

# A WIRELESS PROTOTYPIC HAND TALK ASSISTIVE TECHNIQUE FOR HEARING AND SPEECH IMPAIRED

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**Abstract:** About nine billion people in the world are deaf and dumb. Communications between deaf-mute and a normal person have always been a challenging task. They have their own manual-visual language known as sign language. The languages do not have a common origin and hence difficult to interpret. The project aims to facilitate people by means of a data glove based deaf-mute communication interpreter system. The sensors output a stream of data that varies with degree of bend. The output from the sensor are analog values, it is converted to digital and processed by using a PIC microcontroller and a signal converter then it will be transmitted through wireless communication (RF), finally it will be received in the receiver section and processed using responds in the voice using speaker. The gestures can be converted to voice by using an APR 9600 Voice storage and retrieval chip. Prerecorded voices are stored into APR Memory and when corresponding gestures are received, the appropriate voices are reproduced by the APR through the speaker. Thus corresponding finger gestures are converted into voice commands. This project was meant to be a prototype to check the feasibility of recognizing sign language using sensor gloves.

**Keyword:** Flex sensor, APR9600, PIC Microcontroller

## I. INTRODUCTION

An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing

constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today. Sign language is an expressive and natural way for communication between normal and dumb people (information majorly conveys through the hand gesture). Most of the commercial sign language system uses the glove technique. It's simple to attain data concerning the bending of finger flexure and three dimensional position of the hand.

In the recent years, there has been tremendous research on the hand sign recognition. The technology of gesture recognition is divided into two categories

### A. Vision based method:

In vision-based methods, computer camera is the input device for observing the information of hands or fingers.

### B. Glove based method:

In glove based systems data gloves are used which can archive the accurate positions of hand gestures as its positions are directly measured. The Data-Glove based methods use sensor devices for digitizing hand and finger motions into multi-parametric data.

The American Sign Language (ASL) gestures are considered as the images to be worked upon by decoding them with English alphabet [1]. The implementation focuses on deriving SIFT features from

an image and trying using these features to perform gesture recognition. The following information was depicted [2]. The approach of SIFT feature detection technique is used for object recognition. According to the invariant features extracted from images can be used to perform reliable matching between different views of an object or scene [3]. The features have been shown to be invariant to image rotation and scale and robust across a substantial range of affine distortion, addition of noise, and change in illumination. The approach is efficient on feature extraction and has the ability to identify large numbers of features [5].

The research paper analyses that the data from an instrumented data glove for use in recognition of some signs and gestures. A system is developed for recognizing these signs and their conversion into speech [4]. Data glove is consisted of two sensors; bend sensors and tilt sensor. The output of the tilt sensors is detected by the tilt detection module, while the output of the bend sensors and the overall gesture of the hand are detected by the gesture detection module [7]. The gesture detection module gives an 8-bit address to speech synthesis module; 8-bit address is different for each gesture. Speech Synthesis module speaks the message respective to address received by it [6]. The paper focuses on developing a help for disabled people using this gesture recognition technique. In this system the gestures are converted into text messages for communication [8]. A number of techniques are used to convert these gestures into required output, typically, it is said that either image based or device based [9]. Although hybrids are beginning to come about and this technology is still in its emerging state, a number of applications have been implemented in real time. It is explained that the basic concept that involves the use of data gloves worn by disabled people [10].

## II. SYSTEM ANALYSIS

The project is a simple embedded system based communicating device for deaf and dumb people. Here two major problems are taken into consideration. First one is deaf and dumb people communicating with normal person and second one is communication between deaf and dumb people. To solve this problem, it suggested to use two modes of operation. It is done by measuring the actions performed by the deaf and dumb people using flex sensor and accelerometer attached to gloves in a hand of the user. Once the glove is placed in the hands, whenever an action for sign language is performed, the bending and position of the hand is obtained and the corresponding action is identified by the PIC microcontroller 16F877A.

Not everyone in this world can learn the sign language. So the attempt to convert the sign language they show into the texts which displays in a screen. It's a hardware implementation using flex sensors and PIC 16F877A microcontroller. The flex sensors will give the resistance according to the bend. Both the values are in analog form hence both will be converted to digital data using the ADC (analog to digital converter). The converted digital data will be used as the test cases by the microcontroller PIC 16F877A to invoke the words stored in the flash memory according to the actions performed and the same will be displayed.

## III. PROPOSED SYSTEM

### A. Hardware Description

Flexion sensors are also called bend sensors, measure the amount of deflection caused by bending the sensor. The Figure 4.7 shows the illustration of how a flex sensor looks. There are various ways of sensing deflection, from strain-gauges to hall-effect sensors. The three most common types of flexion sensors are: conductive ink-based, fiber-optic, conductive fabric/thread/polymer-based. Here PIC 16F877A acts as an Analog to Digital conversion module. The PIC16F877A features 256 bytes of EEPROM data memory, self-programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions. It also has a synchronous serial port can be configured as either 3-wire Serial Peripheral Interface or the 2-wire Inter-Integrated Circuit bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications. APR use for voice storage and playback capability, each pin plays the voice for 60 second duration. The voice transmitted to receiver by the help of RF transmitter and it also a portable device. The RF transmitter and receiver used for long distance communication which is specifically designed for wireless speaker.

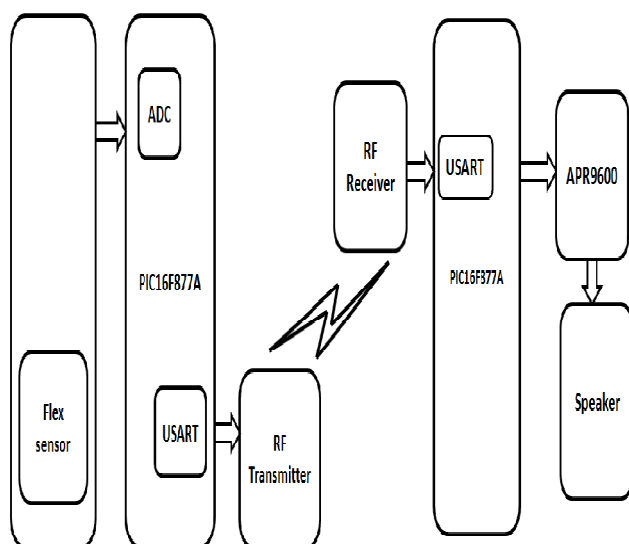


Figure 1: Block diagram of proposed system

### B. Proposed System Explications

The proposed system consists of flex sensors to recognize the hand and palm movements at the input. The sign language translator starts with the Glove, the heart of the project. The glove contains 5 flex sensors. Flex sensors are resistive carbon parts. When bent, the device develops a resistance output correlative to the bend radius. The variation in resistance is just about 10k $\Omega$  to 30k $\Omega$ . A global organization flexed device has 10k $\Omega$  resistance and once bent the resistance will increase to 30k $\Omega$  at 90 degree. The resistance varies as the flex strip is folded to indicate either logical 1 or logical 0 by giving the variable analog resistive input to the voltage divider circuit.

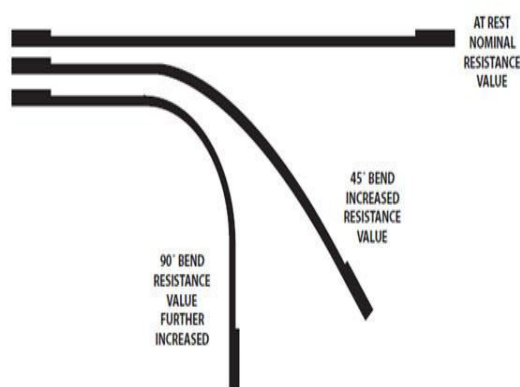


Figure 2: Working of flex

The voltage divider circuit detects the variations in the values obtained from sensors to be compared in with the reference values. Then the inbuilt ADC of PIC 16F877A microcontroller is used. In this way, 10 bit binary digit will be formed for each gesture. These digits are stored in the external memory of PIC. In PIC microcontroller, Analog to Digital conversion takes place which works under successive approximation. This successive approximation ADC is a type of analog-to-digital converter that converts a continuous analog waveform into a discrete digital representation via a binary search through all possible quantization levels before finally converging upon a digital output for each conversion.

An ADC converts analog to digital value and store the value in the buffer. Then Controller compares the static data and digital value for processing to determine the gesture. According to the finger movements microcontroller play the voice (speech). Voice is stored using APR9600 is a single chip used to store high quality voice recording and Non-volatile flash memory, playback capacity for 40 to 60 seconds. The six pins of APR use for voice storage and playback capability, each pin plays the voice for 60 second duration. The voice transmitted to receiver by the help of RF transmitter and it also a portable device. The RF transmitter and receiver used for long distance communication which is specifically designed for wireless speaker

### C. Software Description

In this project the software used is MPLAB IDE. The program for this system is to produce an audio output from the analog input signal from the flexures of the sensors. The program is divided into five modules for simplicity and easy understanding. The first module of programming is flex sensitivity control from where the flexure analog value is given to the ADC channels of the pic microcontroller. The second module of programming is the A/D conversion. The ADC module is turned on by the four registers. The ADC starts configuring when the register ADCON1 = 0x80 is set. The ADC conversion starts when the GO/DONE bit is set 1. The converted values are stored in the buffer. The next programming module is the manipulation of digits. The fourth module is the main function. It uses tris registers and makes it initially as zero. The voltage values of each sensor are compared with the sensor flexures by using if loop. This is done in the port-B. The final module is the RF control system for APR. It is the delay program. This is also included in the main function.

#### D. Algorithm

##### Step 1:

Make the sensor flexed and define the voltage values of each sensor in the macro module of the program. Initialize variables for further programming.

##### Step 2:

For each ADC channels a total of 8 define the address registers and the data registers named as ADCON0, ADCON1, ADRESL and ADRESH.

##### Step 3:

For an A/D conversion to start set the GO/DONE bit to 1 for each ADC channels.

##### Step 4:

Manipulation of each subsequent digit is done in the third module of programming.

##### Step 5:

The next module is main function. Here all the sub modules are defined. Initially all the TRIS registers of ports b, c and d are set to zero. Port B is used to transfer data from controller to RF transmitter.

##### Step 6:

The final value calculated from each A/D conversion is compared with the sensor voltage values and if it is true then the data is sent from port b to the data pin of transmitter. The if loop is used for each adc channels. From the transmitter the input data reaches RF receiver.

#### IV. SYSTEM FLOW

Our proposed system flow charts from Figure shows that first the hand gestures are made which are sensed by the flex sensors. Then they act as sensor data where sign recognition takes place. The recognized signs are then produced as voice output.

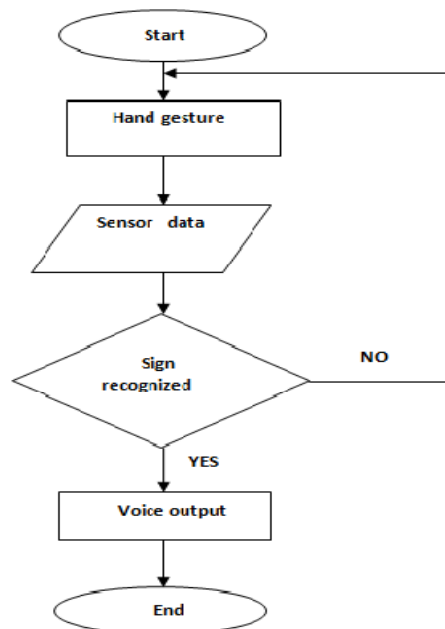


Figure 4: Flow diagram of proposed system.

#### V. IMPLEMENTATION

The flex sensors will give output in 0 to 5v range. The obtained value for each fingers are given below :

- Little finger : 0.99 - 01.09
- Ring finger : 0.89 - 01.73
- Middle finger : 01.02 - 01.66
- Index finger : 01.06 - 01.21
- Thumb finger : 01.07 - 01.85

The ADC converter used is 10bit hence the converted value will be in the range of 0 to 1023 range. Hence to maintain constant range the different ranges for each fingers are converted to the range of **0 to 500**. The converted constant range for all fingers according to the actions is provided in the table.

The flex sensors are provided with a regulated dc power supply of 9v. They work as analog voltage dividers. When the substrate is bend the sensor produces resistance output relative to bending radius nominal, 45 degree and 90 degree. The output voltage of each sensor is measured using a multi meter when connected to ground and output pins



. The analog value from the sensor is given to a voltage divider circuit. In the voltage divider the output voltage depends upon the resistance of the load it drives. The output from the voltage divider is given to the 8 port-A pins of the PIC microcontroller. These pins are used as an analog to digital converter (ADC). Here 10 bit ADC is used i.e., 10 channels are used. The analog input charges a sample and hold capacitor. The output of sample and hold capacitor is the input into the converter. The converter then generates a digital result of this analog level via successive approximation.

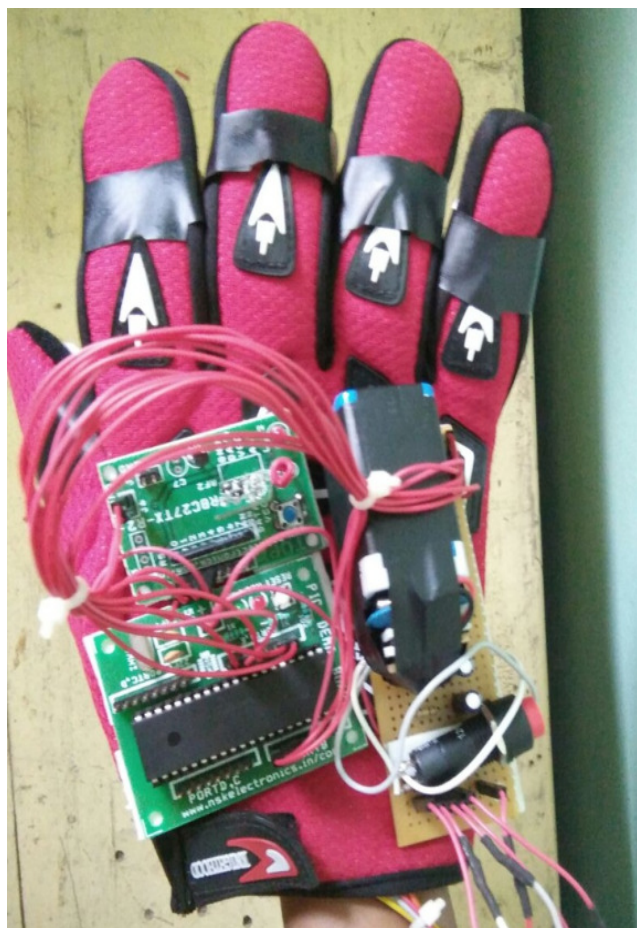


Figure 5: Implementation diagram of Transmitter

The A/D conversion of the analog input signal results in a corresponding 10-bit digital number. This digital output is given as an input to the port-B pins of the microcontroller.

From port-B the digital input is given to a RF module transmitter. The transmitter consists of 4 pins – the input is given to the data pin with the help of antenna pin, a VCC pin is given power supply and then it has a ground pin. The transmitter sends the data to the RF module receiver by means of wireless communication. The receiver consists of 8 pins – the data pin receives and then send data to another PIC microcontroller for the purpose to drive the power supply. The input from the receiver is given to the 4 port- D pins and then it is given to APR 9600 chip from the 8 port - B pins. The input is given to the 8 analog input pins from M1 to M8 pins.

Recording can be fed directly into the Analog Input pin through a DC blocking capacitor, however, the connection between Analog input and Analog Output pin is still required for playback. When play-back is desired the previously stored recording is retrieved from memory, low pass filtered, and amplified. The signal can be heard by connecting a speaker to the SP+ and SP- pins. It eliminates the need for encoding and compression, which often introduce distortion.

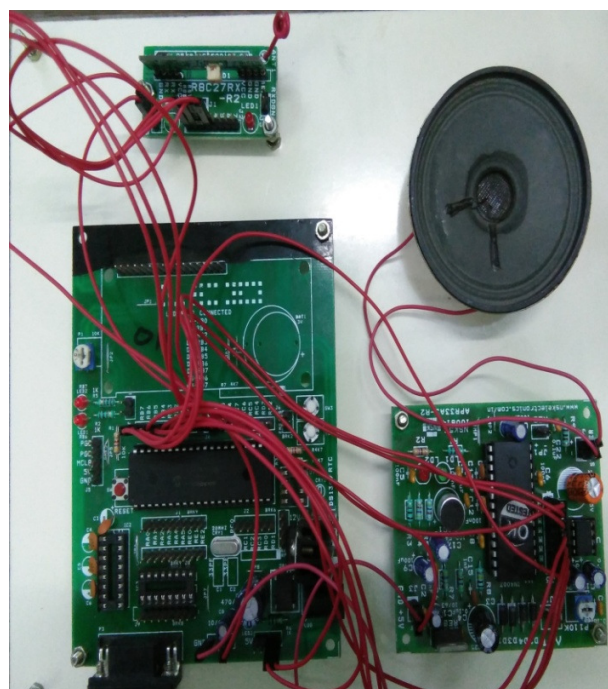


Figure 6: Implementation diagram of Receiver.

## VI. RESULTS

Output data are directly obtained from data glove and each sensors produce different resistance value through the combination of resistance value. Then the respective voice plays according to the combination of resistance values.

#### A. Sample Outputs



**VICTORY**



**GOOD JOB**



**READY??**

## VII. CONCLUSION

The completion of this prototype suggests that sensor gloves can be used for sign language recognition. The flex sensor showed its variations in different ranges. The concurrent codings were written.

Thus the smart data glove was tested and if any errors occurred, then they are identified and corrected.

And the corresponding output were obtained from speakers. In future, this can be developed by miniaturizing the whole system while producing in large scale.

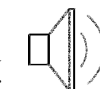


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