An IOT Based Smart Glove Gesture Vocalizer for Deaf and Mute People

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ABSTRACT

Human beings have a ability to see, listen and interact with their external environment. Unfortunately, there are some people who are differently abled and do not have the ability to use their senses to the best extent possible. These people depend on other means of communication like sign language. This presents the major roadblock for people in deaf and dumb communities when they try to engage in interaction with others, especially in their educational, social and professional environment. Therefore, it is necessary to have an advance gesture recognition or sign language recognition system to bridge this communication gap. Here an effort has been made to develop a smart glove using flex sensor for real time gesture recognition. The objective is to create a device which helps the hearing or speech impaired person to communicate with others.

Keywords: Sign language recognition system, smart glove, flex sensor.

INTRODUCTION:

The project came into existence for one sole purpose, to help the deaf and mute community to easily communicate and interact with their nearby surrounding. It mainly focus on converting basic symbols that represent the 26 English alphabet as mentioned under American Sign Language (ASL) script and display them on a smartphone screen. The idea of this project is inspired by controlling robotic arm with the help of hand movements. Accelerometer is used to measure the tilt in the palm. Five flex sensors are placed on a glove, four for the fingers and one for the thumb. These sensors measure the bending angle in the fingers and thumb. According to these bend angle value the Arduino Nano microcontroller understands which set of value represent which symbol and transfer the appropriate result to the Android app in smartphone via Bluetooth which displays the generated symbol and give audio for the same Representing the some symbols was quite easy and fun, but there were few symbols that were difficult to distinguish such as “U” and “V” which are slightly different form each other and gave almost same value. The earlier prototype failed radically to represent the same but this problem was solved by using a metallic strip between the fingers, which was used to tell if they are in contact or not. The accuracy was increased by continuously updating the data set for each and every symbol from time to time.

RELATED WORK:

In[1] the author has observed the disabilities in human beings and as a result he concluded that the human beings have natural ability to see,listen and interact with their surroundings. Unfortunately, there are some who do not have the ability to use their sense .Hence, this paper talks about creating a device using Intel Galileo Gen 2 IoT kit for real time gesture recognition. In[2] the aim of this paper was to design an interface for controlled environment with help of computer vision based technique which is depend on the way human being perceive information about their surroundings. In[3] this paper an automatic sign language recognition system has been developed using Random Forest classifier with machine learning algorithm to translate the sign alphabet and common word into text sound. The main purpose of this paper is to provide ease of sharing basic idea with minimum communication gap and easier collaboration for hard hearing people. In[4] this paper a sign language

recognition system is developed to bring the speech and hearing impaired people a convenient forms of communication. In this paper they have reviewed about the need of sign language and proposed a sign language recognition using leap motion sensor which is portable with the advantage of delivering good result in real time response capability. In[5] the main objective of this paper is to implement a device which is reliable, easy to use and light weighted and also minimize the obstacle for disable people by providing them the home appliance control. This [6] paper talks about a smart glove using speech synthesizer circuitwhich convert the movement of hand into real time speech and display the text for the gesture in LCD. In [7] this paper the author has developed a smart glove with help of Kinect sensor which is used for video spilling and recording the gesture. This project is mostly look forward to interaction between computers and human which is developinginnovations.

PROPOSED ALGORITHM:

A. Design Considerations:

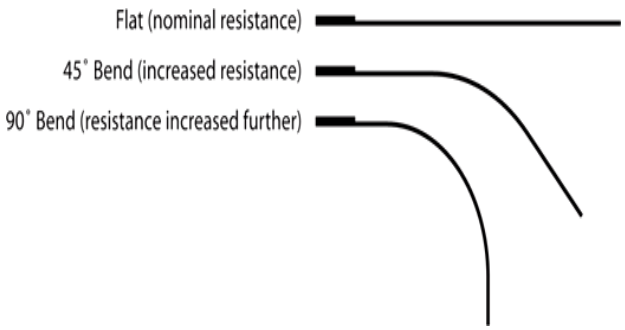
- Flex Sensor to find the bending angle of fingers and thumb.
- Accelerometer to measure the tilt in palm.
- Arduino Nano would be used in this prototype as microcontroller.
- Bluetooth module for the transmission of data.

B. Description of the Proposed Algorithm:

The proposed algorithm is consists of three main steps.

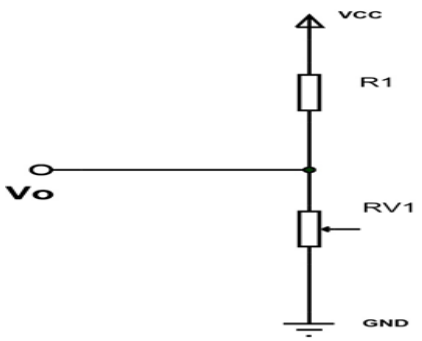
Step 1: Calculating the bend angle using Flex Sensor.

Flex Sensor is primarily a Variable Resistor whose terminal resistance increases when the sensor is bent. So the sensor resistance increases depends on surface linearity. So it is usually used to sense the changes in linearity. It is usuallyused to sense the changes in lineraity.



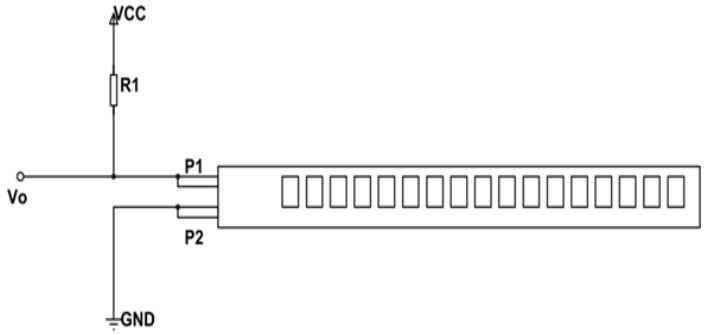
As shown in the above figure, when the surface of Flex Sensor is completely linear. It will be havingits nominal resistance. When it is bent to 45º angle the Flex Sensor resistance increases to twice as before. And when it is bent to 90º the resistance could go high as four times the nominal resistance. So the resistance of the Flex Sensor across the terminals rises linearly with bent angle. Then in a sense the Flex Sensor converts flex angle to Resistance parameter.

For our convenience we convert this Resistance parameter to a Voltage parameter. And for this we are going to use Voltage Divider circuit. A Voltage Divider circuit is shown below.



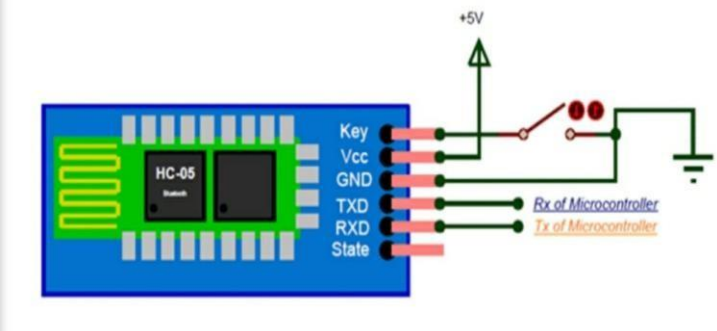
In this resistive network we have two resistances. One is constant resistance (R1) and other one is variable resistance (RV1). Vo is the voltage at midpoint of Voltage Divider circuit and it is also the output voltage and the

voltage across the variable resistance (RV1). When the resistance value of RV1 is changed, the output voltage Vo will also get changed .So we will have resistance change in voltage change with Voltage Divider circuit. Here in this we will replacethe variable resistance (RV1) with the Flex Sensor The circuit will be as shown below.



As shown in the above figure, R1 is a constant resistance and Flex Sensor which acts as a variable resistance. Vo is a output voltage and also the voltage across the Flex Sensor. Here, Vo = VCC (Rx/ (R1+Rx)). Rx-FLEX SENSOR resistance When the Flex Sensor is bent then the terminal resistance increases. This increase will also appears in Voltage Divider circuit. As the drop across the Flex Sensor increases so is Vo. With the increase in bent ofFlex Sensor Vo voltage increases linearly. With it we have Voltage parameter representingthe flex. We can take this Voltage parameter and feed it to ADC to get the digitalvalue which it can be used conveniently.

Step 2: To measure tilt in the palm using Accelerometer:
The ADXL335 can measure at least 3G in the X, Y and Z axis. It is optimal for high-resolution static acceleration measurements like tilt-sensing and also for moderate dynamic accelerations from motion, shock or vibration.
How it works:
MEME(Micro Electro-Mechanical Systems) This sensor consists of a micro-machined structure on a silicon wafer. The structure is suspended by polysilicon springs which allow it to deflect in the when subject to acceleration in the X, Y and/or Z axis. This deflection causes a change in capacitance between fixed plates and plates attached to the suspended structure . Due to this change in capacitance on each axis is converted to an output voltage proportional to the acceleration on that axis.
Ratiometric Output:
The output voltage increases linearly with acceleration over the range. For this ADXL335, that is approximately 0v at - 3G to 3.3 at +3G.
Step 3: Transformation of data via Bluetooth:
The HC-05 Bluetooth module has two operating modes, one is the Data mode in which it sends and receive data from other Bluetooth devices and the other is the AT Command mode in which the default device settings can be changed. We can operate the device in any of these two modes by using the key pin as explained in the pin description. It is very easy to pair the HC-05 module along with microcontrollers because it operates using the Serial Port Protocol (SPP). Simply power the module with +5V and then connect the Rx pin of the module to the Tx of MCU and Tx pin ofmodule to Rx of MCU as shown in the figure.



During power up the key pin can be grounded to enter into Command mode, if it is left free it by default it will enter into the data mode.Once the module is powered we should be able to discover the Bluetooth device as "HC-

05" and then connect with it using the default password 1234 and start communicating with it. The default parameters such asname password and other parameters can be changed by entering into it.

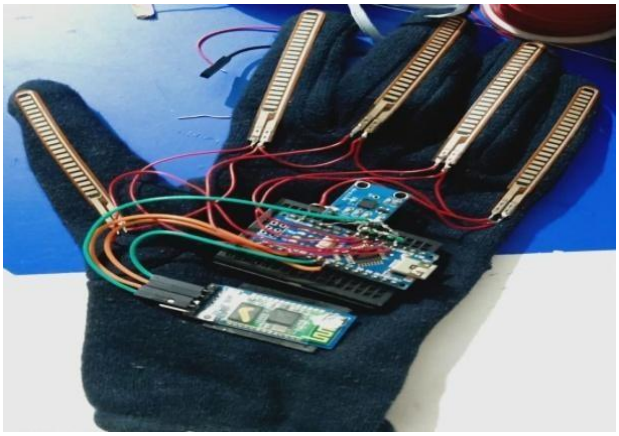
PSEUDO CODE:

Algorithm:
Step 1: Input for a particular gesture.
Get data from flex sensor.
Step 2: The sensor sends the analog signal to microcontroller Step 3: The ADC converts the analog signal into digital signal.Step 4: The digital value of flex will converted into angles.
Step 5: These angle will be compared with the given angles.Step 6:If not matched-nothing is display.
Step 7: If matched-data will send to phone via Bluetooth.Step 8: Output displays on smartphone.
Step 9: End

SIMULATION RESULTS:

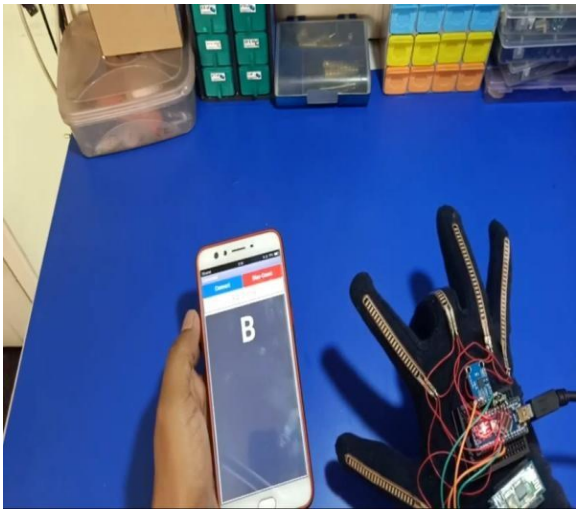
The simulation studies involve the working of the glove as follows. The prototype allows the speech impaired people tocommunicate with the world giving them an opportunity to express themselves to the world without any difficulties.The flex sensor in combination with the Accelerometer is successfully and accurately able to find the angle. Mounting the sensors on a glove, a very convenient to use wearable is made which is not only efficient but also comfortable to use in our daily lives. It provides an efficient method of alleviating the problems of the speech impaired community.

1:Smart Glove with ciruit Diagram:

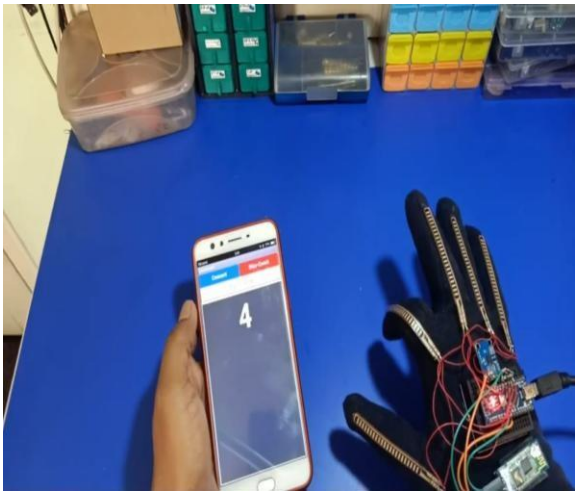


2: Sign Teller Application:

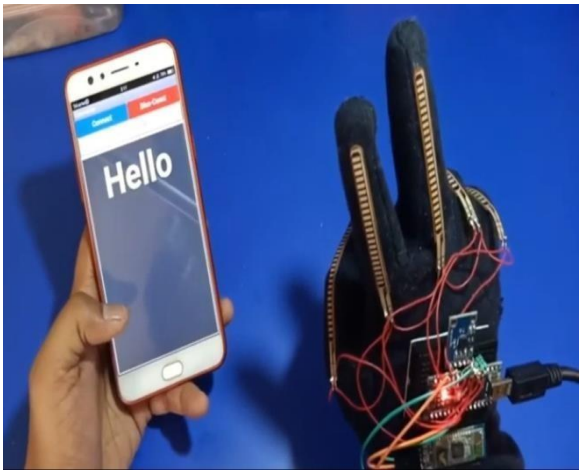
3: Sign Teller application displaying and speaking the output value "B":



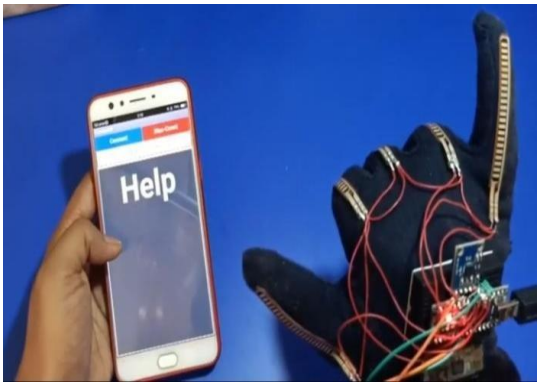
4: Sign Teller application displaying and speaking the output value "4":



5: Android application displaying and speaking the output "Hello":



6:Android application displaying and speaking the output "Help":



7:Android application displaying and speaking the output "Water":

CONCLUSION AND FUTURE WORK:

The technology can mean a new way for about 70 million people with hearing and speech impairment to verbally communicate and around connect to people around them. This project aims to lower the communication gap between the deaf or mute community and the normal world.Gesturing is a way of communication to present a specific meaning. In India nearly 31% of people are either deaf or mute or both. So, the sign language interpretation using sensors isbeing explored as an auxiliary tool for deaf and mute people to blend into society without barriers. It empowers such people with the power of speech and allows them to express themselves better. The glove is used to convert gesture to speech, but by carefully tracking the movement of the palm and fingers with even more accuracy. The human can wear the glove and move the fingers as if the perform the task. It can be concluded that the existing methods assisted in the development of our prototype but inclusion of new technology will surely lay a major impact in this field.

The gesture recognition system designed using sensor fusion and gesture recognition techniques in this venture has a lot of future aspects that has to be taken into consideration in order to support the help for this differently abled people more. This smart glove readily banishes the required interpretation between a speech impaired and a normal person. Future implementation can be made by enhancing the quality of the mobile application which can be used to produce a lot of technical quality research as in what is to be implemented to assist them more.

- The devices has application in home automation .Different gestures can be used to control various basic electronicappliances, etc.
- The device can be paired up with the fitness sensor to monitor health of the individual.
- The glove can be used for tracking user‟s movements in reality.
- Thus smart glove technology has and can have many applications in near future.

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