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'V.A.A.K -Voice Augmented Assistive Kit'

PROJECT REPORT

Submitted for CAL in B.Tech TARP (ECM3999)

By

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(SCHOOL OF ELECTRONICS ENGINEERING)

Electronics and Computer Engineering

March 2019

CERTIFICATE

This is to certify that the Project work entitled " ***VAAK – Voice Augmented Assistive Kit*** " that is being submitted by " ***ADITYA KSHETTRI, ARPAN SATPATHI, DHAROORI RAKESH ACHARYA, NAMAN ARORA, RISHAB AGARWAL, SOHAM SEN GUPTA*** " for CAL In B.Tech TARP (ECM3999) is a record of bonafide work done under my supervision. The contents of this Project work, in full or in parts, are not submitted for any other CAL course.

Place : Chennai

Date : 28 March 2019

Signature of Students:

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We thank our parents, family, and friends for bearing with us throughout the course of our project and for the opportunity they provided us in undergoing this course in such a prestigious institution.

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ABSTRACT :

In our project, we have designed an assistive technology to empower the people with disabilities. Mainly, we have focused on the people who are deaf or dumb. Basically, we have developed a product which will help the disabled people to communicate easily with the rest of us, just by using their hand gestures. Our product has flex sensors placed on the gloves which will be worn by the disabled people. With each of their hand gesture, a particular alphabet or word will be generated and sent to our App which will convert text to speech as well as display the text on screen. As a matter of fact, our product will be beneficial for all, for instance, we will be able to hear and understand what a mute person is trying to convey to us, without even having the knowledge of sign language. In the same way, a deaf person can see the text on the App screen and understand what a mute person wants to say to him. This will enhance their communication as well as increase the literacy rate too. Hence they will be treated as equal in the society

TABLE OF CONTENTS

1. INTRODUCTION

1.1 OBJECTIVES & GOALS :

- To understand the problems faced by deaf and dumb people in their day to day life.
- To understand what kind of product they need to cope up with their problems.
- To understand what exactly they need from the product so that it solves their problems.
- Finally, to come up with a cost efficient solution for their problems.

1.2 MOTIVATION FOR CHOSEN PROJECT :

- We wanted to do some project in the field of humanitarian technology.
- After few brainstorming sessions, we came down to solving problems for the physically challenged people.
- We came up with a thought that communication is a big problem for the mute and deaf people in one of brainstorming sessions, so we wanted to develop a project that would make their communication easy.

1.3 BENEFITS :

- This will help mute and deaf people for communication such that they will no longer be treated as disabled anymore and will get the same education as other children and this will increase literacy in India.

2. FIELD VISIT & SURVEY :

2.1 QUESTIONNAIRE :

- Briefly describe your disability?
- Is it by birth or something else?
- How long have you been going through this disability?
- What are the problems that you have faced because of it?
- How does the society respond to your disability?
- Do you need special arrangement for travel needs...? If yes... How is it arranged?
- Do you think technology can help you cope up with your problems?
- What sort of product do you imagine would be able to solve/ease your problem?
- How do you think technology will solve your issues in the future?
- Do you envisage any activity which you cannot perform?
- Do you think you have adequate facilities of special education for people having disability same as yours?
- What privileges do you expect from the government for the people suffering with this disability?
- How do you communicate to other people?
- Do you use a smartphone?
- How much family support do you get?
- How much can you afford?
- Do you feel it as your disability or have you adapted using your other senses?
- What do you want to become in life? What are your plans for future?
- Do you know Indian or American sign language?
- Do u think our project can solve your problems?

Students **:** (extra questions)

- Do you need special arrangements while attending lectures?
    - If yes... then what all?
- Do you need special equipment's in your studies...?

Teachers **:** (extra questions)

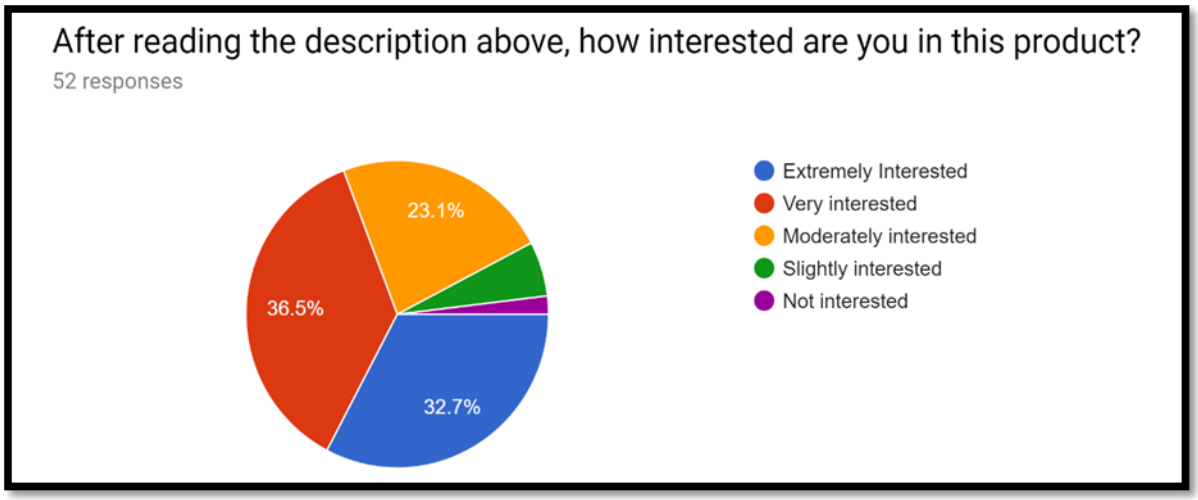
- How do you teach people with these disabilities?
- What are the problems you face while teaching them?
- Do they understand your way of teaching properly?
- How do you get your feedback in class?
- What devices you use to teach them?
- What special attention do you take for people with these disabilities compared to others?
- How often do you go out with children for excursion?
- What issues do you face?
- Who do you think these issues can be solved more efficiently with and without technology?

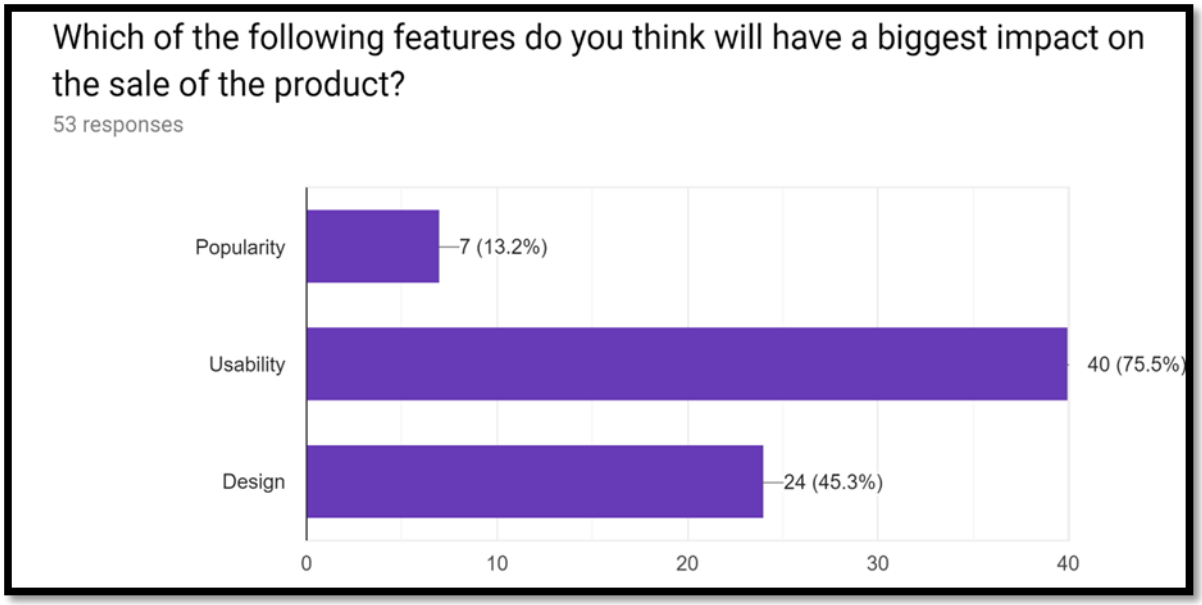
2.2 FIELD VISIT :

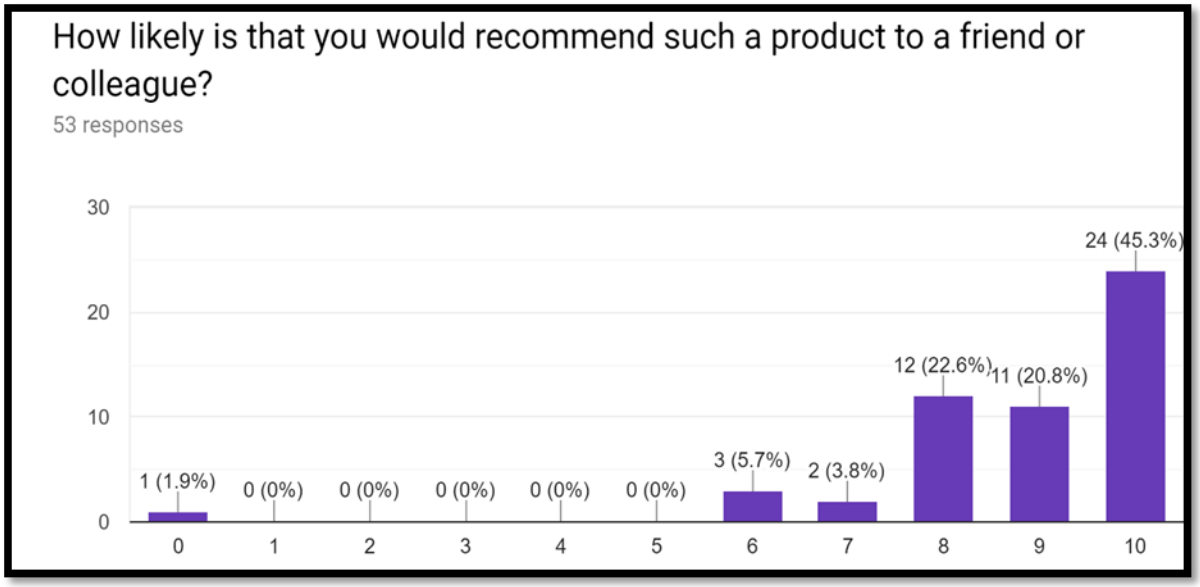
We visited few schools for deaf and dumb people for our survey to know about their problems in daily life communication with people. We mainly focused on framing questions related to the help which the mute people want from the society and government for themselves, what they expect from us and what kind of tech support they want from us and how do they expect our tech to ease their daily life problems.

1) Chettinad Srihari Vikasam, Chennai
2) CSI School for the Deaf, Chennai

2.3 SURVEY :

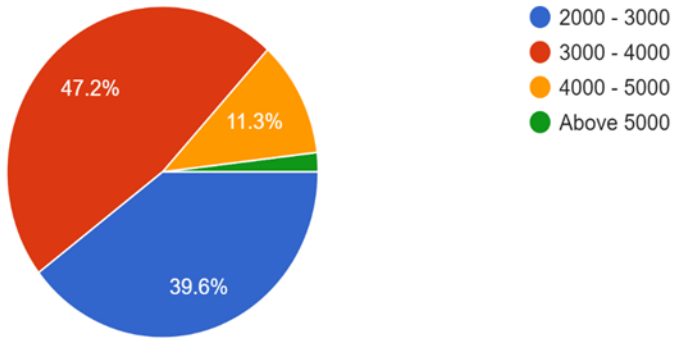

After reading the description above, how interested are you in this product?
52 responses
23.1%
36.5%
32.7%
Extremely Interested
Very interested
Moderately interested
Slightly interested
Not interested


Which of the following features do you think will have a biggest impact on the sale of the product?
53 responses
Popularity
7 (13.2%)
Usability
40 (75.5%)
Design
24 (45.3%)
0
10
20
30
40


How likely is that you would recommend such a product to a friend or colleague?
53 responses
30
20
10
0
1 (1.9%)
0 (0%)
0 (0%)
0 (0%)
0 (0%)
0 (0%)
3 (5.7%)
2 (3.8%)
12 (22.6%)
11 (20.8%)
24 (45.3%)
0
1
2
3
4
5
6
7
8
9
10

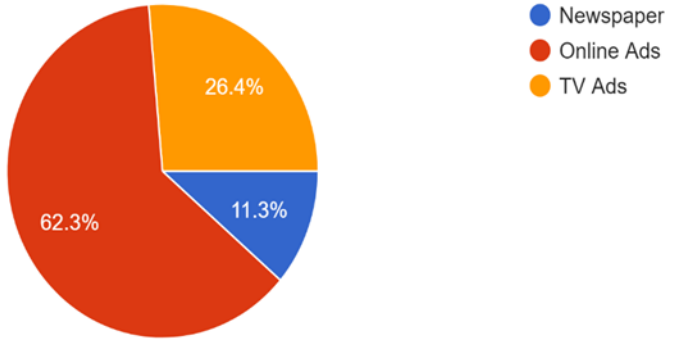
About how much would you be willing to pay for such a product?(The amount is in rupees)

53 responses



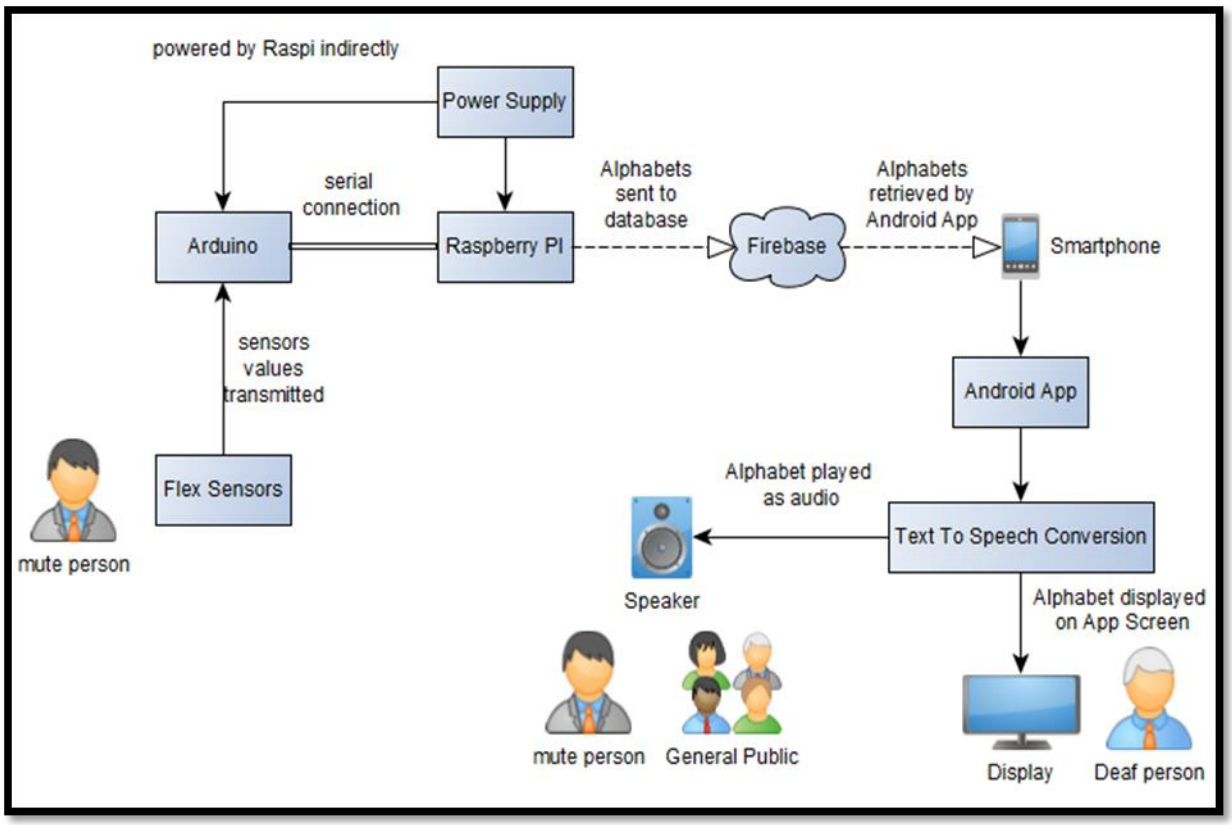
Which of these do you think is the best way to advertise such a product to our target audience?

53 responses



3. CIRCUIT DESIGN

3.1 BLOCK DIAGRAM :



3.2 HARDWARE COMPONENTS :

- Flex Sensors
- Arduino Uno R3 ATmega328P
- Raspberry Pi 3B+
- Resistors : 3.9k ohms
- Connecting Wires
- USB Cables
- Smartphone

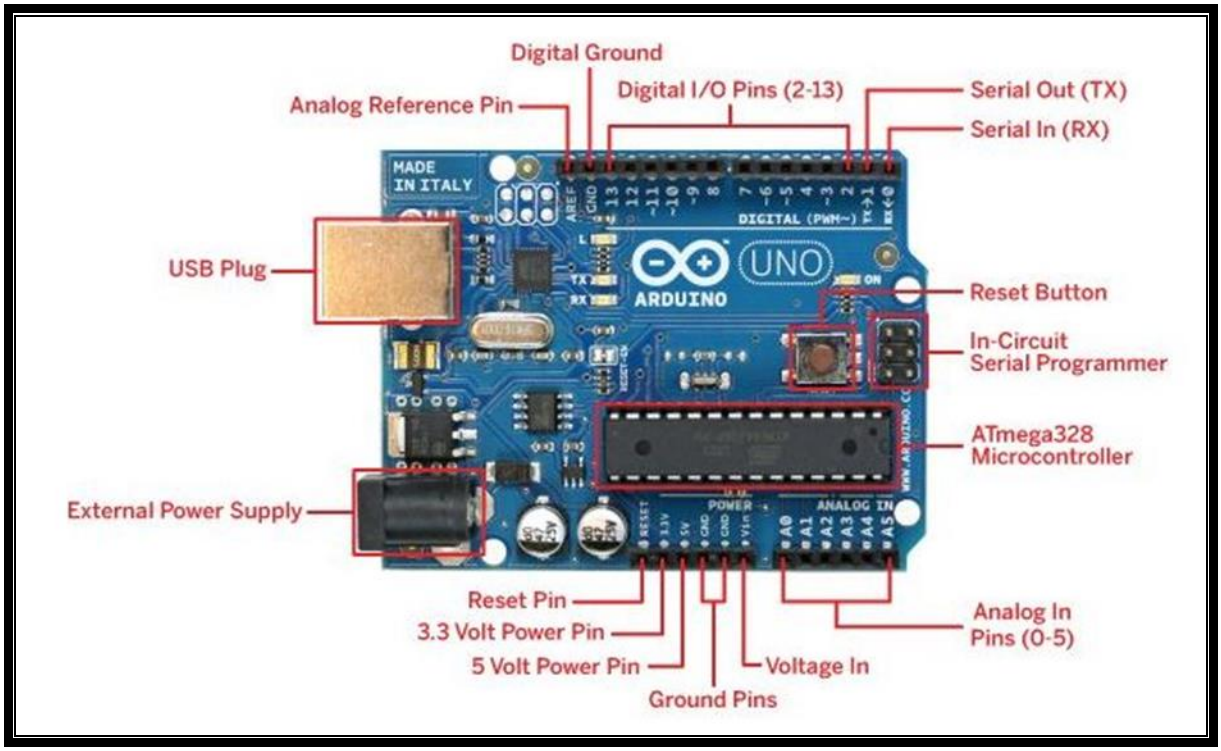
3.3 SOFTWARES REQUIRED :

- Arduino IDE 1.8.9 (for burning the code into the Arduino)
  Language used – Embedded C/C++
- Python 2.7 (to upload the alphabets received by the Raspi to the Firebase)
- Android Studio 3.1.4 (for making an app for text to speech conversion)
  Language used – JAVA and XML

4. CIRCUIT DIAGRAM

4.1 PIN CONFIGURATION :

4.1.1 ARDUINO UNO R3 ATMEGA328P :

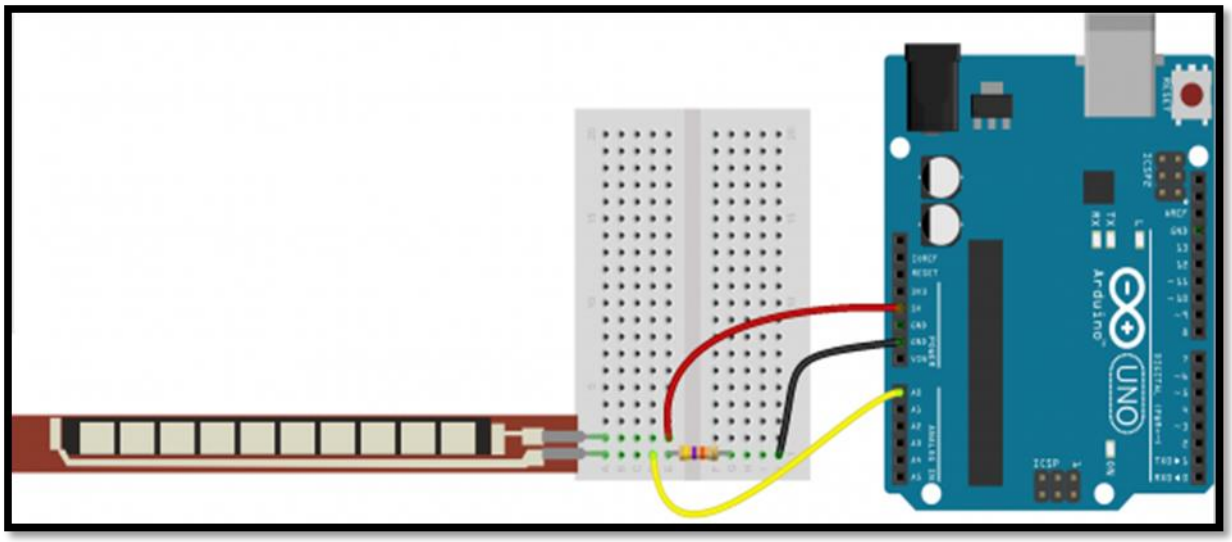


4.1.2 FLEX SENSORS

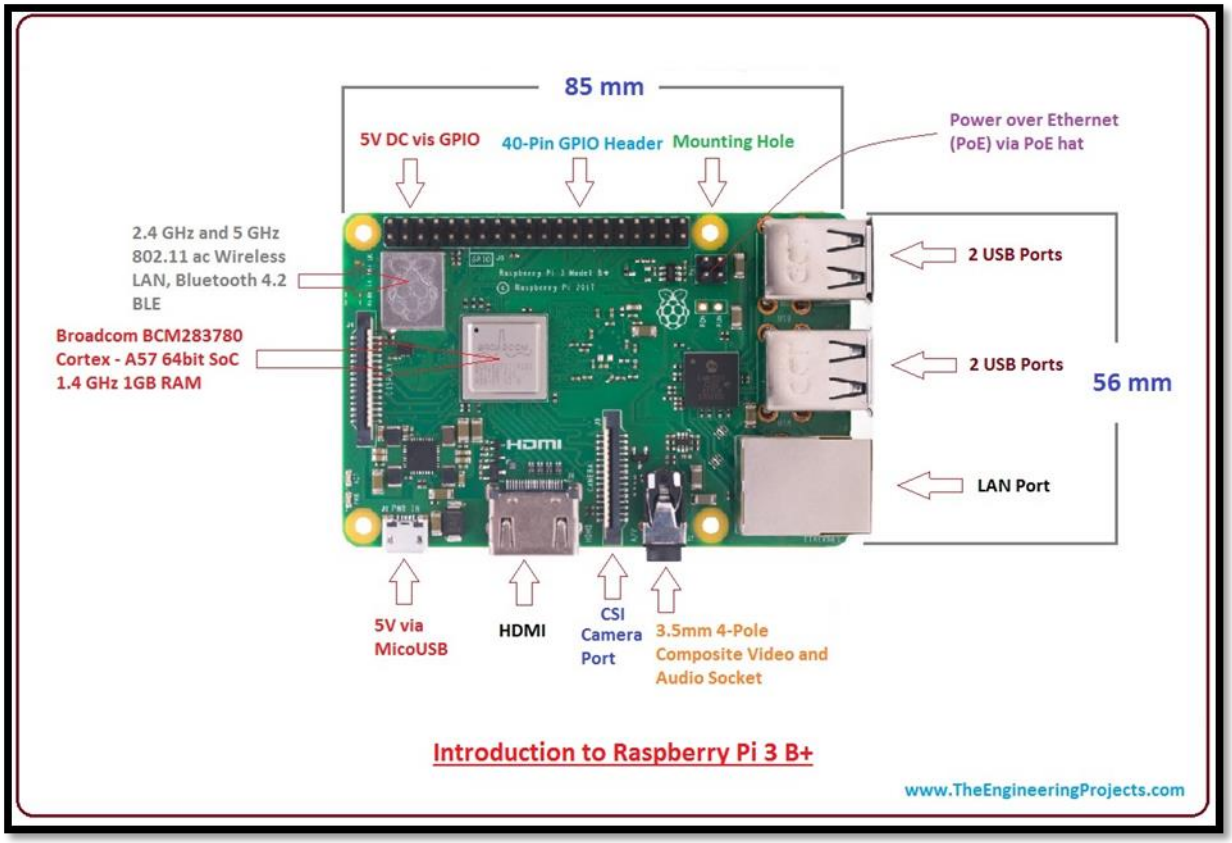
This flex sensor is a variable resistor like no other. The resistance of the flex sensor increases as the body of the component bends.

One side of the sensor is printed with a polymer ink that has conductive particles embedded in it. When the sensor is straight, the particles give the ink a resistance of about 30k Ohms. When the sensor is bent away from the ink, the conductive particles move further apart, increasing this resistance

When the sensor straightens out again, the resistance returns to the original value. By measuring the resistance, you can determine how much the sensor is being bent.

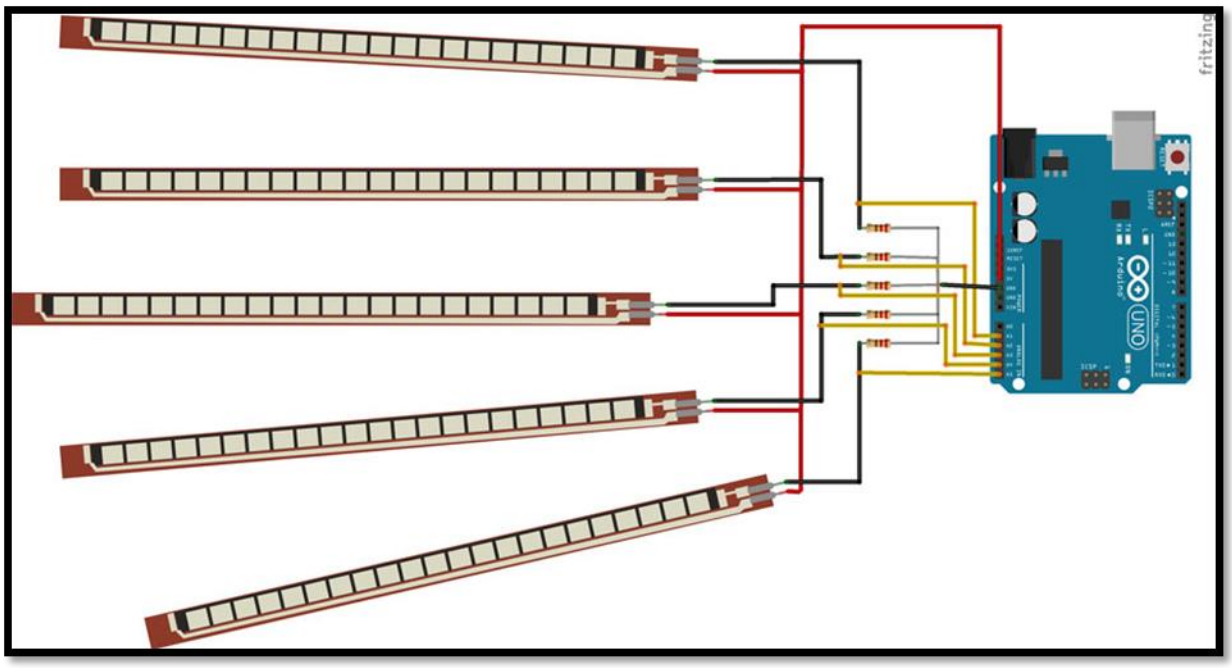


4.1.3 RASPBERRY PI 3B+

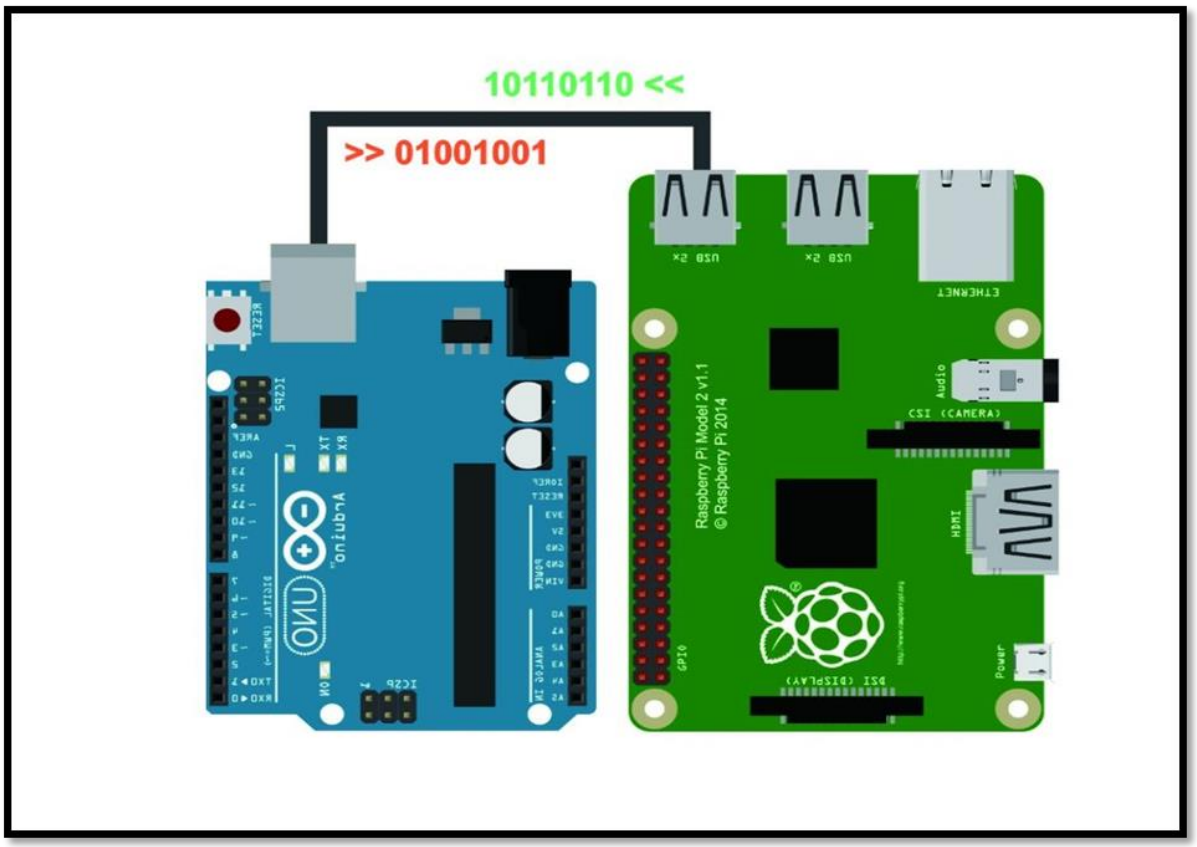


4.2 CIRCUIT DIAGRAM :

4.2.1 Interfacing Flex Sensors with Arduino

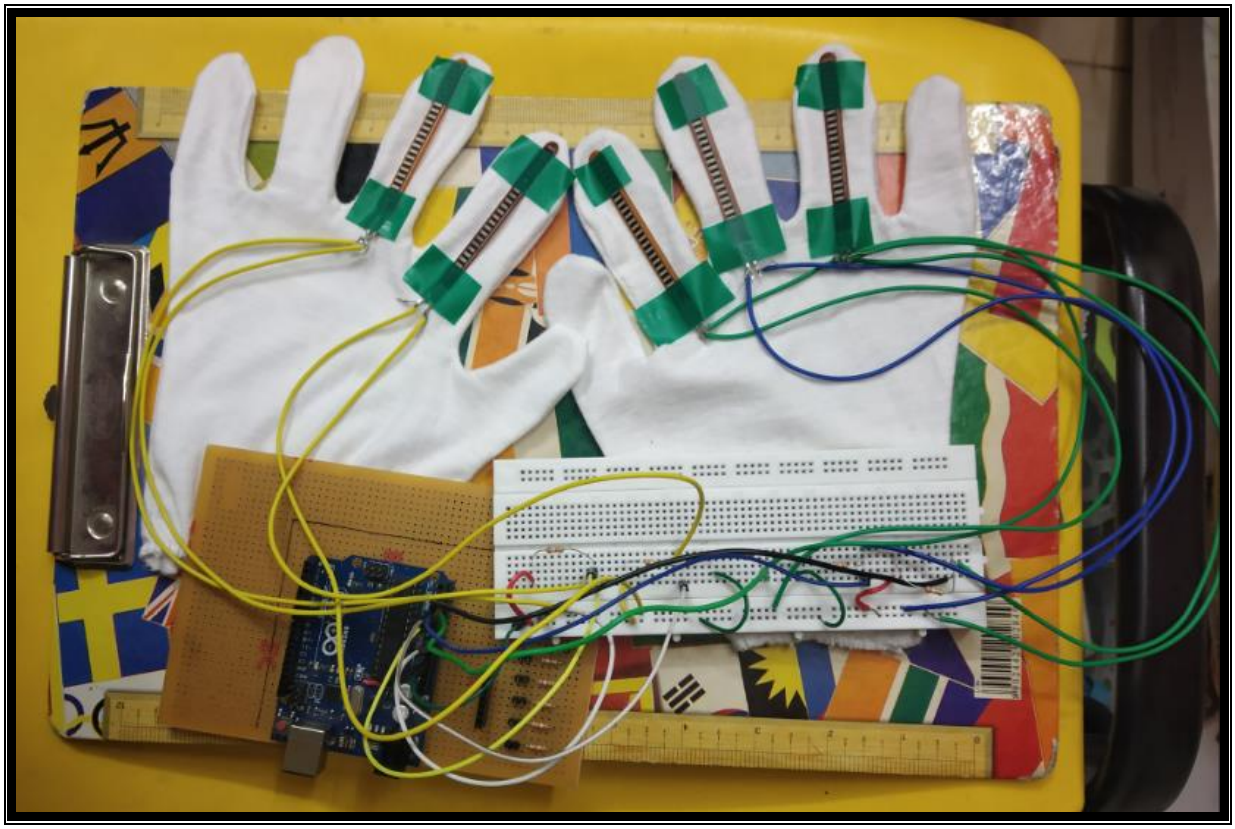


4.2.2 Raspi-Arduino Serial Communication

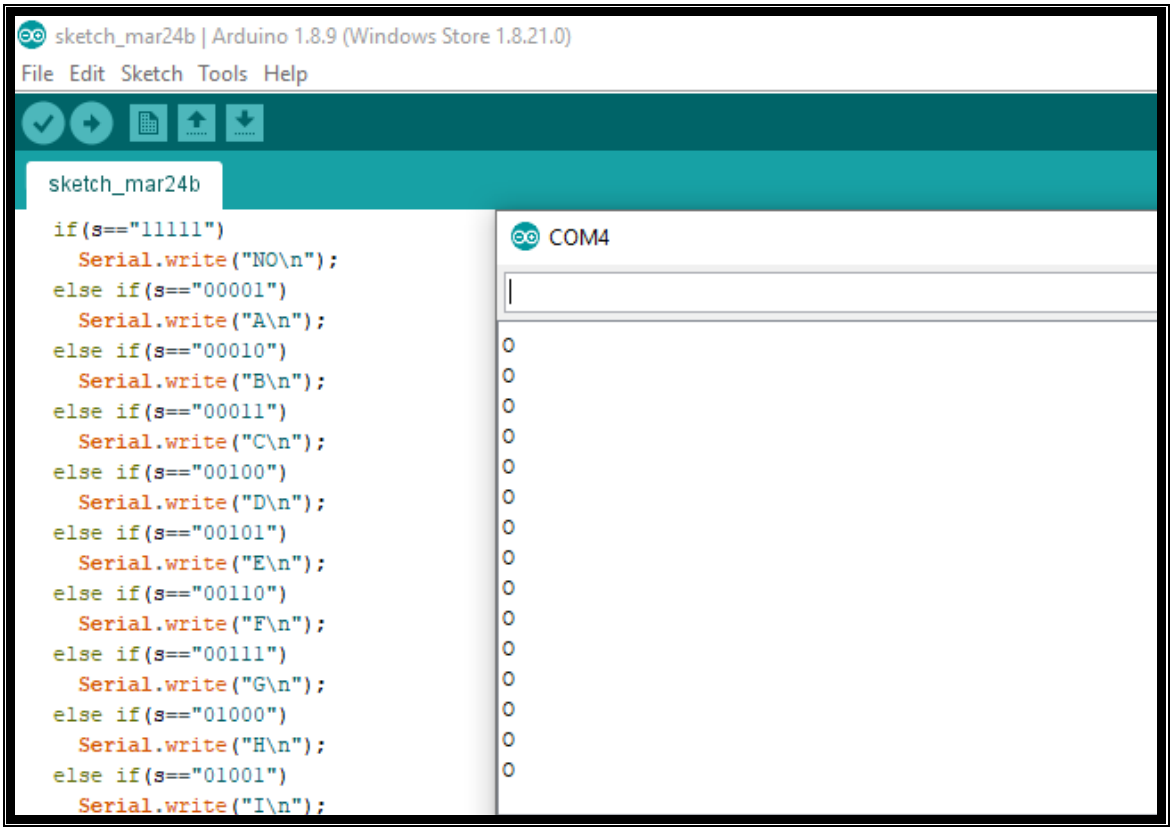


4.3 IMPLEMENTATION

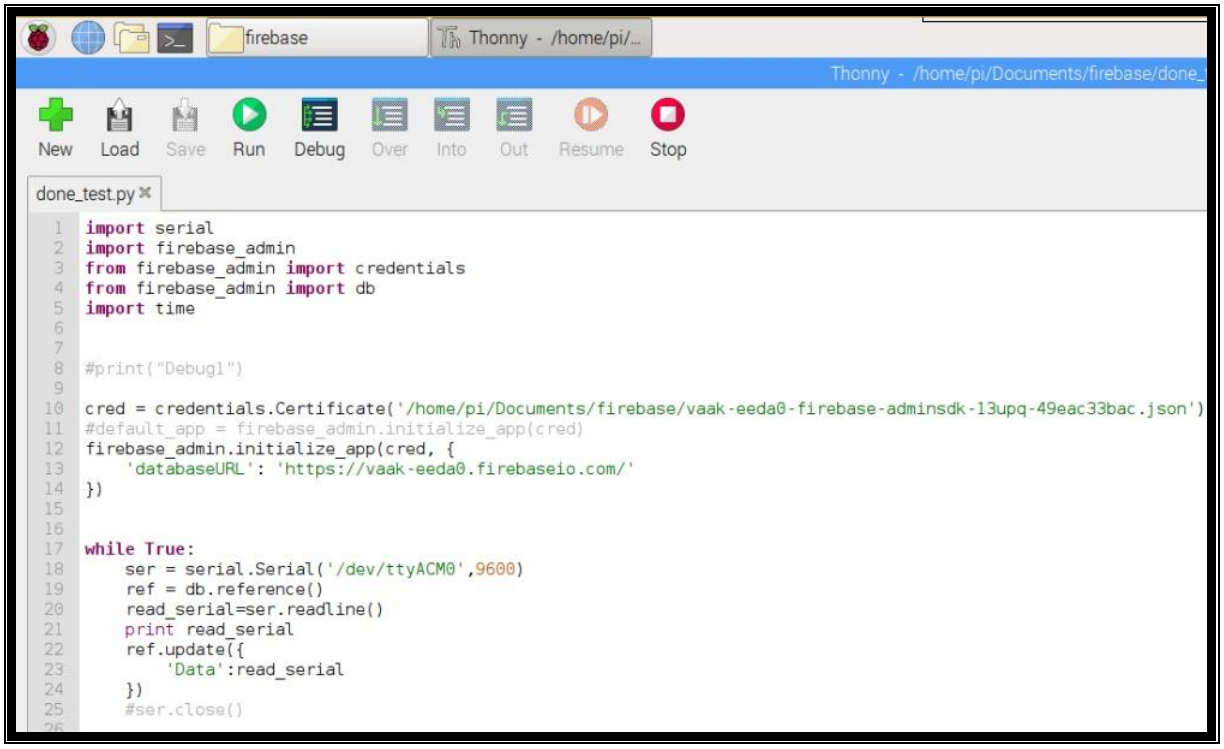
4.3.1 HARDWARE CIRCUIT



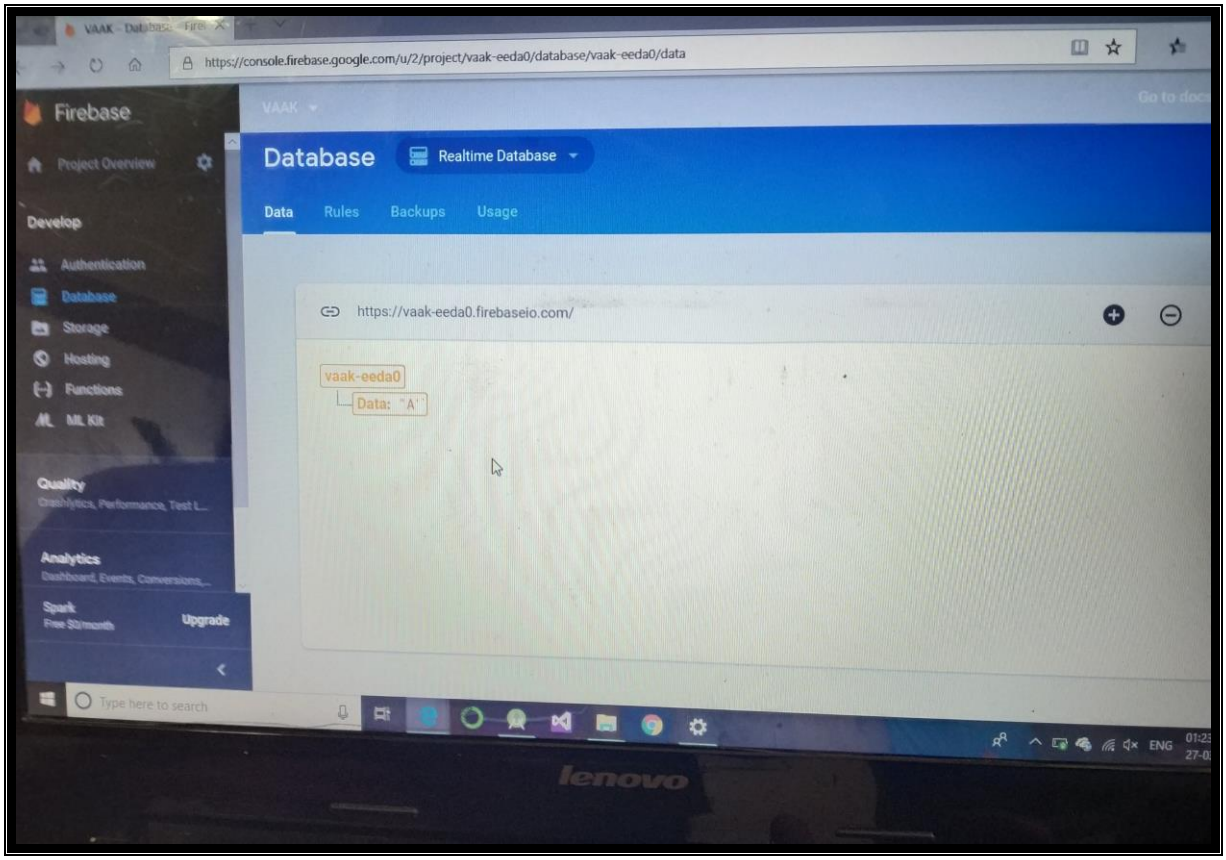
4.3.2 ARDUINO CODING



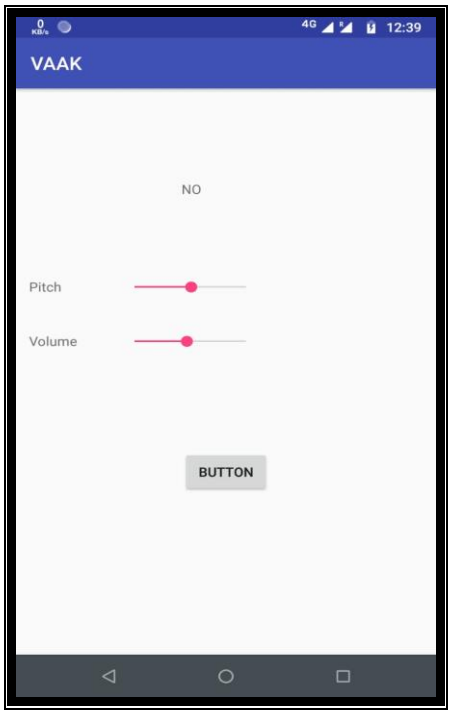
4.3.3 RASPBERRY PI CODING



4.3.4 FIREBASE

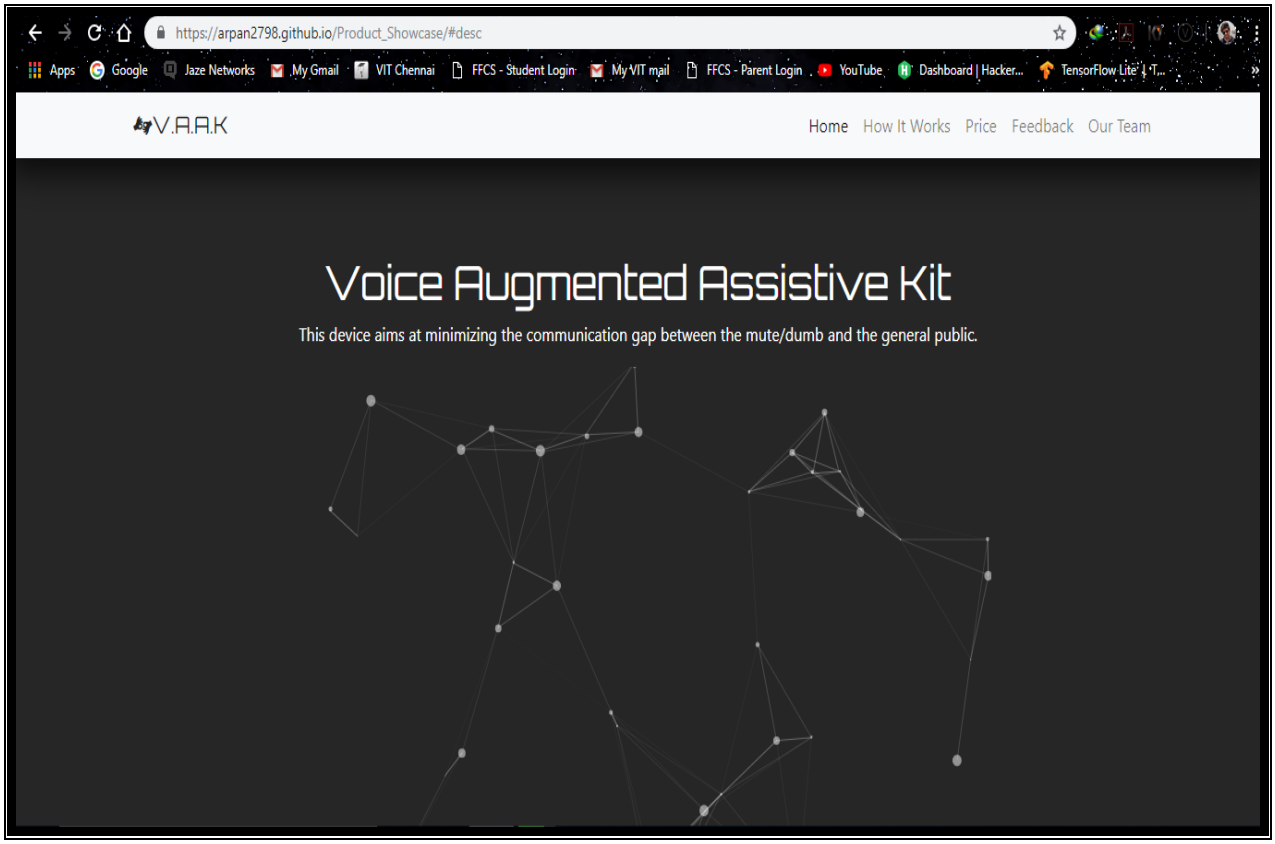


4.3.5 ANDROID APP INTERFACE



4.3.6 PRODUCT WEBSITE – V.A.A.K

https://arpan2798.github.io/Product_Showcase/#desc



5. Working :

1. In our project, we have used flex sensors which are bend sensitive. This way, the system can sense it whenever there is a bent in the sensor.
2. We have used 5 flex sensors, since we need to display only 26 English Alphabets for now, so 2^5=32 binary combinations will be more than enough for that.
3. So, we have placed 5 flex sensors on a pair gloves, 3 on the right hand and 2 on the left.
4. The gloves are then connected to the Arduino Uno.
5. In each flex sensor, one end is connected to Gnd of Arduino. The other end is connected to an AnalogIn pin and a resistor which is hence connected to Vcc of the Arduino.
6. A mute person wears these gloves and the Arduino is connected to 5V power supply.
7. When he tries different gestures using his hand, different values are generated by the flex sensors.
8. We assume that when the flex sensor is straight, it's value is 1 and when it is bent, it's value is 0.
9. When user wears this gloves and try a hand gesture, there comes many binary combination with all sensors, in which each combination represents a different English Alphabet.
10. These binary combination of values are sent to the Arduino.
11. Each combination of values have a different predefined alphabet which is fed to the Arduino.
12. The Arduino is then serially connected to the Raspi using USB cable.
13. The alphabets are sent to the Raspi one by one synchronously.
14. The Raspi directly transfers the received alphabets on the User's Firebase Account.
15. The user then retrieves the alphabets from the Firebase using our Android App.
16. The Android App converts the Text to Speech as well as displays it too.
17. Any person or even a blind person can hear the Speech through the speaker and understand what the mute person wants to convey.
18. If he is a deaf person, he can understand what is conveyed to him by the mute person just by seeing the text display of alphabet or word in our app.
19. This way, this product will make the communication of the disabled people (mainly deaf and mute people) easy.

6. CODING :

6.1 EMBEDDED C CODE TO GENERATE ALPHABETS USING FLEX SENSORS :

```
//initialising the input Analog pins for our 5 Flex Sensors
const int flexPin1 = A0;
const int flexPin2 = A1;
const int flexPin3 = A2;
const int flexPin4 = A3;
const int flexPin5 = A4;

//initialising the global variables that would be used by the flex sensors
int value, i;
int initialSum1=0, sum1;
int initialSum2=0, sum2;
int initialSum3=0, sum3;
int initialSum4=0, sum4;
int initialSum5=0, sum5;
String a,b,c,d,e;

//Adding 10 values from each flex sensors when they are straight to define threshold
void setup()
{
  pinMode(flexPin1, INPUT);
  pinMode(flexPin2, INPUT);
  pinMode(flexPin3, INPUT);
  pinMode(flexPin4, INPUT);
  pinMode(flexPin5, INPUT);
  Serial.begin(9600);
  for(i=0; i<10; ++i)
  {
    value=analogRead(flexPin1);
    initialSum1 += value;
    value=analogRead(flexPin2);
    initialSum2 += value;
    value=analogRead(flexPin3);
    initialSum3 += value;
    value=analogRead(flexPin4);
    initialSum4 += value;
    value=analogRead(flexPin5);
    initialSum5 += value;
  }
}

//Adding the next 10 values from each flex sensor
```

```
void loop()
{
  sum1=sum2=sum3=sum4=sum5=0;
  a=b=c=d=e="1";
  for(i=0; i<10; ++i)
  {
    value = analogRead(flexPin1);
    sum1 += value;
    value = analogRead(flexPin2);
    sum2 += value;
    value = analogRead(flexPin3);
    sum3 += value;
    value = analogRead(flexPin4);
    sum4 += value;
    value = analogRead(flexPin5);
    sum5 += value;
  }
  delay(125);

 //Comparing the sum with initial sum and checking if the variation is more than 100
//or not and accordingly assuming the flex sensor as bent or straight and setting its
//value as 0 or 1 repectively.
  if ( (sum1-initialSum1)>100 )
    a="0";
  if ( (sum2-initialSum2)>100 )
    b="0";
  if ( (sum3-initialSum3)>100 )
    c="0";
  if ( (sum4-initialSum4)>100 )
    d="0";
  if ( (sum5-initialSum5)>100 )
    e="0";

//defining an English Alphabet for each Binary Combination
  String s=a+b+c+d+e;
  if(s=="11111")        Serial.write("NO\n");
  else if(s=="00001")   Serial.write("A\n");
  else if(s=="00010")   Serial.write("B\n");
  else if(s=="00011")   Serial.write("C\n");
  else if(s=="00100")   Serial.write("D\n");
  else if(s=="00101")   Serial.write("E\n");
  else if(s=="00110")   Serial.write("F\n");
  else if(s=="00111")   Serial.write("G\n");
  else if(s=="01000")   Serial.write("H\n");
  else if(s=="01001")   Serial.write("I\n");
  else if(s=="01010")   Serial.write("J\n");
```

```
 else if(s=="01011")   Serial.write("K\n");
 else if(s=="01100")   Serial.write("L\n");
 else if(s=="01101")   Serial.write("M\n");
 else if(s=="01110")   Serial.write("N\n");
 else if(s=="01111")   Serial.write("O\n");
 else if(s=="10000")   Serial.write("P\n");
 else if(s=="10001")   Serial.write("Q\n");
 else if(s=="10010")   Serial.write("R\n");
 else if(s=="10011")   Serial.write("S\n");
 else if(s=="10100")   Serial.write("T\n");
 else if(s=="10101")   Serial.write("U\n");
 else if(s=="10110")   Serial.write("V\n");
 else if(s=="10111")   Serial.write("W\n");
 else if(s=="11000")   Serial.write("X\n");
 else if(s=="11001")   Serial.write("Y\n");
 else if(s=="11010")   Serial.write("Z\n");
}
```

6.2 PYTHON CODE TO UPLOAD ALPHABETS ON FIREBASE

```
import serial
import firebase_admin
from firebase_admin import credentials
from firebase_admin import db
import time

#print("Debug1")

cred = credentials.Certificate('/home/pi/Documents/firebase/vaak-eeda0-firebase-
adminsdk-13upq-49eac33bac.json')
#default_app = firebase_admin.initialize_app(cred)
firebase_admin.initialize_app(cred, {
   'databaseURL': 'https://vaak-eeda0.firebaseio.com/'
})

while True:
   ser = serial.Serial('/dev/ttyACM0',9600)
   ref = db.reference()
   read_serial=ser.readline()
   print read_serial
   ref.update({
      'Data':read_serial
   })
   #ser.close()
```

6.3 TEXT TO SPEECH CONVERSION ANDROID APP

- LOGIN function :

```
public void login()
   {

firebaseAuth.signInWithEmailAndPassword("rishab2000agarwal@gmail.com","vaakv
aak").addOnSuccessListener(new OnSuccessListener<AuthResult>() {
          @Override
          public void onSuccess(AuthResult authResult)
          {
             startActivity(new Intent(MainActivity.this,conversion.class));
          }
       }).addOnFailureListener(new OnFailureListener() {
          @Override
          public void onFailure(@NonNull Exception e)
          {
             Toast.makeText(MainActivity.this, "Access Denied",
Toast.LENGTH_SHORT).show();
          }
       });

   }
```

- FIREBASE authentication :

```
Firebase.setAndroidContext(this);
firebaseAuth= FirebaseAuth.getInstance();
firebaseAuth.getCurrentUser();
```

- SPEAK adjustment function :

```
private void speak()
   {
      String text=textView.getText().toString();
      float pitch =(float) seek_pitch.getProgress()/50;
      if(pitch<0.1) pitch =0.1f;
      float volum =(float) seek_vol.getProgress()/50;
      if(volum<0.1) pitch =0.1f;
      mTTs.setPitch(pitch);
      mTTs.setSpeechRate(volum);
      mTTs.speak(text,TextToSpeech.QUEUE_FLUSH,null);
    }
```

- TEXT to SPEECH conversion :

```
speak_button.setOnClickListener(new View.OnClickListener() {
        @Override
        public void onClick(View v) {
           speak();
        }
      });
      mTTs= new TextToSpeech(this, new TextToSpeech.OnInitListener() {
        @Override
        public void onInit(int status)
        {
           if(status==TextToSpeech.SUCCESS){
              int result=mTTs.setLanguage(Locale.ENGLISH);

              if(result == TextToSpeech.LANG_MISSING_DATA || result ==
TextToSpeech.LANG_NOT_SUPPORTED) {
                 Log.e("TTS", "Language not supported");
              }
           }
           else
           {
              Log.e("TTS","Initialization fail");
           }
        }
      });
```

7. CONSTRAINTS

While we have achieved the primary target of our project, the following constraints restricted us from making further enhancements:

- **Cost constraints**

  Additional and more effective sensors were not procured as these entailed greater expenditure and subsequent increase of the product cost beyond its affordable rate in the target market segment.

- **Usability Constraints**

  The current form of the product is bulky since we do not have access to chip fabrication to miniaturize the product. The same can be attributed other constraints such as time and cost.

- **Safety Constraints**

  Although unlikely, there may be a possibility of mild electrical shock if the sensors come into direct contact with skin and the user is grounded.

- **Technical Constraints**

  The sensor readings were not always constant or dependable. Additionally, the sensors take a while to become straight once they have been bent, leading to erroneous values.

- **Environmental Constraints**

  None. The product should function in all environments (except extreme scenarios such as fire or ice).

- **Time Constraints**

  Inclusion of additional features such as word or sentence generation could not be achieved due to this.

- **Ethical Constraints**

  None. The product aims to empower the differently abled and serve society at large.

- **Social Constraints**

  None. The product aims to create a more inclusive society by empowering the differently abled.

- **Manufacturability and Sustainability**

  The product is fit for mass production. It is also commercially sustainable since its revenue will soon ‘break-even’ with its capital costs.

8. CONCLUSION

8.1 TESTING & QUALITY ASSURANCE

We tested our projects giving various inputs using different hand gestures, it was giving all the alphabets successfully as output. The flex sensors are very sensitive, hence even as slight bend will change the input instantly and hence give the output. Hence, the user doesn't need to bend it too much, a little also is fine. This ensures the quality assurance of our product. Also, the flex sensors are very light in weight. So the user won't feel trouble in handling the gloves at all. Hence, we have made a user friendly product.

8.2 CONCEPTS LEARNED

We understood the working of flex sensors and how its bend-sensitive nature can be used to generate any number of binary combinations of 1's and 0's. We also understood how to interface Raspberry Pi with Arduino.

8.3 PROBLEMS FACED

The most challenging part of our project was calibrating the flex sensors. The main problem was that every sensor gives a different set of values when it is straight as well as for when it is bent. The only thing that could be used was that all the sensors gave higher values for when it was bent than when it was straight. So we used this logic to solve the issue. We coded the Arduino in such a way that as soon as it receives power, it will generate initial Sum of first 10 values of each Sensor and consider it as a threshold value when the sensors are straight. Then, as the sensors are bent or straightened later, again the sum of 10 values of each is calculated and compared with initial Sum. If the difference of any sensor is greater than 100, then it is assumed to be bent, else it is straight. This logic was the key in our project.

8.4 INFERENCE

Flex sensors are highly bent sensitive. They give a higher value when bent as compared to when they are straight. Different Flex Sensors give different values when they are straight as well as when they are bent.

8.5 FUTURE WORK

We have planned to extend our product on a higher level. After alphabets, we will try to generate words from the flex sensors. This will be same like a normal person speaking. It will be of great benefit to the disabled people.

9. REFERENCES

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