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Haptic Based Sign Language Interpreter

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Abstract: There is currently an abundance of systems available that is used to aid dumb/deaf people. These systems, though quite effective, are not very user friendly. We believe that, with the use of glove, signs can be translated with more accuracy and better consistency. In our paper, we are proposing a system which will prove to be an improvement to the existing system in terms of accuracy and ease of use. The use of the sensor glove would enable us to use sign language without relying on a computer. The sign language sensor glove proves to be very useful to aid in communication with the deaf. We believe that such a translator could be an effective means of communication to those who are using sign language in their daily life. The proposed scheme recognizes and interprets American Sign Language symbols that have static gestures. American Sign Language is a widely used and accepted standard for communication for people with hearing and speaking impairments. This project aims to alleviate these hurdles by acting as a bridge between Sign Language and Spoken Language to facilitate effective communication. We propose use of a sensor glove interfaced with a processor and display and audio devices which will translate the gestures made by the wearer to a commensurate word in the regular dialect. The model will also have provisions for the user to choose between 2 dialects and provide output based on the user's choice.

Keywords: American Sign Language; Sensor Glove;Translate; Dialects; Microcontroller; Arduino IDE; accuracy.

I. INTRODUCTION

Dialogues and languages has made it very easy for human beings to communicate effectively and socialize in the true sense. However, there is a faction in our society who are void of their ability to speak and/or listen. While there exists means for such people to communicate i.e. Sign Language, which involves a multitude of gestures that have specific meaning however there are quite a few hindrances associated with it. Communication with people who are deaf/dumb becomes very difficult if one is not familiar with the Sign Language. This project aims to alleviate these hurdles by acting as a bridge between Sign Language and Spoken Language to facilitate effective communication. We propose use of a sensor glove interfaced with a processor and display and audio devices which will translate the gestures made by the wearer to a commensurate word in the regular dialect. The model will also have provisions for the user to choose between 2 dialects and provide output based on the user's choice.A better and more convenient model that can help us to solve the problem that is the need of the hour is to make use of our smartphones that we all always have with us. To make this possible we aim to develop a mobile application using the software- Android Studio. Android Studio is the official IDE for Android app development. The software offers many features that makes it a popular app development platform .

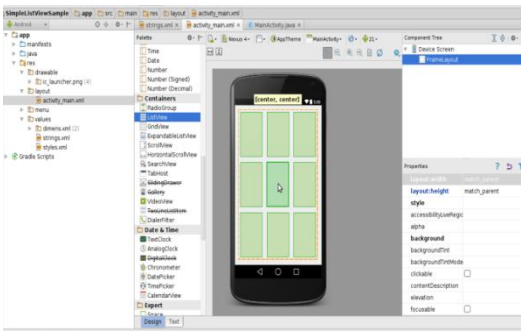

Fig.1: Layout of the App

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To list a few:

- Fast andfeature-rich emulator
- Unified environment where you can develop for all Android devices
- Extensive testing tools and framework.
- C++ and NDK Support
-

II. PROPOSED SYSTEM

A. Block digram of the proposed system. **:**

B. American Sign Language: American Sign Language is the accepted standard for communication of the deaf and the dumb community worldwide.

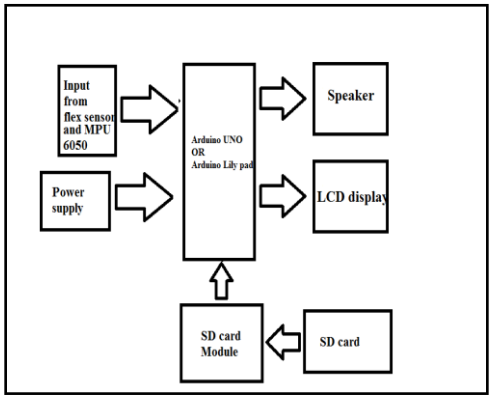

Fig. 2: Block diagram for the system

Flex Sensor: This sensor measures the amount of deflection or bending. The resistance of this sensor varies proportionally with the amount of the bend.

Microcontroller: It is a small computer on a single integrated circuit. This system uses Atmega 328.

Arduino IDE: This Software is used for compiling programs, which are uploaded to the microcontroller 328.

C. Working principle:

Flex sensors are fixed on every finger. When the gesture is done to convey a particular alphabet or a phrase, these sensors and the gyro meter record the values. Every alphabet in the American Sign Language has a different action. There are two phases in the working of the system. First Training and then Testing.

In Training part, we are making different actions with the glove in the hand. These values are being recorded. This process is repeated multiple times to get the most accurate readings. Now every alphabet or an action has a combination of different values from different flex sensors and a gyro meter [2]. When the gesture is done, these recorded values should be observed [5].

In Testing part, the usage of above combination of values is being used. Now every value is assigned to a particular distinct alphabet, digit or a phrase. The glove is adjusted on the hand properly and gestures are made. These gestures will come close to a predefined value. This value will have a particular alphabet and this alphabet will be displayed [5]

The above process will be repeated for different phrases and further for different languages too.

Step 1: Connect the Flex sensors and the MPU-6050 to the Arduino

Step 2: Calibrate the Accelerometer, Flex sensors and record the initial position

Step 3: Upload a program which records and prints (Serial monitor) the values (analog) of flex sensors and accelerometer based on the movements of fingers and hand

Step 4: Create a database of all the flex values corresponding to the gestures into the Android application.

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Step 5: Go to the app and establish the connection between the Bluetooth module and the smart phone.
Step 6: Upload a program to display the meaning of gesture i.e. visual output corresponding to the analog values recorded from the flex sensors and accelerometer on the smart phone screen.
Step 7: Program the Arduino and to play the audio file corresponding to the analog values from flex sensors and accelerometer.
Step 8: Attach the flex sensors and the MPU-6050 on the gloves
Step 9: Upload a final Program which records the values of gestures from flex sensors and MPU-6050, compares it with predetermined value and sends the value to the application for the visual and audio output through the smart phone screen and speaker.

III. HARDWARE COMPONENTS REQUIRED

The hardware being used for implementation of the system are:

A. Arduino Board:

This is open source board. This board comprises of an Atmega 328 chip a 16 MHz clock. There are different ports available on this board. The best advantage of this using this board is its concise size. Majorly analog pins are being used along with few digital pins for sensors.

B. Flex Sensor:

This sensor measures the degree of bend and generates proportional amount of resistance. When used in voltage divider circuit, these sensors produces significant amount of voltages. These voltages are recorded from the analog pins of the Arduino board[2].

C. Blutooth Module HC-05**:**

It is a Bluetooth Device used for wireless communication with Bluetooth enabled device like smart phones. It communicates with Microcontroller using serial communication (USART).Default setting of HC-05 can be changed using certain AT commands

As HC-05 has 3.3v level for RX/TX and microcontroller can detect 3.3v level so there is no need to shift TX voltage level of HC-05 module but we need to shift the transmit voltage level from microcontroller to RX of HC-05[1].

D. Android Studio:

Android Studio is the official Integrate Development Environment (IDE) for Android app development, based on IntelliJ IDEA. On top of IntelliJ's powerful code editor and development tools, Android Studio offers even more features that enhance your productivity when building Android apps.

E. Other Accessories:

LCD Display, SD card Module, Connecting wires, Speaker.

IV. DESIGNING

A. Connecting Flex sensors:

The Five flex sensors are attached on the gloves i.e. on the fingers and on the thumb. These Flex sensors are then connected to the five analog pins of the arduino board through a 10kohm and 47kohm resistors forming a voltage divider circuit. The flex sensor changes its resistance as per the bending of the fingers. Three ranges of values are observed when the flex sensors are full extended, half bend and full bend. These values are then used to display the corresponding letters according to the gesture [5].

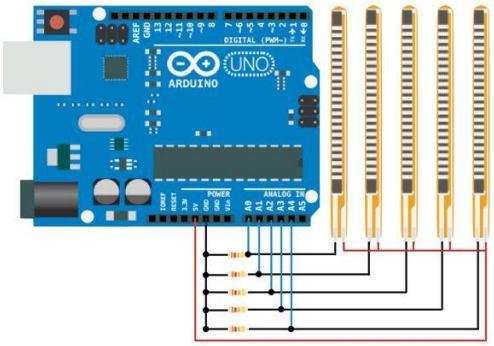

Fig. 3: Connecting Flex sensors

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B. Connecting MPU6050:

The MPU6050 is attached to the back of the glove below the five flex sensors.MPU6050 is an accelerometer and a gyro-meter which is connected to the microcontroller on the analog pins[5]. It is mainly used to set the initial position of the glove. Some gestures involve the movement of the whole hand and wrists and which can be only recorded by the accelerometer since it gives a range of values corresponding to the change in the position of the accelerometer.

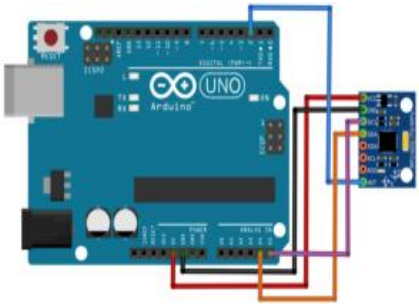

Fig.4:Connecting MPU6050

C. Connecting SD card module. and speaker

A SD card module is connected to the arduino which is used to read the SD card. In SD card the audio files of all the letters and gestures are stored which are played depending upon the movement of MPU6050 and the flex sensors on the speaker. The Software only supports the files having the WAV format[2].

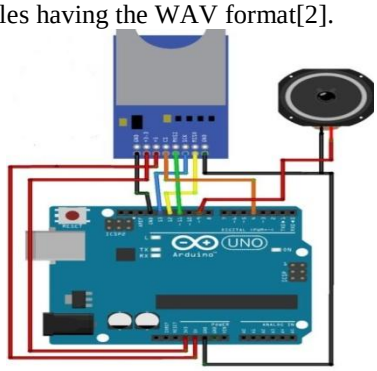

Fig. 5: Connecting SD card module and speaker.

D. Connecting Bluetooth Module HC-05

Hc-05 works on Serial Communication .The Android App is designed to send serial data to the arduino bluetoooth module when a button is pressed on the app. The Arduino Bluetooth module at other end receives the data and sends it to the Arduino to the TX pin of the Bluetooth module (Connected to RX pin of the arduino)[1][2].

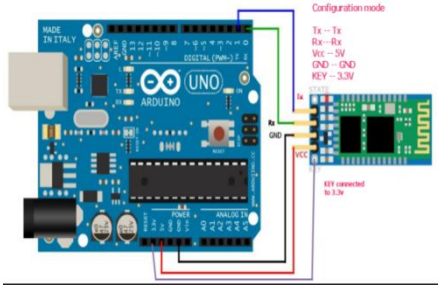

Fig. 6: Connecting Bluetooth Module HC-05

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E. Programming Arduino Studio with Bluetooth Module

The Bluetooth module interfaced with the Arduino is connected to the Android app. The values from the flex sensor are given to the mobile application by the Bluetooth module. These values are compared to the values stored in the database of the Android app and if the values match then the corresponding character is displayed on the mobile screen as well as the character is read out through the mobile speaker.

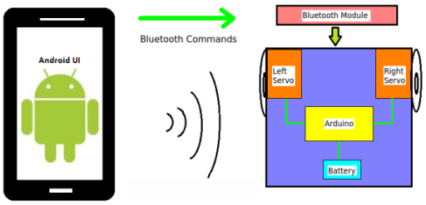

Fig. 7: Interfacing of Mobile App with the sensor glove

V. RESULTS

Fig 8: Sensor Glove

The bend of the flex sensors will send variable resistance values to the microcontroller which will compare it with the values in its database and display the corresponding letter or word for the given gesture. The value also triggers an audio output from the SD card module through the speaker. The interpretation of letters like M,N,O,R,S,X which have been observed to be inaccurate have also been rectified[1]. An added feature incorporated in the system is its ability to transliterate the gesture into two different dialects namely English and Hindi[1][5].

VI. FUTURE SCOPE

The present work on the system suggests that with the use of better components, the product can be made excessively accurate. With the use of efficient coding the results can yield better results. Finally integrating different languages can make the product more diverse for an individual. The model can be made more mobile and compact by designing a mobile application which will allow our mobile telephones to translate the gestures, doing away with the peripheral devices like LCD and speakers.

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