ELECTRICAL ENGINEERING DEPARTMENT

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SMART GLOVE SIGN LANGUAGE

Project Title	SMART GLOVE SIGN LANGUAGE
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ABSTRACT

Speech is the most basic form of communication in the world. Speech and hearing-impaired people, on the other hand, find it difficult to communicate because they rely on sign language. It becomes difficult for ordinary people to comprehend. Smart Glove for Sign Language Translation is a project that aims to provide a simple method of communication for people who are deaf or hard of hearing. This work consists of a glove equipped with sensors that detect various sign language gestures; the data from these sensors is fed into an Arduino and transferred to an Android phone via Bluetooth; a standard Android phone is used in this work for sign to voice translation and voice to sign language translation. The easiest way for communication in the world is speech.

Whereas it becomes difficult for speech impaired and hearing-impaired people to communicate as they use sign language for the communication. It becomes difficult for normal people to understand. This work also transfer data to android phone via Bluetooth module, a common android phone is used in this work for sign to voice translation and voice to sign language translation. In real life, the sign language users mostly use both hands. Thus, this is a prototype work presenting an ease in communication for the speech.

CHAPTER 1

1.1 INTRODUCTION

According to the statistics of the World Federation of the Deaf and the World Health Organization, approximately 70 million people in the world are deaf–mute. A total of 360 million people is deaf, and 32 million of these individuals are children .Communication is the backbone of society nowadays. Communication allows people to resolve daily issues in respectful manner. It helps people to convey their messages, avoid unnecessary conflicts and ensure that the listener understand their main point within limited time. However, this privilege is not provided by those people who suffer from speech impaired, hearing impaired and mute illness.

Sign language has been the common solution for these people to communicate. Sign language which a way of communicating using body movements especially the hand signals, gestures, facial expression to express in parallel with the speaker's thought. Besides that, an interpreter is also used when communication happens between normal people who speaks but do not understand sign languages. However, it is not a convenient method as the interpreter would not be around the whole time to interpret for these people. Another alternative solution is to use a computer or a smart phone as a mediator.

Despite that, in this advance evolution of technologies, people have become more depending on technologies that could help them overcome their problems in every aspect including people who suffer from communicating disabilities. . The majority of speech- and hearing-impaired people cannot read or write in regular languages. Sign language (SL) is the native language used by the deaf and mute to communicate with others. SL relies primarily on gestures rather than voice to convey meaning, and it combines the use of finger shapes, hand movements, and facial expressions .

This language has the following main defects: a lot of hand movements, a limited vocabulary, and learning difficulties. Furthermore, SL is unfamiliar to those who are not deaf and mute, and disabled people face serious difficulties in communicating with able individuals. This communication barrier adversely affects the lives and social relationships of deaf people.

Therefore, in this paper a smart glove sign language translator with the aid of Arduino which is an integrated circuit is proposed. This smart glove eventually translates the sign language based on the movements shown by the gestures of the user who is using the smart glove into speech and in text output shown in the screen of the smart phone which is connected via Bluetooth. This is to ensure that effective communication occurs around them.

1.2 PROBLEM STATEMENT

Sign language is the common communication tool used by people who suffer from speech impaired, hearing impaired and mute illness. However, very few of normal people who understand sign language as it is not the mother language for them. This eventually creates a communication barrier between disability people and normal people.

Besides that, when one who is originally healthy and normal suddenly suffers from having temporary pain which is due to accidents such as temporary hearing issues or being unable to speak. This makes communication difficult to happen in their daily life as they may have never learned another alternative language to communicate. Therefore, it should be essential to have a prototype or an item that aids the problems

1.3 PROBLEM STATEMENT OBJECTIVES

a) To design a smart glove sign language translator using Arduino to eliminate communication barrier.
b) To develop a smart glove sign language translator using Arduino.
c) To test the developed smart glove sign language translator using Arduino by functional testing.

1.4 SCOPE OF PROJECT

- System that can aid in the translation of sign language into voice and voice to sign language in order to ensure effective and simple communication between various communities.

- This project employs a sensor-based technique rather than an image-processing technique.
- Using a flex sensor and an accelerometer, sign language is converted to an analogue voltage signal. The analogue signal is converted to digital using the ADC on the microcontroller.
- The microcontroller processes this digital signal, detects the corresponding characters, and transmits it to the Android phone via Bluetooth.
- Android application is used to display the characters received from the Bluetooth module as text, and the text is converted to voice using Google-text-to-speech.
- In addition, using a speech recognizer, voice is converted to text and then into sign language.

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CHAPTER 2

2.1 LITERATURE REVIEW

Sign language is the only communication tool used by speech impaired and hearing-impaired people to communicate to each other. However, normal people do not understand sign language, and this will create a large communication barrier between speech impaired, hearing impaired and normal people. In addition, the sign language is also not easy to learn due to its natural differences in sentence structure and grammar. Therefore, there is a need to develop a system which can help in translating the sign language into voice and voice to sign language in order to ensure effective and easy communication between different communities.

Many methods for hand gesture recognition using image processing have been proposed. “Hand Gesture Recognition System using Image Processing” uses digital image processing techniques using modified SIFT algorithm. With the help of the algorithm the sign language is decoded successfully. The advantage using this algorithm is high processing speed which can produce result in real time. Although the proposed system is fast requiring expensive materials also [3].

“Sign Language to Speech Translation System Using PIC Microcontroller” consists of flex sensors that is used to detect finger gestures and gyro sensors for providing a signal corresponding to the orientation of the motion of the hand [4].

Design of Smart Gloves” uses pair of gloves with flex sensors along each finger, thumb and arm is used to capture the movement of user. The problem with this work is it can detect only few letters [5]

“A Review Paper on Smart Glove - Converts Gestures into Speech and Text” uses five flex sensors and accelerometer attached on the back of the glove to measure the bending and motion of the hand. The problem with this work is to recognize some letters. Besides that, letters M, N, O, R, S, T, V and X cannot be displayed due similar in gesture with another letters [6]

Mina I et al. proposed a technique using Flex sensor, Gyroscopes and Accelerometer to obtain the hand gestures. Using Arduino and Bluetooth the signals were transmitted from transmitter and receiver section [7]

The flex sensor measures the bending of fingers according to gesture and outputs change in resistances corresponding to the amount of bending. The flex sensor is analogue device where patented technology is based on resistive carbon thick elements. As a variable printed resistor, they are analog sensors, the Flex Sensor achieves great form-factor on a thin flexible substrate. When the substrate is bent, the sensor produces a resistance output correlated to the bend radius where the relation between the bend radius and resistance is inverse. Flex sensors are normally attached to the glove using needle and thread. They require a 5-volt input and output between 0 and 5 V, the resistivity varying with the sensor's degree of bend and the voltage output changing accordingly. The sensors connect to the device via three pin connectors (ground, live, and output). The device can activate the sensors from sleep mode, enabling them to power down when not in use and greatly decreasing power consumption. The flex sensor as shown in the below changes resistance when bent, the resistance increases to 30- 40 kilo ohms at 90 degrees. [8].All the data from sensors are then processed on Arduino UNO involves combination of all the sensor outputs in order to match the resultant output with pre-stored values of different signs regarding the alphabets. For this, appropriate ranges are set for each alphabet and the words that can be recognized with single hand based on the measured data obtained from repeated measurements. A Bluetooth module is connected to Arduino UNO. The Processed data are then transferred to the Bluetooth module (transmitter) obtained in string format. The Android mobile also have an inbuilt Bluetooth capability. These two Bluetooth devices are then paired, and string is transmitted to Android mobile. Android mobile receives data via Bluetooth in bytes format, convert them into string. Finally, the string is converted into voice using the text to speech application of Android mobile. This overall system is mounted over a normal glove for easy handling and recognizes the hand gestures accurately

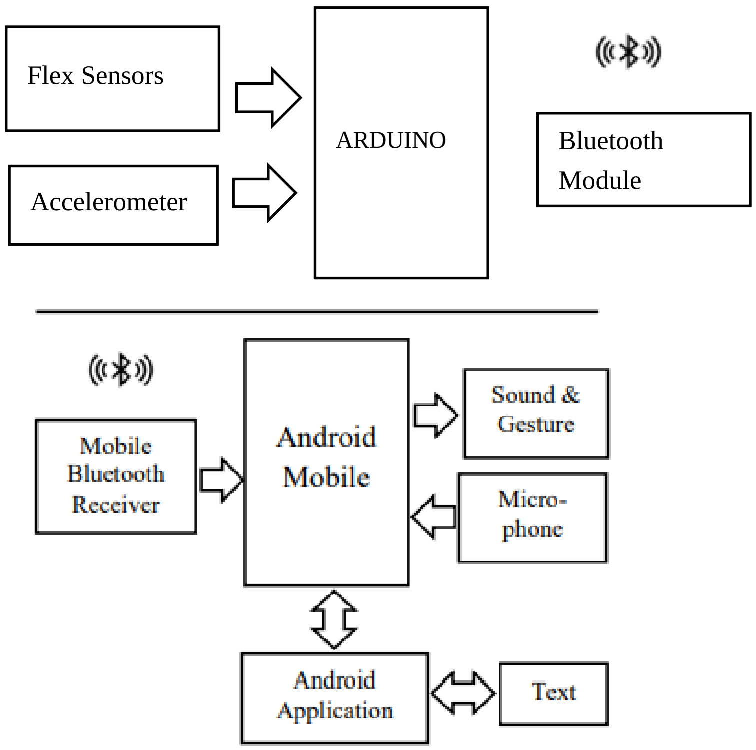
Digital Text and Speech Synthesizer Using Smart Glove for Deaf and Dumb" uses five flex sensor to detect gesture and accelerometer used for sensing axis x, y and z, find the angle of the glove tilted with respect to the. The glove is capable of translating their sign language gestures into speech through android phone. This smart glove focuses the translation of gestures of words only [9]. , "Smart Glove: Gesture Vocalizer for Deaf and Dumb People" uses glove at the transmitter side which has to be worn by the user. This glove is mounted with 4 flex sensors each on the 4 fingers of the glove namely thumb, index, middle and ring. This work also focuses the translation of gestures of words only [10].

CHAPTER 3

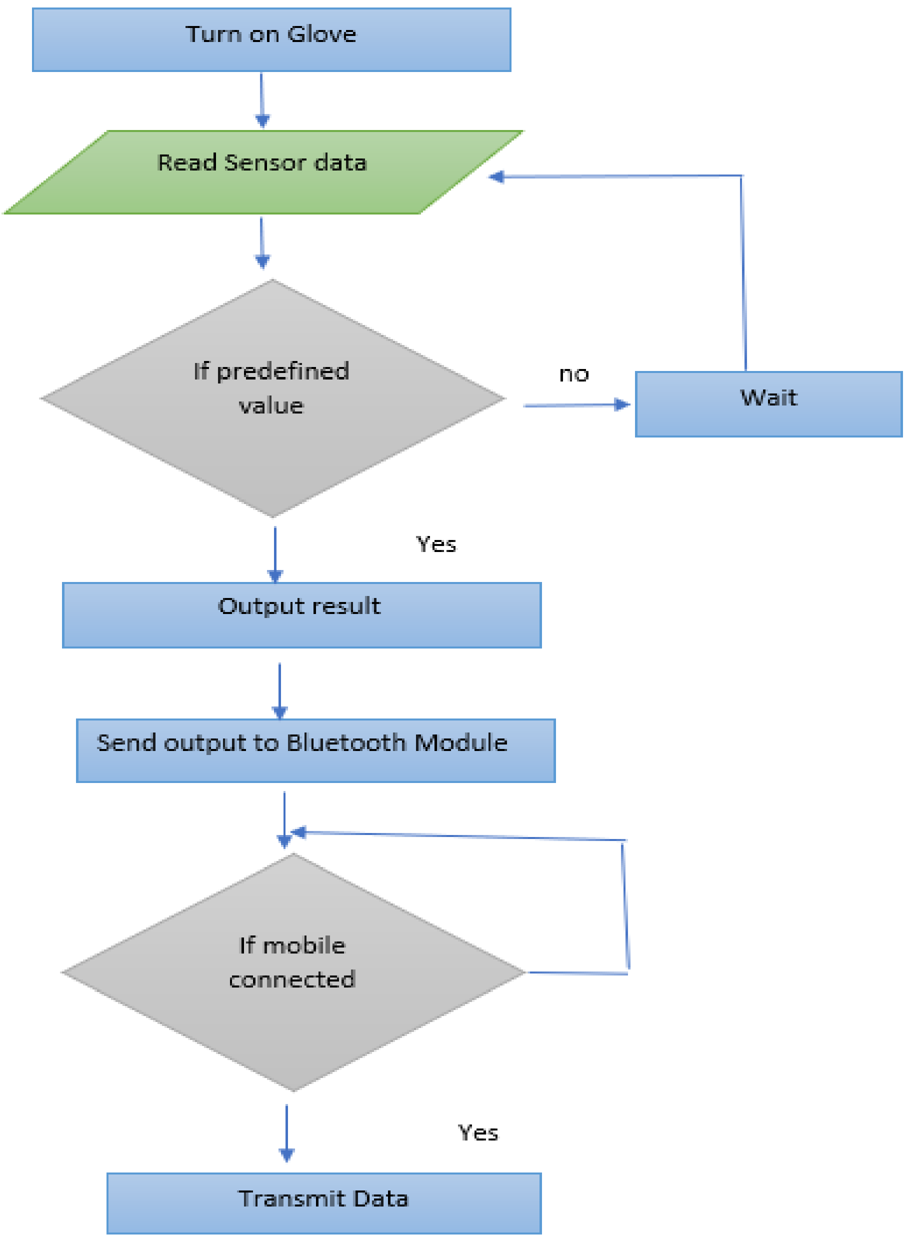
3.1 METHODOLOGY

This work uses sensor-based technique instead of image processing-based technique. First of all, sign language is converted to analog voltage signal using flex sensor and accelerometer. Using ADC from the microcontroller board analog signal is converted to digital signal. Now, the microcontroller processes this digital signal, detects respective characters and transmits through Bluetooth module to Android phone. An application on android is used to display the characters received from Bluetooth module in the form of text and text is transformed to voice using Google-text-to-speech. Also, voice is transformed to display text and convert it into sign language using speech recognizer.

3.2 BLOCK DIAGRAM



3.3 FLOWCHART



3.4 ARDUINO UNO

The Arduino Uno is the primary component of the project since it reads and understands the data from the hand gesture. It is an open-source microcontroller board based on the Microchip ATmega328P microprocessor. The board has sets of digital and analog input/output (I/O) pins that can connect to other expansion boards (shields) and other circuits. The board features 6 analog I/O pins, 14 digital I/O pins (six of which can produce PWM), and 14 digital I/O pins. It can be programmed using the Arduino IDE (Integrated Development Environment) with a type B USB connector. It supports voltages between 7 and 20 volts, but it can also be powered by a 9-volt external battery or via a USB cable. It is comparable to the Arduino Nano and Leonardo.

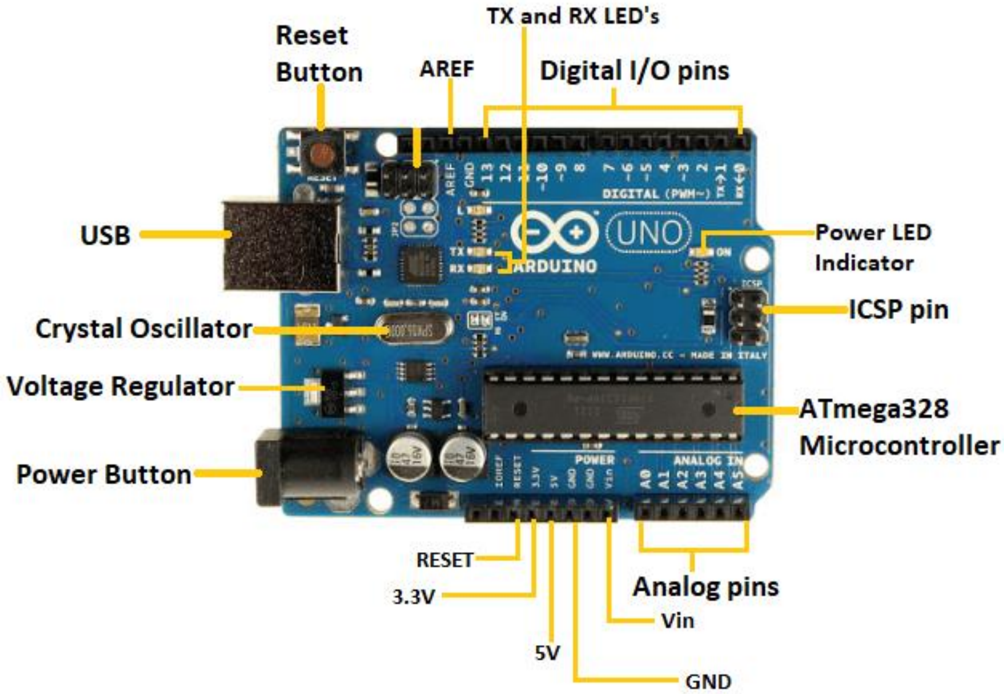
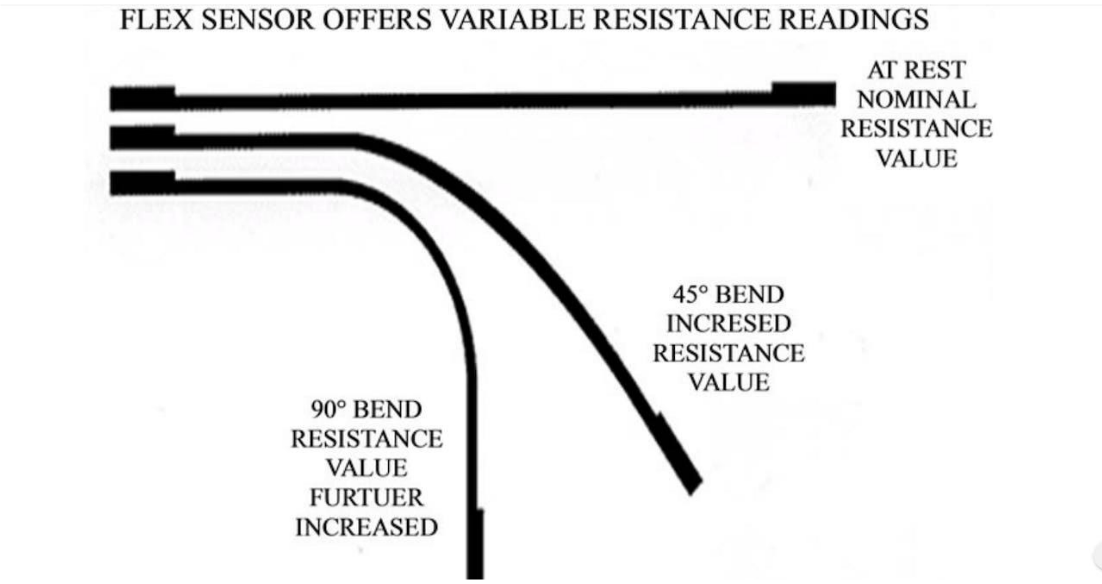


Figure of Arduino UNO with label function.

3.5 FLEX SENSORS

A flex sensor or bend sensor is a sensor that measures the amount of deflection or bending. Usually, the sensor is stuck to the surface, and resistance of sensor element is varied by bending the surface. Since the resistance is directly proportional to the amount of bend it is used as goniometer, and often called flexible potentiometer.



Bending of the fingers can be defined by measuring resistance of each potentiometer when the rotation is transmitted from the fingers to the potentiometer grip. The potentiometer's resistance can be measured using the voltage divider scheme. The voltage divider is used in electrical circuits if you want to reduce voltage and get some of its fixed values. It consists of two or more resistors.

3.6 BLUETOOTH MODULE (HC-05)

One excellent example of wireless connection is Bluetooth. It has several applications. Bluetooth uses a negligibly little amount of power. In most Smartphone-controlled , one of these two wireless technologies is utilized. One is Bluetooth, and the other is WiFi. Here, we'll connect an Arduino Uno to a Bluetooth Module (HC-05).

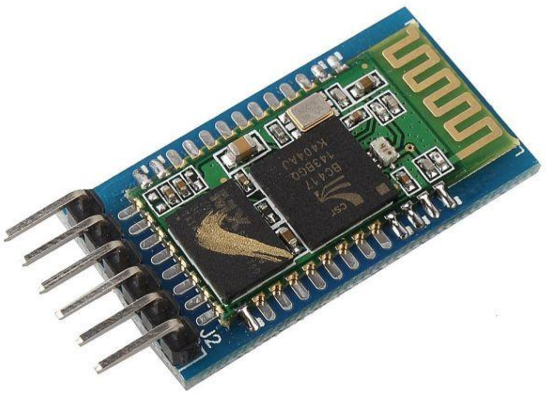
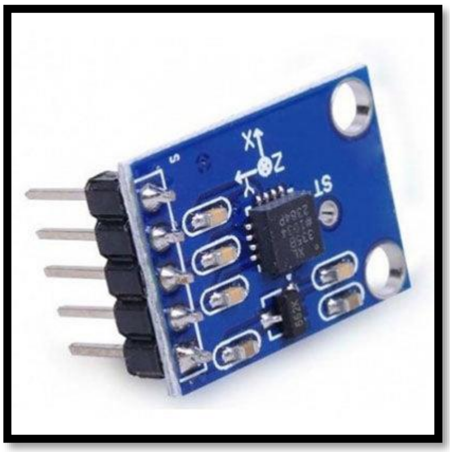


FIGURE OF BLUETOOTH MODULE (HC-05)

3.7 Accelerometer (ADXL 335)

Accelerometer (ADXL 335) in the sign talk system is used as a tilt detector. It has an analog output which varies from 1.5 volt to 3.5 volt. ADXL335 is a three-axis analog accelerometer Integrated Circuit (IC), which reads off the X, Y and Z acceleration as analog voltages. By measuring the amount of acceleration due to gravity, an accelerometer can figure out the angle it is tilted at with respect to the earth. [8] [14].Figure (7) show ADXL335.



Accelerometer (ADXL 335)

3.8 Resistor (10k ohm)

A resistor is an electrical component that limits or regulates the flow of electrical current in an electronic circuit. Resistors can also be used to provide a specific voltage for an active device such as a transistor.

CHAPTER 4

4.0 Operation principal of the system

In this study, the flex sensor takes on the important role of the glove fitted with flex sensors along the length of each forefinger and thumb. The flex sensors provide yield in the form of voltage variation that varies with the amount of twist; this flex sensor yield is provided to the accelerometer.

To advanced sign. Transformation further the prepared information is sent remotely to the collector area. In this segment, the motion is perceived, and the comparing yield is shown on the screen of the phone and at the same time, a discourse yield is played and upheld through the speaker of the phone.

The data glove is equipped with five flex sensors. They are placed on the thumb and index finger of the hand glove. Flex sensors are sensors that change resistance depending on the amount of bend on the sensor. They are analog sensors. They can be made unidirectional or bidirectional. Even a little bend of the finger can be detected. Now the bending of each finger is quantized into 10 levels. At any stage, the finger must be at one of these levels, and it can easily determine how much the finger is bent. The binary data from the flex sensor is then sent to ATMEGA328. The next step is to combine the movement of each finger and name it a particular gesture of the hand.

The accelerometer (ADXL 335) in the gesture vocalizer system is used as a tilt detector. It has an analog output that varies from 1.5 volts to 3.5 volts. ADXL335 is a three-axis analog accelerometer Integrated circuit (IC), which reads X, Y, and Z-axis acceleration as analog voltages. By measuring the amount of acceleration due to gravity, an accelerometer can figure out the angle. It is tilted with respect to the earth. By sensing the amount of dynamic acceleration, the accelerometer can find out how fast and in what direction the device is moving. The basic function of this device is to detect the tilting of the hand and send some binary data according to meaningful gestures, to the accelerometer, which receives the data and saves it.

The Arduino IDE is an open-source software used to provide instructions to micro controller. It provides an environment where you can write code and upload it to your micro controller. It is available for Windows, Linux and MAC operating system-based computers smart_gloves_n | Arduino 1.8.20 Hourly Build 2022/04/25 09:33

File Edit Sketch Tools Help

smart_gloves_n

```
#include <Wire.h>  // Comes with Arduino IDE
#include <SoftwareSerial.h>

#define ledx 13
#define Vib1 10
#define Vib2 11

//-------------------------------------------------------------------

SoftwareSerial ss(2, 3); //(RX,TX)

float Resistance;
int  MODE=0;
float Sens1=0;
float Sens2=0;
float Sens3=0;
float Sens4=0;
float Sens5=0;
float Flex=0;
String Temp1x="";
String PHx="";
String Temp2x="";
String Temp1y="";
String PHy="";
String Temp2y="";
String Temp3y="";
String Temp3x="";
String Temp4y="";
String Temp4x="";
int FlexX=0;
int Wifix=0;
int Maxx=45;
```

```
if (FSR3>=50){
  FSR3x=100-(100-FSR3)/50*100;
}
if (FSR3<50){
  FSR3x=0;
}


if (FSR4>=50){
  FSR4x=100-(100-FSR4)/50*100;
}
if (FSR4<50){
  FSR4x=0;
}


/*
if (FSR5>=50){
  FSR5x=(100-(100-FSR5)/50*100);
}
*/
if (FSR5<10){
  FSR5x=0;
}

if (Sens1>380 && Sens2<380 && Sens3 < 380 && Sens4<380 && Sens5<380){
  Serial.print("A");
  delay(5000);
}
if (Sens1>380 && Sens2>380 && Sens3 < 380 && Sens4<380 && Sens5<380){
  Serial.print("B");
  delay(5000);
}
if (Sens1>380 && Sens2<380 && Sens3 < 380 && Sens4<380 && Sens5>380){
  Serial.print("C");
```

```
int Wifix=0;
int Maxx=45;
float FSR1,FSR2,FSR3,FSR4,FSR5;
float FSR1x,FSR2x,FSR3x,FSR4x,FSR5x;

int Maxy=45;
int TMER=0;
int DataIn=0;
int Counter=0;
```

```
  Sens3 = (5.0 * Sens3 * 100.0)/1024.0;  //convert the analog data to DC AC VOLTAGE
  FSR3=100-(Sens3/500*100);

   Sens4= analogRead(A3);            //read the value from the sensor
  Sens4 = (5.0 * Sens4 * 100.0)/1024.0;  //convert the analog data to DC AC VOLTAGE
  FSR4=100-(Sens4/500*100);

   Sens5= analogRead(A5);            //read the value from the sensor
  Sens5 = (5.0 * Sens5 * 100.0)/1024.0;  //convert the analog data to DC AC VOLTAGE
  FSR5=(100-(Sens5/327*100)) + 60;
//FSR5=Sens5;

if (FSR1>=50){
  FSR1x=100-(100-FSR1)/50*100;
}
if (FSR1<50){
  FSR1x=0;
}


if (FSR1>=50){
  FSR1x=100-(100-FSR1)/50*100;
}
if (FSR1<50){
  FSR1x=0;
}


if (FSR2>=20){
  FSR2x=100-(100-FSR2)/80*100;
}
if (FSR2<20){
  FSR2x=0;
}
```

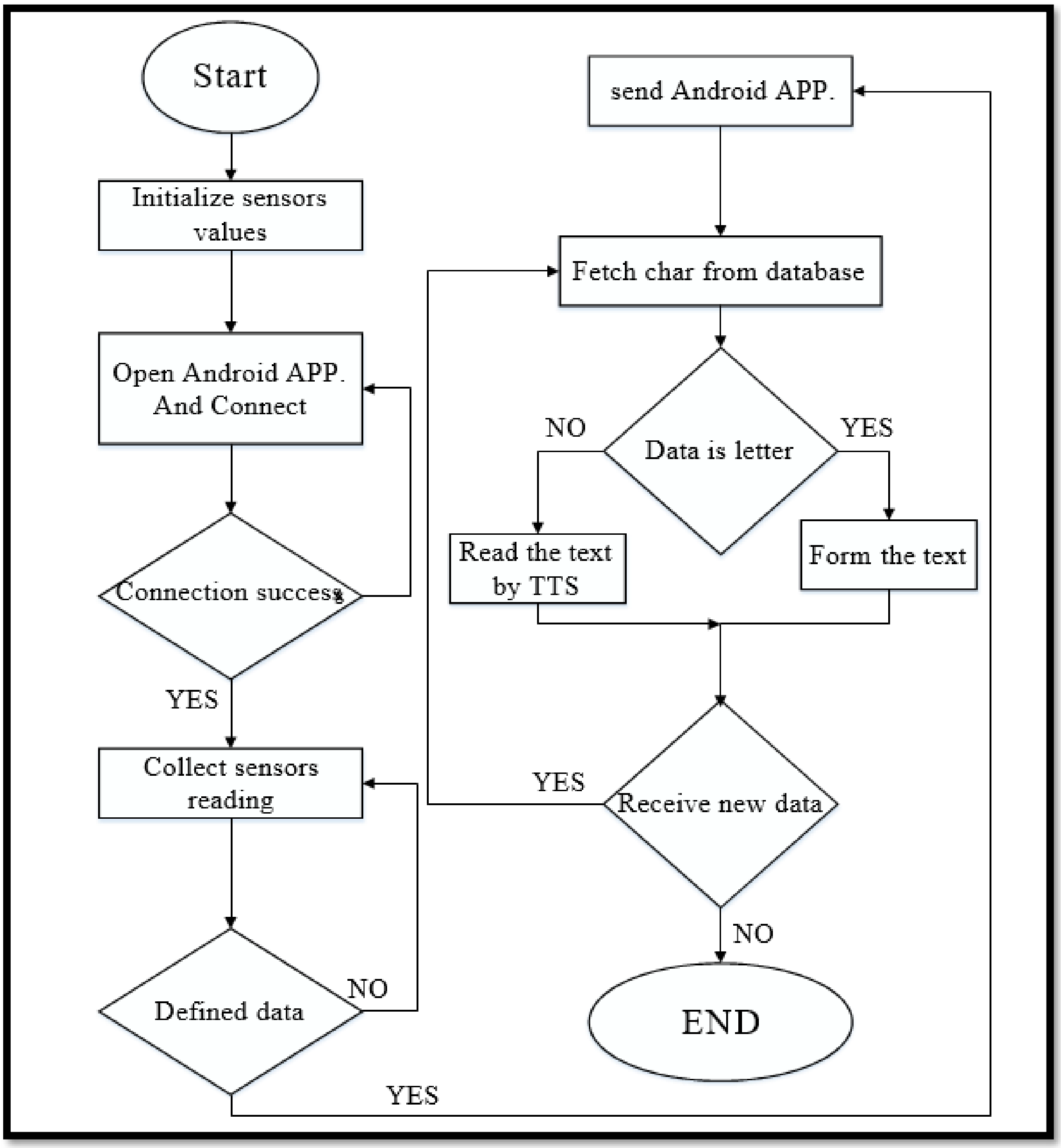
```
Serial.print("\t");
Serial.print(Sens3);
Serial.print("\t");
Serial.print(Sens4);
Serial.print("\t");
Serial.println(Sens5);
*/


   TMER=0;
}



delay(100);


}

void serialEvent() {
  while (Serial.available()) {
    // get the new byte:
    char inChar = (char)Serial.read();


        if (inChar == '1') {
     MODE=1;

    }
    if (inChar == '0') {
     MODE=0;

    }
  }
}
```

4.1 System Implementation

The overall operation of the system is divided into software and hardware part. The hardware part included in the portable wearable glove consists of five flex sensors, an adxl345 3-axis accelerometer, a Bluetooth module, and a smartphone whereas the software part comprises the Arduino programming software written in C language and an android application developed using Java language. The system operation is explained in the flowchart in Figure. To begin this process, a hand gesture is detected by flex sensors bending and accelerometer readings and mapped into binary numbers.

The accelemeter will check if the gesture is valid or not by comparing it with a pre-stored list of valid gestures. Only correct data will be sent to the smartphone for energy saving. The user must release his/her hand to a normal state for beginning another gesture to avoid accidental gestures, as soon as data is received by the Android application the corresponding letter is fetched from the database. The database will store multi-sign language data and the correct letter will be chosen according to the language set by the user.

The aforementioned text, letters, and additional words have been displayed on the phone screen. After the word is complete, the user can send another command by a hand gesture to make the application read the text using text-to-speech. In addition to the letters stored in the database, the user can save the most used words in his daily life. These are saved in the specified category in the application for complete words, as well as he/she can edit the pre-store letters for any gesture he wants.

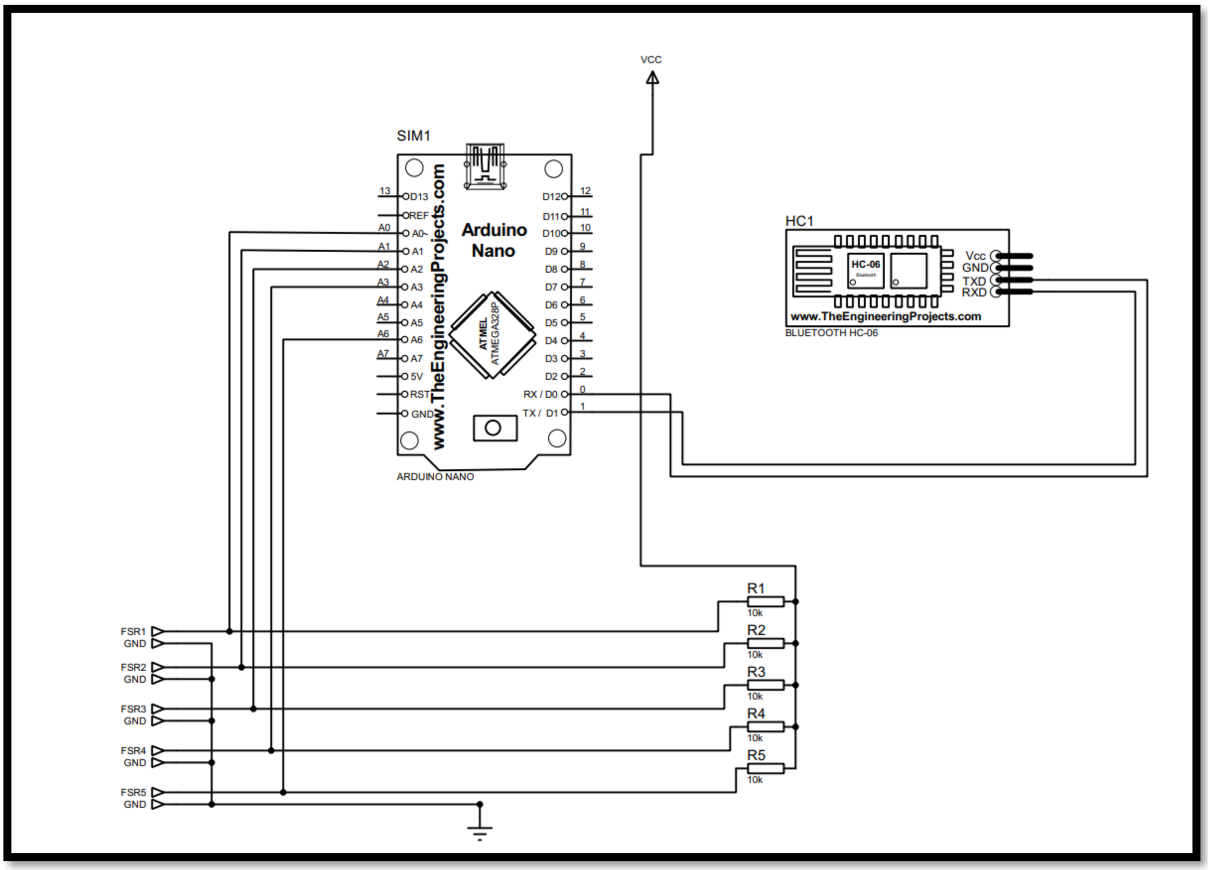

Start
Initialize sensors values
Open Android APP. And Connect
Connection success
YES
Collect sensors reading
Defined data
NO
YES
send Android APP.
Fetch char from database
Data is letter
NO
YES
Read the text by TTS
Form the text
Receive new data
YES
NO
END

CHAPTER 5

5.1 RESULT AND ANALYSIS

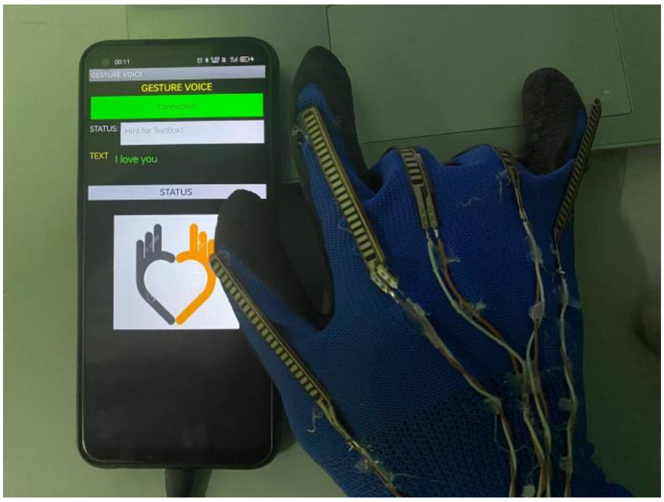
This chapter includes statistics and analysis gained from the testing of smart glove sign language for deaf products. This is to ensure that all research objectives and scope are addressed. To assure the project's success, every piece of data had been evaluated.

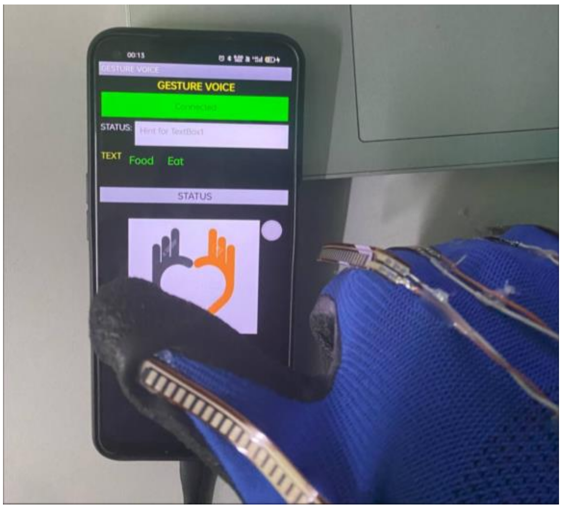
5.2 Schematic Diagram

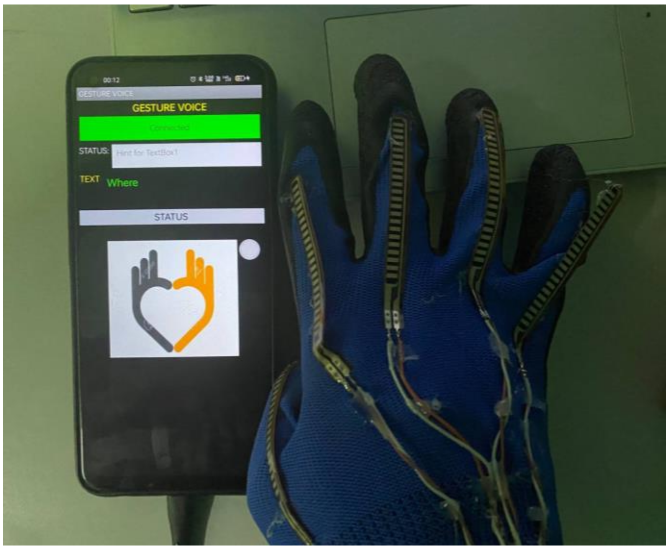


5.3 Product and Result

Smart Glove Sign Language

RESULT	
	TEXT
	I LOVE YOU

RESULT	
	TEXT
	FOOD

<table>
<tr><th colspan="2">RESULT</th></tr>
<tr><td rowspan="2">
</td><td>TEXT</td></tr>
<tr><td>WHERE</td></tr>
</table>

5.4 Discussion

As stated before, few attempts have been made to generate Smart Gloves as tools for hearing problems and speech dis-abilities. The flex sensor assumes a significant job, the glove is fitted with flex sensors, along the length of each forefinger and the thumb. The flex sensors give yield as voltage variety that changes with the level of a twist, this flex sensor yield is given to the ADC channels of the microcontroller. It forms the sign and performs simple to advanced signs. Transformation further, the prepared information is sent remotely to the collector area. In this segment, the motion is perceived, and the comparing yield is shown on the phone screen at the same time a discourse yield.

5.5 Chapter Summery

All circuits are function properly after the maintenance and repair process. As a safety precaution, always ensure the components and connections are correct during the installation process.

CHAPTER 6

6.1 CONCLUSION

Developing an automatic machine-based sign language translation system that transforms sign language into speech and text or vice versa is particularly helpful in improving intercommunication. Progress in pattern recognition offers the promise of automatic translation systems, but many difficult problems need to be solved before they become a reality.

. An in-depth analysis of the literature assists in addressing and describing the challenges, benefits, and recommendations related to using glove-based systems. The results reveal the available glove types, the sensors used for capturing data, the techniques that were adopted for recognition purposes, the identification of the dataset in each article, and the specification of the processing unit and output devices of the recognition systems.

The major advantage of a sensory-based approach is that gloves can acquire data directly (degree of bend, wrist orientation, hand motion, etc.) in terms of voltage values of the computing device, thus eliminating the need to process raw data into meaningful values.

However, glove-based gesture recognition requires that the user wear a cumbersome data glove to capture hand and finger movements. This hinders the convenience and naturalness of human–computer interaction. The limitation faced by this approach is the inability to obtain meaningful data complementary to

Furthermore, sign languages have certain rules and certain grammar for their sentence formation. These rules must be taken into account when translating sign language into spoken language. Additionally, it would be useful to develop a translation system capable of interpreting different sign languages. Finally, reliable segmentation methods should be developed to assist in continuous gesture recognition.

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