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A Helping Hand for Differentially Abled patients

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Abstract: -- **In this world there are many people who cannot speak and hear properly. These people have difficulty in communicating with people who do not understand sign language. In general, deaf people have difficulty in communicating with others who do not understand sign language. Even those who do speak aloud typically have a deaf voice of which they are self-conscious and that can make them reticent. In developing countries, children with hearing loss and deafness rarely receive any schooling. Adults with hearing loss also have a much higher unemployment rate. Among those who are employed, a higher percentage of people with hearing loss are in the lower grades of employment compared to the general workforce. This paper aims to lower the barrier in communication by enabling the mute communities to communicate with general public more efficiently by translating sign language into text using an electronic glove. The Electronic Glove is made up of normal cloth fitted with flex sensors along the length of each finger and on the wrist. Mute people can use the glove to perform hand gesture and it will be conver ted into text and displayed on the LCD display, for easy understanding by normal people.**

I. INTRODUCTION

A huge population in India alone is deaf and mute. It is our social responsibility to make this community more independent in life. Over 5% of the world's population i.e. 360 million people have disabling hearing loss (328 million adults and 32 million children). Hearing disability refers to hearing loss greater than 40dB in the better hearing ear in adults and a hearing loss greater than 30dB in the better hearing ear in children. The foundations and / or associations to support these people are based only on teaching sign language leaving aside the technology.

Communication involves the exchange of information, and this can only occur effectively if all participants use a common language. Sign language is the language used by deaf and mute people. It is a communication skill that uses gestures instead of sound to convey the meaning by simultaneously combining hand shapes, orientations and movement of the hands, arms or body and facial expressions to express fluidly a speaker's thoughts. Signs are used to communicate words and sentences to audience. A gesture in a sign language is a particular movement of the hands with a specific shape made out of them. A sign language usually provides sign for whole words. It can also provide sign for letters to perform words that do not have corresponding sign in that sign language. In this device Flex Sensor plays the significant role. Flex sensor changes its resistance depending upon the amount of bend on the sensor. This electronic device aims to lower the barrier in communication by translating the Sign language into a LCD display to provide sign for letters to perform words that do not have a corresponding sign in the sign language chart.

II. LITERATURE REVIEW

Edin et al [1] developed a robotic hand for grasping and lifting different object. Wald [2] developed software for editing automatic speech recognition in real time for deaf and hard-hearing people.

Simone et al [3] developed a low-cost method to measure hand and finger range of motion. Zhao et al [4] developed a five-fingered prosthetic hand system. Fels S.S. et al [5] describes a system Glove-Talk II which translates hand gestures to speech through an adaptive interface. Hand gestures are mapped continuously to ten control parameters of a speech synthesizer. With Glove-Talk II, the subject can speak slowly but with far more natural sounding pitch variations than a text-to-speech synthesizer. Sayed Atif Mehdi et al [6] examines the possibility of recognizing sign language gestures using sensor gloves by implementing a project called Talking Hands which uses artificial neural networks to recognize the sensor values coming from the sensor glove.

A comprehensive framework is presented that addresses two important problems in gesture recognition systems in [8] An augmented reality tool for vision based hand gesture recognition in a camera- projector system is described in reference [9]

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III. HARDWARE ARCHITECTURE

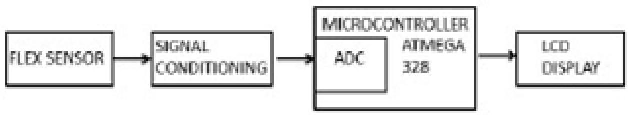

Fig.1 System Block Diagram

The flex sensor will be fitted along the length of each finger. As shown in Fig. 1. The output from the flex sensor will be conditioned and then given to a microcontroller, Atmega328 which has an inbuilt ADC that will convert these readings into corresponding digital values. These digital values are further converted to its equivalent voltages which will be then compared with the pre-coded range. If a match occurs then the letter corresponding to that range will be displayed on the LCD screen

III. HARDWARE REQUIREMENTS

(i) Flex Sensor:

Flex sensor changes its resistance depending upon the amount of bend on the sensor. More the bend, more will be the resistance of the sensor. Inside the flex sensor are carbon resistive elements within a thin flexible substrate. They are usually in the form of a thin strip from 1"- 5" long that vary in resistance from approximately 10kΩ to 50kΩ.They are frequently used in gloves to sense finger movements. When the substrate is bent the sensor resistance varies relative to the bend radius.

(ii) Signal Conditioning:

It has been done by the circuit shown in Fig.2.1. Supply voltage is applied on the voltage divider circuit having 51 KΩ (R1) resistance in series with flex sensor as load resistance (R2).

Since each Flex Sensor has a resistance that varies depending on how much the finger is bent, we use each Flex Sensor (R2) in a voltage divider circuit in order to obtain a corresponding analog voltage that is given to the ADC of the Microcontroller.

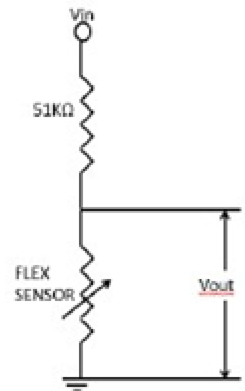

Fig. 2.1 Signal Conditioning Circuit

$$V_{out} = V_{in}\left(\frac{R_2}{R_1 + R_2}\right)$$

The above equation is used to find the value of the analog voltage. The value of R2 depends on the maximum bent in the sensor. The maximum bent in the sensor is obtained when the sensor if fully flexed (bent).

(iii) Contact Sensor:

Fig. 2.2 Contact Sensor

We need to add contact Sensors at several spots on the glove. These would essentially function as switches that would pull the microcontroller input pins to ground to signal

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contact. Our glove so far does not have contact sensors on the index and middle fingers

As a result, it is difficult to predict U and V properly. As you can see, these signs are actually quite similar to each other in terms of hand orientation and flex. To mitigate this, we add two contact sensors: one set on the tips of the index and middle fingers to detect and another pair in between the index and middle fingers to discern between U and V.

Whenever any conductive plate connected to 0V or ground is touched to positive plate, contact would be detected. Hence whenever one finger was in contact with the other, value of contact sensor (which was initially 1) for that particular finger becomes zero.

(iv) ATMEGA328

The Atmega328 is a low-power CMOS 8-bit microcontroller based on the AVR Enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega328 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.
In order to maximize performance and parallelism, the

AVR uses Harvard architecture with separate memories and buses for program and data. Instructions in the program memory are executed with a single level pipelining. While one instruction is being executed, the next instruction is pre-fetched from the program memory. This concept enables instructions to be executed in every clock cycle. The program memory is In-System Reprogrammable Flash memory.

The ATmega328 features a 10-bit successive approximation ADC. The ADC is connected to a 6-channel Analog Multiplexer which allows six single-ended voltage inputs constructed from the pins of Port A. The single-ended voltage inputs refer to 0V (GND).

The board can operate on an external supply of 6 to 20 volts.

(v) LCD display

LCD displays are used in a wide range of applications, Including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc. The 16 x 2 intelligent alphanumeric dot matrix display is used which is capable of displaying 224diFFerent characters and symbols.

(vi) American Sign Language

American Sign Language is the language of choice for most deaf people in the United States. It is part of the deaf culture and includes its own system. However, ASL is one of the many sign languages of the world. As an English speaker would have trouble understanding someone speaking Japanese, a speaker of ASL would have trouble understanding the Sign Language of Sweden. ASL also has its own grammar that is different from English. ASL consists of approximately 6000 gestures of common words with finger spelling used to communicate obscure words or proper nouns. Finger spelling uses one hand and 26 gestures to communicate the 26 letters of the alphabet as shown in Fig.4.

Another interesting characteristic is that ASL offers to describe a person, place and thing. ASL uses facial expressions to distinguish between statements, questions and directives. The eyebrows are raised for a question and held normal for a statement. There has been considerable work and research in facial feature recognition; they will not be used11to aid recognition in the task addressed. This would be feasible in a full real-time ASL dictionary.

V. IMPLEMENTATION

(i) Working:

The flex sensors are fitted along the length of each finger. The output from the flex Sensors is in the form of resistance. In order to convert the resistance of the flex sensors into voltage, a voltage divider circuit is used. The

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output of the voltage divider is fed to the ADC of the Arduino, so as to convert the analog voltage to digital values. These digital values are then converted into equivalent voltages. These are further compared with the pre-stored range of voltages. For a specific gesture, in other words for a particular letter, if the voltage from each sensor falls in the range specified in the program, then the corresponding letter will be displayed on the LCD screen. If it does not satisfy the appropriate condition, the screen will display the previous valid letter that was displayed.

(ii) Calibration of Sensor:

Flex sensor is a thin resistive element that produces a change in its resistance based on a degree bend.

The resistance of flex sensor increases as the bend increases. The graphs in Fig.5.1 shows the relationship between resistance and voltage and Fig.5.2 shows the relationship between resistance and the bending in degrees.

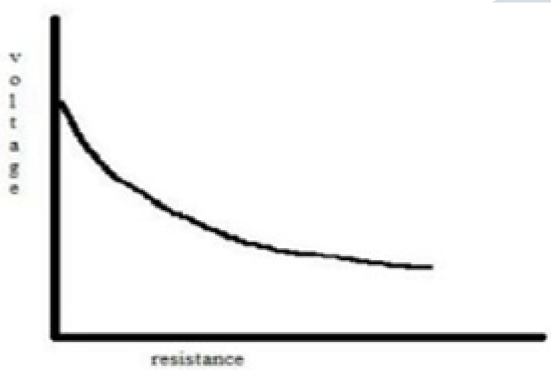

Fig. 5.1 Graph of resistance versus voltage

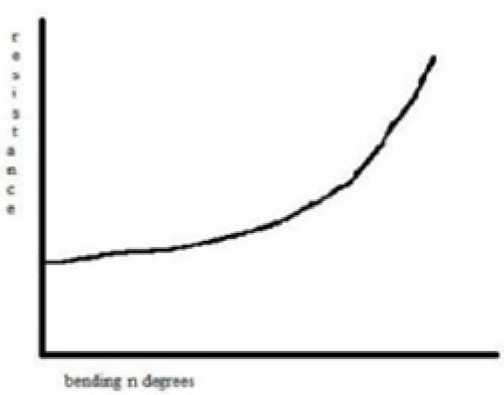

Fig. 5.2 Graph of resitance versus bending in degrees

The Table 1 below shows the relationship between the flex sensor and their corresponding resistance.

Table 1. Resistance values for different flex sensor

Finger	Resistance
Thumb Finger	12kΩ
Index Finger	22kΩ + 2.2kΩ
Middle Finger	33kΩ
Ring Finger	27kΩ+ 2.2kΩ
Pinky Finger	47kΩ

iii) Flex readings:

26 alphabets of the ASL were tested. Proper care Flex sensor is a thin resistive element that produces a change in its resistance based on a degree bend. The resistance of flex sensor increases as the bend increases. The graphs in Fig.5.1 shows the relationship between resistance and voltage and Fig.5.2 shows the Flex sensor is a thin resistive element that produces a change in its resistance based on a degree bend.

The resistance of flex sensor increases as the bend increases. The graphs in Fig.5.1 shows the relationship should be taken when flexing the fingers. This is because even the slightest inappropriate bend in the finger may lead to false reading and thereby displaying wrong letters on the LCD. It might also happen that no letter is displayed on the screen simply because the coded gesture and the ASL gesture do not match.

(iv) Interfacing ARDUINO with LCD:

The most basic form of display is 7 segment displays. Out of all, the most common used one is 16x2 LCD modules which can display 32 ASCII character in two lines. It has 16 lines and can be operated in 4 bit mode or 8 bit mode.

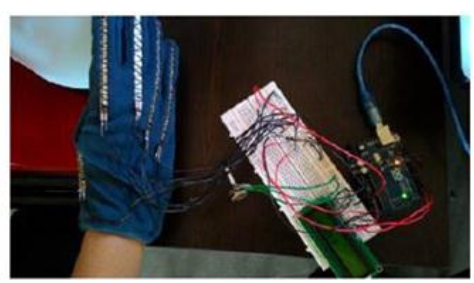

Fig. 5.3 Interfacing Arduino with LCD

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(v) Gestures and text display:

Fig.5.4 ASL C (Gesture and Text display)

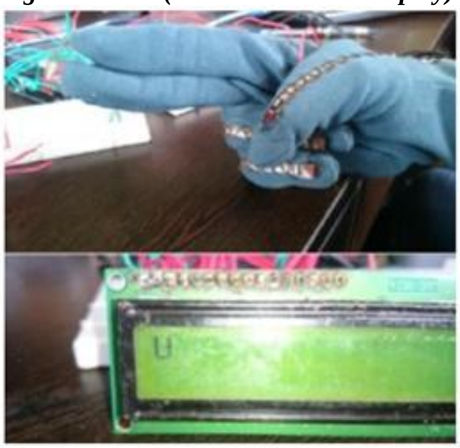

Fig.5.4 ASL U (Gesture and Text display)

Fig.5.5 ASL V (Gesture and Text display)

Fig.5.6 Display of Word 'BAD'

VII. CONCLUSION

The results of the tests conducted shows that the device successfully detects the alphabets/words tested. The bend of the contact sensor helps in differentiating alphabets such as U and V. The total number of alphabets/ words tested was 26 and future work can be done by improvising the current system by using more flex sensors with better sensitivity for full sign language. Also the text could be further converted into speech using voice ICs so that the blind community could take the benefit of using the glove. The device could be made portable by giving it a power supply so that the differently abled (deaf and mute) can carry the device as and when required.

It can be used in applications like house hold and security, gesture based control of electronic wheel chair and virtual reality application for replacing the conventional input devices like joy sticks in videogames with the data glove.

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