SUMMARY

Generally dumb people use sign language for communication but they find difficulty in communicating with others who don’t understand sign language. This project aims to lower this barrier in communication. It is based on the need of developing an electronic device that can translate sign language into speech in order to make the communication take place between the mute communities with the general public possible. A wired data gloves is used which is normal c gloves fitted with flex sensors along the length of each finger and the thumb. Mute people can use the gloves to perform hand gesture and it will be converted into speech so that normal people can understand their expression. Sign language is the language used by mute people and it is a communication skill that uses gestures instead of sound to convey meaning 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 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. Various sign language systems have been formulated by manufacturers around the world but they are neither adaptable nor cost -effective for the actual users. This report presents a system prototype that is able to automatically recognize sign language to help normal people to communicate more effectively with the diminished people.

INTRODUCTION

About nine thousand million people in the world are deaf and dumb. The communication between a deaf and normal person is to be a serious problem compared to communication between blind and normal visual people. Sign language is a non-verbal form of intercommunication which is found amongst deaf people in world and is a more organized and defined way of communication in which every word or alphabet is assigned some gesture. The languages do not have a common origin and hence difficult to translate. A gesture in a sign language is a particular movement of the hands with a various shape made out of fingers. A gesture on the other hand, is a static shape of the hand orientation to show a sign. Gesture recognition is categorized into two main groups i.e. vision based and sensor based. The sensor based technique offers better mobility.

The main aim of this project is to present a system that can efficiently interpret Sign Language gestures to both text and auditory speech. We have focused on designing a Human Computer Interface (HCI) system that can understand the sign language accurately so that the signing people may communicate with the non signing people without the need of an interpreter. It can be used to generate speech or text. The converter here makes use of a glove based technique consisting of flex sensors. The device translates alphabets as well as can form words using specific gestures made by the person.

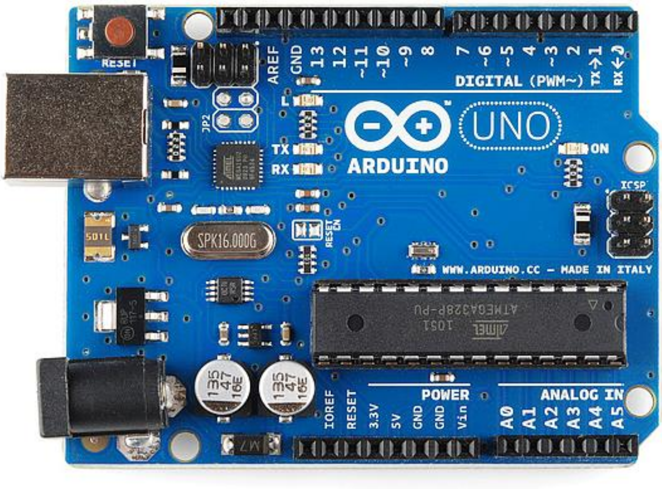
This project also deals with the design and development of a robotic hand with real-time control, which is precise and cost-effective. This five-fingered robotic arm mimics a small degree of dexterity for deaf & dumb. The basic components required in this project is the hand itself, the Arduino, the glove, and the flex sensors, LCD and SDcard module. The glove is mounted with flex sensors: variable resistors that change their value when bent. The Arduino reads the voltage change when the sensors are bent, and triggers the servos to move a proportional amount.

PRODUCT SPECIFICATIONS

HARDWARE DETAILS

1. Arduino UNO

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The ATmega328 has memory of 32 KB (with 0.5 KB occupied by the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM. The Arduino programming language is a simplified version of C/C++. An important feature of the Arduino is that we can create a control program on the host PC, download it to the Arduino and it will run automatically. Remove the USB cable connection to the PC, and the program will still run from the top each time you push the reset button. It will take i/p from Flex sensors at ADC pins and display the corresponding output on LCD. It will get activated from a 12V DC battery. This 12V is further reduced to 9V using voltage regulator(7809) and connected to Vin pin and '–ve' potential is connected to GND pin.



2. Flex Sensor

Flex sensors are sensors that change in resistance depending how much the sensor is bend. Sensors convert the change in bend to electrical resistance - the more the sensor bend, the higher the resistance value. Using the Flex Sensor is very easy. There are couple of different manufacturers in the market. Datasheet instructs you to use operational amplifier (opamps). That may be useful if you plan to use flex sensor as stand-alone device (without any microcontroller).Because We are using arduino, We skipped all OpAmps and made a very simple circuit with only one additional resistor.

Varying the value of the resistor will results different readings. With 10k Ohm resistor we will get the desired values. This works fine for us. In our code we assumed that all values above 900 mean that the sensor is bend. All values below 800 mean that sensor is nor bend. Note that Flex sensor give reliable readings ONLY if you bend it on the specific direction (usually towards on the text side of the sensor).

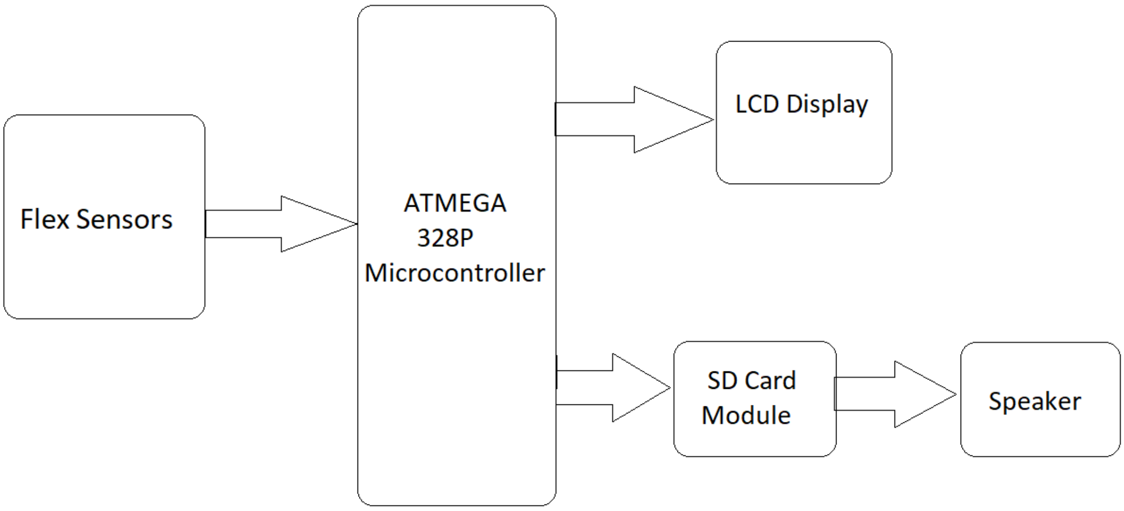
3. Liquid Crystal Display (LCD)

The output of the system is displayed on LCD. In our system16x2 LCD is used. The 16x2 indicates 16 columns and 2 rows. So, we can write 16 characters in each line. So, total 32 characters we can display on 16x2 LCD.The LCD will display the word corresponding to each hand gesture made by user. This enables the mute people to convey their thoughts using words. And also helps deaf people to understand what is conveyed the person communicating with them. As deaf people can read the words directly from the LCD. Hence this system enables deaf people to communicate with Mute as well as normal people.

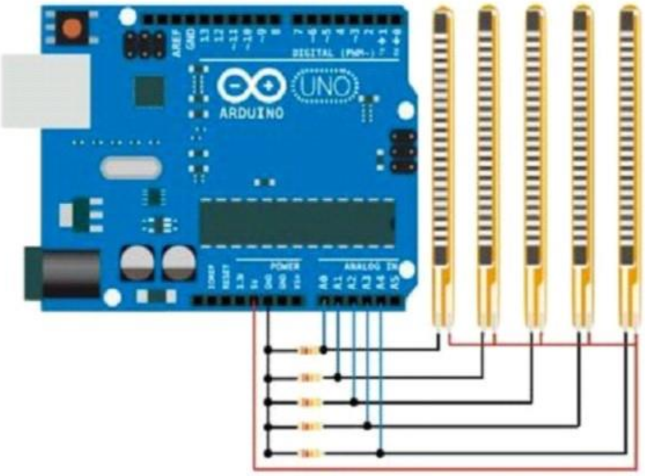
4. SD Card

The purpose of using SD Card in this system is to store the data. In our sys tem the 16GB SD card is used. The SD card stores the .wav file corresponding to each word. This data used to play the output of the system on Loud Speaker and display it on the LCD screen.

IMPLEMENTATION AND CONSTRUCTION



1.SET UP THE SENSOR CIRCUIT



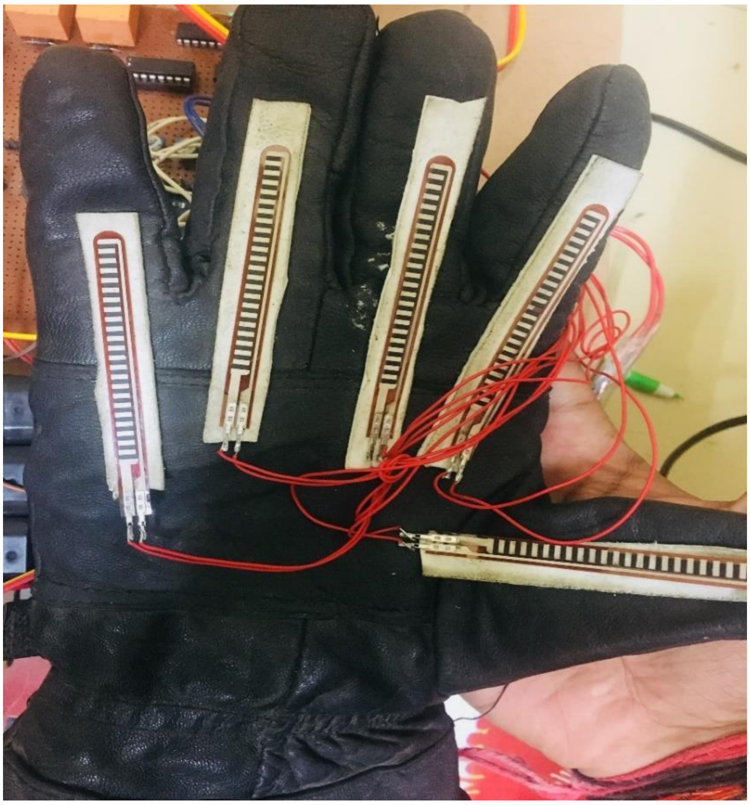
CONSTRUCTION OF SENSOR CIRCUIT

The flex sensors require a circuit in order for them to be compatible with Arduino. It's a voltage divider: the flex sensors are variable resistors, and when paired with resistors of a static value, change in resistance (in this case bending the sensor) can be sensed through the change in voltage between the resistors. This can be measured by the Arduino through its analog inputs.

The schematic is attached (red is positive voltage, black is negative, and blue goes to the Arduino). The resistors in the photo are 10K.

The main GND wire, which is connected to all the individual GND wires from the sensors, gets plugged into the Arduino's GND. The positive end of each of the Flex sensor is connected to one end of the potentiometer which is used to control the voltage provided by the sensors.

2. **FLEX SENSOR MOUNTING**

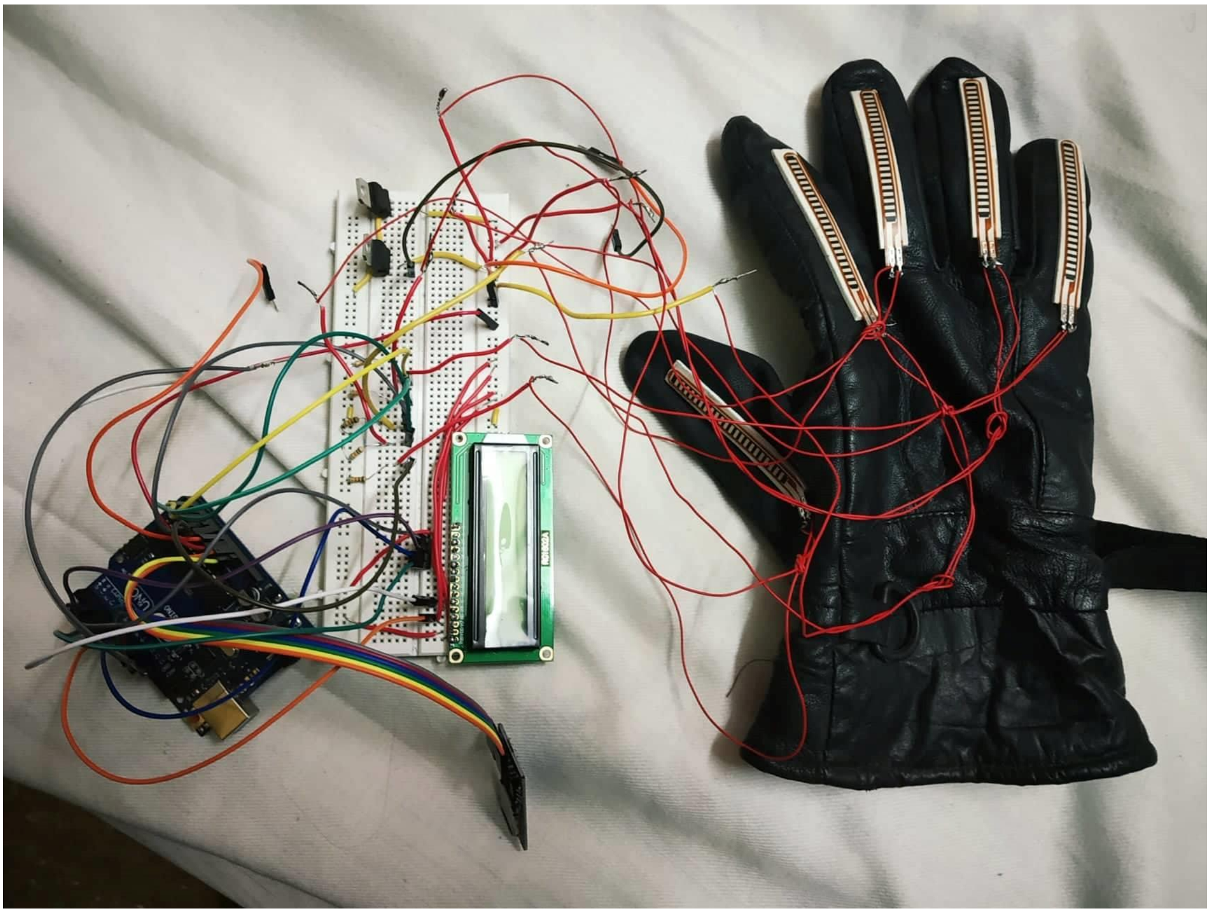


Now it's time to mount the sensors and their circuit onto the glove itself. On each finger, with a pencil or pen, we made small lines over the tops of each joint/knuckle placed on the inside rather than outside and pasted them on the glove using Double sided Tape.

WORKING:

Physical form of the circuit is shown in figure below. I consists of microcontroller interfaced flex sensors, voice module, etc. Change in the values of flex sensors gives some hex code to the microcontroller which after compilation displays the output in LCD and also produces the voice through the speaker. The words or signs are obtained by taking English as a reference. For every word, values of flex sensors are compared with the values already saved in the microcontroller and then the result is displayed in LCD.

Flex sensor and microcontroller are used in this system to capture the words. The work of flex sensor is to obtain changed position of fingers and to capture words.By changing the position of hands the values of flex sensor will not get changed because flex sensor is placed in fingers. Sign language used by deafand dumb people will be using fingers or hands in marked position and rotating hands or fingers. To analyze these positions of fingers or hand microcontroller is used. This microcontroller is placed on the device so that by changing the finger for conversation, flex sensor and microcontroller values will get changed, by comparing these two values, output is displayed in display and voice module gives the voice output.



SOFTWARE DESIGN:

The "Sign Language Trainer & Voice Convertor” software receives the values given by the flex on the two gloves through an Arduino Microcontroller Board. The software end has the following features:

 Visualization of the gloves on real time graphs

 Calibration of gloves

 Creation of libraries

 Saving of audio files for each gesture in SD card

 Gesture recognition and voice emulation.

The software is based on the statistical template matching model and the entire model can be divided into three parts, namely: calibration of the sensors, training of the model and gesture recognition.

Calibration of the sensors is achieved by taking the minimum and maximum sensor values and then normalizing and quantizing the values, so as to convert the read sensor values into a pre-defined range of discrete data set.

SOFTWARE ALGORITHM

The processing code of our project is given below:-

```
#include <LiquidCrystal.h>
#include <SD.h>                         //include SD module library
#include <TMRpcm.h>                      //include speaker control library

#define SD_ChipSelectPin 4               //define CS pin

TMRpcm tmrpcm;                          //crete an object for speaker library
int v1, v2, v3, v4, v5;
int a1, a2, a3, a4, a5;

const int f1=A0;
const int f2=A1;
const int f3=A2;
const int f4=A3;
const int f5=A4;

// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(7, 6, 5, 8, 3, 2);

void setup(){

  tmrpcm.speakerPin = 9;                //define speaker pin.
                                //you must use pin 9 of the Arduino Uno and Nano
                                //the library is using this pin
   // Open serial communications and wait for port to open:
  Serial.begin(9600);
  while (!Serial) {
   ; // wait for serial port to connect. Needed for native USB port only
  }

// set up the LCD's number of columns and rows:
  lcd.begin(16, 2);
  // Print a message to the LCD.
  lcd.print("Hello");
  delay(500);
  lcd.setCursor(0, 1);
  lcd.print("Init SD crd...");
  Serial.print("Initializing SD card...");
  delay(500);



  if (!SD.begin(SD_ChipSelectPin)) {      //see if the card is present and can be initialized
//    lcd.clearLine(1);
    lcd.setCursor(0, 1);
    lcd.print("Init fail!");
    Serial.println("initialization failed!");
    return;                              //don't do anything more if not
  }
// lcd.clearLine(1);
  lcd.setCursor(0, 1);
  lcd.print("Init done!");
  Serial.println("initialization done.");
  tmrpcm.setVolume(5);                    //0 to 7. Set volume level
  delay (1000);
}

void loop()
{
  delay(1000);
  v1=analogRead(f1);
  v2=analogRead(f2);
  v3=analogRead(f3);
  v4=analogRead(f4);
  v5=analogRead(f5);

//  v1=map(v1,700,900,0,255);

  Serial.print("Flex 1 = ");
  Serial.println(v1);
    Serial.print("Flex 2 = ");
  Serial.println(v2);
    Serial.print("Flex 3 = ");
  Serial.println(v3);
    Serial.print("Flex 4 = ");
  Serial.println(v4);
    Serial.print("Flex 5 = ");
  Serial.println(v5);
  delay(100);

  if (v1<800)
  a1=0;
  else if (v1>900)
  a1=1;
  if (v2<900)
  a2=0;
  else if (v2>900)
  a2=1;
  if (v3<800)
  a3=0;
  else if (v3>850)
  a3=1;
  if (v4<820)
  a4=0;
  else if (v4>900)
  a4=1;
  if (v5<800)
  a5=0;
  else if (v5>900)
  a5=1;

  // 1 = Finger Bent
  // 0 = Finger Straight

  if (a1==0 && a2==0 && a3==0 && a4==0 && a5==0)
  {

  Serial.println("Playing....Stop(Change Needed)");
  tmrpcm.play("Z.wav"); //the sound file "Z" will play each time the arduino powers up, or is
reset
  lcd.clear();
  // set the cursor to column 0, line 1
  // (note: line 1 is the second row, since counting begins with 0):
  lcd.setCursor(0, 1);
  //Print a message to second line of LCD
  lcd.print("Stop.(CN)");
  delay(1000);
  Serial.println("Done Playing");
  }
  else if (a1==1 && a2==0 && a3==0 && a4==0 && a5==0)
  {
      Serial.println("Playing....A");
  tmrpcm.play("A.wav");        //the sound file "A" will play each time the arduino powers up,
or is reset
    lcd.clear();
  // set the cursor to column 0, line 1
  // (note: line 1 is the second row, since counting begins with 0):
  lcd.setCursor(0, 1);
  //Print a message to second line of LCD
  lcd.print("A.......");
  delay(1000);
  Serial.println("Done Playing");
  }
```

Code will be similar for other cases.

TROUBLESHOOTING

A. GENERAL SAFETY RULES :

1. As with any machine with moving parts, be careful not to let body parts get pinched. While the hand has very little gaps and it may be difficult to get trapped in them, it could potentially catch on clothing, rings, etc.

2. When operating this hand apply a maximum of 5 VDC to the LCD. Anything above this voltage will destroy the LCD and will void the warranty.

3. When the hand is at rest and not performing all power should be turned off.

4. If excessive force is applied to any finger or thumb for any gesture, it may destroy the sensors.

B. RISKS AND ISSUES ENCOUNTERED WITH THE HARD WARES:

1. BREAD BOARD BURNT OUT

Many small test circuits had to be built on breadboards and tested in the project, under actual circumstances, to make sure they would not fry.

 CAUSE: Several components were not grounded and did in fact fry. A breadboard was also melted. Also, it was difficult to manage a huge circuit on a bread board resulting in improper connections of wires.

 TROUBLE SHOOT: We managed working on it using jumper wires and reducing the use of bread board wire.

2. FLEX SENSOR READING PROBLEMS

 CAUSE: This problem maybe caused due to the wrong design of our analog circuit.

 TROUBLE SHOOT :

1. We connected in series: a 5 Vdc supply, 10K resistor and ground.
2. Because of repeated use of flex sensors, conductive material get weakened and since these sensors are very expensive, instead of buying new ones we can use it through a little bit of moisture. Moisture makes the conductive carbon materials active and makes it work properly for some time.

3. LCD NOT WORKING PROPERLY

 CAUSE:

- **Display showing black boxes:** This problem tends to occur if you have chosen a very low value of the display contrast control resistor. Also, display may show black boxes even when you are writing the data very fast onto the display.
- **Display showing wrong characters:** The display shows wrong characters even when you are sending the right ASCII values. This problem is because the display is not receiving the proper data since there is a problem in the connection of data lines. There might be a short circuit between adjacent data lines or it might also occur if some of the data lines are not properly connected.
- **Display showing totally blank lines:** This problem also occurs if you have set the contrast control resistor value too high. So make sure you have selected the value to be around 4.7K ohms which was default in our case.
- **Contrast OK, Delay OK but still no display:** If you are not getting proper character display even after setting the right contrast values and providing the right delay in code, then there might be a chance that your controller's logic voltage levels are not compatible with the display's.

□ **TROUBLE SHOOT** :

1. You are sending the proper commands. The address of each lines on LCD are not consecutive and there are offsets. So we have to make sure if we are using the appropriate LINE addresses as given in the LCD datasheet.

2. Providing proper delay between data and command writes

3. Hold the enable pin HIGH long enough for the display to latch the data in.

4. Wait for the LCD to initialise itself on power up and then start sending commands. DB7 pin indicates LCD busy.

CONCLUSION

Sign language may be a helpful appliance to ease the communication between the deaf or mute community and additionally the standard people. This project aims to lower the communication gap between the mute community and additionally the standard world. The projected methodology interprets language into speech. The system overcomes the necessary time difficulties of dumb people and improves their manner. Compared with existing system the projected arrangement is compact and is possible to carry to any places. This system converts the language in associate passing voice that's well explicable by blind and ancient people. The language interprets into some text kind displayed on the digital display screen, to facilitate the deaf people likewise. In world applications, this system is helpful for deaf and dumb of us those cannot communicate with ancient person. The foremost characteristic of this project is that the gesture recognizer may be a standalone system, that's applied in commonplace of living. It’s in addition useful for speech impaired and paralysed patient means those do not speak properly and in addition used for Intelligent Home Applications and industrial applications.

FUTURE SCOPE

This project is cheap, efficient and portable. This system also uses simple techniques. Deaf and dumb people are helped by this project doing communication in marking areas, public sectors, working areas with others.

This project is also helpful and play major role in various fields such as Robotics, Biometrics, Automation of industries, Musical instrument by replacing physical buttons and switches by hand gestures.

To present the project 100% waterproof, some protected layers have to be placed in order to save the circuit, battery and speaker from water.

To support more number of signs, and different languages mode the system can be extended.

In future, designing of a jacket which will be capable of detecting movement of animals can also be done by improving the project.

System's efficiency can also be enhanced by doing different software development strategies and various programming techniques.

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