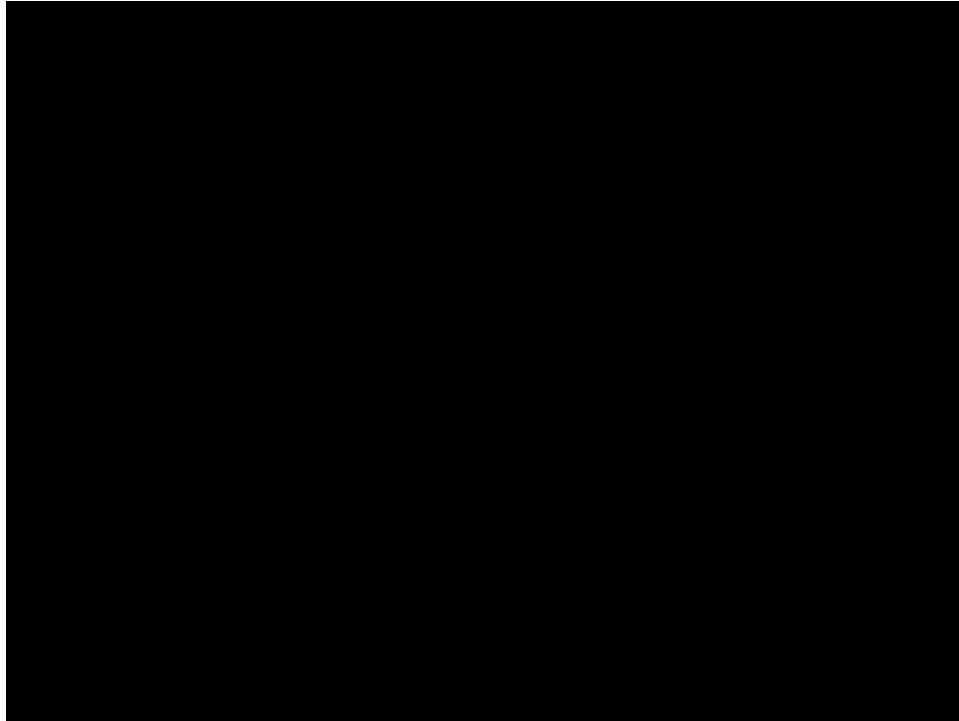
- The android app connects with the bluetooth HC-05 module using phone's bluetooth.
- The android app sends the message to google to convert the voice message into text message and then sends it to the bluetooth module.
- The bluetooth module then sends the data to the arduino module via a connection between the transmitter pin of the bluetooth and the receiver pin of the arduino
- As soon as data becomes available to the arduino the data is read as a string.
- Depending on the message the corresponding pin is set high or low.
- Using the relay circuit the corresponding appliance is turned on or off.

Results Obtained

- We successfully implemented the circuit for secure vocal home appliances control.
- We were able to control the switching on and off of all the appliances both by text messages as well as sound messages
- The bluetooth module works really well in receiving the data from the phone from a close range.
- The code produced has been uploaded on GitHub - [link](#)



Circuit Implementation on Breadboard and working prototype



Video - Working Prototype

Applications

- This system will help us control different appliances with simple voice commands which is very useful for people with disabilities.
- Further, the project can be expanded by adding different sensors (light, smoke, etc.) and build a full scale home automated system.

Possible Future Work

- We can use a Wifi module to control appliances even from long distances.
- We can build the same project on a much larger scale to have a fully automated home.
- We can also make it more secure by using newer and more complex speech classification algorithms in place.

References

- For voice controlled home automation, our circuit and code was inspired by the following webpage link:
<https://www.electronicshub.org/voice-activated-home-automation/>
- We referred to a number of youtube videos to understand the method of communication between arduino and bluetooth module :