Project Synopsis

Smart Glove for Physically Disabled

Submitted by

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in partial fulfillment for the award of the degree

BACHELOR OF ENGINEERING

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Under the Guidance of

Mrs. Shilpa Chaman

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ABSTRACT

Communication plays an important role for human beings. This device helps in improving the communication with the deaf, dumb and physically disabled people using flex sensor technology. Smart Glove for Physically Disabled is a device that can translate different sign language to text as well as voice note, the audio will be in Hindi language. Gesturing is an inherent way of communicating to define the thoughts. The people who are communicating with deaf and dumb may not understand their signs and expressions. Hence, an approach has been created and modified to hear the gesture-based communication. This device will be very helpful to physically disabled for communicating their thoughts to others. In the proposed system, the device's primary objective is to convert hand gestures into vocal and text output through flex sensors. Flex sensors play the major role. The gestures are produced by bending in the sensors, due to bending, there is a variation in the resistance. The change in resistance depends upon the amount of flexion experienced by the sensors. By using the suitable circuit, responses of the sensors are collected by Arduino and serially communicated with raspberry pi for processing. Raspberry pi is a small microcomputer is used for the working of the program in the hardware circuit which offers high reliability and fast response. Here the device recognizes the sign language on the mapping of gestures. The main advantage of using this device is to recognize letters and words. The vocal output is in the form of predefined vocal commands where each gesture is associated with an appropriate command. Our project will lower the barrier in the way of communication between the physically disabled and normal people.

CERTIFICATE

This is to certify that Jaspreet Singh Bahal, Sakina Baranwala, Gavin Furtado and Rupesh Jaisawar are the bonafide students of St. Francis Institute of Technology, Mumbai. They have successfully carried out the project (Stage-II) titled "Smart Glove for Physically Disabled" in partial fulfilment of the requirement of B. E. Degree in Electronics and Telecommunication Engineering of Mumbai University during the academic year 2019-2020. The work has not been presented elsewhere for the award of any other degree or diploma prior to this.

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Signatures of all the students in the group

(Jaspreet Singh Bahal)

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Chapter 1

Introduction

1.1 Motivation

Loss of hearing and speech can cause people to be lonely and isolated. This can cause some bad effect in their both social and working life. The advancement of embedded system provides a space for designing and developing a translator for sign language to assist in reducing the communication gap between speech and hearing-impaired people and normal people. Hand gesture or sign language is a way to communicate between impaired and normal people. Finding an expert interpreter for day to day activities is very difficult and unaffordable. For ease of communication between impaired and normal people we employed various electronics and digital methods.

1.2 Scope of the Project

Gestures might either complement one's speech or totally substitute it especially in the case of the hearing and speech impaired people. However, such differently abled people often have trouble communicating with other people and find themselves in an embarrassing situation. This is because different gestures might be used by different people to convey the same message. Hence, we make an intelligent system comprising which can be customized to the gestures that a person is comfortable with and translates them into textual messages or speech. A Raspberry Pi based hand gesture which takes gesture input through flex sensors and gesture recognition through predefined results provided and then converting the hand gestures into predefined voice commands, this enhances the communication between deferentially abled and normal people thus providing and efficient way to communicate. Moreover, the above idea can be expanded to implement general purpose gesture recognition specifically modelled as a tool for designing and working with virtual objects.

1.3 Organisation of the Project

1.3.1 Literature Survey

In the Initial stages of the conceptualization of this project, the survey of literature on the study work that is already done in this field has been detailed along with the survey of various literature papers where it is focused on four papers which were much relevant to the project. Some of the reference papers related to this field were referred for the understanding of concept and the human-computer interface.

1.3.2 Hardware and Software support

A list of the hardware components and also the software being used for implementation of the project along with their availability and description. A brief introduction of the hardware components being used in the project which includes the description of theory background and also theory of the espeak library in python language for speech conversion were done.

1.3.3 Methodology

The various type of sign language and how does those signs can be implemented on the sensors were done as well as the number of sensors that should be used in the project. And how to convert their data after sensing into voice command and LCD display were researched

1.3.4 Results and Discussion

In the process of conversion of input data into appropriate output, meant that this gesture should be applicable for this action only not any other action. And the due to changes in one sensor does the result for any other sensor changes such kind of dissertation was done.

Chapter 2

Literature Survey

This chapter covers the literature review from different sources related Smart glove for physically disabled-invention of other's project, technology and current industrial product. Observations and findings of their advantages and recommendation from the studies are discussed in this chapter. A portable embedded system which can be a simple solution for detection of hand gestures for speechless patients. Gestures of fingers of a user of this glove will be converted into synthesized speech to convey an audible message to others, for example in a critical communication with doctors. The glove is internally equipped with multiple flex sensors that are made up of "bend-sensitive resistance elements". For each specific gesture, internal flex sensors produce a proportional change in resistance of various elements. The processing of this information sends a unique set of signals to the AVR micro-controller which is pre-programmed to speak desired sentences. Different research on sign language was done like what are the gestures for a sign language. There were several methods available for getting the data of gestures.

- EMG
- MMG
- Load cell
- Wearable conductive fiber
- Deterioration of fiber optic cable
- Sliding fiber optic cable
- Strain gauge tactile sensor
- Flex Sensor

From all this methods Flex sensors were used for signal acquisition it was the best solution provided by the authors. Flex sensors convert the change in bend to electrical resistance. The more the bend, more will be the resistance. SpeakJet needs a definite 8-bit code to speak. It generates synthesized voice that is audible to humans. By combining many phonemes, a word is made and by adding them makes a sentence. The synthesized voice output from SpeakJet is not much audible to human ears therefore; it is fed to an amplifier that enhances its volume [1].

There are five flex sensors used on the glove. The gestures are decoded by the Raspberry Pi. Every gesture has a specific meaning to it. Whenever a gesture is made it will

show a binary code of 5 digits. And Every 5-digit code is interpreted to a predefined text. GPS module is attached to the glove which helps identify the person's location. The GPS modem, speaker, LCD display and RF transmitter are connected to the Raspberry Pi. Serial ADC is used as a communication channel between Raspberry pi and flex sensors. If the deaf and dumb person want to convey a message using this glove, the output of the speaker will be the predefined voice message and also the text format will be displayed on the LCD. The RF transmitter is connected to the Raspberry Pi, it sends the data according to the data. The RF receiver is attached to a micro-controller which in turn controls the home appliances. Depending upon the signal received by the RF receiver it will turn the appliances on or off [2].

Using the ROI selection approach, the process shows better outcomes than conventional approaches in terms of accuracy level and real time detection from video streaming through webcam. Furthermore, this method serves to offer an efficient model which ultimately results in easy addition of more signs to the final prototype made using Raspberry Pi. A reverse engineering method is adopted in which a bounding box will be present on display before the classification starts and user need to move that bounding box to that area where sign is made by hearing impaired individual. Only the region inside the bounding box is sent to the trained CNN model for prediction. The main advantage of this process is CNN does not need to learn a lot of features and detect the ROI. With only a small amount of data it provides much accuracy and faster detection rate. Along with that, with hardware integration using Raspberry Pi it provides much flexibility and scalability for deaf and mute people who uses Bangla Sign Language. At first CNN is trained with training set images and later the trained model is implemented in webcam connected Raspberry Pi which finally perform the task of sign detection and labelling on the display connected with the Pi. The choice of encoding method has a great impact on the prediction model. In this case, rather than using popular one hot encoding method, scikit learn label encoding is used. Because label encoding provided less root mean square error (RMSE) than one hot encoding method [3].

Sign language recognition is composed mainly of two parts: the first part is the method to capture sign gestures while the second part is using a reliable and accurate recognition algorithm for the captured gestures. The detection is done using leap motion sensing device and the recognition is done using various Machine Learning Algorithms (Support Vector Regression algorithm). The sensor-based data is detected using the Flex Sensors and Principle Component Analysis is the Machine Learning Algorithm used to process the data. The image-based data is detected using the Leap Motion Sensing device and either Multi-layer Perceptron or Support Vector Machine with RBF (Radial Basis Function) is used to process the Image-based data. The first step for machine learning is to build a data-set by pre-processing data then sampling. Gestures are visual movements for humans. However, it needs to convert to digital data for computing programs to process, which means gestures must be sampled. The sampled data now can be processed using Machine Learning algorithm as Testing data and Training data. The sampled data will now be converted into a structured data-set and suitable Machine Learning algorithm will be put in order to get the desired results. Each sample will have many features. Sign language is a communication protocol that helps hearing-disabled and other non-verbal speaking persons [4].

Table 2.1: Various existing methods with their research gap

Title	Published Date	Benefits	Limitations
Electronic Speaking Glove for Speechless Patients [1]	Proceedings of the 2010 IEEE Conference on Sustainable Utilization and Development in Engineering and Technology.	Better communication with patients in hospitals, Maximum 243 messages are possible.	Difficult for users to use precisely and does not have memory for human voice.
Implementation of Raspberry Pi Based Inteli Glove for Gesture to Voice Translation with Location Intimation for Deaf and Blind People [2]	International Journal on Future Revolution in Computer Science & Communication Engineering	Uses GPS module to track the location of the person. Easy to store predefined messages in text format will can be displayed on LCD screen and as well on speaker.	Only 32 predefined messages can be stored and the audio is available only in English language
An Efficient Sign Language Translator Device Using Convolutional Neural Network and Customized ROI Segmentation [3]	(12-15 April 2019) 2nd International Conference on Communication Engineering and Technology (ICCET)	Using the ROI selection approach, the process shows better outcomes than conventional approaches in terms of accuracy level and real time detection	Because of the unavailability of the dataset on Bangla sign language only 5 signs are used for making this translator device.
Detection and Recognition of Sign Language Protocol using Motion Sensing Device [4]	Future Technologies Conference (FTC) 2017 29-30 November 2017 — Vancouver, Canada	Accuracy increases, Sensor-based data (using PCA)- 92% accuracy, Image-based data (using SVM)- 99% accuracy.	ML limitations: Spurious readings, Measurement errors and BG Noise.

Chapter 3

Hardware and Software Support

This chapter includes details of various hardware and software used for implementation of this project.

3.1 Flex Sensors

The Flex Sensor is variable flexible carbon resistor. As a variable printed resistor, the Flex Sensor achieves great form-factor on a thin flexible substrate. When the substrate is bent, the sensor produces a resistance output correlated to the bend radius—the smaller the radius, the higher the resistance value as shown in Figure 3.1. Although the sizes are different the basic function remains the same. They are also divided based on resistance. There are LOW resistance, MEDIUM resistance and HIGH resistance types. Choose the appropriate type depending on requirement.

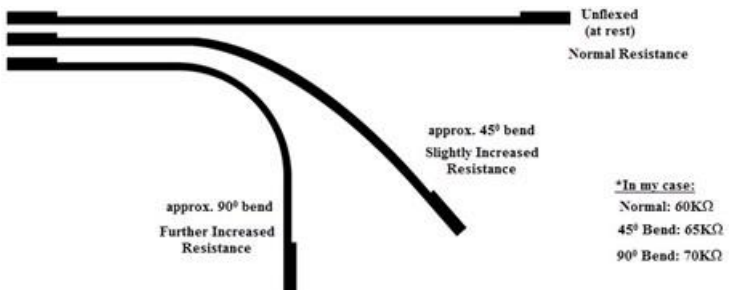

Figure 3.1: Flex Sensor Variable Resistance readings

Flex sensor is a basically a variable resistor whose terminal resistance increases when the sensor is bent. So, this sensor resistance increases depends on surface linearity. So, it is usually used to sense the changes in linearity.

3.1.1 Working of Flex Sensor

Flex sensor is a completely linear it will be having its nominal resistance. When it is bent 45^{o} angle this resistance increases to twice as before. And when the bent is 90^{o} the resistance could go as high as four times the nominal resistance. So, the resistance across the terminals rises linearly with bent angle. So, in a sense the Flex sensor converts flex

angle to resistance. For convenience we convert this resistance into voltage.

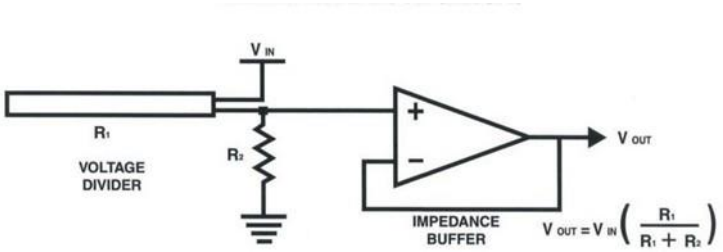

Figure 3.2: Basic Flex Sensor Circuit Diagram

In this resistive network we have two resistances. One is constant resistance (R_2) and other is variable resistance R_1. V_{out} is the voltage at midpoint of VOLTAGE DIVIDER circuit and is also the output voltage. V_{out} is also the voltage across the variable resistance R_1. So when the resistance value of R_1 is changed, the output voltage V_{out} also changes. So, we will have resistance change in voltage change with VOLTAGE DIVIDER circuit as shown in Figure 3.2.

3.1.2 Flex Sensor PIN Configuration

Basically, Flex sensor is a two terminal resistor type as shown in Figure 3.3. So, it is not a polarized terminal like diode.

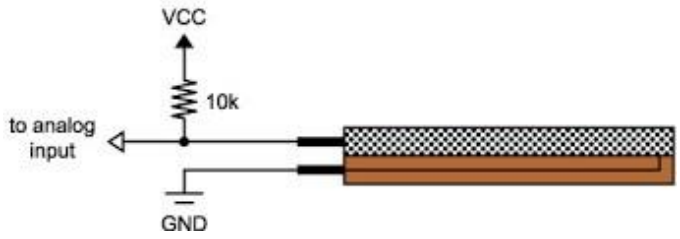

Figure 3.3: Flex Sensor PIN Configuration

- PIN-1: Connected to positive of power supply.
- PIN-2: Connected to ground.

3.2 Raspberry Pi 3

The Raspberry Pi 3 is the third-generation Raspberry Pi which is used here. Raspberry Pi is like a small computer but it does not have a hard drive. For the Raspberry Pi the SD card does the same job as a hard drive does for computers. The SD card must contain the operating system, programs and the data needed to run the Raspberry Pi. The operating

system tells the Raspberry Pi how to function, how to handle any input from the user and how to manage programs when they are running. We have used the Raspbian OS for system which is more secured, open source and easily available for users. Linux kernel is ported in ARMs memory which manages device drivers system libraries [6]. Raspberry-Pi 3 is as shown in Figure 3.4 The following is the specification of Raspberry Pi 3:

- CPU: Quad-core 64-bit ARM Cortex A53 clocked at 1.2 GHz
- BCM43438 wireless LAN and Bluetooth Low Energy (BLE) on board
- 40-pin extended GPIO
- 4 USB ports
- Full size HDMI
- CSI camera port for connecting a Raspberry Pi camera
- DSI display port for connecting a Raspberry Pi touchscreen display
- Micro SD port for loading your operating system and storing data
- Upgraded switched Micro USB power source up to 2.5A
- GPU: 400MHz Video Core IV multimedia
- Memory: 1GB LPDDR2-900 SDRAM (i.e. 900MHz)
- Network: 10/100Mbps Ethernet and 802.11n Wireless
- Peripherals: 17 GPIO plus specific functions, and HAT ID bus
- Bluetooth: 4.1

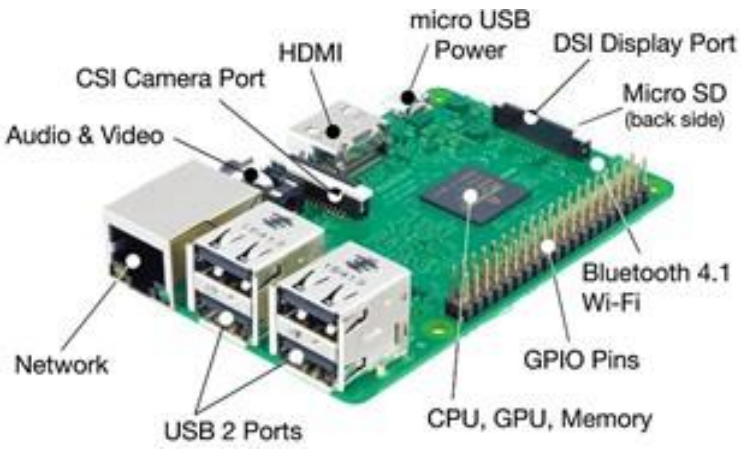

Figure 3.4: Raspberry Pi 3

3.2.1 Raspberry Pi GPIO PIN Description

Figure 3.5: Raspberry Pi 3 GPIO PIN Configuration

3.3 Arduino UNO

The Arduino Uno is a micro-controller board based on the AT-mega328 (data-sheet) as shown in Figure 3.6. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the micro-controller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the At-mega16U2 (At-mega8U2 up to version R2) programmed as a USB-to-serial converter. ”Uno” means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards [7].

3.3.1 Arduino UNO Specifications

- Micro-controller: AT-mega328
- Operating Voltage: 5V
- Input Voltage (recommended): 7-12V
- Input Voltage (limits): 6-20V
- Full size HDMI
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6

- DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB (AT-mega328) of which 0.5 KB used by boot-loader
- SRAM: 2 KB (AT-mega328)
- EEPROM: 1 KB (AT-mega328)
- Clock Speed: 16 MHz

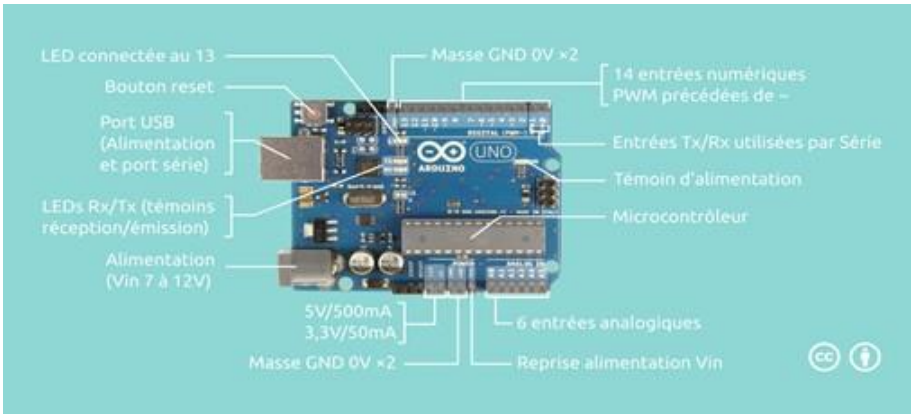

Figure 3.6: Arduino UNO

3.3.2 Arduino UNO Input and Output

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 k. In addition, some pins have specialized functions:

- Serial: 0 (R_X) and 1 (T_X). Used to receive (R_X) and transmit (T_X) TTL serial data. These pins are connected to the corresponding pins of the AT-mega8U2 USB-to-TTL Serial chip.
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Uno has 6 analog inputs, labelled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default, they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function. Additionally, some pins have specialized functionality:

- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

There are a couple of other pins on the board:

- AREF: Reference voltage for the analog inputs. Used with analogReference().
- Reset: Bring this line LOW to reset the micro-controller. Typically used to add a reset button to shields which block the one on the board

3.4 HDMI to VGA Converter

3.4.1 Specifications

Performance:

- Maximum Analog Resolutions: 1920x1080
- Maximum Digital Resolutions: 1920x1080
- Supported Resolutions: 1920x1080 (1080p) at 60Hz
- Wide Screen Supported: Yes

Connector(s):

- Connector A1-HDMI (19 pin) Male Input
- Connector B1-VGA (15 pins, High Density D-Sub) Female Output

Environmental:

- Humidity: 40% to 85% RH Non-Condensing
- Operating Temperature: 0C to 60C (32F to 140F)
- Storage Temperature: -10C to 70C (14F to 158F)

Figure 3.7: HDMI to VGA Converter Cable [8]

3.5 RF Transmitter and Receiver

The term RF stands for “Radio Frequency”. A RF transceiver module will always work in a pair such that it needs a Transmitter and Receiver to send and receive data respectively. A transmitter can only send information and a Receiver and can only receive it, so data can always be sent from one end to another and not the other way around. The Transmitter module consists of three pins namely V_{cc}, D_{in} and ground. The center pin is the data pin through which the signal to be transmitted is sent. This signal is then modulated using the ASK (Amplitude Shift Keying) and then sent on air at a frequency of 433MHz. The Receiver module has four pins namely V_{cc}, D_{out}, $Linear_{out}$ and Ground, the operating current of this module is less than 5.5mA. The pins D_{out} and $Linear_{out}$ are shorted together to receive the 433MHz signal from air. This signal is then demodulated to get the data and is sent out through the data pin.

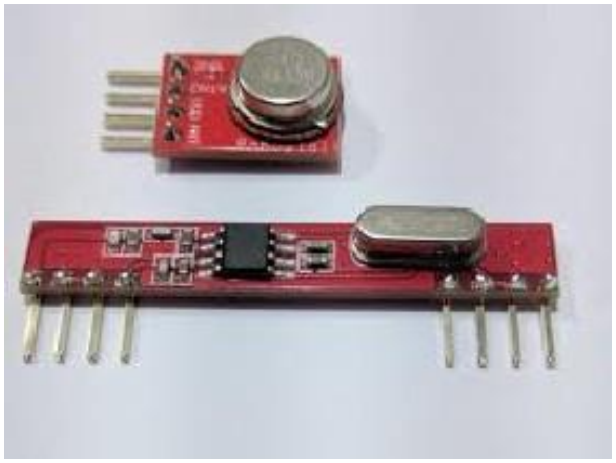

Figure 3.8: RF Transmitter and Receiver

3.5.1 RF Transmitter and Receiver with Arduino

Here, Two Arduino UNO Boards communicate with each other using 434MHz RF Transmitter and Receiver forming wireless communication. RF Transmitter is connected to Arduino UNO-1 that is implemented on the Glove as follows:

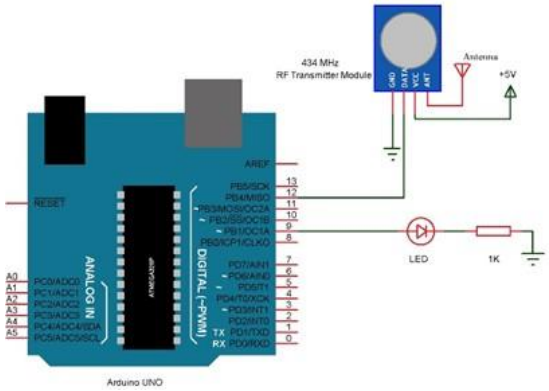

Figure 3.9: RF Transmitter and Arduino-1

RF Receiver is connected to Arduino UNO-2 as follows:

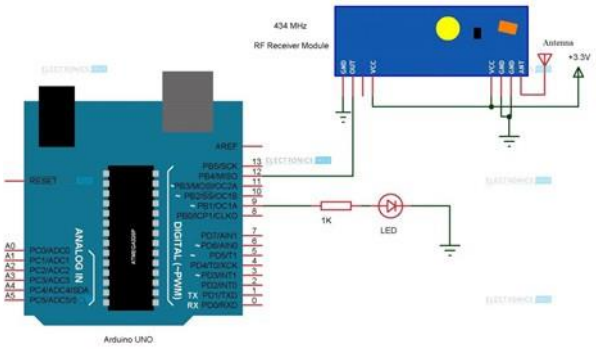

Figure 3.10: RF Transmitter and Arduino-2

3.6 Relay Module

A relay is an electrically operated switch that can be turned on or off, letting the current go through or not, and can be controlled with low voltages, like the 5V provided by the Arduino pins. In this project we are using a relay module with 4 channels. This module should is powered with 5V, which is appropriate to use with an Arduino.

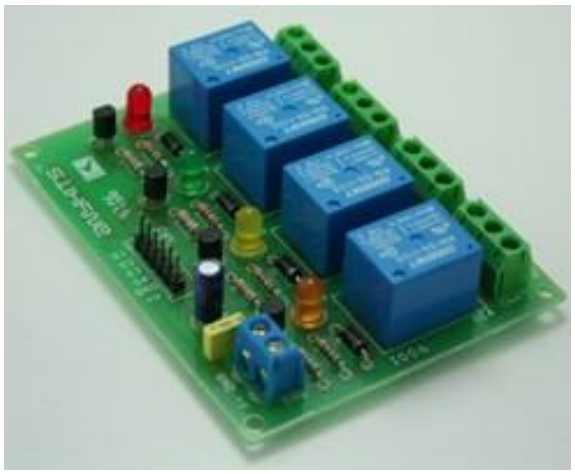

Figure 3.11: Channel Relay Module

3.6.1 Relay Pinout

Figure 3.12: Relay Pinout

The six pins on the left side of the relay module connect high voltage, and the pins on the right side connect the component that requires low voltage—the Arduino pins.

3.7 LCD Display

An LCD is an electronic display module which uses liquid crystal to produce a visible image as shown in Figure 3.13. The 162 LCD display is a very basic module commonly used circuit. The 162 translates and display 16 characters per line in 2 such lines. In this LCD each character is displayed in a 57-pixel matrix.

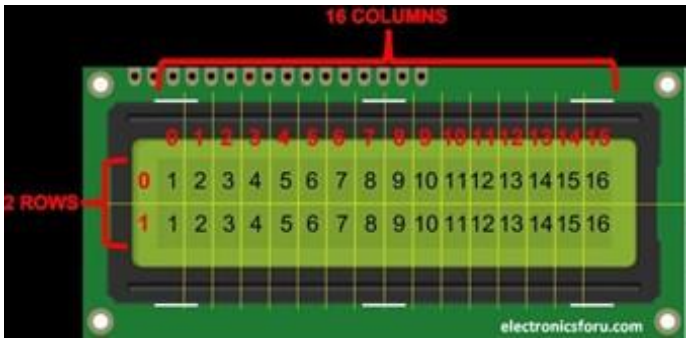

Figure 3.13: LCD Display

3.7.1 16X2 LCD PIN Configuration

Figure 3.14: LCD PIN Configuration

- Pin1 (Ground/Source Pin): This is a GND pin of display, used to connect the GND terminal of the micro-controller unit or power source.
- Pin2 (VCC/Source Pin): This is the voltage supply pin of the display, used to connect the supply pin of the power source.
- Pin3 (V0/VEE/Control Pin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.

- Pin4 (Register Select/Control Pin): This pin toggles among command or data register, used to connect a micro-controller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).
- Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a micro-controller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).
- Pin 6 (Enable/Control Pin): This pin should be held high to execute Read/Write process, and it is connected to the micro-controller unit constantly held high.
- Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the micro-controller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to micro-controller unit like 0 to 7.
- Pin15 (+ve pin of the LED): This pin is connected to +5V
- Pin 16 (-ve pin of the LED): This pin is connected to GND.

3.8 Speaker

The Speaker is use to amplify the output from Raspberry Pi 3, it is as shown in Figure 3.15. There is a slot available in Raspberry Pi 3 for Speaker using which the speaker can be directly connected to the Raspberry Pi without implementation of any other circuit.

Figure 3.15: Speaker

3.9 Arduino IDE

For our project purpose, the Arduino IDE is the cross-platform used to program Flex sensors connected to Arduino and upload the code on it as shown in Figure 3.16. Generally, Arduino IDE (Integrated Development Environment) is a cross-platform application (for Windows, mac-OS, Linux) that is written in the programming language Java or C. Arduino IDE is used to write and upload programs to Arduino compatible boards, and also, with the help of 3rd party cores, other vendor development boards. Arduino IDE is

an open source software that is mainly used for writing and compiling the code into the Arduino Module. It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process. It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment.

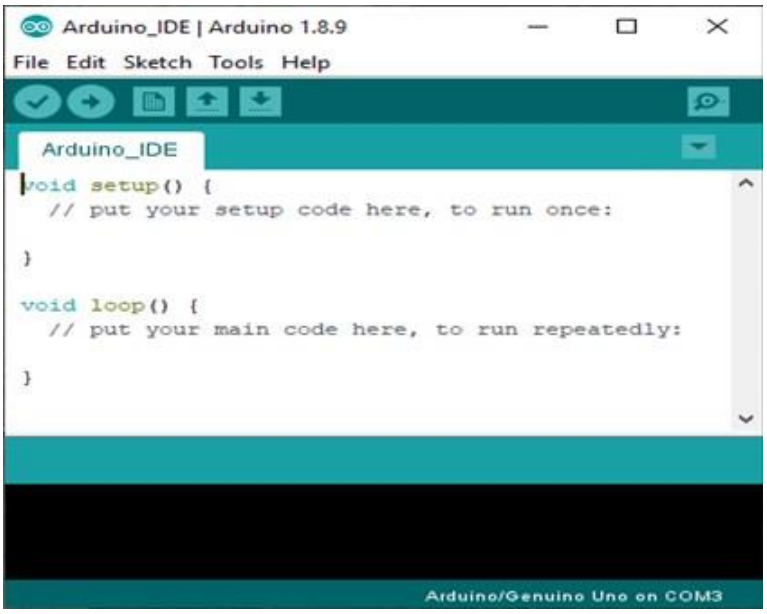

Figure 3.16: Arduino IDE

The main screen includes the void setup() and the void loop() functions.

- void setup() is required in every Arduino sketch code which is useful for one-time "setup" lines of code that prepare the Arduino to run the rest of its program.
- void loop() is for the execution of bulk Arduino sketch repeatedly.

3.10 Raspbian OS

Raspbian OS is a free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs and utilities that make the Raspberry Pi run. However, Raspbian OS provides more than a pure OS, it comes with over 35,000 packages, pre-compiled software bundled in an appropriate format for easy installation on our Raspberry Pi.

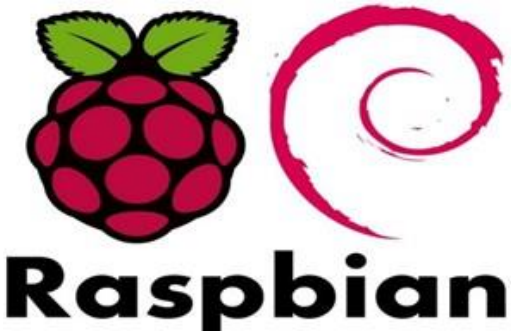

Figure 3.17: Raspbian OS

Steps to install Raspbian OS (full stretched) on Raspberry Pi:

1. Download Win32 Disk Imager, SD Card Formatter and Raspbian Noobs OS.
2. Get the SD Card and Card Reader.
3. Check the drive-in which SD card is mounted, format it using SD Card Formatter.
4. Write the OS on the SD Card using Win32 Disk Imager.
5. Eject the SD Card and remove it from the Card Reader and put it into Raspberry-Pi.

3.10.1 Enabling SSH to work with Raspberry Pi

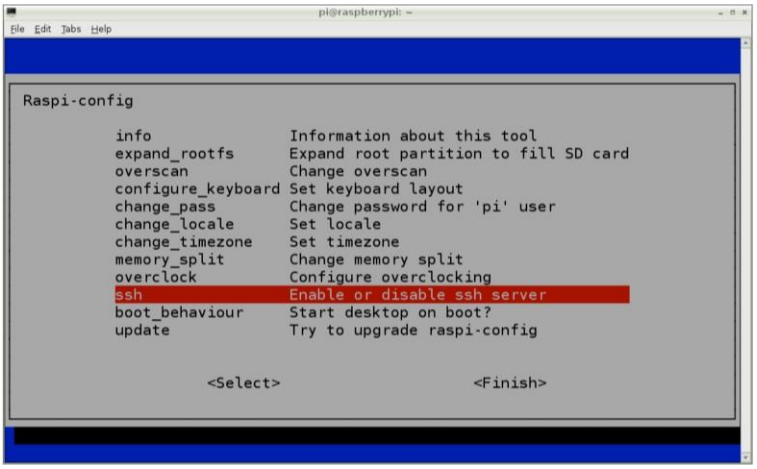

Figure 3.18: Enabling SSH in Raspberry Pi Configuration Settings

3.10.2 Enabling VNC Viewer to work with Raspberry Pi

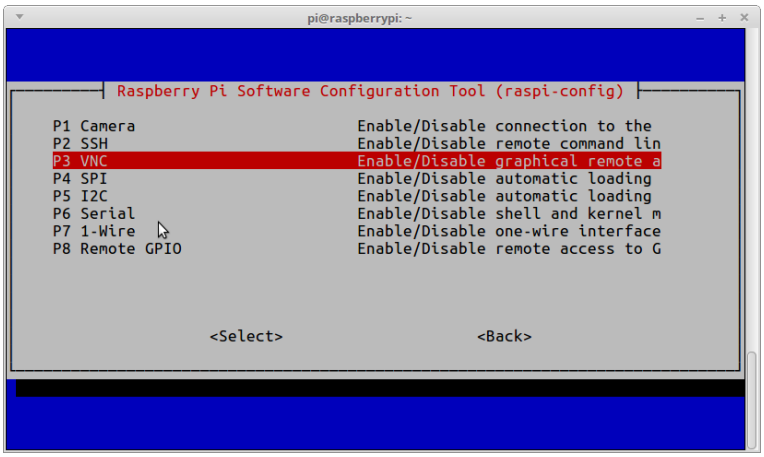

Figure 3.19: Enabling VNC in Raspberry Pi Configuration Settings

3.11 Python IDE

Python is a widely used high-level programming language for general-purpose programming. An interpreted language, Python has a design philosophy that emphasizes code readability (notably using white-space indentation to delimit code blocks rather than curly brackets or keywords), and a syntax that allows programmers to express concepts in fewer lines of code than might be used in languages such as C++ or Java. The language provides constructs intended to enable writing clear programs on both a small and large scale. Python features a dynamic type system and automatic memory management and supports multiple programming paradigm, including object-oriented, imperative, functional, programming, and procedural styles. It has a large and comprehensive standard library.

Raspbian OS comes with number of IDE's for programming and one of these IDE's is the official Python IDE. Opening it is simply clicking on Raspbian Logo, go to programming then click on Python 3 (IDLE). Python IDE is used for serial communication between the Arduino IDE and Raspberry-Pi Terminal (Python 3 IDE) so as to work Arduino and Raspberry-Pi as one single team. Python IDE is as shown in Figure 3.20

Figure 3.20: Python IDE

3.12 PuTTY Software

Putty is a very useful application that can be used to connect to serial ports and Secure Shell(SSH) to Raspberry Pi's Putty is mostly used on Windows to connect to remote devices but it can also run on a Raspberry Pi as shown in Figure 3.21.PuTTY is a free and open-source terminal emulator, serial console and network file transfer application. In our project, PuTTY software was used to wirelessly connect the Raspberry-Pi with the laptop. The IP address of Raspberry-Pi is searched using the Advanced IP Scanner and put into PuTTY software which directly opens the Raspberry-Pi terminal where we add the login ID and password of Raspberry-Pi and access it wirelessly using VNC Viewer.

PuTTY supports many variations on the secure remote terminal, and provides user control over the SSH encryption key and protocol version, alternate ciphers such as AES, 3DES, Arcfour, Blowfish, DES, and Public-key authentication.PuTTY supports SSO through GSSAPI, including user provided GSSAPI DLLs.

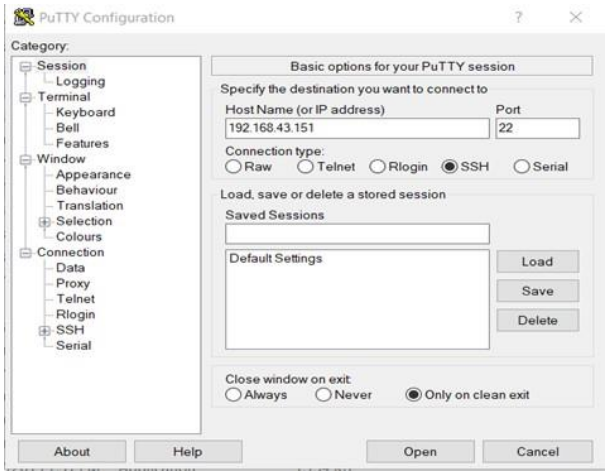

Figure 3.21: PuTTY Software

3.13 VNC Viewer

Virtual network computing (VNC) is a type of remote-control software that makes it possible to control another computer over a network connection as shown in Figure **??**. Keystrokes and mouse clicks are transmitted from one computer to another, allowing technical support staff to manage a desktop, server, or other networked device without being in the same physical location. VNC works on a client/server model: A VNC viewer (or client) is installed on the local computer and connects to the server component, which must be installed on the remote computer. The server transmits a duplicate of the remote computer's display screen to the viewer. It also interprets commands coming from the viewer and carries them out on the remote computer. VNC is platform independent and is compatible with any operating system. Computers must be networked with TCP/IP and have open ports allowing traffic from the IP addresses of devices that may need to connect. VNC was developed at ATT Laboratories. Sometimes it is not convenient to work directly on the Raspberry-Pi, we would like to work on it from another device using remote control. VNC is a graphical desktop sharing system that allows us to remotely control the desktop interface of one computer (running VNC Server) from another computer or mobile device running VNC Viewer. VNC Viewer transmits the keyboard and either mouse or touch

events to VNC Server, and receives updates to the screen in return. Displayed content is the desktop of Raspberry-Pi inside a window on the computer or mobile device. Thus, we can control it just like we are working on the Raspberry-Pi [9].

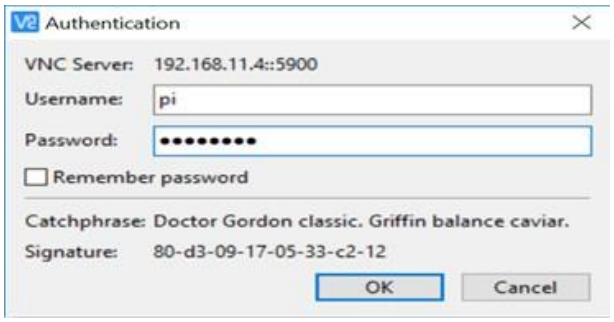

Figure 3.22: VNC Viewer

3.14 Advanced IP Scanner

Advanced IP Scanner is a free, fast and powerful network scanner with a user-friendly interface as shown in Figure 3.23. In a few seconds, Advanced IP Scanner can locate all the computers on your wired or wireless local network and conduct a scan of their ports. The app scans all network devices, and gives you access to shared folders and FTP servers. It provides remote control of computers (via RDP and Radmin) and can even remotely switch computers off.

The program provides easy access to various network resources. It also enables you to detect all the IP addresses on your Wi-Fi network. The remote PC shutdown feature lets you shut down any remote computer or group of computers running Windows. You can also wake these machines up remotely using Advanced IP Scanner, if their network cards support the Wake-On-LAN function.

Advanced IP Scanner is also deeply integrated with Radmin remote control software. Advanced IP Scanner lets you scan your network, and find all computers running Radmin Server, and connect to any one of them in a click.

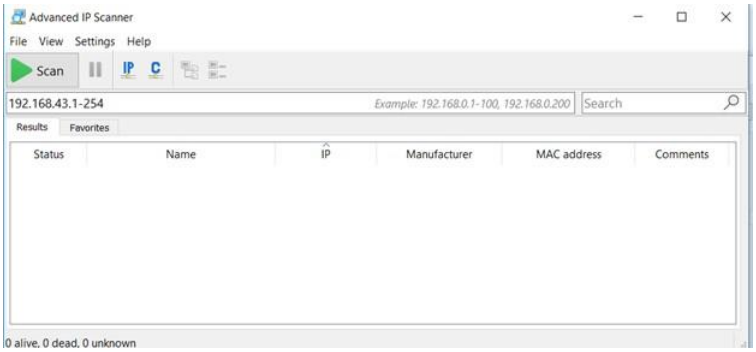

Figure 3.23: Advanced IP Scanner

Chapter 4

Methodology

This chapter is devoted to detailed explanation for design of the working and explanation of block diagram.

4.1 Block Diagram

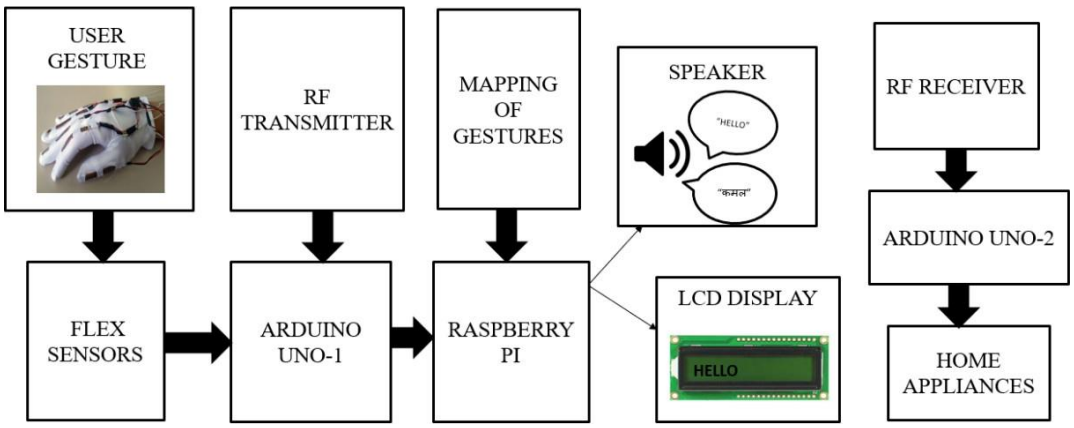

Figure 4.1: Basic Block Diagram

4.2 Working

In this project the basic idea is to extract the information based on the gesture produced by the user. Following steps illustrates design methodology of a smart glove for Physically disabled people:

4.2.1 Data Acquisition

Smart gloves comprises of the working of flex sensors based on user's gesture

- Gestures: The hand gesture plays a vital role in this project. The gestures are decoded by Raspberry pi. Every specific gesture (i.e. creating various positions of fingers) has a meaning associated with it. So, whenever a gesture is shown, a

binary code with 5 digits will be generated. Every 5-digit code is interpreted to a predefined text.

- Flex Sensor: The flex sensors which are connected to the gloves act as variable resistors, their resistance value changes corresponding to the amount of curvature it undergoes. When the flex sensor is straight its resistance is around 40k ohms and when it is bent its resistance will keep increasing. Five such flex sensors are used on the glove one for each finger including the thumb. The voltage from the flex sensors is taken by using voltage divider circuit. A fixed resistor of suitable voltage is connected in series with the variable flex sensor resistor and the voltage across the variable resistor is given to the micro-controller, Arduino UNO.

4.2.2 Conversion of Analog data to Digital data

The resistance of flex sensor is an analog signal whereas Raspberry-Pi accepts only digital signal for processing, thus Arduino UNO is used as an intermediate between flex sensor's and Raspberry-Pi for analog to digital conversion.

- Arduino UNO: Then after generating the data from the user using the bending of the flex sensors this data is in Analog form, these data is now given to the Arduino which converts this Analog signal into a digital signal. Arduino UNO converts the analog signal into digital form. Based on the user's gesture, the data is acquired from the flex sensor and corresponding output voltage is yielded in Arduino UNO using a Voltage -Divider circuit.

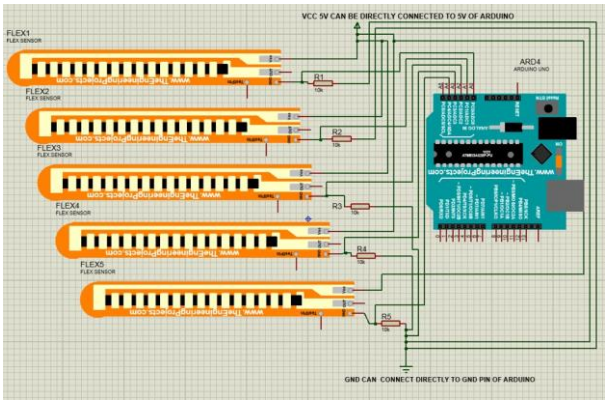

Figure 4.2: Flex Sensor and Arduino UNO connection

The above circuit diagram shows the interconnection of flex sensor with Arduino [9]. Here, only a signal flex sensor connection is shown but we can at least connect five flex sensors to the Arduino at a time the connection will be same only on different port of Arduino. The voltage obtained due to voltage-divider circuit at analog pin of Arduino is of different range for different flex sensor. According to that range, flex sensor is assigned two designation '1' for bent whereas '0' for straight. This was the end of data collection phase which consisted of transferring flex sensors voltage to the Arduino UNO.

4.2.3 Conversion of Analog data to Audio and Text

The digital data from Arduino UNO needs to be serially communicated with Raspberry-Pi for its conversion into text and audio format.

- Raspberry Pi: To access this microprocessor a long procedure has to be followed.

Method 1: To access Raspberry Pi wirelessly using laptop and mobile hotspot

To access Raspberry Pi wirelessly using laptop and mobile hotspot: The Raspbian OS has to be installed in a SD card using Etcher software. This SD card also have a separate text file which contains the name and password of the network which it is supposed to be connected. The SD card is inserted in the raspberry pi and the microprocessor is switched on. It is essential that the laptop is connected to the same Network/ mobile hotspot whose name and password were stored in Raspberry Pi SD card. A software called Advance IP scanner is used to detect the devices connected to the same network. Once the IP address on the Raspberry Pi is obtained it has to be entered in PUTTY software. Putty will open a new command prompt window and it will ask for Login ID and password. Now the user has access to Raspberry Pi terminal. However, if the user wants to access the GUI window of the micro-controller then he has to use another software called VNC viewer. VNC viewer will provide the GUI access to the Raspberry Pi Desktop.

Method 2: To access Raspberry Pi using a monitor

SD card with Raspbian OS is required in this method too. In this method a key-board, mouse, monitor along with a HDMI to VGA converter cable is required to access the micro-controller. Once these equipment's are connected to the Raspberry Pi and its power is switched on it is ready to use. The user gets direct access to the Raspbian desktop. Further python software is used to for processing the data obtained from Arduino UNO. Serial communication is used to transfer the data from Arduino UNO to Raspberry Pi 3. In python a serial communication library has to be imported. For each code word generated by the Arduino UNO, the R-Pi stores a predefined letter corresponding to the gesture/binary code present in our language database.

- gTTS: gTTs(Google Text-to-Speech), a Python library and CLI tool to interface with Google Translate's text-to-speech API. Writes spoken mp3 data to a file, a file-like object (bytestring) for further audio manipulation. It features flexible pre-processing and tokenizing, as well as automatic retrieval of supported language.

- PyGame: Pygame is a python module used to write multimedia programs. In this project text output is converted to audio using gTTs creating a mp3 file. This mp3 file is then played using Pygame module of python. Pygame is free. Released under the LGPL licence, you can create open source, freeware, shareware, and commercial games with it.

- Speaker and LCD Display: The output from Raspberry pi in audio form can be heard using speaker and the message will be displayed on LCD Display.

4.3 Database for English Language

Figure 4.3: Database for English Language

4.4 Database for Hindi Language

Figure 4.4: Database for Hindi Language

4.4.1 Database for Hindi vowels

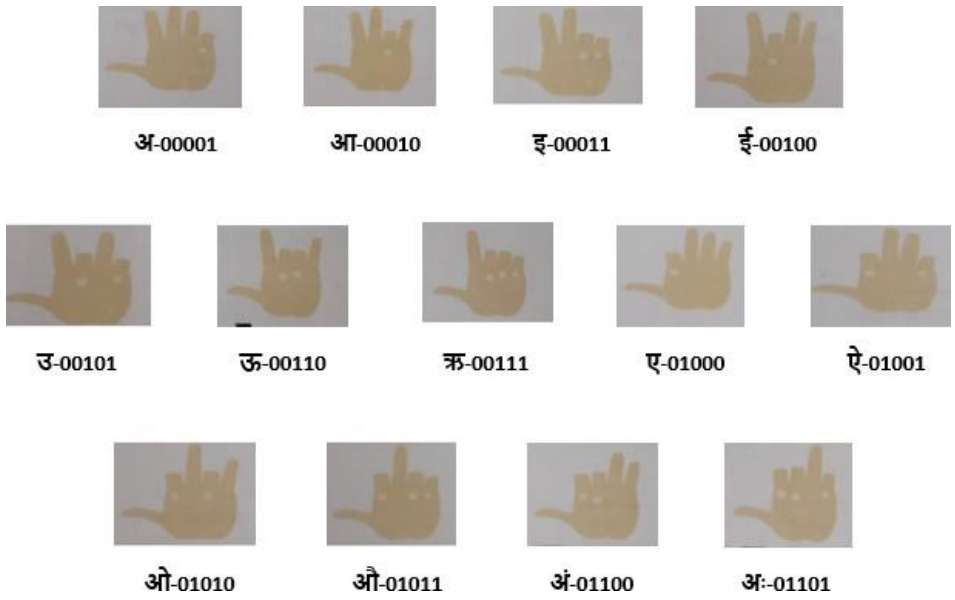

Figure 4.5: Database for Hindi Vowels

4.5 Home Automation

This is an additional mode which helps the bed ridden patients to operate their household electronic appliances with ease. In this mode, two Arduino UNO boards communicate with each other using 433MHz RF Transmitter and Receiver wirelessly. The RF Transmitter is connected to Arduino (Arduino UNO-1) which is further connected to the flex sensors on the glove whereas the RF Receiver is connected to another Arduino (Arduino UNO -2). The data from 5 flex sensors is first converted to binary form, this binary data from Arduino UNO-1 is then sent through Transmitter which then received by the RF Receiver connected to Arduino UNO-2. This data is then used by relay module to switch on or off the electronic-appliances connected to it. Here, we are using 4-channel relay module. Thus, 4 electronic appliances can be controlled by this glove at a time.

Chapter 5

Results

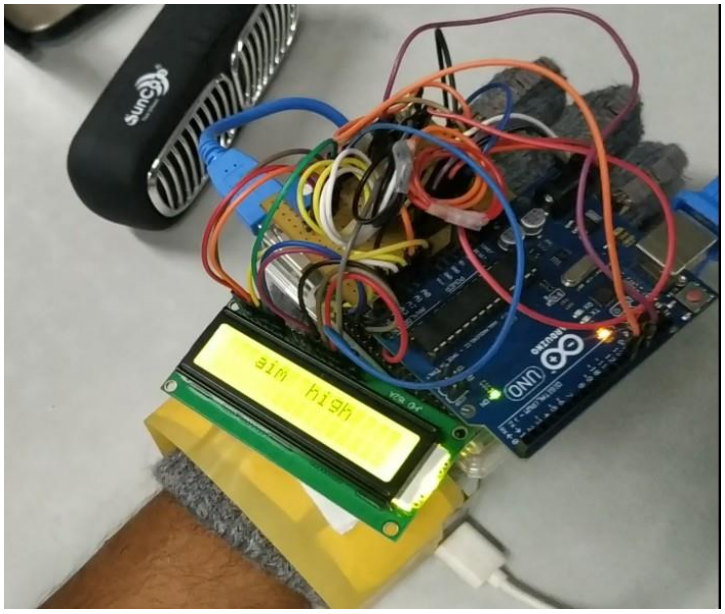

Figure 5.1: Final Hardware

As far the result part goes, if any kind of gestures is made by the user the corresponding word is displayed on the LCD and the voice is heard from the speaker. As shown in the above figure the speaker is wirelessly connected to the glove so it becomes portable for use. The mechanism for the whole transformation of user generated gesture to the desired result is done in three steps: 1. Data Acquisition. 2. Conversion of Analog data to Digital data. 3. Conversion of Analog data to Audio and Text. The full explanation of these steps are given in the methodology section.

Figure 5.2: Home Automation Inclusion

We have also added home automation part in our device. It is an additional mode which helps the bed ridden patients to operate basic electric appliances such as fan or a light bulb at home so they ain't be dependent on others for basic work. This process uses a Radio Frequency Transmitter and Receiver and for the appliances to switch on and off a 4-Channel Relay is connected to the Radio Frequency Receiver part, as 4-Channel Relay is used we can control four appliances through it.

Chapter 6

Conclusion and Future work

6.1 Conclusion

The project undertaken satisfies the need of physically disabled people giving voice to dumb and better understanding of sign language known by speech-impaired people. Generally, the speech-impaired people have their own sign language to communicate with the surrounding people, but there is a barrier of communication with people who don't know their sign language, Smart glove helps deaf and dumb people in conveying some important messages to the people who are not aware of their sign languages. The project proposes Smart gloves for physically disabled people where it will improve their communication with the world. Also, an addition of another mode in the same glove which can control the home appliances will help the bed ridden people in using some of the important home appliances without any assistance. Most of the Indian people are comfortable with Hindi language rather than English, Smart gloves consists of a speaker that produces voice commands in Hindi language.

6.2 Future Scope

- We can use regional languages of India to make the device familiar to remote people.
- Along-with regional language, foreign language Smart glove can also be designed.
- People who lose their speech due to an accident or brain haemorrhage requires speech therapist to improve or get back the lost speech. The speech therapist makes the patient repeat a word or a letter right after therapist speaks it. So, the smart glove can act as speech therapist and help bring back lost speech of a patient.
- Also a patient who's ability to speak is temporarily lost won't be aware of any sign language hence, the patient can use the glove to communicate with people until the patient gets its speech back.

Appendix

Timeline Chart:

TIMELINE CHART FOR SEMESTER VII															
MONTH	JULY			AUGUST					SEPTEMBER				OCTOBER		
WEEK NO.	W1	W2	W3	W1	W2	W3	W4	W5	W1	W2	W3	W4	W1	W2	W3
WORK TASK															
1.PROBLEM DEFINATION															
Search for topics		■	■												
Identify the goal of project				■											
2.PREPARATION															
Study IEEE related papers					■										
Study Hardware, working of Raspberry Pi Module							■	■							
Interfacing Raspberry Pi and Arduino									■						
3.PLANNING															
Study of Flex Sensors										■					
Processing the data of Flex Sensors										■	■				
4.EXECUTION OF THE PROJECT															
Simulation of Codes using Python													■	■	
Documentation															■

TIMELINE CHART FOR SEMESTER VIII														
MONTH	JANUARY			FEBRUARY				MARCH				APRIL		
WEEK NO.	W1	W2	W3	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3
WORK TASK														
1.EXECUTION OF PROJECT														
Sending data from Arduino to Raspberry-Pi														
Mapping of Gestures														
Programming using Python on Raspberry-Pi														
2.DEBUGGING														
Testing the code using different input samples														
3.RESULTS														
Interfacing LCD with Raspberry-Pi														
Getting audio output using gTTS and PyGame														
4.DOCUMENTATION														
IEEE Paper														
Black Book														

Bibliography

[1]Syed Faiz Ahmed, Syed Muhammad Baber Ali, Sh. Saqib Munawwar Qureshi's *Electronic Speaking Glove for Speechless Patients A Tongue to a Dumb Proceedings* of the 2010 IEEE Conference on Sustainable Utilization and Development in Engineering and Technology University Tunku Abdul Rahman 20 21 November 2010, Faculty of Engineering, Kuala Lumpur, Malaysia

[2]T. Gopi, P.V.N Lakshmi *Implementation of Raspberry Pi Based Inteli Glove for Gesture to Voice Translation with Location Intimation for Deaf and Blind People* International Journal on Future Revolution in Computer Science Communication Engineering

[3]Saleh Ahmad Khan, S. M. Asaduzzaman, Amit Debnath Joy, Morsalin Hossain *An Efficient Sign Language Translator Device Using Convolutional Neural Network and Customized ROI Segmentation* 2019 2nd International Conference on Communication Engineering and Technology

[4]Rita Tse, AoXuan, Zachary Chui, Marcus Im *Detection and Recognition of Sign Language Protocol using Motion Sensing Device* Future Technologies Conference (FTC) 2017 29-30 November 2017 — Vancouver, Canada

[5] Flex Sensor working-
https://www.researchgate.net/figure/Basic-flex-sensor-circuit_fig2_
290081916

[6] Raspberry Pi 3-
https://www.silverlineelectronics.in/raspberry-pi-3-model-b-armv8-with-1gb-ram.html

[7] Arduino UNO-
https://www.theengineeringprojects.com/2018/06/introduction-to-arduino-uno.html

[8] HDMI to VGA Converter-
https://www.silverlineelectronics.in/raspberry-pi-3-model-b-armv8-with-1gb-ram.html

[9] FLex Sensor and Arduino Connection-
http://www.theorycircuit.com/flex-sensor-with-arduino/