Hand Gesture Recognition and Voice Conversion System for Deaf and Dumb

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Abstract

In the past, hand postures and gestures as a mechanism for interaction with computers, describing both the various techniques for performing accurate recognition and the technological aspects inherent to posture- and gesture-based interaction. First, the technological requirements and limitations for using hand postures and gestures are described by discussing both glove-based and vision-based recognition systems along with advantages and disadvantages of each method. Second, the various types of techniques used in recognizing hand postures and gestures are compared and contrasted. Third, the applications that have used hand posture and gesture interfaces are examined. Then it will help the deaf person to communicate with others by typing text on LCD screen through hand gestures. The design aims to produce a product to perform vibrations in six position of blind’s person right hand. The text is converted into speech so that the blind person could hear and communicate.

Keywords: Feature extraction, pattern recognition, sensor gloves, sign language recognition

1. Introduction

Communications between deaf-dumb and a normal person have always been a challenging task. About around billion people in the world are deaf and dumb. The communication between a deaf and hearing person possess to be a serious problem compared to communication between blind and normal visual people. The blind people can talk freely by means of normal language whereas the deaf-dumb have their own manual-visual language known as Gestures and sign language. Human hand plays an important role while conveying information in between deaf and normal person. Gestures are powerful tools of communication among normal people and deaf and dumb community. This project aimed to developing an electronic support system that can translate sign language into text and speech in order to make the communication take place between the mute communities with the general public.

Sign language is the language used by mute people and it is a communication skill that uses gestures instead of sound to convey meaning of 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 don’t have corresponding sign in that sign language. In this project Flex Sensor plays the major role, Flex sensors are sensors that change in resistance depending on the amount of bend on the sensor. This flex sensor fixed on the five fingers of the glove. System will analyze these gestures and synthesize the sound for the corresponding word or letter for normal people to understand. We have developed a prototype using this process to reduce the communication gap between differently able and normal people. The Sign language interpreter developed uses a hand glove fitted with flex sensors that can interpret the English letters, numbers and some words in American Sign Language (ASL) & Indian sign language (ISL).

The series of gestures such as hand movements and facial expressions indicating words, are referred to as sign language. It is a form of communication used mostly by people with impaired hearing. Sign language recognition systems are used to convert sign language into text or speech to enable communication with people who do not know these gestures. Usually, the focus of these systems is to recognize hand configurations including position, orientation, and movements. Generally, there are three levels of sign language recognition: finger spelling (alphabets), isolated words, and continuous gesturing (sentences). Accordingly, these configurations are captured to determine their corresponding meanings, using two approaches: sensor-based and vision-based. While the former entails wearable devices to capture gestures, it is usually simpler and more accurate. On the other hand, vision-based approaches utilize cameras to capture the sequence of images. Although, the latter is a more natural approach, it is usually more complex and less accurate.

2. Experimental Technique

2.1 Methodologies Used

2.1.1 Sign Language

Sign language is the language used by deaf and mute people for communication. In our system we are using American sign language which is commonly used. User performs various sign and sensor generated data is used for correlating these with specific signs and mapping them to a database. The system stores sensor data in memory. When it matches with the set of values associated with a sign system recognizes that sign and particular output it as text as well as speech.

2.1.2 Flex Sensor

Flex sensor is nothing but a variable resistor; it changes its resistance depending on bend. It is an important part of this project. Length of sensor that we are using is 2.2”. In this project total five flex sensors F1, F2, F3, F4 and F5 are used. Flex sensors are attached to gloves which can be easily handled by a deaf and dumb person. There will be change in resistance values and thereby, output voltage of flex sensors corresponding to different gestures that values are passed to the ADC (Analog to digital conversion) section of PIC microcontroller. The Flex sensor patented technology is based on resistive carbon thick elements. As a variable printed resistor, the flex sensor achieves great form-factor on a thin flexible substrate. When the substrate is bent, the sensor produces a resistance output correlated to the bend radius, the smaller the radius, the higher the resistance value. Flex sensor are normally attached to the glove as shown in figure. They require a 5 Volt input and output between 0 and 5V, the resistivity
varying with the sensor’s degree of bend and the voltage output changing accordingly. Fig 4 shows flex sensor “FSL0095103ST” the sensors connect to the device via three pin connector (ground, live and output).

**Features**
- Angle Displacement Measurement
- Bends and Flexes physically with motion device
- Simple Construction
- Temperature Range: -35°C to +80°C
- Resistance Tolerance: ±30%
- Possible uses
  - Robotics
  - Medical Devices

**FIG 1: FLEX SENSOR**

**Flex Sensor Characteristics**

Fig. 2 shows the basic flex sensor circuit which uses voltage divider concept the output voltage is determined and it ranges from 1.35 V to 2.5V. The output voltage is determined based on the equation $V_{out} = \frac{V_{in} \times R1}{(R1+R2)}$, where $R1$ is the other input resistor to the non-inverting terminal. Fig. 3 shows the flex sensor offers variable resistance readings for different degree of bending of flex sensor.
2.1.2 PIC Microcontroller

PIC 16XXXX Series Microcontroller has six variants ranging from 3.5K-14 Kbytes of Flash memory, up to 256 bytes of RAM and a mix of peripherals including EUSART, CCP and onboard analog comparators. These devices are well suited for designers with applications that need more code space or I/O than 14-pin variants supply, and are looking to increase system performance and code efficiency by employing hardware motor control and communications capability.
2.2 Block Diagram

3. Results and Discussion

Table 1: Hand gesture of sign language for alphabet A, B & C with Logic Levels as per values of Flex Sensor

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Alphabet</th>
<th>Hand Gesture of Sign Language for Alphabet</th>
<th>Logic Levels as per Values of Flex Sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>F1</td>
</tr>
<tr>
<td>1</td>
<td>A</td>
<td><img src="Image" alt="Hand Gesture A" /></td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>B</td>
<td><img src="Image" alt="Hand Gesture B" /></td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>C</td>
<td><img src="Image" alt="Hand Gesture C" /></td>
<td>0</td>
</tr>
</tbody>
</table>
Flex sensors are fitted on hand gloves. As per the hand gesture movement it will bend the flex sensors of all fingers. The value of bending is in resistance. All fingers give different resistance value depending on bending. The output of flex sensor is given to the ADC of PIC microcontroller which used to convert analog signal into digital signal. The required program written in embedded c language. Depending on code generated by hand movement text is displayed on LCD and also the text is converted into speech by using voice section.

As shown in Table 1 it gives information of gesture for English letters A to C with logic levels, similarly we can obtain for remaining English letters like D to Z and as shown in Table 2 it gives information of gesture for numbers 0 and 1 with logic levels, similarly we can obtain for remaining numbers like 2 to 9.

**Table 2:** Hand gesture of sign language for Number 0 and 1 with Logic Levels as per values of Flex Sensor

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>ALPHABET</th>
<th>HAND GESTURE OF SIGN LANGUAGE FOR ALPHABET</th>
<th>LOGIC LEVELS AS PER VALUES OF FLEX SENSOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td><img src="image1.png" alt="Image" /></td>
<td>1 1 1 1 1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td><img src="image2.png" alt="Image" /></td>
<td>1 0 2 2 2</td>
</tr>
</tbody>
</table>

4. Conclusion

The hand gesture glove a clear that the breadth of research in glove devices has expanded and grown over the past three decades. This area of research remains very active and it is evident that technological advances in computing, sensor devices, materials and processing/classification techniques will make the next generation of glove devices cheaper, more powerful, versatile and, we hope, more ubiquitous. The maximum sentence-based classification rate was 98.9%. It is compared with an existing vision-based solution that uses the same dataset. The highest sentence-based classification rate for the reviewed system was 75%. Finally, since the proposed solution is sensor-based then all of the inherent limitations of vision-based systems are overcome. The same technique can be used in various languages like Bengali, Hindi, Tamil, French, etc., other developments like through signal, and the blind can also convey reply to visible person produce the vibration hand glove as the best kit for two way communication.
References

[1] Pooja Gupta, Dr. Ambuj Kumar Agrawal, Dr. Shahnaz Fatima, Sign Language Problem And Solutions For Deaf And Dumb People, (2014)124-127


