American Sign Language Translating Glove using Flex Sensor

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Abstract: This topic presents the development of a sensory data glove using flex sensors as finger-bend measurement sensors. The main motive of the project is to develop a cheap glove that can be used by disabled people for communication. The glove consists four flex sensors each sits on each finger. The bending of flex sensor is continuously checked by the microcontroller. When the gesture of an alphabet is made respective alphabet is shown in the LCD. The glove consists of several contact sensors which help in distinguishing between few similar gestures like of ‘U’ and ‘V’.

Keywords: Glove, Flex Sensor, American Sign Language, Microcontroller, ADC, and LCD.

1. INTRODUCTION
Sign language is a way by which the gestures made by the user are used for communication. Human gestures are an efficient and powerful way of interaction. These are sometimes used to express ourselves. This paper focus on developing a help for disabled people using this gesture recognition technique. In this system the gestures are converted into text messages for communication. The basic concept involves the use of data gloves worn by disabled people. These gloves are designed using Flex sensors and contact sensors no accelerometer is used for tilt detection. The flex four sensors are normally attached to the glove. Flex sensors are analog resistors that function as analog voltage dividers. Whenever a flex sensor is bend there is a change in resistance which is read by the ADC of the microcontroller.

2. LITERATURE SURVEY
There seems to be other devices and patents that aim to do the same process of translation of sign language into speech. In most of these cases it seems that the inventors augment the device with several more sensors than what we use, but we hold no claim of originality.

A sign language editing apparatus includes a glove-type sensor for converting movement of fingers in the sign language into an electrical signal to produce time series data of sign language words, a sign language word data editing device for adding predetermined additional data to the time series data inputted from the glove-type sensor to process the time series data, a sign language word dictionary for storing the time series data of sign language words processed by the sign language word data editing device, a sign language sentence data editing device for reading out the time series data of sign language words stored in the sign language word dictionary in accordance with the predetermined characters inputted from the input unit and adding predetermined additional information to the time series data of sign language words to produce time series data of sign language sentence, a sign language animation synthesizing device inputted with the time series data of sign language sentence produced by the sign language sentence data editing device to produce sign language animation expressing movement of the sign language, and a display unit for displaying the sign language animation produced by the sign language animation synthesizing device.

Method and apparatus for translating hand gestures; Inventor: Hernandez-Rebollar; PN: 7,565,295

A sign language recognition apparatus and method is provided for translating hand gestures into speech or written text. The apparatus includes a number of sensors on the hand, arm and shoulder to measure dynamic and static gestures. The sensors are connected to a microprocessor to search a library of gestures and generate output signals that can then be used to produce a synthesized voice or written text. The apparatus includes sensors such as accelerometers on the fingers and thumb and two accelerometers on the back of the hand to detect
motion and orientation of the hand. Sensors are also provided on the back of the hand or wrist to detect forearm rotation, an angle sensor to detect flexing of the elbow, two sensors on the upper arm to detect arm elevation and rotation, and a sensor on the upper arm to detect arm twist. The sensors transmit the data to the microprocessor to determine the shape, position and orientation of the hand relative to the body of the user.

3. SYSTEM FUNCTIONALITY

Four flex sensors are used and voltage required for each flex sensor is +5v. When power is ON, Each flex sensor get +5v supply. When user made gesture of a letter, the four signals coming from each flex sensor goes in microcontroller which are then converted from analog signals to digital values. And then display the output in the LCD. If there is no letter matches current state of the hand, there is no output shown in the LCD. If a person wants to write a whole word he can use contact sensors, the contact sensor in the glove are of two uses firstly they are used of differentiating words of similar gesture, secondly they are being used for moving the cursor of the LCD and clearing of the LCD. The flowchart of this system is shown below.

5. MICROCONTROLLER

(AMega16)

FEATURES

Memory: It has 8 Kb of Flash program memories. I/O Ports: 23 I/ line can be obtained from three ports; namely Port B, Port C and Port D. Interrupts: Two External Interrupt source, located at port D. Timer/Counter: Three Internal Timers are available, two 8 bit, one 16 bit. Analog to Digital Converter: Inbuilt analog to digital converter can convert an analog input signal into digital data of 10bit resolution.
6. 16X2 LCD (LIQUID CRYSTAL DISPLAY)

LCD (Liquid Crystal Display) screen is an electronic display module. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. The command register stores the command instructions given to the LCD. The data register stores the data to be displayed on the LCD.

7. ANALOG TO DIGITAL CONVERTER

Most of the physical quantities around us are continuous we mean that the quantity can take any value between two extremes. For example, the atmospheric temperature can take any value within a certain range. If an electrical quantity is made to vary directly in proportion to this value then what we have is an analog signal. Now we have brought a physical quantity into the electrical domain. The electrical quantity in most cases is voltage. To bring this quantity into digital domain we have to convert this into digital form. For this an analogous to digital converter is needed. Most modern MCU including AVRs have an ADC on chip.

An ADC converts an input voltage into a number. An ADC has a resolution. A 8 bit ADC has a range of 0-255. (28=256) The ADC also has a reference voltage (Aref.). When the input voltage is GND the output is 0 and when the input voltage is equal to Aref. the output is 255. So the input range is 0 to Aref and the output range is 0 to 255.

<table>
<thead>
<tr>
<th>Input voltage</th>
<th>Digital voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0v</td>
<td>0</td>
</tr>
<tr>
<td>2.5v</td>
<td>127</td>
</tr>
<tr>
<td>5v</td>
<td>255</td>
</tr>
</tbody>
</table>

You can see that any analogous signal is not perfectly converted – a factor that affects the output quality is the “sampling rate”. The ADC cannot continuously read the input signal and change its output – it does so in certain time intervals. The frequency at which it simplifies the input is called its sampling rate.

8. RESULT

The averaging we do at each interval helps to account for any noise or glitches that the flex sensors are sometimes prone to. The accuracy of the glove is also somewhat limited by the size of the person’s hands. The accuracy of each flex sensor is limited beyond a certain point. Smaller hands will result in a larger degree of bend. As a result, the difference between slightly different signs with a lot of flex might be too small for users with small hands.

The device uses a low voltage environment, and extremely low frequency communication. The sensors are well-attached, and there are no sharp edges. As a result, we don’t see any large safety issues associated with the glove. Furthermore, since all communication is done via cables, our device does not interfere with other designs. The glove can be used by anyone who fits into it, they would only have to train on it and generate new datasets if they wish for a higher prediction accuracy than the standard or to incorporate new signs.

9. Conclusion

The project was able to meet our expectations quite well. Our initial goal was to create a system capable of recognizing and classifying gestures and we were able to do so with average accuracy across all 26 alphabets. This project is useful for deaf and dumb people those cannot communicate with normal person. It is also useful for speech impaired and paralyzed patient means those do not speak properly.

10. Future work

There are few improvements that can be done in the present model of the translating glove. Such as

- Making the glove wireless
- Using accelerometer for detecting the movement of the hand
- Connecting speaker so that the output will be in audio form

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