AUGMENTATIVE COMMUNICATION DEVICE FOR DEAF AND DUMB PEOPLE

ENR305

Sensors, Instruments and Experimentation

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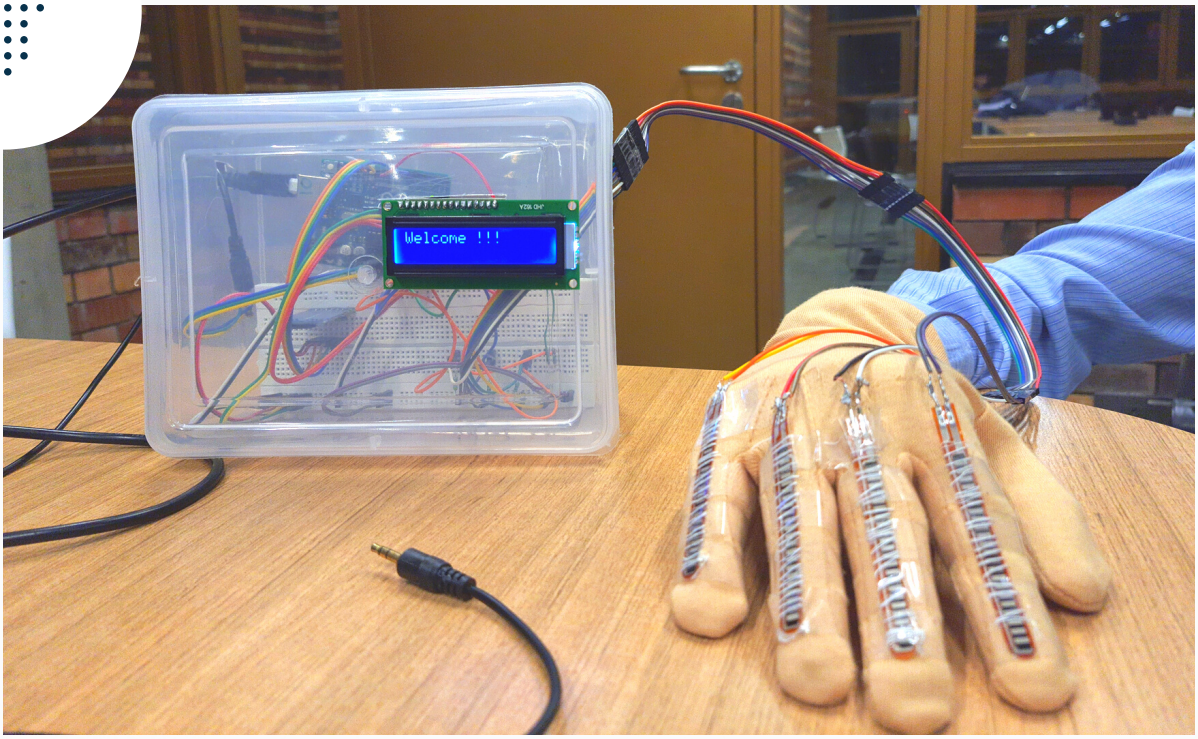


Preface

People with disabilities have always faced difficulties in coping up with this advancing world. However, this advancement in technology will be the main reason for making their lives easy.

People with deafness and dumbness often face problems in communication. One of the reasons is unawareness of common people about the sign language.

Considering the aforesaid problem, we came up with an idea of gesture controlled sign language converter device. This contains a sensor attached glove which will recognise the gestures using sensors and convert that gestures to audio and textual signals.

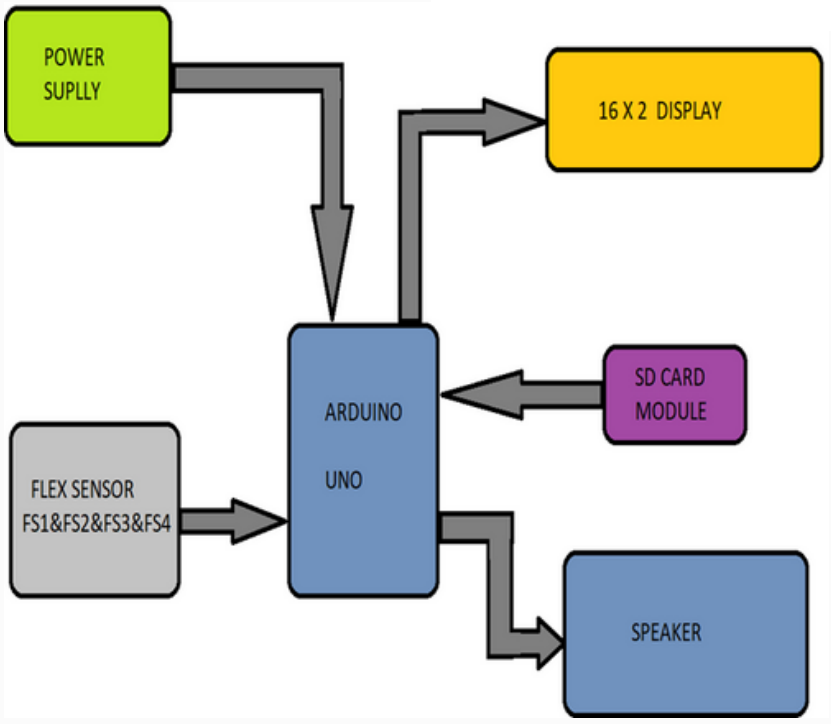
Acknowledgement

We would like to express our special thanks of gratitude to Professor **Dr. Sanket Patel Sir** and **Dr. Vinod Mall Sir** On the occasion of the accomplishment of our project on HAND GESTURE ASSISTANT FOR DEAF AND DUMB PEOPLE.

Both the professors helped us with whatever difficulties faced during the project and constantly supported us throughout the process of making this utility based device. Being a professor, you both spared much time from your busy schedules for us and patiently heard all of our concerns which were really very overwhelming. Thank you so much, sir.

We are also thankful to our Dean of Students, **Dr. Sanjay Chaudhary Sir** of Ahmedabad University, for providing all the required facilities for the completion of this project.

Finally, we are thankful to all our teaching assistants for their support and coordination, and we hope we receive more valuable guidance from them in our future endeavors.



The block-diagram of the proposed system is shown in the figure above

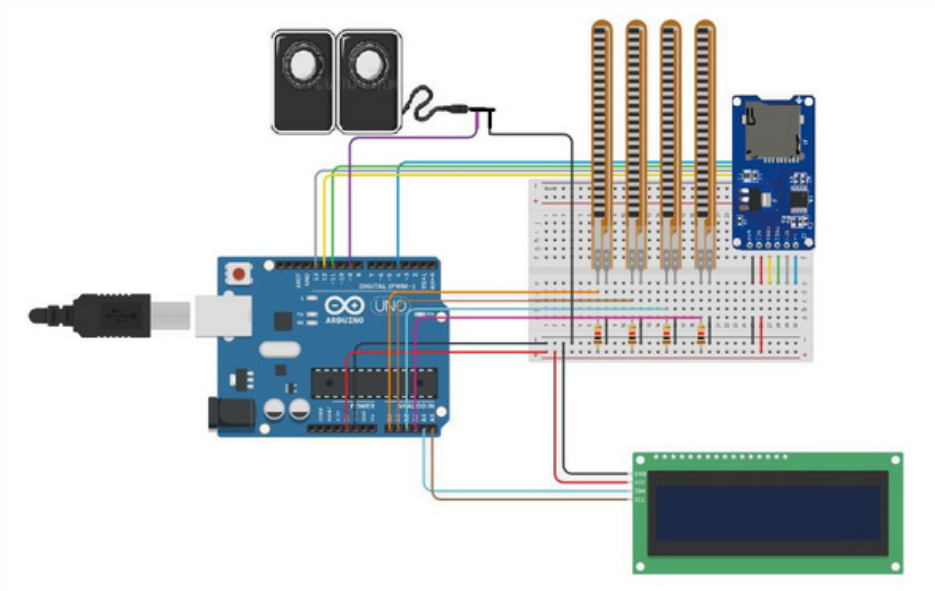
Block Diagram

DESCRIPTION:

- Four flex sensors are attached to all the four fingers of the glove.
- The bending of finger is sensed by the flex sensors. These values are taken as an input and sent to the arduino board.
- Signals are generated based on the decision making program loaded on the arduino processor, which are sent to the respective devices.
- The audio files are saved in a SD Card which are read using Sd Card module and output is sent to arduino board.
- The input received from the module is sent to the PWM pin of arduino board where the audio output device is connected.
- The output is displayed on 16x2 LCD display and the audio file is played on speaker.

Circuit Diagram

The circuit-diagram of the proposed system is as per the shown in the figure below.



CIRCUIT DIAGRAM DISCRIPTION:

- This circuit uses 4 flex sensors connected to a Arduino Uno board. Arduino board has a total of 14 digital I/O pins and 6 analog I/O pins. The Flex sensors are connected to the analog I/O pins. Audio output is on Pin Number 9 of the digital I/O pins. For LCD Display, I2C module is used which have predefined connections of SDA and SCL on A4 and A5 respectively.

- When the first finger is straight and the remaining 3 fingers are bent, the value of the Flex sensor will be converted from the analog value to the digital value by arduino board and is used as an input to the program. If the pre-decided conditions are satisfied, the SD card module will come into action and will send the Wav file named 1.wav to the digital I/O pin number 9. The speaker will play the received input and we will hear "HELLO" stored in the 1.wav file. Further more "HELLO" will also be printed on the 16x2 LCD display.

- When the first and second finger are straight and the remaining two fingers are bent, the value of the Flex sensor will be converted from the analog value to the digital value by arduino board and is used as an input to the program. If the pre-decided conditions are satisfied, the SD card module will come into action and will send the Wav file named 2.wav to the digital I/O pin number 9. The speaker will play the received input and we will hear "HOW ARE YOU?" stored in the 2.wav file. Further more "HOW ARE YOU?" will also be printed on the 16x2 LCD display.

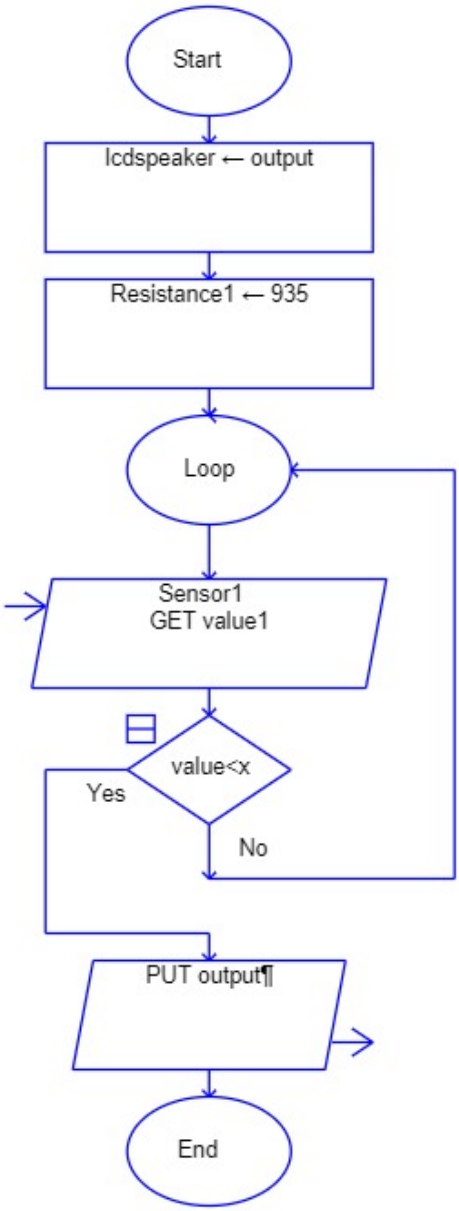
- When the first three finger are straight and the remaining one finger is bent, the value of the Flex sensor will be converted from the analog value to the digital value by arduino board and is used as an input to the program. If the pre-decided conditions are satisfied, the SD card module will come into action and will send the Wav file named 3.wav to the digital I/O pin number 9. The speaker will play the received input and we will hear "I NEED HELP" stored in the 3.wav file. Further more "I NEED HELP" will also be printed on the 16x2 LCD display.

- When all the four fingers are straight, the value of the Flex sensor will be converted from the analog value to the digital value by arduino board and is used as an input to the program. If the pre-decided conditions are satisfied, the SD card module will come into action and will send the Wav file named 4.wav to the digital I/O pin number 9. The speaker will play the received input and we will hear "I NEED WATER" stored in the 4.wav file. Further more "I NEED HELP" will also be printed on the 16x2 LCD display.

- When the second and third finger are straight and the remaining two fingers are bent, the value of the Flex sensor will be converted from the analog value to the digital value by arduino board and is used as an input to the program. If the pre-decided conditions are satisfied, the SD card module will come into action and will send the Wav file named 5.wav to the digital I/O pin number 9. The speaker will play the received input and we will hear "THANK YOU" stored in the 5.wav file. Further more "THANK YOU" will also be printed on the 16x2 LCD display.

- When the third and fourth finger are straight and the remaining two fingers are bent, the value of the Flex sensor will be converted from the analog value to the digital value by arduino board and is used as an input to the program. If the pre-decided conditions are satisfied, the SD card module will come into action and will send the Wav file named 6.wav to the digital I/O pin number 9. The speaker will play the received input and we will hear "BYE" stored in the 6.wav file. Further more "BYE" will also be printed on the 16x2 LCD display.

FLOW CHART OF THE PROGRAM



The flow chart of the program is as per shown above

COMPONENTS:

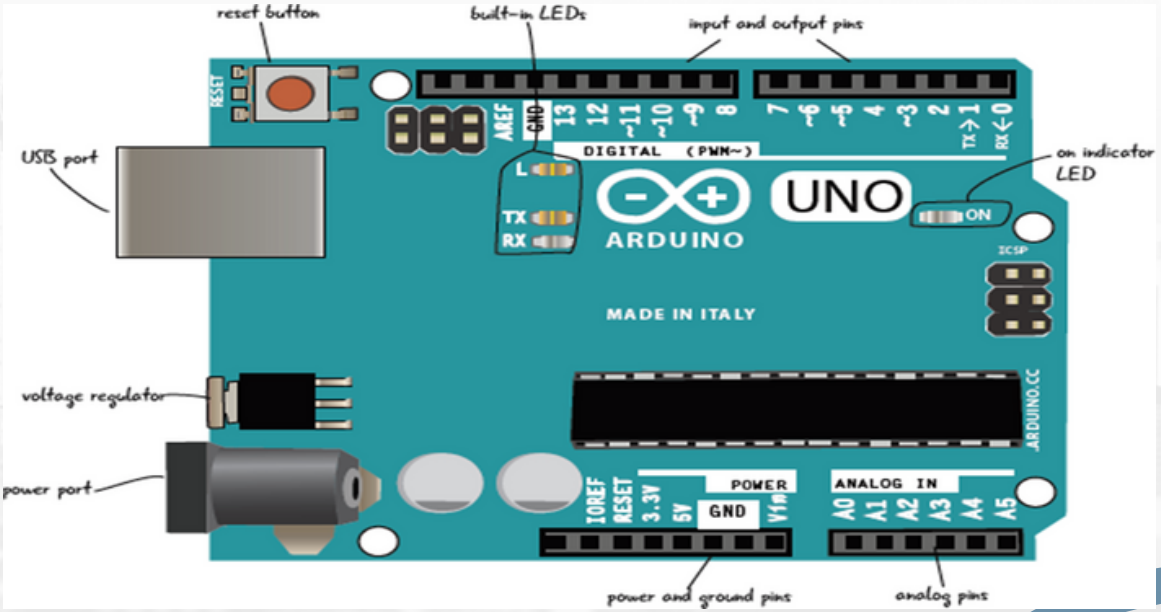
We have used different components as listed below:

1. Arduino Uno
2. Glove & Flex Sensors
3. SD Card Module
4. LCD Display
5. Power Supply
6. Speaker

The description of the components Used:

1.Arduino Uno:

- The Arduino Uno is the “standard” Arduino board and is most feasible and easily available.
- It is powered by an Atmel ATmega328 with a total of 32 KB of l ash memory, 2 KB of SRAM, and 1 KB of EEPROM memory.
- With a total of 14 digital I/O pins and 6 analog I/O pins, it is a highly capable device and is able to run most of the programs.
- An on-board ATmega16u2 chip manages serial communication.
- It is one of the most widely used and cost effective boards.



Pin Description:

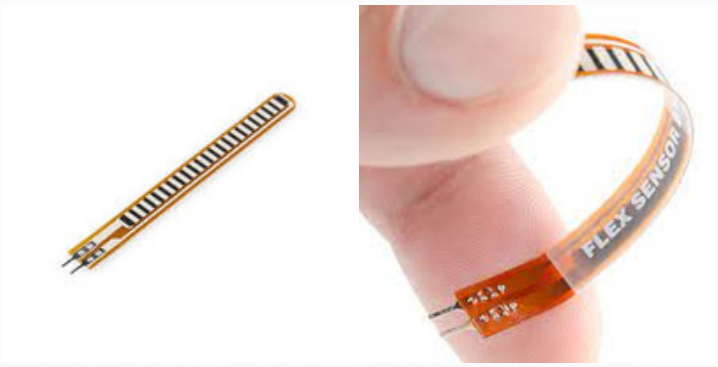
Power	Vin, 3.3V, 5V, GND	Vin: Input voltage to Arduino when using an external power source. 5V: Regulated power supply used to power microcontroller and other components on the board. 3.3V: 3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA. GND: ground pins.
Reset	Reset	Resets the microcontroller.
Analog Pins	A0 – A5	Used to provide analog input in the range of 0-5V
Input/output Pins	Digital Pins 0 – 13	Can be used as input or output pins.
Serial	0(Rx), 1(Tx)	Used to receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.
SPI	4 (CS), 11 (MOSI), 12 (MISO) and 13 (SCK)	Used for SPI communication.
Inbuilt LED	13	To turn on the inbuilt LED.
TWI	A4 (SDA), A5 (SCL)	Used for TWI communication.
AREF	AREF	To provide reference voltage for input voltage.

Arduino Uno Technical Specifications:

Microcontroller	ATmega328P – 8 bit AVR family microcontroller
Operating Voltage	5V
Recommended Input Voltage	7-12V
Input Voltage Limits	6-20V
Analog Input Pins	6 (A0 – A5)
Digital I/O Pins	14 (Out of which 6 provide PWM output)
DC Current on I/O Pins	40 Ma
DC Current on 3.3V Pin	50 Ma
Flash Memory	32 KB (0.5 KB is used for Boot loader)
SRAM	2 KB
EEPROM	1 KB
Frequency (Clock Speed)	16 MHz

2. Flex Sensors:

The flex sensor or a bend sensor is a sensor that measures the amount of deflection or bending. Usually, the sensor is fixed to the surface. The resistance varies depending upon the bending of surface. Since the resistance is directly proportional to the amount of bend it is often called flexible potentiometer.



Types of flex sensors:

- Conductive ink based flex sensor
- Fibre optic flex sensor
- Capacitive flex sensor
- Velostat flex sensor (popular among hobbyists)

Flex sensors are usually available in two sizes. One is 2.2 inch and another is 4.5 inch. Although the sizes are different the basic functionremains the same.

Flex sensor Pin Configuration:

Flex sensor is a two terminal device. The Flex sensor does not have polarized terminals like diode. So there is no positive and negative.

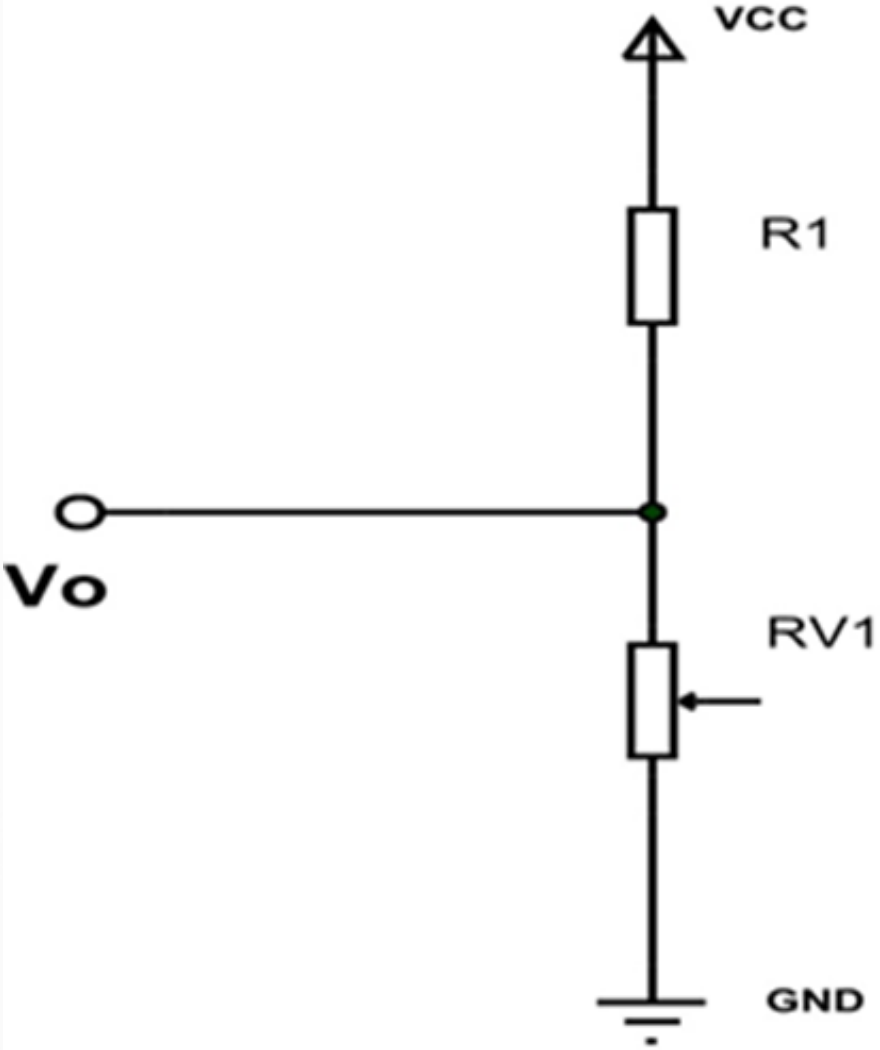
Pin Number	Description
P1	Usually connected to positive side of power source.
P2	Usually connected to the ground.

Flex sensor Features and Specifications

- Operating voltage of FLEX SENSOR: 0-5V.
- Can operate on LOW voltages
- Power rating : 0.5Watt (continuous), 1 Watt (peak)
- Life: 1 million bends
- Operating temperature: -45ºC to +80ºC
- Flat Resistance: 25K Ω
- Resistance Tolerance: ±30%
- Bend Resistance Range: 45K to 125K Ohms(depending on bend)

How to Use Flex sensor?

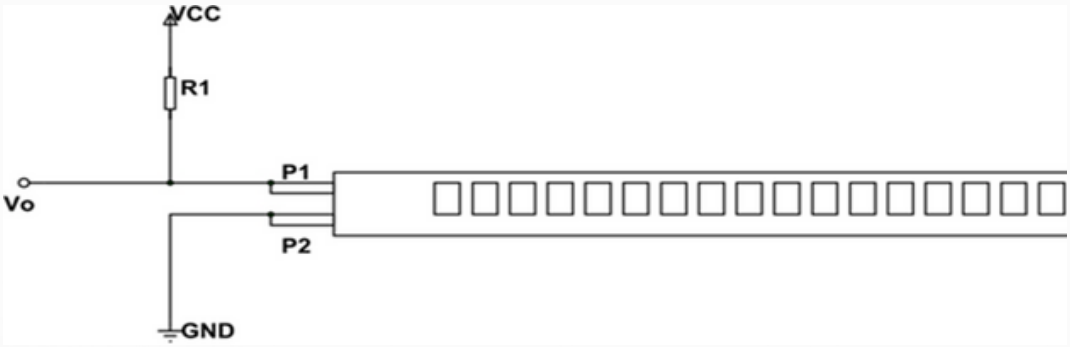
As mentioned earlier, the FLEX SENSOR is basically a VARIABLE RESISTOR whose resistance increases when the sensor is bent. The resistance changes, depending on the linearity of the surface. So it is usually used to sense the changes in linearity.



- The resistance across the terminals rises linearly with bent angle.Therefore, in a sense the FLEX sensor converts flex angle to RESISTANCE parameter.
- For convenience, we convert this RESISTANCE parameter to the VOLTAGE parameter. For that, we are going to use VOLTAGE DIVIDER circuit. A typical VOLTAGE DIVIDER circuit is shown below.

- In this resistive network, we have two resistance. One is constant resistance(R1) and other is variable resistance(RV1). Vo is the voltage at midpoint of VOLTAGE DIVIDER circuit and is also the output voltage. Vo is also the voltage across the variable resistance(RV1). So when the resistance value of RV1 is changed the output voltage Vo also changes. So we will have resistance change in voltage change with VOLTAGE DIVIDER circuit.

- Here, we will replace the variable resistance (RV1) with FLEX SENSOR. The circuit will be as below.



As shown in figure, R1 here is a constant resistance and the FLEX SENSOR, which acts as a variable resistance. Vo being output voltage and also the voltage across the FLEX SENSOR.

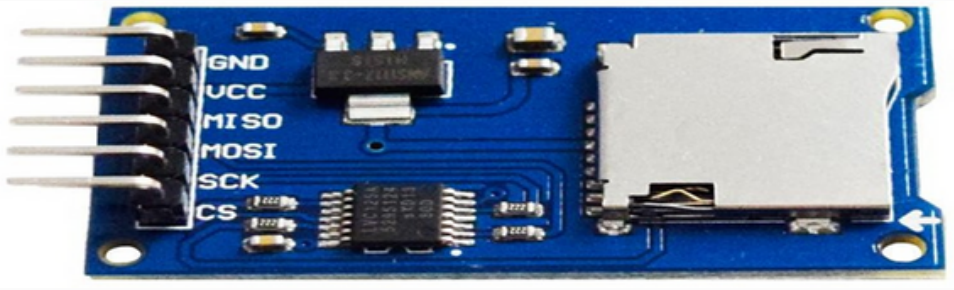
Here,

$Vo = VCC(RRx/1+ Rx)$ **Where, Rx - FLEX SENSOR resistance**

- Now, when the flex sensor is bent, the resistance increases. This increase also appears in VOLTAGE DIVIDER circuit. With that, the drop across the flex sensor increases and so does V0. So with increase in bending of flex sensor, V0 voltage increases linearly. With that, we have VOLTAGE parameter representing the flex.

- We can take this VOLTAGE parameter and feed it to ADC to get the digital value which can be used conveniently.

3. SD CARD MODULE:



- The micro- SD Card Module is a simple solution for transferring data to and from a standard SD card.
- The pin out is directly compatible with Arduino,but can also be used with other microcontrollers. It allows you to add mass storage and data logging to your project.
- This module has SPI interface which is compatible with any sd card and it uses 5V or 3.3V power supply which is compatible with Arduino UNO/Mega.
- SD module has various applications such as data logger,audio, video, graphics.
- This module will greatly expand the capability of an Arduino than it can do with their poor limited memory.

Specifications

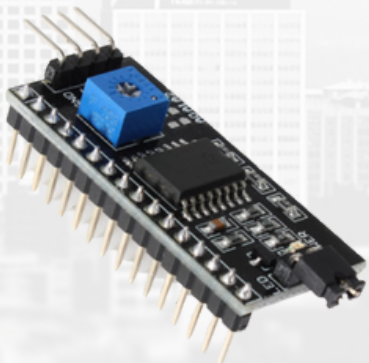
- Working Voltage: 5V/3.3V
- Size:20x28mm
- Interface: SPI
- Compatible: MicroSD

4. 16* 2 LCD display:

- A liquid crystal display (LCD) is mainly used in panel display, electronic visual display or video display.
- Most common LCDs connected to the microcontrollers are 16x2 and 20x2 displays.
- This means 16 characters per line by 2 lines and 20 characters per line by 2 lines, respectively.

5. I2C Module

- I2C stands for Inter-Integrated Circuit. It is a bus interface connection protocol incorporated into devices for serial communication
- In our project, we have used I2C module for LCD Display to decrease the number of wires



Estimate Project Cost

Sr.no	Component Name	Place of Purchased	No. Of Component	Price (Rupees)
1.	Arduino	College	1	380
2.	SD Card Module	Gizmotronics	1	100
3.	LCD Display	Gizmotronics	1	150
4.	Memory Card	Self	1	795
5.	Flex sensor	Gizmotronics + Delta Electronics	4	1992
6.	Speaker	Self	1	1000
7.	Jumper Wire	Gizmotronics	1	90
8.	Aux Cable	New Vishal Interprise	1	150
9.	Gloves	Omkar's Selection	1 Pair	50
10.	Bread Board	College	1	100
11.	Resistor	College	4	10
TOTAL				4817

Limitations and Future Scope:

Limitations:

- The life cycle of bending the flex sensor is less than one million.
- Most important thing is every time we bend the sensor, it decreases the accuracy.
- Usage for long time leads to generation of heat melts the sensor.

Future scope:

- This project can be also used as Sign Language Convertor/Interpreter.
- For gaming purposes like 3D gaming, at the place of joysticks.
- It can be used in military actions based on hand gestures, which can be used for squad communication.
- The hand gesture recognition system can be used in robotics, desktop and tablet PC applications and gaming.
- The gesture controlled device can also be used for home automation.
- It can be made using wireless connection.
- We can include more sensors and more combination to generate more gestures.

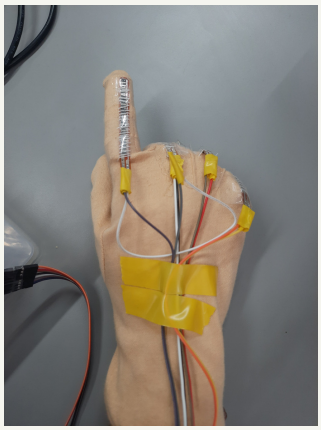
Technical Problems:

- The build quality of the Flex sensor is not good enough to bear the wear and tear due to using.
- As the length of the wire increases, it leads to deflection in the value from the sensor due to added resistance of wires.
- Soldering on flex sensor fixed on the glove doesn't last.
- Configuration of sensors is difficult.
- SD Card module sometimes show error while reading SD Card.
- Arduino supports only .wav file files which are generated based on following parameters bit resolution to "8bit", audio frequency to "16000Hz", audio channels "mono", PCM format "unsigned 8 bit".
- The name of wav file must be a numerical value only eg. "1.wav", "2.wav". It should not contain any alphabets or special characters.
- STM does not support audio library and Liquid Crystal I2C.

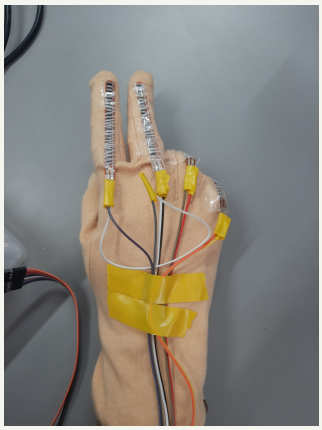
Conclusion:

- Through this project, we are trying to create a system that will make life easier for differently abled people. An attempt to convert sign language to text and audio using finger gestures sensed by the flex sensors of disabled people can be efficiently transmitted to a normal person and vice-versa. The technology transforms the physically disabled person's sign language into text and audio that can be read by everyone and hence decreasing the gap in communication.

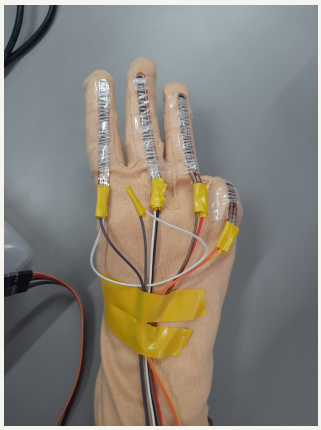
OUTPUTS:



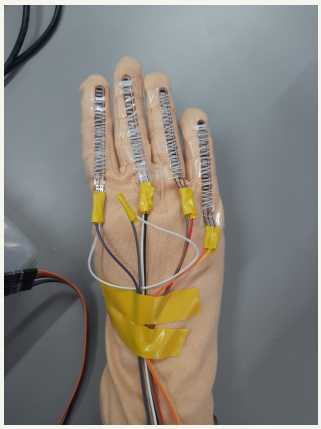
Hello !!



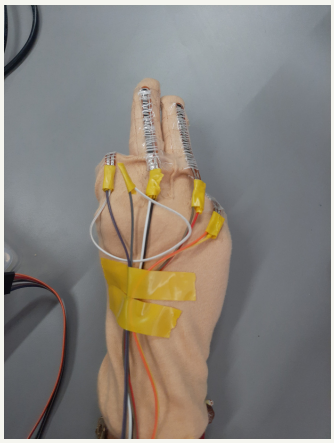
How are You?



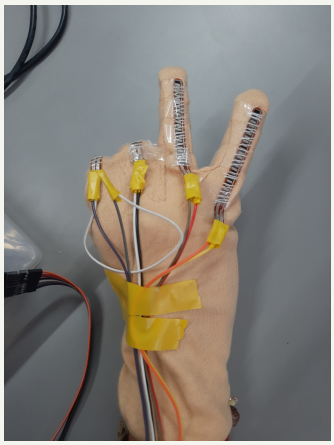
I Need Help



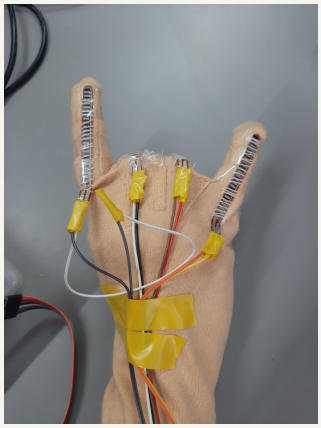
I Need Water



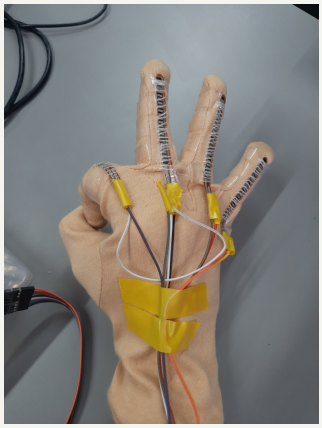
Thank You



Bye !!



Sanket Sir's the Best!!



Vinod Sir Teaches Amazing!!

Arduino Program Code

```
/*
The circuit:
**flex no.1 - pin A0
**flex no.2 - pin A1
**flex no.3 - pin A2
**flex no.4 - pin A3
** Audio Out - pin 9
**SD card attached to SPI bus as follows:
** MOSI - pin 11
** MISO - pin 12
** CLK - pin 13
** CS - pin 4
** Display attached pin follows
** LCD RS pin to digital pin 8
** LCD Enable pin to digital pin 7
** LCD D4 pin to digital pin 6
** LCD D5 pin to digital pin 5
** LCD D6 pin to digital pin 3
** LCD D7 pin to digital pin 2
** LCD R/W pin to ground
** LCD VSS pin to ground
** LCD VCC pin to 5V
** 10K resistor:
** ends to +5V and ground
*/

#include "SD.h" //Lib to read SD card
#include "TMRpcm.h" //Lib to play auido
#include "SPI.h" //SPI lib for SD card
//#include <LiquidCrystal.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);
#define SD_ChipSelectPin 4 //Chip select is pin number 4
TMRpcm music; //Lib object is named "music"

const int flexpin_1 = A0;
const int flexpin_2 = A1;
const int flexpin_3 = A2;
const int flexpin_4 = A3;
//const int rs =8, en =7, d4=6, d5=5, d6=3, d7=2;

//LiquidCrystal lcd(rs, en, d4, d5, d6, d7);
```

```
float f1,f2,f3,f4;
void setup()
{
 //lcd.begin(16, 2);
 lcd.init();
 lcd.backlight();
 music.speakerPin = 9; //Auido out on pin 9
 Serial.begin(9600); //Serial Com for debugging
 if (!SD.begin(SD_ChipSelectPin))
 {
  Serial.println("SD fail");
  lcd.print("SD fail");
  delay(1000);
  lcd.clear();
  return;
 }

 music.setVolume(5); // 0 to 7. Set volume level
 music.quality(1); // Set 1 for 2x oversampling Set 0 for normal
}

void loop()
{
 lcd.setCursor(0, 1);
 Serial.println("READING.....");
 lcd.print("READING.....");
 delay(1000);
 lcd.clear();
 f1=analogRead(flexpin_1);
 f2=analogRead(flexpin_2);
 f3=analogRead(flexpin_3);
 f4=analogRead(flexpin_4);
 Serial.print("f1 - ");
 Serial.println(f1);
 Serial.print("f2 - ");
 Serial.println(f2);
 Serial.print("f3 - ");
 Serial.println(f3);
 Serial.print("f4 - ");
 Serial.println(f4);
```

```
//1
  while (f1 <935 && f2>765 && f3>920 && f4 >995 ) //music play 1
  {
    music.play("1.wav"); delay(5000);
    Serial.println("HELLO !!");
    lcd.print("HELLO !!");
    delay(5000);
    lcd.clear();
    f1=analogRead(flexpin_1);
    f2=analogRead(flexpin_2);
    f3=analogRead(flexpin_3);
    f4=analogRead(flexpin_4);
  }
//2
  while (f1 <935 && f2<765 && f3>920 && f4 >995 ) //music play 2
  {
    music.play("2.wav");delay(5000);
    Serial.println("HOW ARE YOU?");
    lcd.print("HOW ARE YOU?");
    delay(5000);
    lcd.clear();
    f1=analogRead(flexpin_1);
    f2=analogRead(flexpin_2);
    f3=analogRead(flexpin_3);
    f4=analogRead(flexpin_4);
  }
//3
  while (f1 <935 && f2<765 && f3<920 && f4 >995 ) //music play 3
  {
    music.play("3.wav");delay(5000);
    Serial.println("I NEED HELP");
    lcd.print("I NEED HELP");
    delay(5000);
    lcd.clear();
    f1=analogRead(flexpin_1);
    f2=analogRead(flexpin_2);
    f3=analogRead(flexpin_3);
    f4=analogRead(flexpin_4);
  }
```

```
//4
  while (f1 <935 && f2<765 && f3<920 && f4 <995 ) //music play 4
  {
    music.play("4.wav");delay(5000);
    Serial.println("I NEED WATER");
    lcd.print("I NEED WATER");
    delay(5000);
    lcd.clear();
    f1=analogRead(flexpin_1);
    f2=analogRead(flexpin_2);
    f3=analogRead(flexpin_3);
    f4=analogRead(flexpin_4);
  }

  //23
  while (f1 >935 && f2<765 && f3<920 && f4 >995 ) //music play 5
  {
    music.play("5.wav");delay(5000);
    Serial.println("THANK YOU");
    lcd.print("THANK YOU");
    //lcd.setCursor(0, 2);
    //lcd.print("teaches Amazing!");
    delay(5000);
    lcd.clear();
    f1=analogRead(flexpin_1);
    f2=analogRead(flexpin_2);
    f3=analogRead(flexpin_3);
    f4=analogRead(flexpin_4);
  }
//34
  while (f1 >935 && f2>765 && f3<920 && f4 <995 ) //music play 6
  {
    music.play("6.wav");delay(5000);
    Serial.println("BYE !!");
    lcd.print("BYE !!");
    delay(5000);
    lcd.clear();
    f1=analogRead(flexpin_1);
    f2=analogRead(flexpin_2);
    f3=analogRead(flexpin_3);
    f4=analogRead(flexpin_4);
  }
```

```
//234
  while (f1 >935 && f2<765 && f3<920 && f4 <995 ) //music play 7
 {
  music.play("7.wav");delay(5000);
  Serial.println("VINOD SIR TEACHES AMAZING!");
  lcd.print("VINOD SIR");
  lcd.setCursor(0, 1);
  lcd.print("TEACHES AMAZING!");
  delay(5000);
  lcd.clear();
  f1=analogRead(flexpin_1);
  f2=analogRead(flexpin_2);
  f3=analogRead(flexpin_3);
  f4=analogRead(flexpin_4);
 }
//14
  while (f1 <935 && f2>765 && f3>920 && f4 <995 ) //music play 8
 {
  music.play("8.wav");delay(5000);
  Serial.println("SANKET SIR IS THE BEST !!!");
  lcd.print("SANKET SIR IS");
  lcd.setCursor(0, 1);
  lcd.print("THE BEST !!!");
  delay(5000);
  lcd.clear();
  f1=analogRead(flexpin_1);
  f2=analogRead(flexpin_2);
  f3=analogRead(flexpin_3);
  f4=analogRead(flexpin_4);
 }

}
```

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Meet Our Team

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