

# Smart Gloves for Hand Gesture Recognition and Translation into Text and Audio

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**Abstract** - Smart Gloves used for hand gesture recognition and translation which acts as a tool for communication by the deaf and dumb people in real life. The gloves make use of Sign language which is translated in text and audio. It uses hand gesture and orientation of the fingers which has flex sensors embedded to it to measure the movement and convey the message. This data is then sent to the microcontroller. The input signal needs to stay constant for the defined period and if the gesture remains unchanged then it is valid and the translated text and audio is observed on the smart phone application. The transmission of signals is done with the help of Bluetooth.

**Key Words:** Bluetooth Module, Flex Sensor, PIC 16F877A, Sign language, Arduino text to speech convertor.

## 1. INTRODUCTION

Hand Gesture Recognition (HGR) is one of the emerging semantic Human Computer Interaction (HCI) methods [6]. Sign language helps in expressing and enables a physically challenged person to freely communicate with normal person which not only help them in workspace but also in day to day life. In this paper we propose a wireless hand glove which make use of orientation of the fingers to depict a particular sentence. The language being used is American English. There are only about 250 certified sign language interpreters in India, translating for a deaf population of between 1.8 million and 7 million [7]. Thus, the purpose of the project is to provide mode of communication to the mass and remove the dependence of the disabled on the interpreter. The application on which the output is displayed and heard is an open source software which can be easily available to any person.

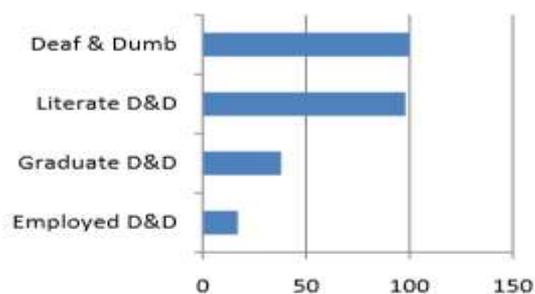


Fig. 1: Deaf and Dumb Work Survey

Chart -1: Deaf and dumb work survey

From the chart. We can see the decreasing ratio of literates and employed deaf and dumb population which is a result of the disability due to lack of communication between the deaf and dumb and normal person. This glove will be helpful to remove the differences in communication.

## 2. SIGN LANGUAGE

Sign languages are the languages which make use of the visual-manual modality to convey meaning. Sign languages are fully natural languages consisting of their own grammar and lexicon [6]. This proves that sign languages are not universal at all, although there are some similarities among different sign languages. They have become easy means of communication for mute people. It is used by people suffering from hearing problems, those who are unable to physically speak, those who have trouble with spoken language due to a disability. Each country generally has its own one or more native sign languages. According to ethnologic lists of 2013 edition, there are 137 sign languages in total. Out of which,

some sign languages have obtained some sort of legal recognition, while other languages have no status at all. In this paper we are going to use gestures for English language.

### 3. RELATED WORK

Many attempts are made to convert sign language into different languages.

In [1] sign language is converted to a Taiwanese language. Here a wireless hand gesture recognition glove is used for real-time translation of sign language into Taiwanese sign language. The flex and inertial sensors are embedded into the glove. The input is given by finger flexion postures acquired by flex sensors, the orientation of palm acquired by G-sensor, and the trajectory of motion acquired by gyroscope are used as the input signals of the proposed system. The paper delivers an accuracy of 94%.

For Chinese language [2] uses a virtual keyboard constructed to provide a visualized interface to retrieve sign icons from a sign database. A proposed language model (LM), based on a predictive sentence template (PST) tree, integrates a statistical variable -gram LM and linguistic constraints. The PST tree collected from the deaf schools is used in the model for correspondence between signed and written Chinese. These approaches improved the efficiency of text generation and the accuracy of word prediction and, thus, improved the input rate.

Different sign gestures are converted into Arabic language [3]. Flex sensors are used to recognize the degree of bend. The input is given to the microcontroller-based Arduino UNO board at analog pin which is programmed. Then the digital output is connected to the display which gives output as Arabic alphabet. The project gives output only for alphabets.

However, our model is based on a system that converts sign language in English in both text and audio format which depicts sentences and the model uses PIC microcontroller which gives high power efficiency.

## 4. HARDWARE COMPONENTS AND THEORETICAL BACKGROUND

### 4.1 FLEX SENSOR

A flex sensor is a sensor which calculates the amount of degree of bend. It is a non-inverting operational amplifier. It works at 5V input voltage. The degree of bend is calculated with respect to the resistance. Greater the degree of bend lower will be the output voltage.

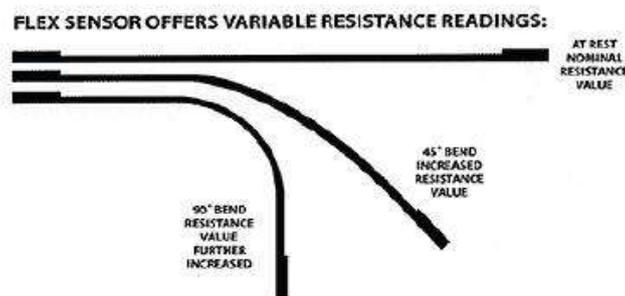


Fig -1: Flex sensor w.r.t degree of bend.

### 4.2 PIC MICROCONTROLLER

It is a 40-bit microcontroller IC. It has one 16-bit and two 8-bit timers. Five input/output ports along with serial and parallel ports are present in it. Under software control it can also self-reprogram itself.

### 4.3 BLUETOOTH MODULE

A Bluetooth module (HC-05) is used to transfer data from the microcontroller to a mobile application. The operating voltage of this Bluetooth module is 4V to 6V and the operating frequency is 30mA. It is used for serial communication. Also, it supports different baud rates: 9600, 19200, 38400, 57600, 115200, 230400, 460800.

5. WORKING

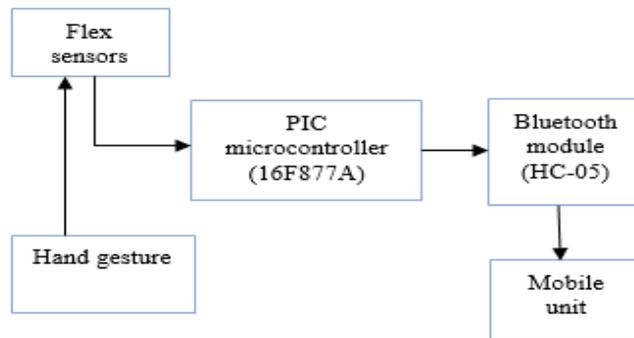


Fig -2: Block Diagram

The model proposed in this paper is an interpreter that translates. The sign language makes use of various hand gestures that have their generic meaning in their respective language like the sentence “hello” is stated by keeping all the fingers bend apart from the little finger which is kept straight. The word hello in binary would be denoted as 00001.

The first step to recognize hand gesture is to detect the orientation of the finger from the 31 fundamental postures as shown in fig 3. are the sample examples. These hand gestures are sensed by the flex sensor. The flex sensor varies its resistance with respect to the degree of bend. The flex sensor output voltage varies from 0-5V. It is a non-inverting operational amplifier working on the principles of voltage divider rule. The sensors are connected via three pins they are the ground, live and output pins. When a finger bends the output from the flex sensor are taken which is concatenated with fixed resistors. Then we measure the output voltage between the fixed resistor ( $R_b$ ) and flex sensor ( $R$ ) as given by (1).

$$V_0 = V_i \frac{R_F}{R_F + R_B} \dots\dots\dots (1)$$

If for flex 1 we get a value 207 then  $207 * 5 = 1035mV$  which will be the output of the flex sensor.

All output signals generated by flex sensors are in analog form and it is digitized by using PIC microcontroller, as it has 10-bit inbuilt ADC. All digital values are then stored in the buffer. Microcontroller compares static data and digital values to determine the gesture. According to the finger movement, it generates further output. The values sensed by flex sensors are in number form and to send those numbers over Bluetooth module we need to convert it into ASCII characters so that it can be readable at the receiver end.

For each flex sensor, there is a fixed threshold value that is based on the bend of the finger. Threshold values are obtained with the help of ADC values. ADC values are calculated using free Android software named as Bluetooth terminal HC-05. Calculated threshold values of each flex sensor are as shown below in the table.

Table -1: Threshold values of flex sensors

Flex sensor	Threshold value
H1	150
H2	150
H3	165
H4	160
H5	235

By considering the above table, if threshold value of flex sensor H1 is greater than 150 then it will give 1 as output and if it is less than 150 it will give 0 as output.

According to gestures different binary combinations and their respective messages are stored in program memory. This stored message is then transferred to a free Android

application named as Arduino Bluetooth text to speech converter via Bluetooth connected in the UART interface. This communication is made at a baud rate of 9600 bits/sec. When an application receives the message, it will convert it into speech.

		
HELLO 00001	This is smart glove 01100	It helps me to communicate with others 01111
		
I need a doctor 00110	It is useful for people suffering from speech disorders 00111	Could you please help me to cross the road? 01000

Fig -3: Sample gestures used for communication along with binary code.

## 6. PROGRAMMING IN C

All the signs corresponding to the sentences were decoded using C programming language the code was then dumped into the PIC microcontroller. We have used an open source software for the display of the output in both text and audio form.

## 7. RESULT



Fig 4-: Obtained sample result for sentence "IT HELPS TO COMMUNICATE WITH OTHERS".

## 8. CONCLUSION

In this paper a real-time and portable system for English language. To provide a mode of communication, an independent smart glove was designed for mute people at a low cost. We were able to achieve a high degree of accuracy for gesture recognition. The model can be coded for 31 sentences. The whole system is made up of easily available electronic components and free android apps which helped in reducing the overall cost. Such cheap but effective product will help the mute people to put forward their words through gestures and reduce the dependency they have on the interpreters.

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