Manual Communication using Sign Language Conversion System

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Abstract - Sign language is a language through which communication is possible without the means of acoustic sounds. The objective of Sign Language Conversion System is improving developed uses a glove fitted with sensors that can interpret the 26 English letters in American Sign Language (ASL). The glove uses flex sensors, contact sensors, and accelerometers in three dimensions to gather data on each finger's position and the hand's motion to differentiate the letters. The translation is transmitted to the base station, which displays as well as pronounces the letter. The scope of the proposed solution is to improve acts as a very good medium between normal people and deaf people, by using ASL sign language we can form all sentences and Cost effective because of implementing on single hand.

***Keywords* - American Sign Language, flex sensors, Microcontroller PIC 16F887.**

1. Introduction

Sign language is a language through which communication is possible without the means of acoustic sounds. Instead, sign language relies on sign patterns, i.e., body language, facial expression orientation and movements of the arm to facilitate understanding between people [1]. It exploits unique features of the visual medium through spatial grammar. Body language refers to various forms of nonverbal communication, wherein a person may reveal clues as to some unspoken intention or feeling through their physical behavior. These behaviors can include posture, gestures, facial expressions, and eye movements. Body language also varies depending on the culture and most behavior is not universally accepted. Although this article focuses on interpretations of human body language, also animals use body language as a communication mechanism. Body language is typically subconscious behavior, and is therefore considered distinct from sign language, which is a fully conscious and intentional act of communication.

There are so many sign languages like British Sign Language French Sign Language &American Sign Language but we are mainly concentrated about American sign language because in the British sign language uses both hands for communication. French sign language uses only one hand but in this language it is not able to form all words [2]. To overcome these problems we are used American Sign Language.

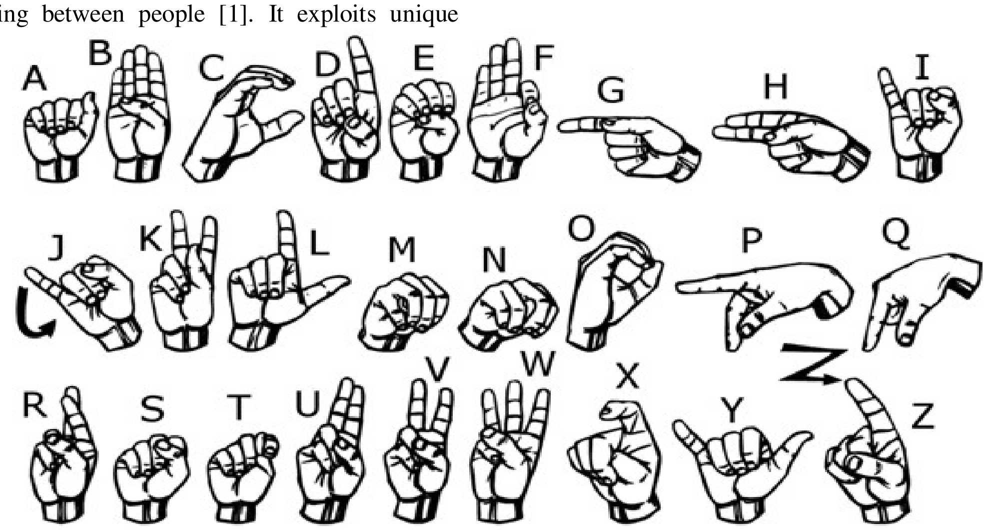

Fig.1: American Sign Language

Early in the 1800s, there were only a few thousand deaf Americans. No standard signed language existed at this time, but various signing systems were created in the deaf communities. These sign systems are now known as Old American Sign Language. The American Sign Language of today is actually related to this language.

American Sign Language (ASL) is a complete, complex language that employs signs made by moving the hands combined with facial expressions and postures of the body. It is the primary language of many North Americans who are deaf and is one of several communication options used by people who are deaf or hard-of-hearing.

2. Proposed Work

The sign language translator we have developed uses a glove fitted with sensors that can interpret the 26 English letters in American Sign Language (ASL). The glove uses flex sensors, contact sensors, and accelerometers in three dimensions to gather data on each finger's position and the hand's motion to differentiate the letters. The translation is transmitted to the base station, which displays as well as pronounces the letter. The sign language translator starts with the Glove, the heart of the project. The black glove contains nine flex sensors, four contact sensors, one two dimensional x-y axis accelerometer and one dimensional z axis accelerometer.

The flex sensors are the most critical sensors because most letters can be distinguished based on fingers flexes. All the fingers except the thumb have two flex sensors, one over the knuckle and the other over the lower joint. This provides two degrees of flexes for these fingers. For the thumb there is one flex sensors over the lower joint.

The contact sensors help distinguish between a set of letters in which the flex sensors were ambiguous. Letters such as U and V have only one difference the distance between the index and middle finger. Contact sensors determine which fingers are touching and how the fingers are oriented relative to each other.

Finally, the accelerometers are used for movement and orientation detection. Specific hand motions are the only way to detect the letters J and Z. For letters such as G and Q, the only way to distinguish between them is their orientation--while G has the palm facing sideways, Q has the palm facing downwards.

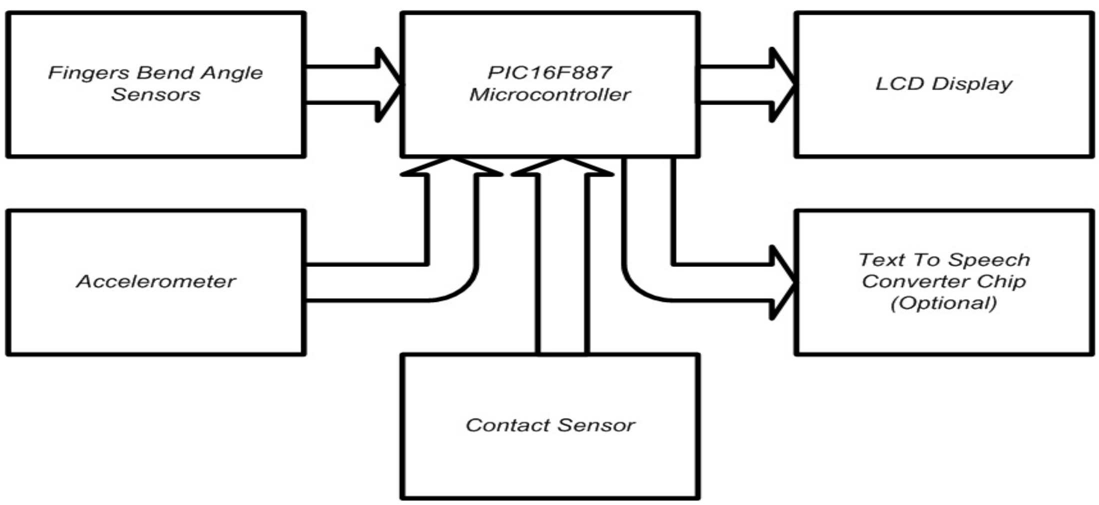

Fig 2: Block Diagram of Sign Language Conversion System

2.1 IC PIC16F887 Microcontroller

PIC16F887 Microcontroller it is the heart of our project. PIC stands for Peripheral Interface Controller. It is a 16 bit microcontroller. (F stands for Flash memory). It has Only 35 Instructions. Operating Speed:DC – 20 MHz, oscillator/clockinputDC – 200 ns instruction cycle. It has Direct, Indirect and Relative Addressing modes.

2.2 Flex Sensors

In our proposedwork five Flex sensors are placed on 5 fingers of the right hand. Each are having length of 2.5"[6]. Flat Resistance: 10K Ohms. Resistance Tolerance: ±30%. Bend Resistance Range: 60K to 110K Ohms. Power Rating: 0.50 Watts continuous. 1 Watt Peak.

Flex sensors are usually in the form of thin strip as shown in the figure 3.They can be made unidirectional or bi directional. Flex sensors that change in resistance depending on the amount of bend on the sensors. They convert bend to electrical resistance- more the bend, the more the resistance value shown in figure 4.

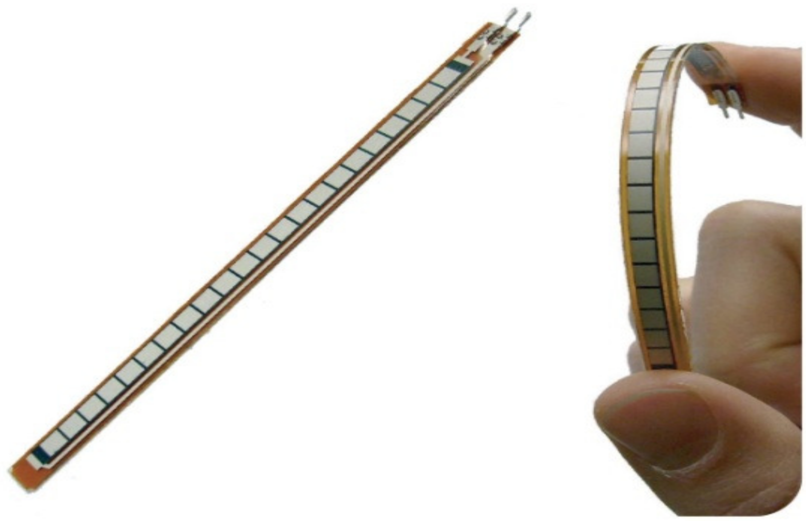

Fig: 3 Flex sensor

2.3 Accelerometer

Most accelerometers are Micro-Electro-Mechanical Sensors (MEMS). The basic principle of operation behind the MEMS accelerometer is the displacement of a small proof mass etched into the silicon surface of the integrated circuit and suspended by small beams. Consistent with Newton's second law of motion (**F = ma**), as an acceleration is applied to the device, a force develops which displaces the mass. The support beams act as a spring, and the fluid (usually air) trapped inside the IC acts as a damper, resulting in a second order lumped physical system [3]. This is the source of the limited operational bandwidth and non-uniform frequency response of accelerometers.

A three axis accelerometer detects linear accelerations in three perpendicular directions. If it helps, picture a ball inside a box with pressure sensitive walls. As you shake the box around, the ball presses against different walls, which tells you the direction of acceleration. If the accelerometer is not moving, the ball will still push against the walls simply due to gravity. By comparing the readings on the x, y and z axis, you can work out the orientation of a stationary object.

2.4 Contact Sensor

In our proposed work we use the 6 contact switches and two ground points as shown in the below figure in order to increase the accuracy. In the American Sign Language there is some similarities present in the alphabets for example alphabet E and S.

In the case of alphabet E we bend the all finger but we cannot touch the contact switches but in the case of alphabet S we bend all the finger and also the contact sensor 6 is connected to the ground point that means it is shorted on the basis of flex sensor value and the contact sensor value the microcontroller identify the correct alphabet.

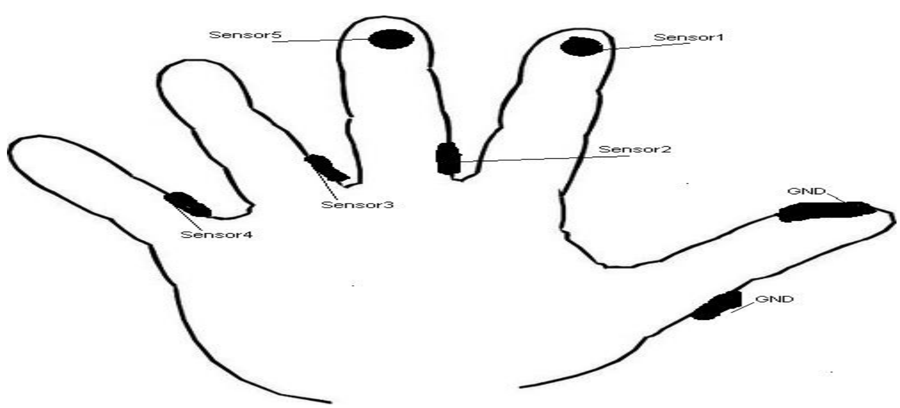

Fig 4: Contact sensors

2.5 LCD Display

In our proposed work the HD44780 LCD display is usedto show the output of the accelerometer and the flex sensors. It is a 2*16 dot matrix display it means it having 2 rows.

The HD44780U has pin function compatibility with the HD44780S which allows the user to easily replace an LCD-II with an HD44780U. The HD44780U character generator ROM is extended to generate 208 5 ´ 8 dot character fonts and 32 5 ´ 10 dot character fonts for a total of 240 different character fonts [4].

The low power supply (2.7V to 5.5V) of the HD44780U is suitable for any portable battery-driven product requiring low power dissipation.

2.6 Schematic Diagram

The Microcontroller PIC 16F887 having 5 ports (Port A to Port E) all are I/O Ports. Some ports are having the multiple features, on the basis of multiple features we are interfacing the sensors and other devices.

In our proposed work the Port A B and E are used as a input port and Port D used as the output port. Pin no. 1 is connected to reset button to initialize the microcontroller. High signal that means logic 1 (Vdd=5v) is directly connected to this pin continues high signal is passed through this pin. When the reset button is pressed the pin is connected to the ground so the logic 0 (Gnd=0) is passed to pin no. 1, when the logic 0 is passed the microcontroller will reset.

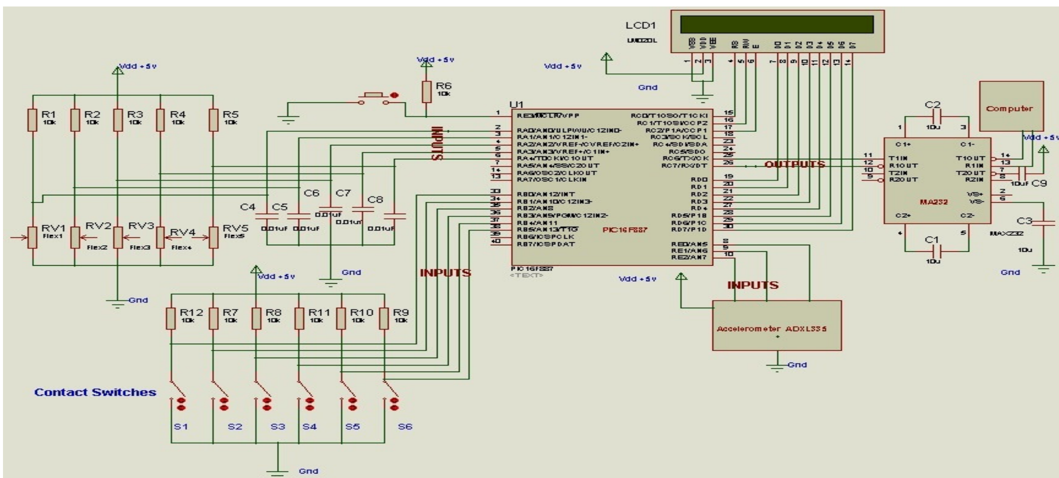

Fig 5: Schematic Diagram

The flex sensors are connected to the Port A (pin no. 2 to 6) because it can be used as I/O Port as well as ADC channel. Flex sensors are connected to the port A through capacitor C4 to C8 in order to provide the ground path if any AC components present in the DC supply.

The contact sensors are connected to the Port B (pin no.33 to 38). When switch is open logic 1 (Vdd=5v) is passed to the microcontroller. When switch is closed logic zero is passed to the microcontroller and it identify the correct alphabet.

Accelerometer is directly connected to port E (pin no.8 to 10). In our system we use only 5 pins (Gnd, Vdd, X Y & Z).

LCD display is connected to the port D because this port having less features compared to other ports. This port used as a output port. LCD pin 1 & 3 are shorted and connected to the ground. Pin no. 2 is connected to the Vdd=5v.

To communicate with the PC we are connect pin no. 25 & 26 (Tx& Rx) to the PC through IC MAX 232.

2.7 IC MAX232

MAX232 is compatible with RS-232 standard, and consists of dual transceiver. Each receiver converts TIA/EIA-232-E levels into 5V TTL/CMOS levels. Each driver converts TTL/ COMS levels into TIA/EIA-232-E levels. The MAX232 is characterized for operation from -40°C to +85°C for all packages [5].

MAX232 is purposed for application in high-performance information processing systems and control devices of wide application.

3. Implementation and Coding

Microsoft Visual C# 2008 express edition, MPLAB IDE v8.10 Proteus v8.0 these are the software requirements for “Sign Language Conversion System”[6].

3.1 Experimental Results

In the section below table shows some alphabets and corresponding reading of ADC of that alphabets.

Initially all Flex sensors are in original position, all flex sensors value are equal except the flex 1. Because flex 1 is represent thumb.

For alphabet A, Flex1 value is lesser than other flexes because we are not bend the thumb refer Fig 1.For alphabet A the accelerometer value is not changed because we cannot change the wrist position.

Table 1: Output of the Flex sensors

Flex Sensors	**Alphabet 'A'**		**Alphabet 'G'**
	Initial ADC output value	**Approximate ADC output value**	**Approximate ADC output value**
Flex 1	810	826	896
Flex 2	840	960	806
Flex 3	840	960	960
Flex 4	840	911	908
Flex 5	840	911	908

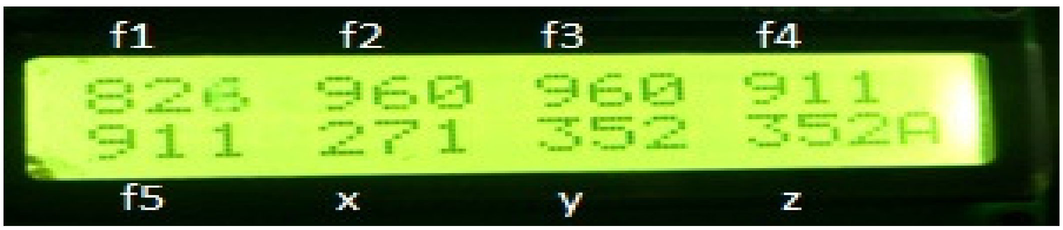

Fig 6: Output of alphabet 'A'

Fig 7: Output of alphabet 'G'

Table 2: Accelerometer voltages

Accelerometer Direction	**Alphabet 'A'**		**Alphabet 'G'**
	Initial Voltage	**Approxi-mated Voltage**	**Approxi-mated Voltage**
X	1.32v	1.33v	1.78v
Y	1.71v	1.75v	1.77v
Z	1.71v	1.80v	1.98v

For alphabet G, Flex 2 value is lesser than other flexes because we are not bend the flex 2. For alphabet G accelerometer value is changed because we change the position of the wrist refer Fig 1.

4. Conclusions

This tool acts as a very good medium between normal people and deaf people.By using ASL sign language we can form all sentences.Cost effective because of implementing on single hand. It is easy to remember all the alphabets. Compared to other technologies we achieve 90% efficiency.

References

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