International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 10 Issue: 04 | Apr 2023 www.irjet.net p-ISSN: 2395-0072

Gestures Based Sign Interpretation System using Hand Glove

V. Leela Krishna[1], P. Sekhar[2], P. Gowri Priya Mani[3], S. Bala Satya Phani Kumar[4]

[1,2,3,4] *Students, Dept. of Electronics & Communication Engineering, R.V.R. & J.C. College of Engineering, Guntur, Andhra Pradesh, India*

Abstract – *In this article, we introduce a system for interpreting sign language that utilizes a glove. People who are unable to speak often communicate using sign language, which can pose a challenge when trying to communicate with those who do not understand it. To address this issue, we propose a glove-based system that utilizes Arduino Uno and flex sensors to translate hand gestures into text and speech. By doing so, we hope to reduce the communication gap between those who use sign language and those who do not, making it easier for people with speech impairments to communicate with others.*

The glove-based sign interpretation system is a promising solution for enabling communication between individuals who use sign language and those who do not. This paper presents a system that uses Arduino Uno and flex sensors to interpret hand gestures and convert them into text and speech. The proposed system has the potential to greatly reduce the communication gap between speech-impaired individuals and those who do not understand sign language. This could revolutionize communication for those who use sign language and help break down barriers to communication.

Key Words: ***Glove-based sign interpretation system, communication, sign language, Arduino Uno, flex sensors, hand gestures, text, speech, machine learning, speech impairment.***

1. INTRODUCTION

A glove-based sign interpretation system is a device that utilizes advanced technology to help people who are deaf or hard of hearing communicate with others who do not understand sign language. This device consists of a special glove equipped with sensors that track the movement of the wearer's hands and fingers, and then translate the gestures into written or spoken language.

The system uses machine learning algorithms to recognize and interpret the sign language gestures made by the wearer. It can then convert these gestures into a variety of languages, including English, Spanish, French, and others. This technology has the potential to revolutionize communication for the deaf and hard of hearing, as it enables them to express themselves more effectively and easily with the people around them.

Glove-based sign interpretation systems are still in their early stages of development, but they hold immense promise for the future. As the technology advances, we can expect to see even more advanced systems that can accurately interpret more complex sign language gestures and provide more sophisticated translations. Ultimately, these devices have the potential to break down the communication barriers that exist between the deaf and hard of hearing and the rest of society, opening up new possibilities for personal and professional relationships.

The main objective of developing the Sign Language Interpreter was to facilitate communication between the deaf and hearing communities. This is achieved through the use of a sensor-based hand glove that is connected to an Arduino microcontroller, allowing for the translation of hand gestures into text and sound. With this smart glove, communication barriers between communities can be eliminated.

Individuals with speech disabilities often experience difficulties in communicating with others. The purpose of this device is to enhance their quality of life by converting their gestures into speech, providing a voice for those who are unable to speak. Speech is an important tool for conveying messages, and this project utilizes flex sensors that are attached to the gloves to capture hand movements. The output from these sensors is then sent to the Arduino, where the data is used to display text on an LCD screen and produce speech output through an Android app.

The main focus of this project is to create a system that can recognize a predefined set of hand gestures, particularly the American Sign Language alphabet, using a data glove as an input device. To achieve this, the system will employ artificial intelligence tools such as artificial neural networks to facilitate interaction between the user and the computer. The system will classify and recognize the hand gestures performed by the user. The ASL alphabet comprises static and dynamic gestures, where static gestures are accomplished by maintaining a hand pose while dynamic gestures involve both hand pose and movement.

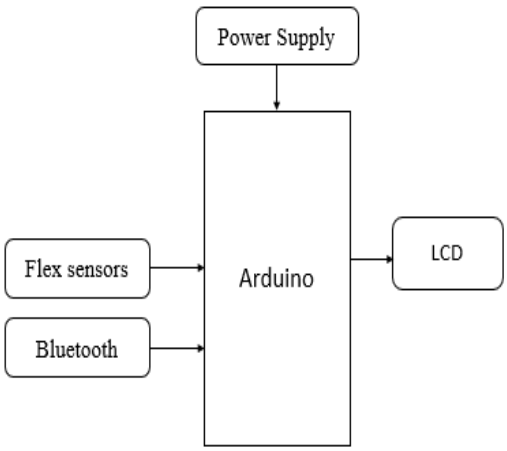

Fig-1: Block diagram of Glove based Sign Interpretation System

There are various approaches of Glove Based Sign Interpretation system which can be used to interpret hand gestures into text and speech. These approaches include:

- **Sensor-Based Approach:** In this approach, a sensor-based glove is used to recognize the hand gestures. The glove contains sensors that detect the movements of the fingers and hand, and send the data to the microcontroller. The microcontroller then processes the data and produces text or speech output.
- **Machine Learning Approach:** This approach involves the use of machine learning algorithms to recognize hand gestures. A large dataset of hand gestures is used to train the machine learning model, which is then used to recognize new hand gestures.
- **Computer Vision Approach:** In this approach, a camera is used to capture the hand gestures. The captured images are then processed using computer vision algorithms to recognize the hand gestures. This approach requires a high-resolution camera and complex algorithms to process the data.
- **Hybrid Approach:** The hybrid approach combines the sensor-based, machine learning, and computer vision approaches to achieve high accuracy in recognizing hand gestures. The data from the sensors and camera are combined and processed using machine learning algorithms to produce text or speech output.

Each of these approaches has its advantages and disadvantages, and the choice of approach depends on the specific requirements of the application.

1.1 Sensor-Based Approach

The sensor-based approach in glove-based sign interpretation system involves the use of sensors placed on a glove to capture hand movements and gestures. Flex sensors are commonly used to measure the degree of flexion in each finger of the hand, while accelerometer sensors can be placed on top of the glove to capture the orientation of the hand in three axes. These sensors send analog signals to an Arduino microcontroller, which is programmed to interpret the signals and translate them into text and speech using artificial intelligence tools like neural networks. The sensor-based approach offers a non-invasive and intuitive way for individuals with speech impairments to communicate with others. However, it requires careful calibration of the sensors and may not be suitable for individuals with severe motor impairments.

1.2 Machine Learning Approach

The machine learning approach is a popular method used in glove-based sign interpretation systems. It involves using algorithms and statistical models to enable the system to learn and improve its performance based on the data collected from the user. This approach involves training the system to recognize specific sign gestures by providing it with a large dataset of pre-recorded sign language samples.

The system then uses this dataset to learn and develop an understanding of the patterns and features that distinguish one gesture from another. The machine learning approach typically involves the use of neural networks, decision trees, and support vector machines to classify and interpret the hand gestures.

One advantage of the machine learning approach is that it can improve the accuracy of the system over time as it learns from more data. However, this approach requires a large amount of training data and complex algorithms, which can be time-consuming and challenging to implement.

1.3 Computer Vision Approach

Computer-based approach is a popular method used in the glove-based sign interpretation system. This approach uses a data glove as an input device that is connected to a computer. The computer uses artificial intelligence techniques such as neural networks, fuzzy logic, and machine learning algorithms to recognize and interpret the hand gestures made by the user.

The computer-based approach involves the use of sensors that are embedded in the data glove. These sensors measure the degree of flexion in each finger and the orientation of the hand in three axes. The data collected by the sensors is then transmitted to the computer for processing and interpretation.

One of the advantages of the computer-based approach is its ability to recognize a wide range of hand gestures. This approach is highly accurate and can recognize hand gestures even in noisy environments. Additionally, the computer-based approach is highly flexible, as it can be easily modified and updated to recognize new hand gestures.

However, one of the disadvantages of this approach is its complexity. The computer-based approach requires a high level of technical expertise and specialized equipment. Furthermore, the processing time required to interpret hand gestures can be significant, which may result in delays in communication.

1.4 Hybrid Approach

Hybrid approach combines the advantages of both the rule-based and machine learning approaches. In this approach, rules are used to identify basic hand gestures, and machine learning algorithms are used to recognize more complex gestures. This approach is more accurate than the rule-based approach and is also capable of recognizing a wider range of gestures. It involves collecting data using sensors and cameras and then using machine learning algorithms to recognize the gestures. The hybrid approach provides a more efficient and accurate interpretation of sign language, making communication easier between deaf and hearing individuals. However, this approach requires significant amounts of training data and computational resources to achieve high accuracy.

2. Hardware Requirements

In this project, we have implemented Glove-based Sign Interpretation using Arduino.

The components used in Glove based Sign Interpretation system using Arduino are:

- **Arduino Uno board:** It is the main controller of the system that receives input from sensors and processes the data to generate the output.
- **Flex sensors:** These sensors are attached to the fingers of the glove and measure the degree of flexion in each finger.
- **Bluetooth module:** The Bluetooth module in a Glove Based Sign Interpretation System enables wireless communication between the gloves and a computer or mobile device, allowing for real-time sign language interpretation.
- **Breadboard:** It is used to make connections between different components.
- **Wires:** These are used to connect different components together.
- **Power source:** A battery or USB cable is used to power the Arduino board and the components.

2.1 Arduino Uno Board

Arduino Uno is an open-source microcontroller board designed by Arduino.cc. It is based on the ATmega328P microcontroller chip and comes with 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button. The board is designed to be easy to use and is often used in various projects, from hobbyist to professional level.

The ATmega328P microcontroller chip has 32 KB of flash memory, 2 KB of SRAM, and 1 KB of EEPROM. The digital pins on the board can be used as inputs or outputs and can be controlled with digitalWrite () and digitalRead () functions in the Arduino IDE. The analog inputs are used to read analog signals and can be controlled with analogRead () function.

Fig-2: Arduino Uno board (ATmega328p)

The board can be powered through the USB connection or through an external power source, such as a battery or an AC-to-DC adapter. The power jack on the board accepts a 9-12V DC input, and the voltage regulator on the board converts this voltage to 5V DC, which is used to power the microcontroller and other components on the board.

The board also comes with an ICSP header, which allows the board to be programmed with an external programmer, and a reset button, which resets the microcontroller when pressed.

Overall, Arduino Uno is a versatile and easy-to-use microcontroller board that is widely used in the maker and DIY community for various projects, including the Glove based Sign Interpretation system.

2.2 Flex Sensors

Flex sensors are bend sensors that work on the principle of piezoresistive effect. It means that their resistance changes when they are bent or flexed. They are made up of a thin strip

of flexible material, such as plastic or rubber, that is coated with a conductive material, such as carbon or metal. When the sensor is flexed, the distance between the conductive strips changes, which results in a change in resistance.

Flex sensors are available in different shapes and sizes, depending on the application. They are commonly used in robotics, gaming, and medical devices, such as prosthetics. They are also used in wearable technology, such as smart gloves, to detect hand gestures and movements.

In the Glove based Sign Interpretation system using Arduino, flex sensors are attached to the fingers of the glove to detect the bending of fingers. Flex sensors are shown in below figure.

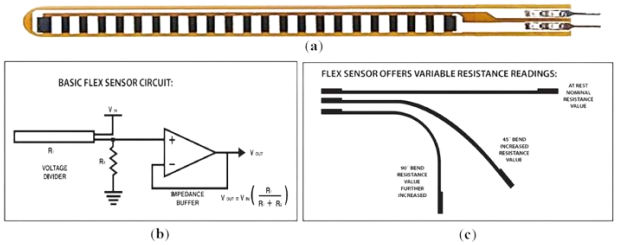

Fig-3(a): Flex Sensor

Fig-3(b): Basic Flex Sensor

Fig-3(c): Flex Sensor offers variable resistance readings

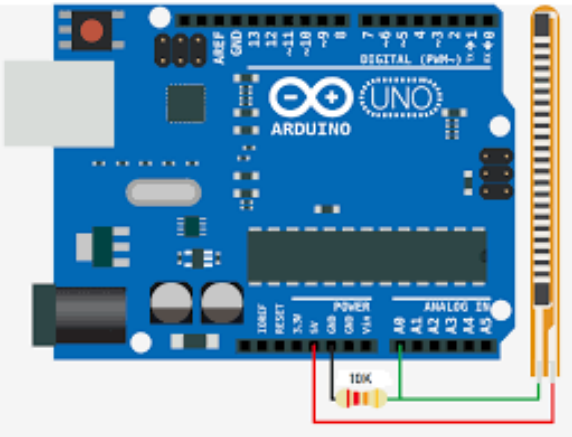

Fig-4: Flex Sensor with Arduino

The output signal from the flex sensors is fed into the Arduino board, which processes the data and converts it into text and speech output. The flex sensors are calibrated according to the range of motion of each finger to ensure accurate detection of gestures.

2.3 Bluetooth module:

A Glove Based Sign Interpretation System typically uses a Bluetooth module to communicate between the glove and the computer or other devices it is connected to. The Bluetooth module enables wireless communication between the two devices, allowing for greater flexibility and mobility.

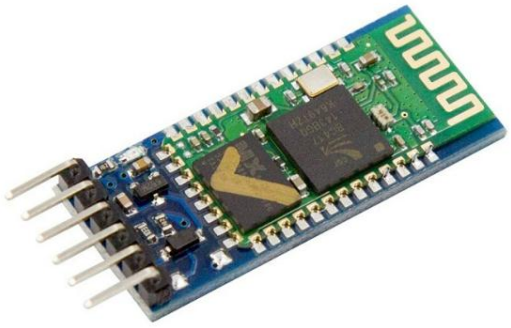

Fig-5: Bluetooth Module

The Bluetooth module typically operates on the 2.4 GHz frequency band and uses the Bluetooth protocol to establish a connection with the device it is paired with. Once paired, the device can send and receive data from the glove, such as the hand gestures made by the user wearing the glove.

There are various types of Bluetooth modules available on the market, and the specific module used in a Glove Based Sign Interpretation System would depend on factors such as the range and speed of communication required, power consumption, and compatibility with the other devices in the system.

2.4 Bread Board:

A breadboard is a device used for prototyping electronic circuits. It allows the user to create and experiment with circuits without the need for soldering. A breadboard is a reusable board with holes drilled into it that are used to insert electronic components such as resistors, capacitors, transistors, and integrated circuits.

The holes on a breadboard are typically used to hold the legs of electronic components. The legs are inserted into the holes and are held in place by the friction between the legs and the sides of the hole. Once the components are inserted into the breadboard, they can be wired together using small lengths of wire. The wires are inserted into the holes on the breadboard and are used to create the necessary connections between components.

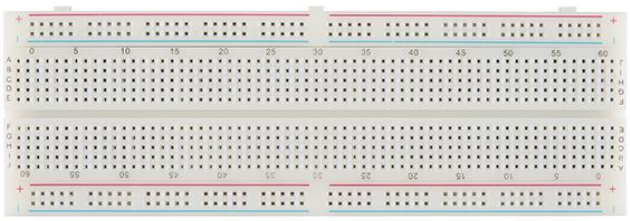

Fig-6: Bread Board

2.5 Wires:

Wires are an important component in the glove-based sign interpretation system as they are used to connect the various components together. These wires can be of different types, such as jumper wires, breadboard wires, and shielded wires.

Jumper wires are used to connect the pins of different components on a breadboard. These wires are pre-stripped and pre-formed, making it easy to use them for various connections. They are available in different lengths, colors, and gauges to suit different requirements.

Breadboard wires are similar to jumper wires, but they are designed to be used specifically on breadboards. They come with a pin on one end that can be inserted into the breadboard and a socket on the other end that can be connected to a component. These wires are also available in different lengths and colors.

Shielded wires are used in situations where the signal needs to be protected from interference. These wires have a shield that surrounds the signal wire, which helps to reduce the amount of interference picked up by the wire. Shielded wires are commonly used in audio and video applications where signal quality is important.

Fig-7: Jumper Wires

In the glove-based sign interpretation system, wires are used to connect the flex sensors, accelerometer, and Bluetooth module to the Arduino board. The wires are also used to connect the Arduino board to the power source and the output devices such as LCD display and speaker. The length and type of wires used in the system depend on the specific requirements of the project.

2.6 Power Source:

The power source in Glove Based Sign Interpretation System is typically a 9V battery or a USB cable connected to a power source such as a computer or wall adapter. The Arduino board and other components are powered by this source, providing the necessary power to run the system. It is important to use a reliable power source to ensure that the system functions properly and does not experience any power-related issues. Additionally, the power source should be chosen based on the specific requirements of the system and the components being used.

3. Software Resources:

The Arduino Integrated Development Environment (IDE) is an application used for writing, compiling, and uploading code to Arduino microcontrollers. It is a cross-platform application that is available for Windows, Mac OS X, and Linux operating systems.

The Arduino IDE provides a user-friendly interface for programming Arduino boards and supports a variety of programming languages, including C, C++, and a simplified version of C++ called Arduino Sketch.

In addition to providing a text editor for writing code, the Arduino IDE also includes a serial monitor for debugging and communication with the Arduino board. It also supports various libraries that make it easier to interface with external sensors and devices.

The Arduino IDE is open-source software and is free to download and use. It is regularly updated with new features and bug fixes, and the community provides a wealth of resources and support for those who are new to programming with Arduino.

4. Proposed Method:

The proposed system utilizes flex sensors to capture a user's hand gestures, which produce a stream of data that varies based on the degree of bend. The Arduino is used to process this data and send voice commands to an Android app via a Bluetooth module. The flex sensors are responsible for detecting the hand posture and are made up of carbon resistive elements. As the sensor is bent, it produces output resistance corresponding to the bend radius. Therefore, this system enables communication between people.

Fig-8: Proposed System

5. CONCLUSION

In conclusion, the Glove Based Sign Interpretation system using Arduino is an innovative solution to bridge the communication gap between the hearing and speech-impaired community. The system uses flex sensors to capture hand gestures and translate them into text and sound. The Arduino microcontroller processes the sensor data and sends it to an Android app via Bluetooth module to generate voice commands. The breadboard, wires, and power source are essential components of the system. The hybrid approach of using both rule-based and machine learning algorithms enhances the accuracy of gesture recognition. This system has the potential to improve the quality of life for individuals with speech disabilities by providing them with an efficient means of communication. Further improvements and enhancements can be made to this system to make it more user-friendly and accessible.

REFERENCES

[1] Safayet Ahmed; Rafiqul Islam; Md. Saniat Rahman Zishan; Md. Rabiul Hassan, “Electronics speaking system for speech impaired people”, May .2015.

[2] B.G. Lee, Member, IEEE, and S.M. Lee, “Smart wearable hand device for sign language interpretation system with sensor fusion”, Apr. 2017.

[3] Ghotkar, Archana S., “Hand Gesture Recognition for Indian Sign Language”, International Conference on Computer Communication and Informatics (ICCCI), 2012, pp 1-4.

[4] S. Vigneshwaran; M. Shifa Fathima; V. Vijay Sagar; R. Sree Arshika, "Hand Gesture Recognition and Voice Conversion System for Dump People,” IEEE International Conference on Intelligent and Advanced Systems, 2019.

[5] Jinsu Kunjumon; Rajesh Kannan Megalingam, "Hand Gesture Recognition System for Translating Indian Sign Language into Text and Speech”, IEEE International Conference on Intelligent and Advanced Systems, 2019, pp 597-600.

[6] Byung-woo min, Ho-sub yoon, Jung soh, Takeshi ohashi and Toshiaki jima," Visual Recognition of Static/Dynamic Gesture: Gesture-Driven Editing System”, Journal of Visual Languages & Computing Volume10, Issue3, June 1999, pp 291-309.