

# Hand Talk: Intelligent Sign Language Recognition for Deaf and Dumb

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**ABSTRACT:** The Proposed system introduces an efficient and fast algorithm for identification of the number of fingers opened in a gesture representing an alphabet of the Binary Sign Language. The idea consisted of designing and building up an intelligent system using group of Flex sensor, machine learning and artificial intelligence concepts to take visual inputs of sign language's hand gestures and generate easily recognizable form of outputs. The objective of this project is to develop an intelligent system which can act as a translator between the sign language and the spoken language dynamically and can make the communication between people with hearing impairment and normal people both effective and efficient. After recognizing the gesture the output are expressed in terms of voice and text for display.

**KEYWORDS:** Hand gloves, Flex Sensors, Sign Language interpretation, Language translation

## I. INTRODUCTION

Dumb people are usually deprived of normal communication with other people in the society. It has been observed that they find it really difficult at times to interact with normal people with their gestures, as only a very few of those are recognized by most people. Since people with hearing impairment or deaf people cannot talk like normal people so they have to depend on some sort of visual communication in most of the time. Sign Language is the primary means of communication in the deaf and dumb community.

As like any other language it has also got grammar and vocabulary but uses visual modality for exchanging information. The problem arises when dumb or deaf people try to express themselves to other people with the help of these sign language grammars. This is because normal people are usually unaware of these grammars. As a result it has been seen that communication of a dumb person are only limited within his/her family or the deaf community.

The work described in this project is with an aim of developing a system to aid deaf-dumb people which translate the sign language recognition into text with static palm side of right hand images. This project introduces an efficient and fast algorithm for identification of the number of fingers opened in a gesture representing an alphabet of the Binary Sign Language.

The idea consisted of designing and building up an intelligent system using group of Flex sensor, machine learning and artificial intelligence concepts to take visual inputs of sign language's hand gestures and generate easily recognizable form of outputs.

Hence the objective of this project is to develop an intelligent system which can act as a translator between the sign language and the spoken language dynamically and can make the communication between people with hearing impairment and normal people both effective and efficient. The signals are expressed in terms of voice and text for display.

## II. RELATED WORKS

The present paper explains the characteristics of a commercial glove, the available programming languages and provides

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a guide to develop an application to communicate with the device and the presentation of data on a screen for further analysis and interpretation on a specific interface and also as a voice message.

Virtual reality is a computer interface that includes simulation and interactions through different sensory channels in real time, which may be visual, acoustic, tactile, and olfactory stimulus [12]. The high prices that characterize virtual reality devices, has led the search for alternative, less sophisticated as the simulation by conventional computing devices such as keyboard, mouse, and monitor. This is known as desktop virtual reality and into the main computer programs can be mentioned VRML (Virtual Reality Modeling Language), Java 3D [3], Direct X, Maya [6], etc.

The limitation of these programs is the complicated interaction for the user as he navigates a three dimensional environment, this becomes a difficult task, since it must combine the functions of the mouse and keyboard to perform more complex movements like walking forward and turn, or rotate and rise.

In the area of technology applied to sign language interpretation will have some significant works in two ways, first is to translate the language either spoken or sign language text and the second which means a signer for be translated into spoken or text.

In the first case [6], we can cite the work of Fernando Lopez, Javier Tejedor, Daniel Bolaños and José Colas [2], which develop a text transcript of sign language in the presentation to the end user is performed through an animated character in three dimensions and can be used to translate a Web page or a mobile phone to translate a conversation.

In the second case [5], which is covered by this research, one of the early work is that developed by Sidney S. Fels and Geoffrey E. Hinton in which a multilayer neural network used in conjunction with a VPL glove connected to a DECTalk speech synthesizer to make the system generate audible speech from an input of sign language, which conclude that the system has limitations for using a limited data glove static movements [3].

In 2002, Hernandez, Kyriakopoulos and Linderman present the AceleGlove application as an interface to write in a virtual keyboard by a recognition of 26 signals from ASL (American Sign Language) [4].

More recently Leybon-Ibarra, Ramírez-Barba and Taboada-Picazo [1], developed and implemented a glove with photoelectric devices to distinguish four positions during the flexor movement of fingers distinguishing hand shape a signer performs to communicate through sign language, and functional new development which presents some limitations on the movement of the hand and in the direction of hand movement. In our case, we are using a commercial Data-Glove with more moving capacities and with a minimum cost.

### III. HARDWARE USED

If you are using *Word*, use either the Microsoft Equation Editor or the *MathType* add-on (<http://www.mathtype.com>) for equations in your paper (Insert | Object | Create New | Microsoft Equation *or* MathType Equation). “Float over text” should *not* be selected.

#### A. Processor

According to the proposed system, the best choice of microcontroller is PIC microcontroller due to following reasons

- PIC microcontrollers has reduced instruction set RISC.
- MiWi are compatible only with PIC microcontrollers
- Low cost
- Free development tools available

Hence from PIC microcontroller family PIC18F45J11 is used in this system. PIC18F45J11 has 32k program memory and 3.8k data memory. This family provides low power and high performance 8-bit MCU with peripheral flexibility in a small package for cost sensitive applications in the PIC18 J-series. New features include Deep sleep mode for low power applications, Peripheral Pin Select for design flexibility for mapping peripherals to I/O pins and a CTMU module for easy capacitive touch user interfaces. The PIC18F46J11 family is ideal for applications requiring cost-effective, low-power solutions with a robust peripheral set in a small package. The 18 series inherits the following features

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- A memory mapped accumulator.
- Read access to code memory (table reads).
- Direct register to register moves (prior cores needed to move registers through the accumulator).
- An external program memory interface to expand the code space.
- An 8-bit  $\times$  8-bit hardware multiplier.
- A second indirect register pair.
- Auto-increment/decrement addressing controlled by control bits in a status register (ALUSTA).
- Call stack is 21 bits wide and much deeper (31 levels deep).
- The call stack may be read and written (TOSU: TOSH: TOSL registers).
- Conditional branch instructions.
- Indexed addressing mode (PLUSW).
- Extending the FSR registers to 12 bits, allowing them to linearly address the entire data address space.
- The addition of another FSR register (bringing the number up to 3).

### B. Flex sensors

Flex sensors are sensors that change in resistance depending on the amount of bend on the sensor. They convert the change in bend to electrical resistance - the more the bend, the more the resistance value. They are usually in the form of a thin strip from 1"-5" long that vary in resistance from approximately 10 to 50 kilohms. They are often used in gloves to sense finger movement. The resistance of the flex sensor changes when the metal pads are on the outside of the bend (text on inside of bend).

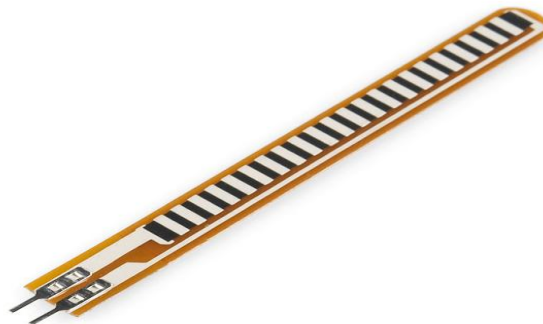


Fig – 1 Flex Sensor

The membrane construction is both resilient and somewhat durable, and can be used within a temperature range of  $-35^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$  for an operational life rating of over 1 million movements if the sensor is secured properly. There are two types of flex sensors. They are unidirectional and bidirectional. Unidirectional 4.5" flex sensors are used in this system as the movement of our fingers are confined in one direction.

Flex sensors are analog resistors. They work as variable analog voltage dividers. Inside the flex sensor are carbon resistive elements within a thin flexible substrate. More carbon means less resistance.

When the substrate is bent the sensor produces a resistance output relative to the bend radius. With a typical flex sensor, a flex of 0 degrees will give 10K resistance will a flex of 90 will give 30-40 K ohms. The Bend Sensor lists resistance of 30-250 K ohms.

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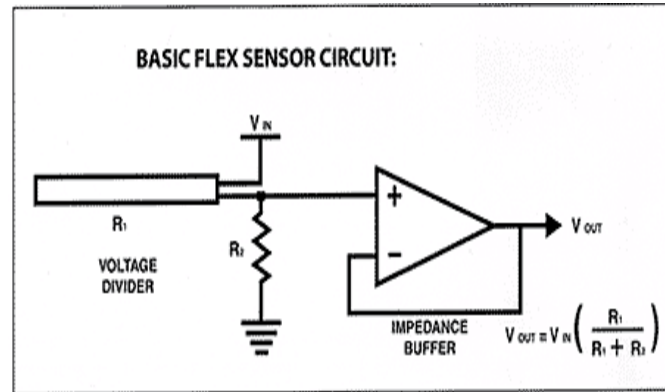


Fig – 2 Basic Circuit: Flex Sensor as Voltage Divider

## IV. TEST PREPARATION

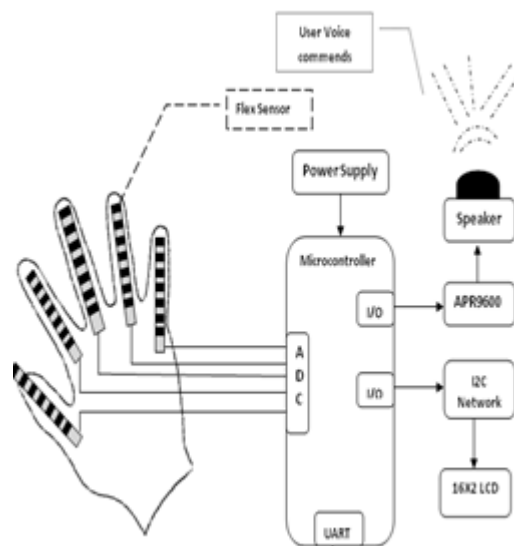


Fig – 3 Hardware Setup

In this project data glove is implemented to capture the hand gestures of a user. The data glove is fitted with flex sensors along the length of each finger and the thumb. The flex sensors output a stream of data that varies with degree of bend.

The analog outputs from the sensors are then fed to the PIC (Peripheral Interface Controller) microcontroller. It processes the signals and perform analog to digital signal conversion. The resulting digital signal is displayed in the LCD via I2C network. The gesture is recognized and the corresponding text information is identified.

Text to speech conversion takes place in the voice section and plays out through the speaker. The user need to know the signs of particular alphabets and he need to stay with the sign for two seconds. There are no limitations for signs it is hard to build a standard library of signs.

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The new sign introduced should be supported by the software used in the system. The system can also be designed such that it can translate words from one language to another. A pair of gloves along with sensors enables mute people to interact with the public in the required language.

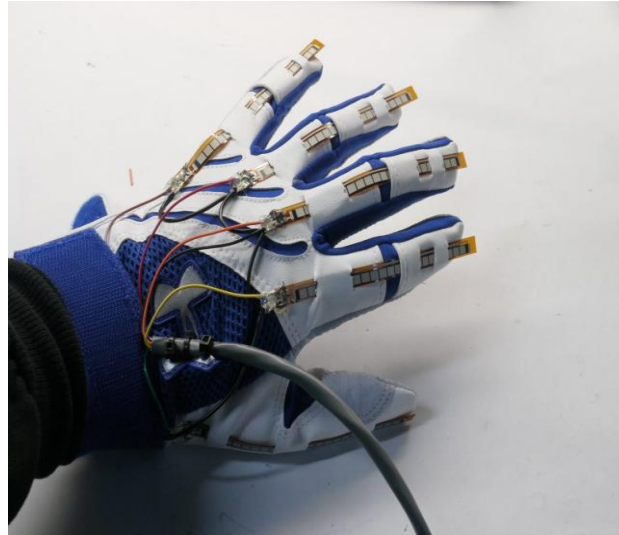


Fig – 4 Hardware Implementation

The performance accuracy of this device can be improved by increasing the number of sensors in the series. These sensors are attached along the fingers and thumb. The degree of bending of fingers and thumb produces the output voltage variation which in turn on converting to analog form produces required voice.

## V. CONCLUSION

Sign language is a useful tool to ease the communication between the deaf or mute community and the normal people. Yet there is a communication barrier between these communities with normal people. This project aims to lower the communication gap between the deaf or mute community and the normal world. This project was meant to be a prototype to check the feasibility of recognizing sign language using sensor gloves. With this project the deaf or mute people can use the gloves to perform sign language and it will be converted into speech so that normal people can easily understand.

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