

SMART GLOVE TO CONVERT SIGN LANGUAGE TO SPEECH

Submitted in partial fulfilment of the requirements for the award of Bachelor of
Engineering degree in Electronics and Communication Engineering

By

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SCHOOL OF ELECTRICAL AND ELECTRONICS**

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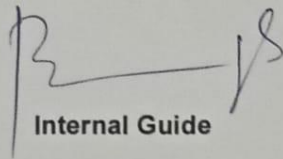
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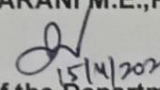
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **V. HUSSAIN BASHA (40130250)**, **G. SARATH SURYA (40130702)** who carried out the project entitled "**SMART GLOVE TO CONVERT SIGN LANGUAGE TO SPEECH**" under our supervision from November 2023 to April 2024.

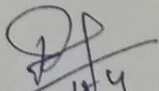

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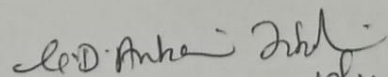
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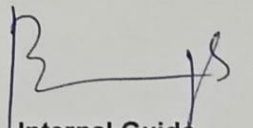
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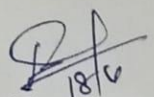

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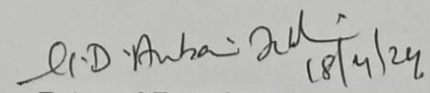
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DECLARATION

I **V.HUSSAIN BASHA (40130250)** hereby declare that the Project Report entitled "**SMART GLOVE TO CONVERT SIGN LANGUAGE TO SPEECH**" done by us under the guidance of **DR.S.BARANI M.E.,Ph.D.** Department of Electronics and Communication Engineering, SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and communication Engineering.

DATE: 18-04-2024

PLACE: Chennai

V. Hussain Basha
SIGNATURE OF THE CANDIDATE

DECLARATION

I **G.SARATH SURYA (40130702)** hereby declare that the Project Report entitled **"SMART GLOVE TO CONVERT SIGN LANGUAGE TO SPEECH"** done by us under the guidance of **DR.S.BARANI M.E., Ph.D.** Department of Electronics and Communication Engineering, SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electronics and communication Engineering.

DATE: 18-04-2024

PLACE: Chennai

G.S. Surya

SIGNATURE OF THE CANDIDATE

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We convey our thanks to **Dr. N. M. NANDHITHA, M.Tech., Ph.D., Dean, School of Electronics and Communication Engineering** and **Dr. T. RAVI, M.E., Ph.D., Head of the Department, Department of Electronics and Communication Engineering** for providing us necessary support during the progressive reviews.

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ABSTRACT

Smart gloves are a promising technological development aimed at enhancing communication for individuals who are dumb. These innovative gloves are designed to convert sign language into audible speech, opening up new possibilities for effective and accessible communication. The gloves are equipped with an array of sensors and microcontrollers that capture the hand movements and gestures involved in signing. These signals are then processed by a specialized algorithm that translates them into spoken words. By seamlessly bridging the gap between sign language and spoken language, smart gloves have the potential to improve communication for dumb individuals in various settings, such as educational institutions, workplaces, and social gatherings. The gloves are lightweight, comfortable, and easy to use, allowing individuals to quickly adapt to using them in their everyday lives. This technology has the potential to significantly enhance the quality of life for dumb individuals by enabling them to engage in real-time conversations with hearing individuals without the need for an interpreter. Additionally, smart gloves may also facilitate learning and educational opportunities for dumb students, as they can now interact more effectively with teachers and peers. Overall, smart gloves represent a significant advancement in assistive technology and have the potential to revolutionize communication for the dumb and hearing-impaired community.

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CHAPTER 1

INTRODUCTION

Smart gloves are innovative wearable devices that have been developed to bridge the communication gap between people who use sign language (SL) and those who do not understand it. These gloves are equipped with sensors and technology that allow them to convert sign language into speech, thereby facilitating effective communication between individuals who are deaf or hard of hearing and those who rely on spoken language.

The main function of smart gloves is to capture the motion and gestures of the wearer's hands and fingers as they perform SL. The sensors embedded in the gloves detect and analyze these movements, translating them into digital information. This information is then processed by the built-in software, which converts it into spoken language. This speech output can be transmitted through a speaker or a connected device, enabling the person wearing the gloves to effectively communicate with others who may not understand SL.

One of the key advantages of smart gloves is their ability to recognize a wide range of SL gestures and hand movements. They can interpret complex finger spelling, handshapes, and facial expressions, allowing for a more nuanced and natural form of communication. Additionally, smart gloves can be customized to accommodate different sign language variations, making them adaptable to the various regional dialects and styles of signing.

The development of smart gloves holds great potential for empowering the deaf and hard of hearing community, as it enables them to express themselves and engage in real-time conversations without the need for an interpreter. This technology can also benefit individuals who are learning sign language or are in the process of transitioning between sign language and spoken language, as it offers real-time feedback on their signing accuracy.

Smart gloves represent a revolutionary leap in accessibility and inclusivity, designed to empower individuals with hearing impairments to communicate effortlessly with the broader community. These gloves are equipped with an array of sensors strategically placed across the fingers and hands, capable of capturing the

subtle movements and gestures inherent in sign language.

The technology powering smart gloves harnesses the capabilities of machine learning and artificial intelligence to interpret these captures gestures in real-time. Through sophisticated algorithms trained on vast datasets of sign language gestures, the gloves accurately translate these movements into spoken language with remarkable precision and speed. Whether it's American sign language (ASL), British Sign language (BSL), or any other regional variant, Smart gloves are adapt at understanding and translating diverse sign language.

Moreover, mart gloves are designed with user convenience and comfort in mind. The gloves boast an ergonomic and lightweight design, ensuring prolonged use with discomfort. The intuitive user interface allows for seamless interaction, with features such as customizable voice outputs and language preferences tailored to individual user needs. Additionally, Smart gloves are equipped with feedback mechanisms, providing users with real-time guidance to ensure accurate gesture recognition and translation.

Beyond facilitating one-on-one communication, Smart gloves are also capable of enhancing learning experiences. With built-in educational modules and interactive excersices, these gloves serve as invaluable tools for individuals learning sign language, providing instant feedback and guidance to accelerate proficiency.

The societal impact of smart gloves is profound. By breaking down communication barriers, these gloves foster greater inclusion and understanding within our communities. They enable individuals with hearing impairments to participate fully inconversations, interactions, and activity that were previously inaccessible to them. Moreover, by promoting awarness and acceptance of sign languages, Smart gloves contribute to the broader goal of building a more inclusive and empathetic society

CHAPTER 2

LITERATURE SURVEY

Amin, M. S., Amin, M. T., Latif, M. Y., Jathol, A. A., Ahmed, N., & Tarar, M. I. N. (2020, November).

Amin, M. S., Amin, M. T., Latif, M. Y., Jathol, A. A., Ahmed, N., and Tarar, M. I. N. (2020) developed a novel system for alphabet gesture recognition of American Sign Language (ASL) using an e-voice smart glove. Their research was published in the IEEE 23rd International Multitopic Conference (INMIC) in November 2020. The smart glove is designed to convert sign language gestures into speech, providing a means of communication for individuals with hearing disabilities. The system demonstrates the potential for smart gloves to enhance accessibility and inclusive communication by bridging the gap between sign language and spoken language.

Bhat, K., & Chayalakshmi, C. L. (2020, November)

The study conducted by Bhat and Chayalakshmi (2020) focuses on the development of an advanced glove for the deaf and dumb. This glove aims to convert sign language (SL) into speech and text messages on an Android cell phone. The researchers presented their findings at the 2020 IEEE International Conference for Innovation in Technology (INOCON) as a means of innovative technology in assisting individuals with communication challenges. The study offers potential advancements in facilitating communication and enhancing the quality of life for the deaf and dumb community.

Athreya H. P., Mamatha G., Manasa R., Raj S., & Yashwanth R. (2021).

The study conducted by Athreya et al. (2021) focuses on a smart glove designed to assist individuals with disabilities. The objective of the research is to survey the current state of smart gloves and their potential in converting sign language to speech. The authors provide a comprehensive overview of existing technologies, applications, and challenges associated with smart gloves. The study aims to

contribute to the development of an innovative and effective solution for facilitating communication accessibility for the disabled.

Balasubramaniam P. ICICSE, 2021,” P.M., Bizu B., Guhathakurta R., Velayutham P., Sharma D. K., Rangaswamy, R., Sengan, S. (2002)

Balasubramaniam et al. (2022) developed advanced smart gloves that aim to assist physically disabled individuals. These gloves utilize LABVIEW software to convert sign language gestures into speech. The study is documented in the book “Innovations in Computer Science And Engineering” proceedings of the Ninth ICICSE, 2021,” published by Springer Singapore. The research presents the technology and its potential to enhance communication for those with physical impairments.

Pooja, B. S, S. M., Tarannum, N. N., Pradheep, S., & Patgar, R. G. (2022, December)

Pooja, B. S., George, S.M., Tarannum, N. N., Pradheep, S., & Patgar, R.G. (2022) Developed smart gloves for hand gesture recognition in Kannada. Their research was presented at the 2022 4th International Conference on Circuits, Control, Communication and Computing (I4C), where they discussed the application of these gloves in converting sign language to speech.

Sapkota B., Gurung M. K., Mali P., & Gupta R. (2018, September)

Sapkota, Gurung, Mali and Gupta (2018) developed a smart glove using Arduino to facilitate sign language translation. Their research focuses on converting sign language gestures into speech. The smart gloves detect the movements and positions of the wearer's fingers and transmit the data wirelessly to a computer for processing. This technological innovation has the potential to bridge communication gaps between individuals who use sign language and those who do not, enhancing inclusivity and accessibility.

Ahmed M. A., Zaidan B. B., Zaidan A. A., Salih M. M., & Lakulu M. M. B. (2018)

Ahmed M. A., Zaidan B. B., Zaidan A. A., Salih M. M. and Lakulu M. M. B. (2018) conducted a comprehensive review on system-based sensory gloves for sign

language recognition between 2007 and 2017. The study focuses on the state of the art in developing smart gloves that can convert sign language into speech. The authors highlight the advancements made in wearable technology and signal processing during the specific period. The review provides valuable insights into the progress made in this field, offering valuable information for researchers and developers working on sign language recognition systems.

Manware A., Raj R., Kumar A., & Pawar T. (2017)

Manware et al. (2017) developed smart gloves as a communication tool for individuals with speech and hearing impairments. These gloves are capable of converting sign language into audible speech, enabling better communication for the users.

CHAPTER 3

AIM

3.1 OBJECTIVES

- To reduce the communication barrier between vocally impaired people and normal persons.
- To express their feelings with normal people.
- To convert hand gestures into voice. An electronic glove is designed for deaf-mute communication that allows the deaf and dumb to communicate with ease.

The aim of a smart glove for deaf and dumb people is to create a wearable device that can translate sign language into speech. The project's scope involves designing a glove that can recognize hand gestures and convert into speech in real-time.

The smart glove project seeks to provide an alternative method of communication for individuals who are dumb and who use sign language as their primary mode of communication. The smart glove would allow them to communicate more easily with people who do not know sign language, such as family members, friends, strangers. Overall, the aim and scope of the smart glove is to create a wearable device that can improve communication and enhance the quality of life for individuals who are dumb and who use sign language as their primary mode of communication.

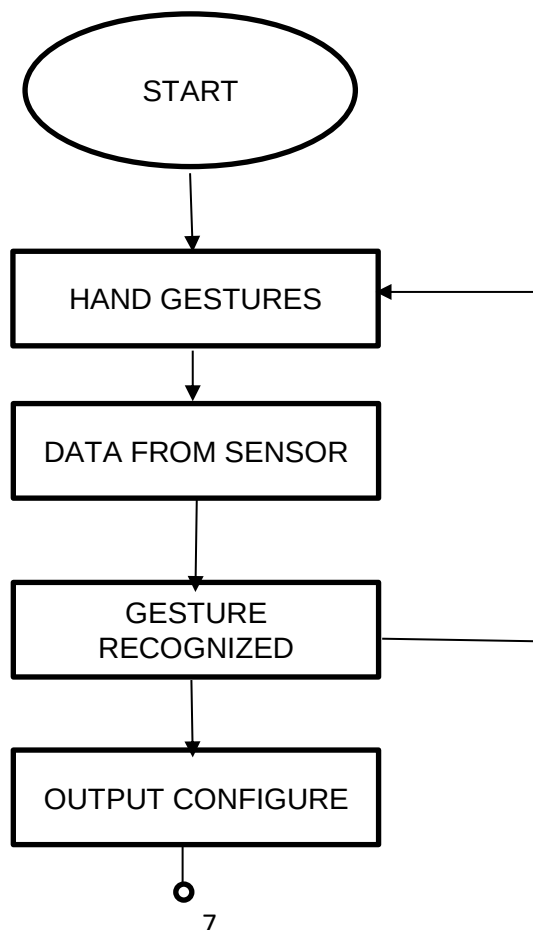
CHAPTER 4

COMPONENTS AND METHODS

4.1 PROPOSED SYSTEM

There are two units in this project. One is the transmitter circuit and the other is the receiver circuit. Transmitter circuit comprises of Flex sensor, A-D converter Microcontroller. Receiver comprises of audio Module, Amplifier, Speaker. Depending on the gestures made by with the help of flex sensor corresponding digital output is generated with the help of A to D converter. This values are now send to the microcontroller. Microcontroller matches this values in the database. This project presents a solution that will not only automatically recognize the hand gestures but will convert it into speech output so that impaired person can easily communicate with the normal people.

4.1.1. Process Flow of Proposed Work



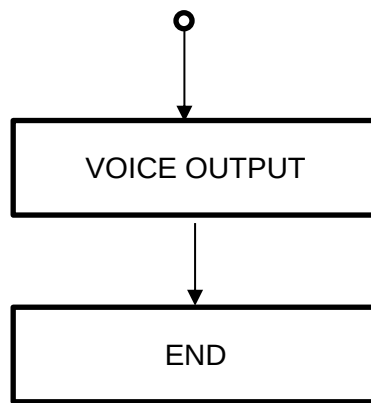


Fig – 4.1-Flow Chart

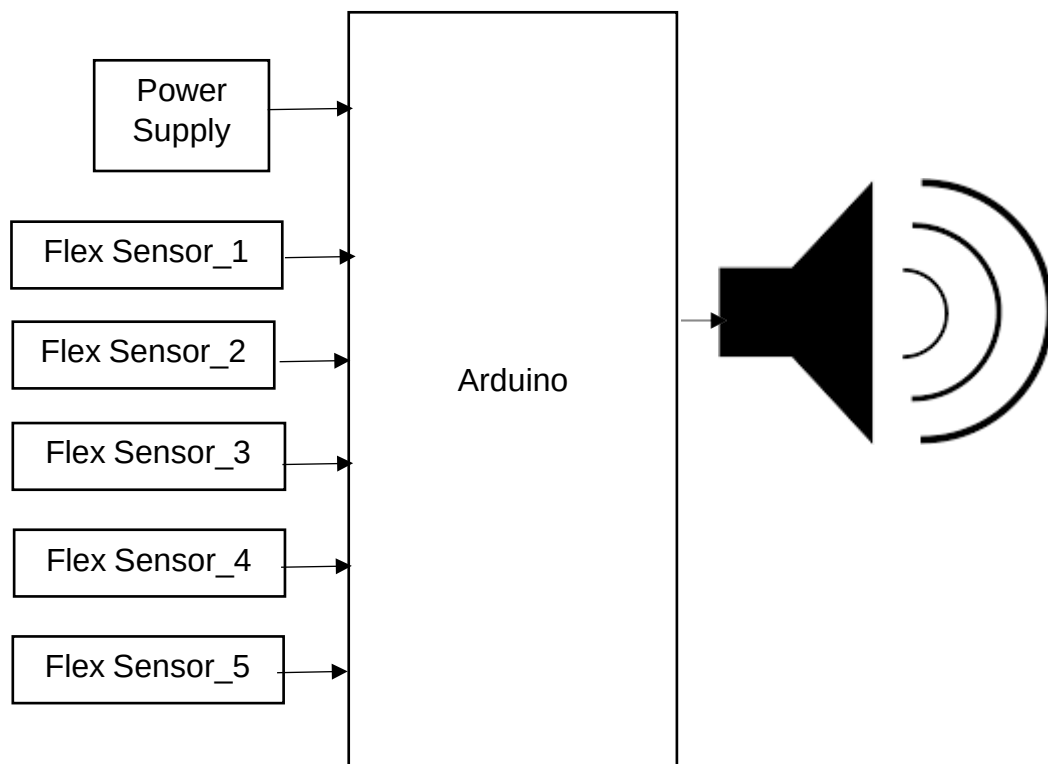


Fig- 4.2- Block Diagram

- Connect the +5V pin of the Arduino to the +5V pin of the Flex Sensor and DF Mini Player.
- Connect the GND (ground) pin of the Arduino to the GND pins of the Flex Sensor and DF Mini Player.
- Connect the analogue output pin (A0) of the Flex Sensor to the A0 pin of the Arduino.
- Connect the digital pins D9 and D10 of the Arduino to the TX and RX pins of the DF Mini Player, respectively.
- Connect the +5V and GND pins of the DF Mini Player to the +5V and GND pins of the Arduino.
- Connect digital pins D2, D3, and D4 of the Arduino to the Blue, Green, and Red LEDs, respectively.
- Connect the Speaker/Headphones to the audio output jack of the DF Mini Player.

1. ***Flex sensor data acquisition*** – flex sensors attached to the smart glove detect the bending of the fingers when making sign language gestures. The resistance of these sensors changes based on the degree of bending, which is then converted into analog voltage signals.
2. ***Analog to Digital conversion*** – The Arduino uno reads the analog voltage signals from the flex sensors and converts them into digital data using its built-in analog-to-digital converter(ADC).
3. ***Signal processing*** – The Arduino Uno processes the digital data from the flex sensors to recognize the sign language gestures. This may involve comparing sensor readings to predefined thresholds or patterns to identify specific gestures.
4. ***Audio playback*** – Once a sign language gesture is recognized, the corresponding audio file stored on the microSD card of the DF mini player is triggered for playback.
5. ***Speech Output*** – The audio signal from the DF Mini player is sent to the

speaker, which it converts it into the sound wave. The synthesized speech corresponding to the recognized the sign language gesture is then heard through speaker.

Over all the block diagram outlines the flow of data and operations involved in converting sign language gestures detected by flex sensors into synthesized speech output using Arduino Uno, DF Mini player, and a Speaker.

4.2 HARDWARE REQUIREMENTS

4.2.1 ARDUINO UNO : Arduino UNO is a microcontroller board based on the ATmega328P. 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 microcontroller, simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

In Arduino UNO board, the main component is the ATmega328P. It is the heart of the Arduino UNO. Near the MCU you can see a 16MHz resonator which will give the ATmega328P the clock signal to work. Near that you can also see a connector names ICSP. It is used to burn the Arduino bootloader into the chip. And you can also see the header pins for I/O.

The other side of the board, spot another microcontroller in aQFN package. It is an ATmega16U and Is used as a USB -TTL converter. Near that, it will have its crystal and ICSP port to burn the firmware. There will be a resetbutton near it, which will reset ATmega328P.

To activate the Arduino board on the board, dump the program code with the selection of Files-> Examples..>Basics..>Flash. When the programming codes are dumped into the IDE, and then click the bottom 'upload' on the top bar. Once this process is completed, check the LED flash on the board.

The Arduino Uno board has a rearrange able poly fuse that defends the USB port of the PC from over-voltage. Though most of the PC's have their own inner protection, the fuse gives an additional coating of safety. If above 500mA is given to the USB port, then the fuse will routinely crack the connection until the over-voltage is removed.

The Arduino is based on AVR microcontroller called Atmega328. This controller comes with 2KB SRAM., 32KB of flash memory, 1KB of EEPROM. Arduino board comes with 14 digital pins and 6 analog pins. ON-chip ADC is used to sample these pins. A 16 MHz frequency crystal oscillator is equipped on the board.

The Arduino Integrated Development Environment (IDE) is a cross platform application (for Windows, macOS, Linux) that is written in functions from C and C++. It is used to write and uploads programs to Arduino.

There are several IO digital and analog pins placed on the board which operates at V. These pins come with the standards operating ratings ranging between 20mA to 40mA. Internal pull-up resistors are used in the board that limits the current exceeding from the given operating conditions. However, too much increase in current make these resistors useless and damages the device.

LED: Arduino Uno comes with built-in LED which is connected through pin 13. Providing HIGH value to the pin will turn it On and Low will turn it Off.

Vin : It is the input voltage provided to the Arduino Board. It is different that 5V supplied through a USB port. This pin is used to supply voltage. If a voltage is provided through power jack, it can be accessed through this pin.

5V : This board comes with the ability to provide voltage regulation. 5V pin is used to provide output regulated voltage. The board is powered up using three ways i.e, USB, Vin pin of the board or DC power jack. USB supports voltage around 5V while Vin and power Jack support a voltage ranges between 7V to 20V. It is recommended to operate the board on 5V. It is important to note that, if a voltage is supplied through 5V or 3.3 pins.

GND: These are ground pins. More than one ground pins are provided on the board which can be used as per requirement.

Reset: This pin is incorporated on the board which resets the program running on the board. Instead of physical reset on the board, IDE comes with a feature of resetting the board through programming.

IOREF: This pin is very useful for providing voltage reference to the board. A shield is used to read the voltage across this pin which then selects the proper power source.

PWM: PWM is provided by 3,5,6,9,10,11 pins. These pins are configured to provide 8-bit output PWM.

SPI : It is known as serial peripheral Interface. Four pins 10(SS), 11(MOSI), 12(MISO), 13(SCK) provide SPI communication with the help of SPI library.

AREF : It is called Analog Reference. This pin is used for providing a reference voltage to the analog inputs.

TWI : It is called Two-wire Interface. TWI communication is accessed through wire library. A4 and A5 pins are used for this purpose.

Serial Communications : Serial communication is carried out through two pins called pin 0(Rx) and pin 1 (Tx). Rx pin is used to receive data while Tx pin used to transmit data.

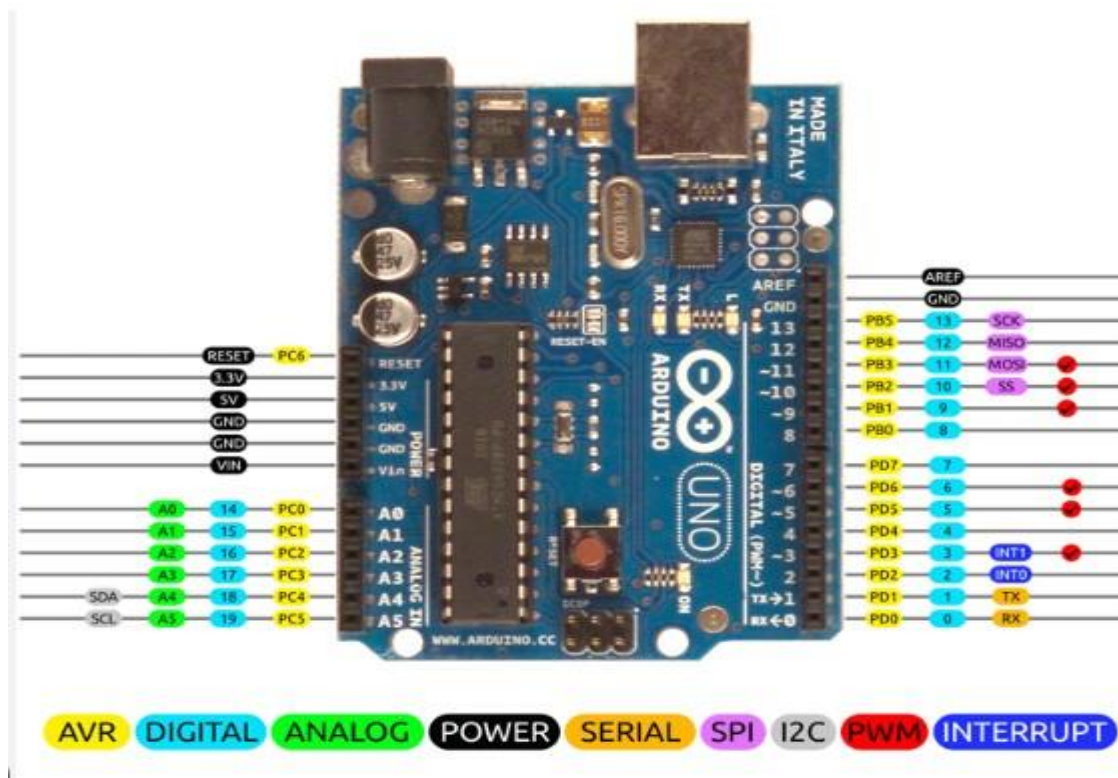


Fig.4.3- Arduino Pin Configuration



Figure 4.4 – Arduino UNO

4.2.2 FLEX SENSOR : A flex sensor is a kind of sensor which is used to measure the amount of deflection otherwise bending. The designing of this sensor can be done by using materials like plastic and carbon. The carbon surface is arranged on a plastic strip as strip is turned aside then the sensor's resistance will be changed. It is also named a bend sensor. As its varying resistance can be directly proportional to the quantity of turn thus it can also be employed like a goniometer. Flex sensor are classified into two types based on its size namely 2.2-inch flex sensor and 4.5-inch flex sensor. The size, as well as the resistance of these sensors, is dissimilar except the working principle.



Figure 4.5 – Flex sensors



Fig – 4.6 – Flex sensor pin configuration

Pin Configuration: Flex sensor is a two-terminal device, and the terminals are like p1 and p2. This sensor doesn't contain any polarized terminal which means there is

no positive and negative terminal. The required voltage of this sensor to activate the sensor ranges from 3.3V-5V DC which can be gained from any type of interfacing.

- Pin P1: This pin is generally connected to the +ve terminal of the powersource.
- Pin P2: This pin is generally connected to GND pin of the power source.

Basically, the flex sensor uses the voltage divider circuits and buffer. To the non-inverting mode op-amps. Flex sensor output is inputted to amplify the voltage. This increase in the bending degree decreases the output voltage. It is determined with a basic flex sensor circuit that uses the voltage divider principle and range between 1.35V and 2.5 V. The voltage output is calculated by $V_{in} R_2 / (R_1 + R_2)$, where R_1 is the non-inverting terminal input resistor. The flexible sensor offers flexible resistance readability with another degree of flexible sensor flexion.

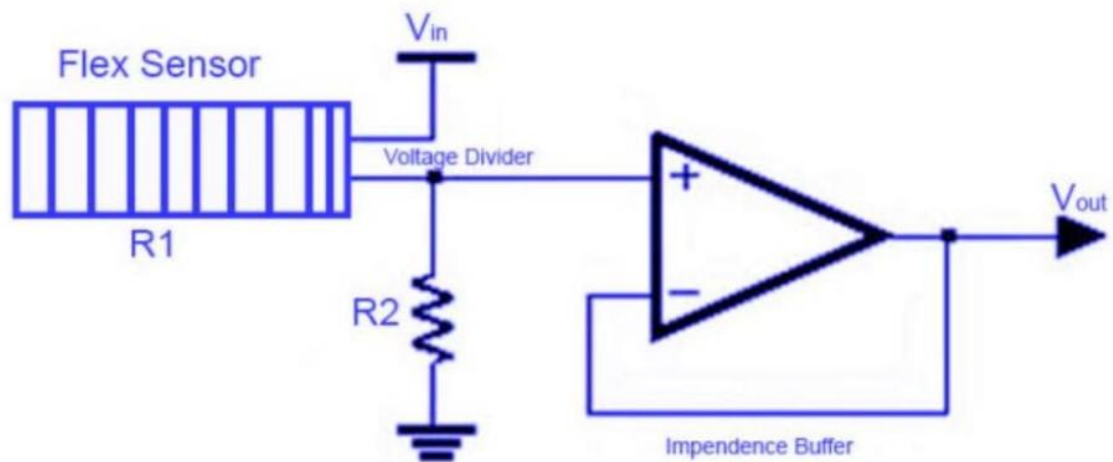


Fig – 4.7- Signal conditioning of flex sensor

- Operating voltage of this sensor ranges from 0V to 5V.
- It can function on low voltages.
- Power rating is 1 Watt for peak and 0.5 Watt for continuous.
- Flat resistance is 25K Ohms.

Flex sensors are commonly used in applications such as robotics, medical devices, virtual reality gloves, and motion capture systems. They provide a way to measure the degree of bending or flexing in real-time. By interfacing flex sensors with microcontrollers like Arduino, the degree of bend can be translated into useful data for controlling actuators, triggering events, or providing feedback in various systems. These sensors come in various shapes and sizes and resistance ranges, allowing for flexibility in design and adaption to different applications. They are often lightweight and durable. They typically consist of a flexible substrate with a conductive material deposited on it, forming a resistance element. When the sensor is bent, the distance between particles in the conductive material changes, altering the resistance of the sensor.

Flex sensors offer several advantages and characteristics that make them valuable components in electronics projects :

- **Linear response** – Flex sensors typically exhibit a linear response, meaning that the change in resistance is directly proportional to the degree of bending. This makes them predictable and easy to calibrate.
- **Customizable** – Flex sensors can be customized in terms of length, width, and resistance range to suit specific application requirements. This flexibility enables them to be integrated into various designs with ease.
- **Simple interface** – These sensors are easy to interface with microcontrollers and other electronic components. They can be connected directly to analog inputs of microcontrollers like Arduino, where the change in resistance can be measured and interpreted.
- **Low power consumption** – Flex sensors usually have low power requirements, making them suitable for battery-operated devices and applications where power efficiency is crucial.

- **Durable Construction** – Flex sensors are designed to withstand repeated bending and flexing without significant degradation in performance. This durability makes them suitable for use in wearable devices and other applications where mechanical stress is common.
- **Wide range of applications** – Flex sensors find applications in diverse fields such as robotics, prosthetics, gaming, sports equipment, and industrial automation. They provide a means to measure and control movement accurately, enhancing the functionality and performance of various systems.

4.2.3 SPEAKER



Fig – 4.8 - Speaker

A speaker is an electroacoustic transducer that converts an electrical audio signal into a corresponding sound. A speaker system, also referred to as a speaker system, also often simply referred to as a speaker, comprises one or more such speaker drivers, an enclosure, and electrical connections possibly including a crossover network. The speaker driver can be viewed as a linear motor attached to

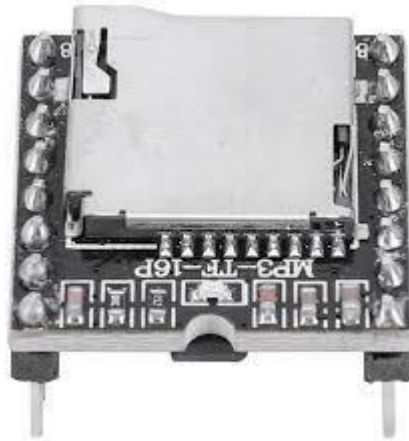
a diaphragm which couples that motor's movement to motion of air, that is sound. An audio signal, typically from a microphone, recording, or radio broadcast, is amplified electronically to a power level capable of driving that in motor in order to reproduce the sound corresponding to the original unamplified electronic signal.

Speakers fundamental idea or an analogy is to transform electrical energy into mechanical energy. Initially air is compressed as mechanical energy, which converts motion into sound energy. A magnetic field is created when current passes through the coil and the generated current is passed through the voice coil in the speaker which then again coil generates electric field which interact with the magnetic field in the speakers. Moving back and forth of the coil when the sound is delivered gives the air which produce some pressure, here that pressure waves is called sound (output).

- **Impedance** – Typically, speakers used in such projects have an impedance rating from 4 to 8 ohms. This impedance value ensures compatibility with the most audio amplifiers or driver circuits.
- **Power handling** – The power handling capability of the speakers indicates the maximum amount of power it can handle without being damaged. For small-scale projects, Speakers with a power handling capacity of around 1 to 4 Watts may be sufficient.
- **Frequency Response** – The frequency response of the speaker defines the range of frequencies it can reproduce effectively. For speech applications, a frequency response range of around 100 Hz to 20kHz is usually suitable.
- **Sensitivity** – Speaker sensitivity refers to how efficiently it converts electrical power into sound. Higher sensitivity ratings indicate that the speaker can produce louder sound levels with less input power. A sensitivity rating of around 85 to 90dB SPL is common for small speakers used in portable mode.
- **Durability** – Since the smart gloves may be subject to various environmental conditions and handling, the speaker should be durable and

able to with stand moderate wear and tear.

4.2.4 DF MINI PLAYER



4.9 - DF Mini Player

The DF Mini player is a compact audio player module. It is designed to play audio files from a microSD card and is controlled via serial communication. The module typically includes features such as volume control, track selection, and playback control. The DF Mini player is known for its simplicity, low cost, and ease of integration.

- Support of sampling rate of 8KHz, 11.05KHz, 12 KHz, 16KHz, 22.05KHz, up to 48KHz
- 24-bit DAC output, dynamic range support 90dB, SNR supports 85dB

- Supports FAT16, FAT32 file systems, maximum support 32GB TF card.
- A variety of control modes, serial mode, AD key control mode.
- The broadcast language spots feature, you can pause the background music being played.
- Built-in 3W amplifier.
- The audio data is sorted by folder; supports up to 100 folders, each folder can be assigned to close to 1000 songs.
- 30 levels of volume adjustable, 10 levels EQ adjustable.

4.2.5 GESTURE RECOGNITION SYSTEM

Managing gestures is an important part of the system of recognition. It has data that suits incoming data. The system attempts to match incoming data to the existing posture. The finger bending values and the distance from the current data are determined for each posture definition.

The position/orientation data are further compared gesture recognition is a research area that aims to incorporate gestural networks into human-computer interaction. Virtual reality, symbolic, RDC, and musical formation are some of the applications available on the framework. The more general pattern recognition method recognizes human gestures. The process translates raw numerical data into a decision making type and then uses it to make decisions. The two major types are device-based and vision-based.

4.2.6 VOICE SECTION

The data is processed to the voice section after the gesture recognition system. This conflates with the data fed, if the information matches the data provided and output come from the speaker. To make easy for the opposite side ones, the speech output will be easy to recognize the signs than the displayed one.

4.3 SOFTWARE REQUIREMENTS

ARDUINO IDE: The Arduino Integrated Development Environment contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them. Programs written using Arduino Software (IDE) are called Sketches. These sketches are written in the text editor and are saved with file extension in the editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays the text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

The IDE environment is mainly distributed into three sections

1. Menu Bar
2. Text Editor
3. Output Panel

The bar appearing on the top is called Menu Bar that comes with five different options as follow

- **File** – You can open a new window for writing the code or open an existing one. The following table shows the number of further subdivisions the file option is categorized into.
- As you go to the preference section and check the compilation section, the output panel will show the code compilation as you click the upload button.
- And at the end of the compilation, it will show the next file it has

generated for the recent sketch that will send to the Arduino board for the specific task to achieve.

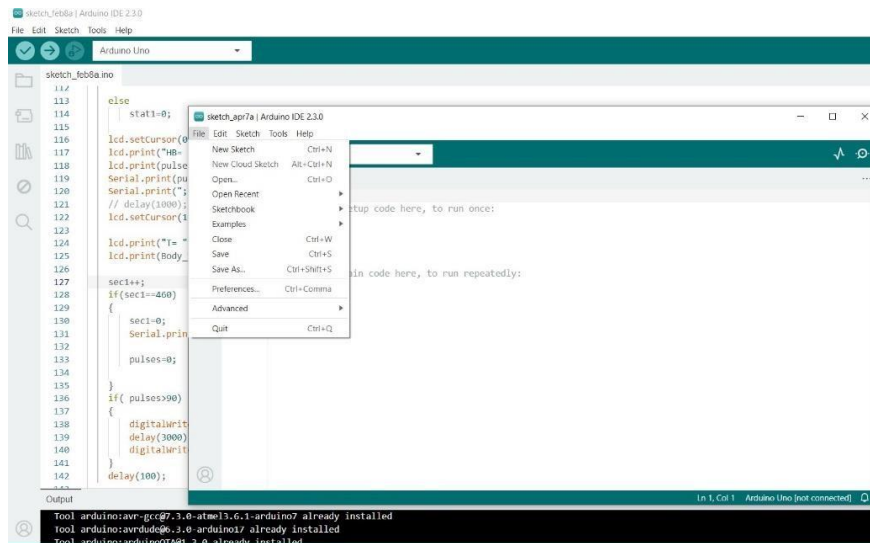


Fig – 4.10.a – Arduino IDE

- **Edit** – Used for copying and pasting the code with further modification for font.

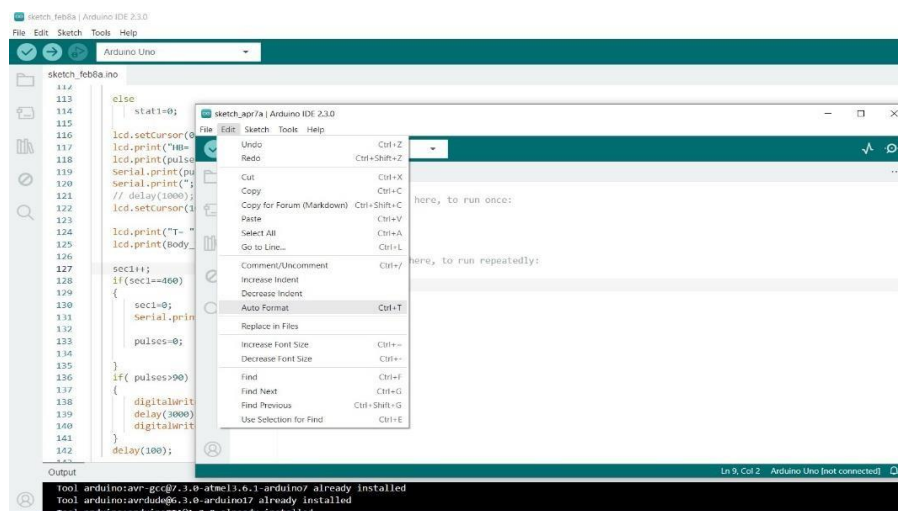
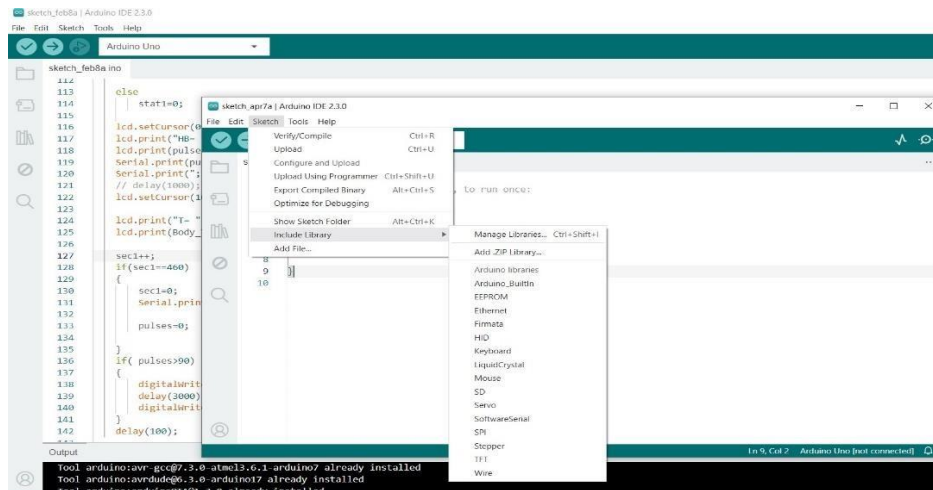
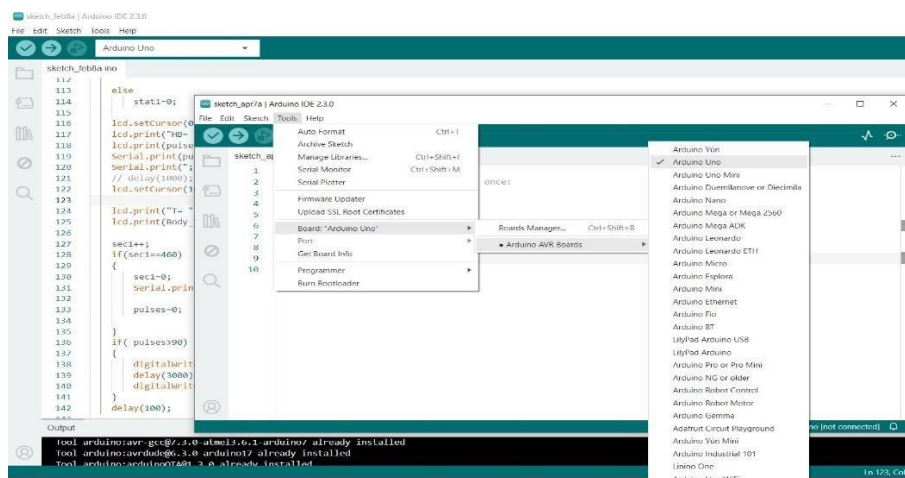


Fig 4.10.b – Arduino IDE

- **Sketch** – For compilation and programming.



- **Tools** – Mainly used for testing projects. The programmer section in this panel is used for burning a bootloader to the new microcontroller.



- **Help** – In case you are feeling skeptical about software, complete help is available from getting started to troubleshooting.

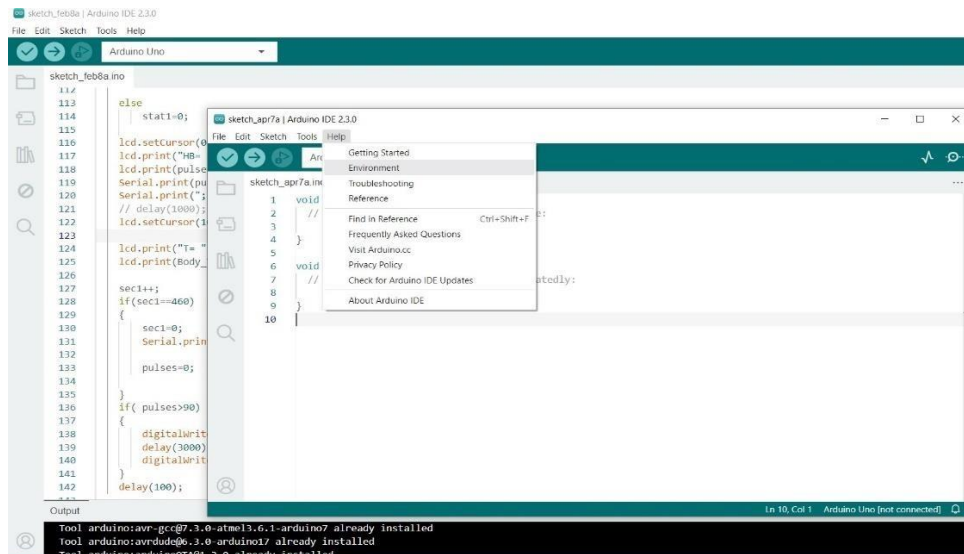


Fig 4.10.e – Arduino IDE

The six buttons appearing under the menu tab are connected with the running program as follows :

- The check mark appearing in the circular button is used to verify the code. Click this one after completion of the code.
- The arrow key will upload and transfer the required code to the Arduino board.
- The upward arrow is reserved for opening an existing Arduino project.
- The downward arrow is used to save the current running code.
- The button appearing on the top right corner is a serial monitor – A separate pop-up window that acts as an independent terminal and plays a vital role in sending and receiving the serial data or pressing Ctrl+Shift+M all at once will open it instantly. The serial monitor will actually help to debug the written sketches where program is operating. Arduino module should be connected to computer by USB cable in order to activate the serial monitor.
- The main screen below the menu bar is known as a simple text editor used for writing the required code.
- More or less, Arduino C language works similar to the regular C language used for any embedded system microcontroller, however there are some dedicated libraries used for calling and executing specific functions on the

board.

Circuit Diagram

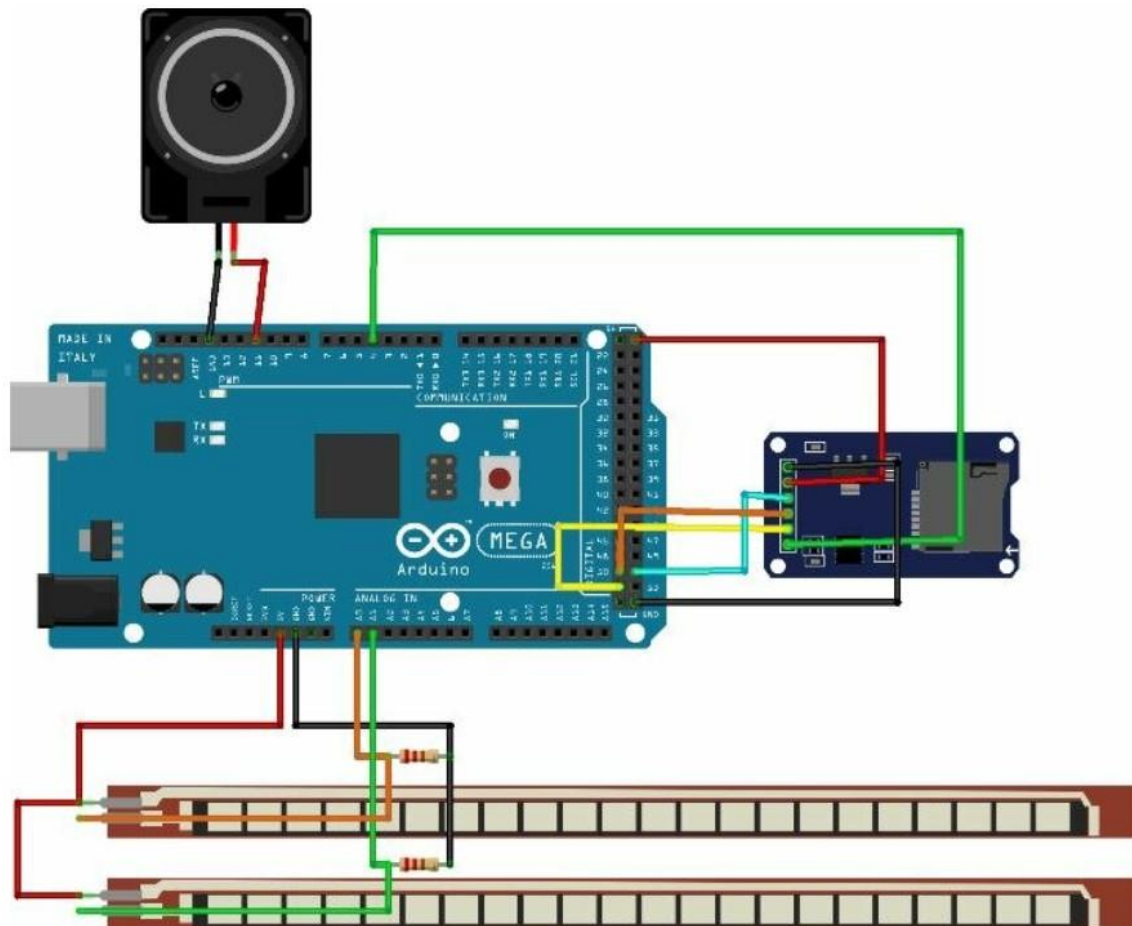


Fig – 4.11 – Circuit diagram

4.4 METHODOLOGY

The project proposes a method to read the sign language and convert it into speech. The prototype developed included various components such as Arduino Uno, Flex sensors.

Arduino Uno is a microcontroller based on the chip Atmega328. It works on an operating voltage of 5V with the cutoff limit for input voltage being 6-20V. It consists of 14 digital I/O pins and 6 Analog pins. The 5 analog input is connected to the five different flex sensors placed on the fingers of the glove, we can get the reading which varies continuously with the help of these pins.

Flex sensors is a variable resistor that can be used to detect the variation in resistance as per the bend in the sensor. The flex sensors are mounted on the fingers and thumb of each band. These are directly connected to the microcontrollers on both the arm and are the base of gathering information regarding the human gesture at a particular moment.

1. Data from the flex sensor will be continuously taken for 5 loop cycles for a particular gesture.
2. Values received will be averaged to get the mean value of each of each flex sensor. Then the standard deviation is calculated and the range for a particular gesture.
3. The output of the glove gives the values for each sensors which are rechecked with the database and it is then converted into the speech from if the values are accurate otherwise provide a feature of predicting words.
4. The microcontroller then sends the data to the microprocessor by serial communication.
5. The translated sentence can be sent as a speech.

People have the voice ability for communicating among one other. Tragically, not

every person has the ability to talk and hear. Gesture based communication utilized among the local area of individuals who are distinctive abled as the methods for correspondence. Communication through signing is a motion portrayal that includes concurrent joining hand shapes and development of the hands, arms to communicate. The people who can't talk utilizes the gesture based communications to speak with other individuals who knows the implications of gesture based communications to speak.

In any case it's anything but consistently workable for a person to associate with constantly to decipher the communications via gestures and not every person can gain proficiency with the communications through signing. In this way, another option is that we can utilize a gadget gesture vocalizer as an arbiter. The gesture vocalizer can take the motions a contribution from the vocally impeded individual and interaction it's anything but a literacy and sound type of yield. Hardware version of the project gesture vocalizer is a multi-microcontroller-based framework being intended. In this project, gestures vocalizer based on a microcontroller and sensors. Gestures vocalizer designed is basically a hand glove and a microcontroller.

4.5 WORKING

Flex Sensors: Flex sensors are placed on each finger of the glove. These sensors detect the bending or flexing of the fingers when forming signs in sign language.

Arduino Microcontroller: An Arduino microcontroller is used to process the data from the flex sensors. The flex sensor readings are converted into digital signals that the Arduino can interpret.

Signal Processing: The Arduino processes the sensor data, interpreting the finger movements based on predefined patterns corresponding to different signs in sign language. This may involve using algorithms to map sensor readings to specific signs.

Speech Synthesis Module: Once a sign is recognized, the Arduino triggers a speech synthesis module. This module converts the recognized sign into speech. This could involve pre-recorded audio files corresponding to each sign.

Audio Output: The synthesized speech is then output through a speaker, allowing the user to hear the spoken interpretation of the sign language.

4.6 STANDARDS

1. **Interfacing Standards** – IEEE 1451 is a family of standards for smart transducers, which are sensors or actuators with embedded signal processing capabilities.
2. **Communication Protocols** – IEEE 802.15.4 is a standard for low-rate wireless personal area networks. Although not specific to Arduino Uno, understanding communication protocols like SPI (serial peripheral interface) and I2C (inter-integrated circuit) can be helpful when interfacing sensors with Microcontrollers.
3. **Sensor Standards** – IEEE2700 is a standard for sensor performance parameter definitions. While it provides guidelines for evaluating sensor specifications, which can be useful when selecting flex sensors for your project.
4. **Safety Standards** – Depending on the application and environment of our project, you may need to consider safety standards such as IEEE 1584 for arc-flash hazard calculations or IEEE 61010 for electrical safety requirements for measurement, control, and laboratory use.
5. **Microcontroller Standards** – IEEE 12207 provides a framework for software life cycle processes, which can be relevant when developing framework for Arduino Uno. Adhering to software development best practices outlined in this standards can improve the reliability and maintainability of code.

CONSTRAINTS

- Difficult to take the accurate values of flex sensors.
- Balancing Hardware connections are challengeable.
- Comfort is crucial for prolonged use, so the gloves should be lightweight and flexible.
- With more features glove can be bulkier and less comfortable to wear.

TRADE OFF

- Though the model may be bulkier, it is cost effective.
- This model is an efficient way of communication with others and hence the discomfort in wearing could be neglected.
- The existing prototype could be developed with light weight material and could be made comfortable for wearing.

CHAPTER 5

RESULT AND DISCUSSION

5.1 RESULT AND DISCUSSION

FINGER	POSITION	REQUIREMENT
FINGER 1		I need water
FINGER 2		How are you
FINGER 3		I am hungry

FINGER 4		I want to go to washroom
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Table 5.1 Result



Fig-5.1 Final Image of the Hardware



Fig-5.2 - Hand gesture of finger 1



Fig 5.3 - Hand gesture of finger 2

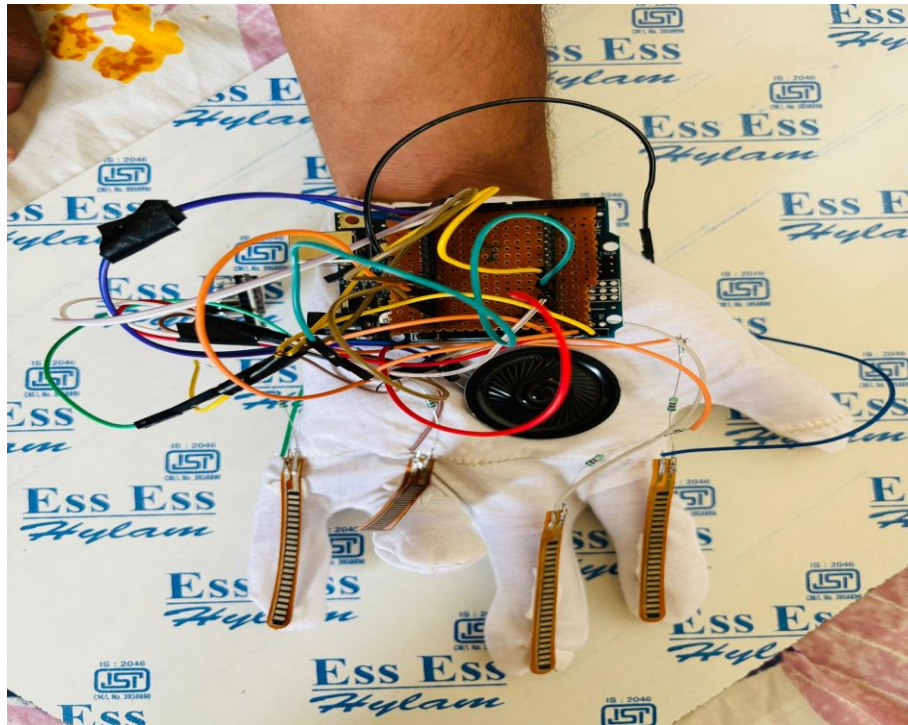


Fig 5.4 - Hand gesture of finger 3

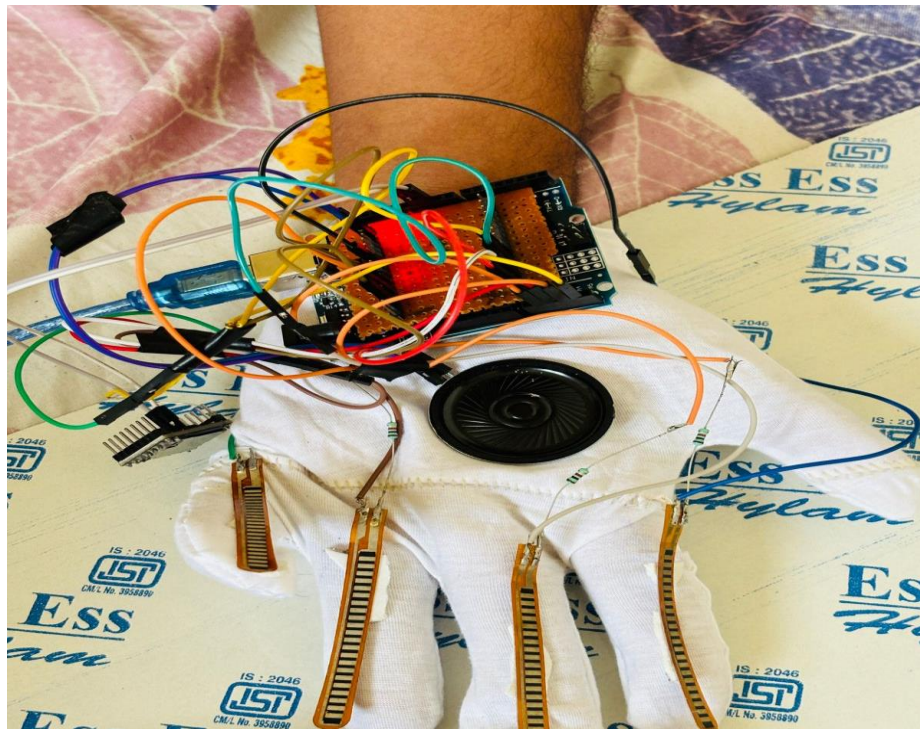


Fig 5.5 - Hand gesture of finger 4

5.2 FUTURE SCOPE

This project suggests that these data glove can be used for partial sign language recognition. In further it can support more number of signs. We can make this system wireless so that it become handy and portable for commercial use. Talking wireless using this we can even transmit the signal to a mobile phone.

CHAPTER 6

CONCLUSION

This system makes the communication easy through gestures and beats the ongoing challenge faced by deaf-mute people in their normal life. A Smart Glove used in this work distinguishes gestures made by hand and converts the sign language to speech. This application suggests a newly integrated full-duplex communication for voice impairments. This electronic mouth allows deafened people to communicate as normal. The flex sensor helps to collect the user's data. The meaning of each action would be distinct. With the aid of smart gloves, this makes the user feel natural.

Sign language is an instrument of communication used by a disabled person. Here the smart gloves translate the sign language through text and speech to remove the communication barrier between the various communities. The use of smart gloves would also enable disabled people will be satisfied, motivated and gain self confidence that their feelings will also be understood by other people.

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