# GIVENING VOICE TO MUTE PEOPLE USING FLEX SENSOR

Prof.A.H.Ansari[1],Ms.JoriAshwini Sanjay[2], Ms.DolasAshwini Shesherao[3], Ms.GaikwadPrajakta chandrakant[4]

[1]Prof.A.H.Ansari, Department of E&TCEngineering,PRECloni, Maharashtra, India.
[2]Ms.Ms.JoriAshwini Sanjay, Department of E&TC Engineering, PREC loni, Maharashtra, India.
[3]Ms. DolasAshwiniShesherao,Department of E&TC Engineering,PRECloni, Maharashtra, India.
[4]Ms, Ms.GaikwadPrajaktaChandrakant, Department of E&TCEngineering,PRECloni, Maharashtra, India.

## ABSTRACT

*Communication problem between deaf-mute and a normal person have always been a difficult task. The paper illustrate to aid people by means of a glove based deaf-mute communication translator system. The glove is internally fitted out with five flex sensors, tactile sensors and accelerometer. For each particular movement, the flex sensor produces a proportional change in resistance and accelerometer measures the emplacement of hand. The processing of these movements is done by Microprocessor. The system includes a text to speech conversion (TTS) block which interprets the matched gestures i.e. text to speech output.Hand gesture is one of the typical methods used in sign language for non-verbal communication. It is most commonly used by deaf and dumb people to communicate among themselves or with normal people. Various sign language systems have been formulated by manufacturers around the world but they are neither adaptable nor cost-effective for the actual users. This paper presents a system prototype that is able to automatically recognize sign language to help normal people to communicate more effectively with the diminished people. The Sign to Voice system prototype, S2V, was developed using Feed Forward Neural Network for two-sequence signs detection.Mute people can't speak and normal people don't know the sign language which is used for inter communication between mute people. This system will be useful to solve this problem.*

**Keyword**: *Flex Sensor[1]*

---

## INTRODUCTION:

About nine thousand million people in the world are deaf and dumb. How frequently we come across these people communicating with the normal world? The communication between a deaf and normal person is to be a serious problem compared to communication between blind and normal visual people. This creates a very small space for them as communication being a fundamental aspect of our life. The blind people can talk freely by means of normal language whereas the deaf-mute people have their own manual-visual language popularly known as sign language. Sign language is a non-verbal form of intercommunication which is found amongst deaf people in world. The languages do not have a common origin and hence difficult to translate. Deaf-Mute communication interpreter is a device that translates the hand gestures to auditory voice. A gesture in a sign language is a particular movement of the hands with a various shape made out of fingers. Facial expressions are also taken into consideration towards the gesture, at the same time. A gesture on the other hand, is a static shape of the hand orientation to show a sign. Gesture recognition is categorized into two main groups i.e. vision based and sensor based. The sensor based technique offers better mobility. The main aim of this paper is to present a system that can efficiently interpret American Sign Language gestures to both text and auditory speech. The converter here makes use of a glove based technique consisting of flex sensors. For each hand gesture made a signal is produced by the sensors corresponding to the hand sign the controller matches the gesture with already stored inputs in the SD card. The device translates alphabets as well as can form words using specific gestures made by person.

## 2. GESTURE TO VOICECONVERSION SYSTEM:

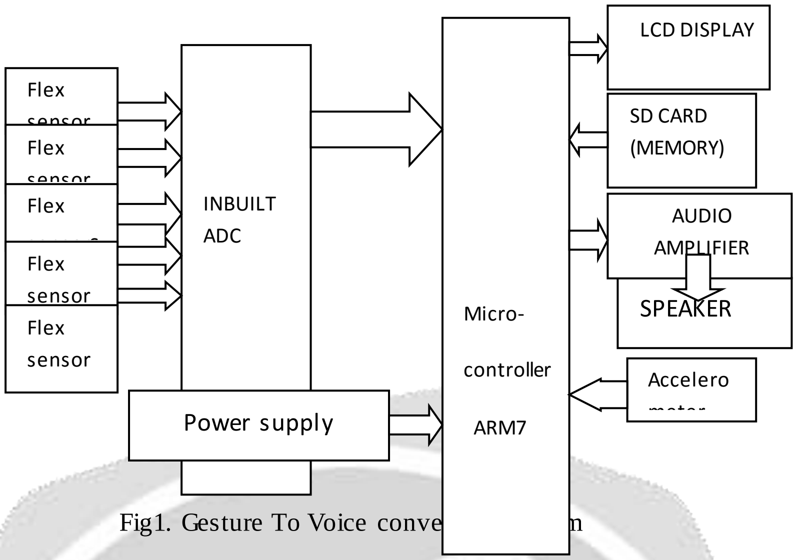



Fig1. Gesture To Voice conve m

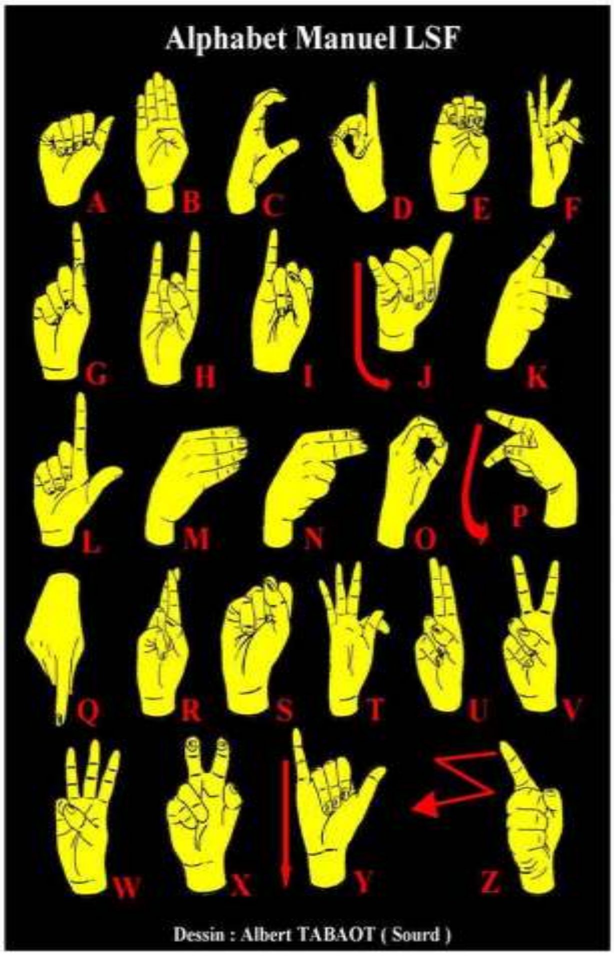
**2.1.Block Diagram Explanation:**

As shown in figure, Flex sensors are used to detect hand posture. Flex sensors are resistive carbon elements. When bent, the sensor produces a resistance output correlated to the bend radius. The variation in resistance is approximately 10 to 30 Kohm. An unflexed sensor has 10Kohm resistance and when bent the resistance increases to 30Kohm at 90 degree. The sensor is about ¼ inch wide, 4-1/2 inches long. The five flex sensors are mounted on the fingers and thumb of the user. When user makes a hand gesture to express a specific word the flex sensors gets folded. As the posture of each finger is different, so resistance value of each flex sensor is also different.

The microprocessor will then compare these readings to the look up table stored in the internal program memory. Whichever reading is closest to the lookup table the microprocessor will then select that word.

After this the microprocessor will search the SD card for the .wav file with similar name. For example:

If the user hand is showing the following gesture then microprocessor will read the flex sensor reading and compares it with look-up table reading. obtains the word “P R E C” from the loosearch word “P R E C” in the look- If the user hand is showing the following posture then according to the flex sensors reading , the microprocessor will search the word “GOOD”. After this the microprocessor will search the wave file with the name good.wav. If the file exists in the SD card then microprocessor will play the corresponding file with the word pronunciation.




Here we are using two keys i.e English and Hindi/Marathi, if user want to play English/hindi/Marathi words(.wav file). Then select those keys. Here we are storing 12 English and 2 hindi/Marathi words.

**2.1.1.FLEX SENSOR**

Flex sensors are resistive carbon elements. When bent, the sensor produces a resistance output correlated to the bend radius. The variation in resistance is approximately 10 to 30 KOhm's. An unflexed sensor has 10Kohm resistance and

when bent the resistance increases to 30Kohm at 90 degree. The sensor is about ¼ inch wide, 4-1/2 inches long.

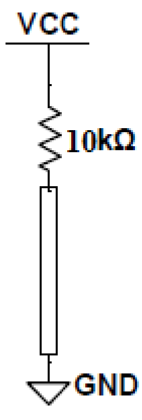



**Fig. 2 Voltage divider circuit.**

Vout = Vin [ R1/ R1 + R2 ]

The sensor is incorporated in device using a voltage divider network. Voltage divider is used to determine the output voltage across two resistances connected in series i.e. basically resistance to voltage converter. The resistor and flex forms a voltage divider which divides the input voltage by a ratio determined by the variable and fixed resistors.

**2.1.2.ANNOUNCEMENT SYSTEM**:

This system is used to play the output of our project. Announcement system consists of LM389 Audio Amplifier and Loud Speaker. The microprocessor provides data from SD Card to Audio Amplifier. The audio amplifier amplifies the signal and provides it to Loud speaker. Then the loud speaker plays the audio output of the project.

**2.1.3.Liquid Crystal Display:**

The output of the system is displayed on LCD. In our system16x2 LCD is used. The 16x2 indicates 16 columns and 2 rows. So, we can write 16 characters in each line. So, total 32 characters we can display on 16x2 LCD.
The LCD displays the name of the system when the project is switched ON. The LCD will display the word corresponding to each hand gesture made by user. This enables the mute people to convey their thoughts using words. And also helps deaf people to understand what is conveyed the person communicating with them. As deaf people can read the words directly from the LCD. Hence this system enables deaf people to communicate with Mute as well as normal people.

**2.1.4.SD CARD**:

The purpose of using SD Card in this system is to store the data. In our system the 2GB SD card is used. The SD card stores the .wav file corresponding to each word present in the internal program memory of the ARM7 microprocessor. The microprocessor uses this data to play the output of the system on Loud Speaker. The interfacing between SD card and microprocessor is through SPI protocol.

Accelerometer: Accelerometer is used to find the orientation of Hand

Common Types of Accelerometers

Sensor Category Key Technologies

•Capacitive-Metal beam or micro machined feature produces capacitance; change in capacitance related to acceleration •Piezoelectric-Piezoelectric crystal mounted to mass – voltage output converted to acceleration

•Piezoresistive-Beam or micro machined feature whose resistance changes with acceleration

•Hall Effect-Motion converted to electrical signal by sensing of changing magnetic fields

•Magneto resistive-Material resistivity changes in presence of magnetic field

•Heat Transfer-Location of heated mass tracked during acceleration by sensing temperature

## 3.DESIGN OF THE PROPOSED SYSTEM

### 3.1.Hardware Design

There are a total of 5 Flexion (Bend) sensors (for the 5 fingers) used in each glove which are used to detect the movement of joints in fingers and thumb. As the sensor is flexed, the resistance across the sensor increases. Also, a single tri-axial accelerometer is fitted on the back of the palm of each glove so as to capture the orientation of the hands along with the bend angle of the fingers.

### 3.2.Software Design

The "Sign Language Trainer & Voice Convertor" software receives the values given by the flex sensors and the accelerometers on the two gloves through an Arduino
Duemilanove Microcontroller Board. The software end has the following features:

- Visualization of the gloves on real time graphs
- Calibration of gloves
- Creation of libraries
- Saving of multiple samples for each gesture in a library
- Gesture recognition and voice emulation.

The software is based on the statistical template matching model and the entire model can be divided into three parts, namely: calibration of the sensors, training of the model and gesture recognition.

Calibration of the sensors is achieved by taking the minimum and maximum sensor values and then normalizing and quantizing the values, so as to convert the read sensor values into a pre-defined range of discrete data set, according to a scale down factor as:

$$N_i = (S_i - S_{i\,min}) \times \frac{(R_{max} - R_{min})}{S_{i\,max} - S_{i\,min}} + S_{i\,min} \quad (1)$$

$$F = \frac{(R_{max} - R_{min})}{L} \quad (2)$$

$$Q_i = N_i - (N_i \; mod \; F) \quad (3)$$

where, Ni is the normalized value for the ith sensor, Rmax & Rmin (set to 500 and 0 respectively, for the proposed system) define the required range, Si(min) & Si(max) are the read minimum and maximum sensor values, Si is the actual value of the ith sensor, F is the scale down factor, L (set to 40 for the proposed system) is the number of required quantization levels and Qi is the final quantized and normalized value of the ith sensor.

- The data collection phase of the model is called „Training" in which all the quantized sensor values are taken as input and stored in the database as samples for a particular gesture in the library.
- The third phase of „Recognition" involves building of the statistical template matching model by calculating the mean and standard deviation of each sensor, for each gesture stored in the library and only recognizing those input samples as correct which lie within the threshold times the standard deviation bounded mean of a particular gesture in the selected library.

The gesture boundaries [2] are calculated as:

$$\mu_{i,j} = \frac{1}{n} \times \sum_{k=1}^{n} x_{i,j,k} \quad (4)$$

$$\sigma_{i,j} = \sqrt{\frac{1}{n} \times \sum_{k=1}^{n} \left(x_{i,j,k} - \mu_{i,j}\right)^2} \quad (5)$$

$$\mu_{i,j} - \alpha.\sigma_{i,j} < Q_j < \mu_{i,j} + \alpha.\sigma_{i,j} \quad (6)$$

where, $\mu_{i,j}$ and $\sigma_{i,j}$ are the mean and standard deviation of the ithgesture"sjth sensor, xi,j,k is the value of the kth sample, n is the total number of samples stored for a gesture, $\alpha$ is the user defined threshold and Qj is the jthsensor"s quantized and normalized value from the input sample.

For a large threshold value $(\alpha)$ , there are frequent cases when more than one gesture matches the classification due to overlapping recognition ranges. In such a case, the closest match can be calculated by using the technique of Least Mean Square Error (LMSE) [21], amongst all the chosen gestures, as in the Boltay Haath Project [2]. Mean square errors for all the available gestures of a particular library are calculated and then, the least value amongst them is selected as the LMSE. If „i" be the total number of available gestures, $\mu_{i,j}$ be the mean of ithgesture"sjth sensor and xk be the jthsensor"s value from the kth sample of a particular gesture, then LMSE would be given by:

$$LMSE = \min_i \left\{ \left( \sum_j \sum_k (x_k - \mu_{i,j})^2 \right) \ \forall\ i \right\} \quad (7)$$

In spite of using the LMSE technique, the statistical model"s accuracy is effectively reduced as the dataset grows in size due to overlapping of boundary conditions.

## 4. IMPLEMENTATION

### 4.1.Hardware Implementation

A startling inference that can be drawn from Table I is that all of the commercially available gloves cost anywhere between 1,000 – 20,000 US dollars, consequently rendering production of sign language translation systems infeasible for general masses, in terms of production cost. To overcome this issue as well as, to enhance the overall user experience of using glove based technology, the proposed system uses specially designed cotton gloves embedded with self fabricated bend sensors and standard accelerometers, which measure the bend of each finger separately and the orientation of the hand as gestures are made. This results in highly reduced manufacturing costs and greater user comfort.

Bend sensors and accelerometers that are available in the market cost about 16 US dollars per sensor and 30 US dollars respectively. However, this cost can be brought down drastically by self fabricating the bend sensors instead of purchasing the same from the market. Each bend sensor then costs under $1. The total optimized cost for a pair of gloves using this approach = 10 * 1 + 2 * 30 = 70 US dollars (excluding cost of gloves themselves).

#### 4.1.1.Steps for constructing a flex sensor:

Velostat, Brass Foil, Conducting wires and Electrical Tape.

- Wires are soldered to the ends of two brass foil strips, which act as the two electrical terminals (Fig. 1)
- 3 layers of Velostat (Eonyx) is sandwiched between the two brass strips using electrical tape (Fig. 2 and 3)
- Different bend sensors are then customized according to the relative ratios of the finger lengths and then embedded onto the cotton gloves (Fig. 4)

### 4.2.Software Implementation

The software end of the system has been developed in Java, along with Java Swings to provide a rich user interface. Every program in Java has a set of initial threads, where the application logic needs to begin. However, the Swing elements are processed only on the Event Dispatch Thread (EDT) which handles the events from the Abstract Window Toolkit (AWT) graphical user interface (GUI) event queue.

In case of multi threaded programs, it is of utmost importance to not run time consuming tasks on the EDT, otherwise the entire GUI becomes unresponsive. Thus, any computationally intensive application, which needs to have a long running task in the background providing updates to the UI, either when done or during processing, needs two threads, one to perform the lengthy task (known as swing workers) and also the EDT for all the GUI related activities [7]. Since our application needs to handle computations of large amounts of incoming data, as well as, needs an active user input at the same time, therefore we implemented Java Swing Workers for this purpose, which also help in maintaining a near real time simulation of the system.

## 5.APPLICATIONS

Gesture recognition
As a translating device for Mute people
Can be used for Mobiles for SMS sending ETC….

## 6.ADVANTAGES

Efficient way for Mute Communication
Less Time Delays
Quick Response Time
Fully Automate System
Robust System Low Power Requirement

## 7. METHODOLOGY

To convert sign language to speech user needs to wear the Gloves which consist of the flex sensors. When the user makes the hand gesture the fingers are either folded or may not be folded. When fingers are folded the value of resistance of flex sensor changes it becomes 30KOhms.When fingers are not folded the value of resistance of flex sensors is 10KOhms.These resistance values are used to determine the gesture of hand and text corresponding to which are stored in look up table. The same text wav file is search in SD card. This wav file consist of speech which is played and also the text is displayed on the LCD.

• Commands made using flex sensors and an accelerometer to maximize user inputs.
• A transmitter that fits comfortably on the back of a medium sized glove.
• A transmitter/receiver combination consisting of two low-power MSP430 microcontrollers paired with XBees.
• The capability to detect volume, channel, guide, and number gestures efficiently.
• A wireless setup that allows for directional freedom while inputting commands.
• A feedback LED on the transmitter and a feedback LCD screen on the receiver.

## CONCLUSION

Sign language is used all over the world by the mute and hearing-impaired to communicate with each other. It is a combination of finger spelling and facial expressions. Sign language has crossed barriers because of its beautiful expressive characteristics. The facial expressions and gestures that accompany sign language have opened the way for visual articulation in art, drama, therapy, and many other non- traditional settings. It has become a language for both the hearing-impaired and the mute. Research in the area of assistive technologies is progressing at a good pace. Our Glove-based sign language recognition system using Statistical Template Matching Technique was implemented successfully with accuracy comparable to those of commercially available systems and that too at a highly optimized cost

## REFERENCES:

[1] Agarwal, R, and J Sklansky Estimating Optical Flow from Clustered Trajectories in Velocity-Time In Proceedings of the 11th IAPR nternational Conference on Pattern Recognition Vol #1 Conference A: Computer Vision and Applications, 215-219, 1992.
[2] Aleem Khalid Alvi, M Yousuf Bin Azhar, Mehmood Usman, Suleman Mumtaz, Sameer Rafiq,et al, "Pakistan Sign Language Recognition Using Statistical Template Matching", 2005.
[3] Anderson, James A. An Introduction to Neural Networks.Bradford Books, Boston, 1995.
[4] Andrea Corradini ,Horst-Michael Gross 2000, Hybrid Stochastic-Connectionist Architecture for Gesture Reognition",2000 IEEE 336-341.
[5] Andrea Corradini, Horst-Michael Gross 2000, "Camera-based Gesture Recognition for Robot Control",2000 IEEE 133-138.
[6] Auer, T, A Pinz, and M Gervautz Tracking in a Multi-User Augmented Reality System In Proceedings of the IASTED International Conference on Computer Graphics and Imaging, 249-253, 1998.
[7] Bruce Eckel, "Thinking In Java" Delhi, India: Dorling Kindersley (India) Pvt Ltd, 2008, pp1109-1376.
[8] Charniak, Eugene. Statistical Language Learning. MIT Press, Cambridge, 1993.

[9] Defanti, Thomas, and Daniel Sandin Final Report to the National Endowment of the Arts US NEA R60-34-163, University of Illinois at Chicago Circle, Chicago, Illinois, 1977.

[10] Encarnac¸ ˜ao, M. A Survey on Input Technology for the Virtual Table Interface, Device Technical Report, Fraunhofer Center for Research in Computer Graphics.

[11] Dr Nasir Sulman, Sadaf Zuberi, “Pakistan Sign Language – A Synopsis“, Pakistan, June 2000.

[12] Eglowstein, Howard Reach Out and Touch Your Data Byte, July, 283- 290, 1990.

[13] Encarnac¸ ˜ao, M A Survey on Input Technology for the Virtual Table Interface.

[14] Fakespace Pinch Glove System Installation Guide and User Handbook, Mountain View, California, 1997.

[15] Fels, Sidney Glove-TalkII: Mapping Hand Gestures to Speech Using Neural Networks – An Approach to Building Adaptive Interfaces PhD dissertation, University of Toronto, 1994.