

Deaf Sign Language using Automatic Hand Gesture Robot Based on Microcontroller System

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ABSTRACT

Nowadays, the gesture is one of the most natural interaction methods of the human being. In fact, a great percentage of the human communication is based on visual communication rather than verbal communication. The robot and the gesture device are connected wirelessly via Bluetooth modules. The wireless communication enables the user to interact with the robot in a more friendly way. Gesture controlled robot is a robot which has been controlled by simple gestures. The user needs to wear a gesture device which includes a sensor. The sensor records the movement of hand in a specific direction which results in the movement of the robot in the respective direction. This robot helps people with deafness and dumbness by showing hand gestures assigned English alphabets. This paper discusses the design and implementation of deaf sign language using automatic hand gesture robot using Bluetooth and Arduino board.

KEYWORDS: Arduino UNO, Arduino NANO, HC-05 Bluetooth module, WTV-020 SD sound module, I2C module, Flex sensor, MG90S servo motor, servo driver, LCD, DC convector, Speaker

I. INTRODUCTION

The communication between deafness and hearing person poses to be an important disadvantage compared to communication between blind and ancient visual people. Sign language is a way by which the gestures made by the user are used for communication.

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The blind people speaks freely by implies that of ancient language whereas the dumb has own manual visual language referred to as language. A dumb communication interpreter is also a tool that interprets the hand gestures to sensibility speech. In this system, the gestures are converted into text message for communication. Basically there are two main parts of this paper that are transmitter and receiver. Flex sensors mainly attached on the glove. Main goals of the system are to convert hand gestures to auditory speech for communication between deaf and normal people and to convert speech to readable text for communication between deaf and normal people.

II. System Block Diagram

The user wears a glove with flex sensor. The gesture robot made by the information is sending from the flex sensors. The glove with flex sensors occurs at the transmitter end. Gesture controlled robot works on the principle of flex sensors which records hand movement and sends that data to the Arduino which assigns proper voltage levels to the recorded movement. The information is then transferred to the Bluetooth module. The microcontroller processes make these signals and encode it. These signals are transmitted to the receiver end.

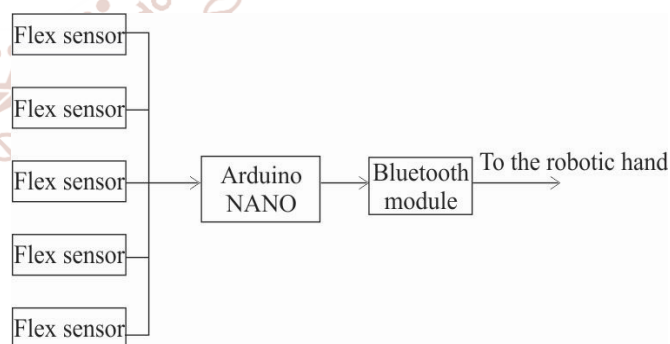


Fig1: Block Diagram of Automatic Hand Gesture (Transmit)

On the receiving end, the information is received wirelessly via the Bluetooth module and then passed onto the microcontroller which takes various decisions based on the received information. These decisions are passed to the motor driver IC which triggers the motors in different configurations to move the robot in a specific direction. Then, Arduino also makes the decision such as displays on Liquid Crystal Display (LCD) with alphabet and executes sound in the following block diagram.

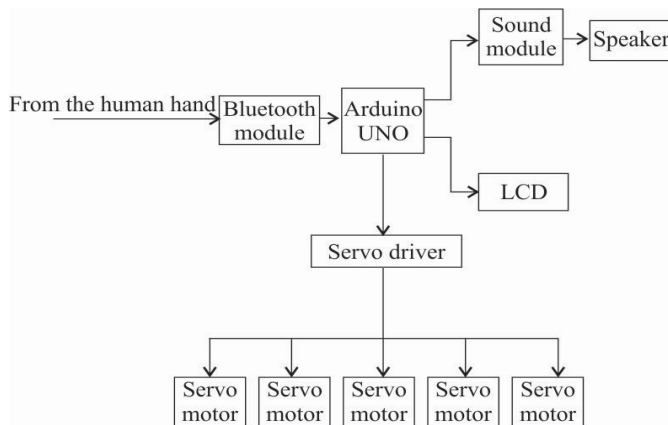


Fig 2: Block Diagram of Robotic Hand Gesture (Receive)

III. Implementation

A. Software Implementation

Software Implementation to Find Header Thumb Finger (T) Character

```

c=bluetooth.find('T');
if(c=true)
{
  T = bluetooth.parseInt();
  Serial.print(T);
  Serial.print(" ");
  // pwm.setPWM(5, 0, pulseWidth(T));
}
  
```

It is to find header thumb finger (T) character. If T was not found, result c is false and if it was found, result c is true. The header T and servo angle integer are separated and showed servo angle as integer. The servo is driven by using PWM driver library "setPWM (servo pin,address,pwmvalue).

Software Implementation to Find Header Index Finger (I) Character

```

c=bluetooth.find('I');
if(c=true)
{
  I = bluetooth.parseInt();
  Serial.print(I);
  Serial.print(" ");
  // pwm.setPWM(1, 0, pulseWidth(I))
}
  
```

This is to find header index finger (I) character. If I was not found, result c is false and if it was found, result c is true. The header I and servo angle integer are separated and showed servo angle as integer. The servo is driven by using PWM driver library "setPWM (servo pin,address,pwmvalue).

Software Implementation to Find Header Middle Finger (M) Character

```

c=bluetooth.find('M');
if(c=true)
{
  M = bluetooth.parseInt();
  Serial.print(M);
  Serial.print(" ");
  // pwm.setPWM(2, 0, pulselength(M));
}
  
```

This is to find header middle finger (M) character. If M was not found, result c is false and if it was found, result c is true. The header M and servo angle integer are separated and

showed servo angle as integer. The servo is driven by using PWM driver library "setPWM (servo pin,address,pwmvalue).

Software Implementation to Find Header Ring Finger (R) Character

```

c=bluetooth.find('R');
if(c=true)
{
  R = bluetooth.parseInt();
  Serial.print(R);
  Serial.print(" ");
  // pwm.setPWM(3, 0, pulseWidth(R));
}
  
```

This is to find header ring finger (R) character. If R was not found, result c is false and if it was found, result c is true. The header R and servo angle integer are separated and showed servo angle as integer. The servo is driven by using PWM driver library "setPWM (servo pin,address,pwmvalue).

Software Implementation to Find Header Pinkie Finger(P) Character

```

c=bluetooth.find('P');
if(c=true)
{
  P = bluetooth.parseInt();
  Serial.print(P);
  Serial.print(" ");
  // pwm.setPWM(4, 0, pulseWidth(P));
}
  
```

This is to find header pinkie finger (P) character. If P was not found, result c is false and if it was found, result c is true. The header P and servo angle integer are separated and showed servo angle as integer. The servo is driven by using PWM driver library "setPWM (servo pin,address,pwmvalue).

Software Implementation for Alphabet B

B alphabet is displayed on LCD and turned on voice sound. Delay time is one second to stop voice sound and be clear displayed alphabet on LCD.

```

if(T<50 && I>75 && M>75 && R>75 && P>75)
{
  lcd.print("B");
  Serial.println("B");
  wtv020sd16p.asyncPlayVoice(1);
  delay(1000);
  wtv020sd16p.stopVoice();
  lcd.clear();
}
  
```

Software Implementation for Alphabet D

D alphabet is displayed on LCD and turned on voice sound. Delay time is one second to stop voice sound and be clear displayed alphabet on LCD.

```

if(T<20 && I>65 && M<20 && R<20 && P<20)
{
  lcd.print("D");
  Serial.println("D");
  wtv020sd16p.asyncPlayVoice(3);
  wtv020sd16p.stopVoice();
  delay(1000);
  lcd.clear();
}
  
```

Software Implementation for Alphabet F

F alphabet is displayed on LCD and turned on voice sound. Delay time is one second to stop voice sound and be clear displayed alphabet on LCD.

```
if(T>20&&T<80 && I>=0&&I<50 &&M>60 && R>60 && P>60)
{
  lcd.print("F");
  Serial.println("F");
  wtv020sd16p.asyncPlayVoice(5);
  wtv020sd16p.stopVoice();
  delay(1000);
  lcd.clear();
}
```

Software Implementation for Alphabet G

G alphabet is displayed on LCD and turned on voice sound. Delay time is one second to stop voice sound and be clear displayed alphabet on LCD.

```
if(T>75 && I>65 &&M<20 && R<20 && P<20)
{
  lcd.print("G");
  Serial.println("G");
  wtv020sd16p.asyncPlayVoice(6);
  wtv020sd16p.stopVoice();
  delay(1000);
  lcd.clear();
}
```

Software Implementation for Alphabet K

K alphabet is displayed on LCD and turned on voice sound. Delay time is one second to stop voice sound and be clear displayed alphabet on LCD.

```
if(T<75 && I>65 &&M>65 && R<20 && P<20)
{
  lcd.print("K");
  Serial.println("K");
  wtv020sd16p.asyncPlayVoice(10);
  wtv020sd16p.stopVoice();
  delay(1000);
  lcd.clear();
}
```

B. Hardware Implementation

The design is used flex sensors to sense the motion of fingers. It is five sensors that were arranged in a hand glove which makes the sensors comfortable to wear. The glove is mounted with flex sensors that change their resistance value when bending. They are attached to one side of voltage divider with resistor of a constant value on the other side. The Arduino reads the voltage change when the sensors are bent and triggers the servos to move a proportional amount. The side of robotic hand is used 12 V external power supply. The analog values obtained from the flexible sensor are transmitted to the robotic hand gesture side via Bluetooth module. These values which are converted into digital operation and then sent to the Arduino UNO platform connected to the robotic hand via the Bluetooth module. The Bluetooth modules are connected at the control glove (human hand) and given the signal to the Arduino of robotic hand. The Arduino UNO receives the signals and executes the signals with three main functions. In the first step, Arduino UNO finds the header and separates the servo angle for

thumb, index, middle, ring and pinkie. Then the servo angle passes the 16 channels PWM servo driver and the servo driver rotates the servo motor by applying the pulse width modulation. Therefore, the servo driver supported to the current of servo motor which loaded current base on required operated torque. Then, Arduino UNO executes the sign language converted into English alphabets display on LCD. Finally, Arduino UNO commands the sound module. The sounds of alphabet are stored in 2 GB SD card that installed on sound module and Arduino commands the sound module to talk the speaker what received. The sound module of CLK pin is plugged in Arduino UNO of digital pin 3, the sound module of data pin is plugged in Arduino UNO of digital pin 4, the sound module of busy pin is plugged in Arduino UNO of digital pin 5 and reset pin is plugged in Arduino UNO of digital pin 9. Main goals of the system are that converting hand gestures into auditory speech for communication to be readable text for communication between deaf and normal people.

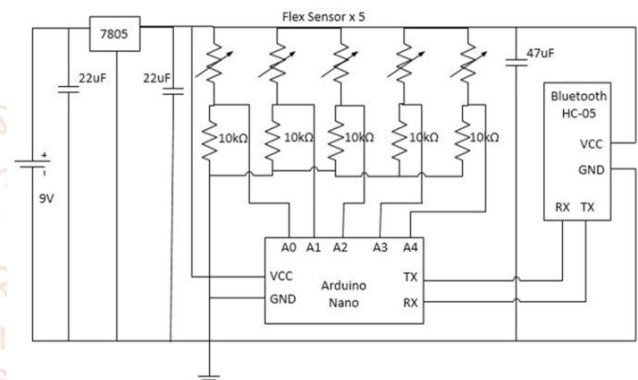


Fig 3: Circuit Diagram of Automatic Hand Gesture (Transmit)

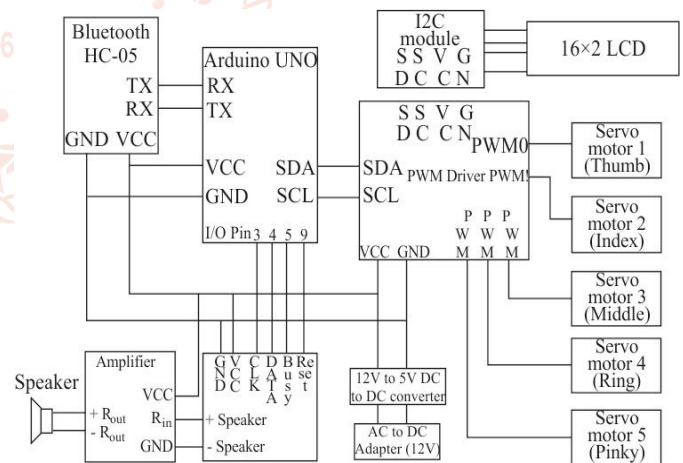


Fig 4: Circuit Diagram of Robotic Hand Gesture (Receive)

IV. Results

Firstly, the flex sensors are powered from 9 V battery. The side of the robotic hand supplies 12 V to the Arduino and another supply to the step down power module. After the flex sensors are power ON, the robotic hand was initializing on the normal position. Fig 5 shows robotic hand gesture under the power OFF state. The condition of robotic hand is not ready for showing hand gesture in normal position. Fig 6 shows robotic hand gesture under the power ON state. The robotic hand is ready for showing hand gesture when the flex sensor is bending.

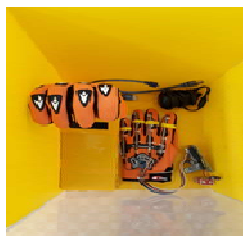


Fig 5: Robotic Hand Gesture under the Power OFF State



Fig 6: Robotic Hand Gesture under the Power ON State

Testing for Alphabet B

This testing is alphabet B for the robotic hand and LCD.

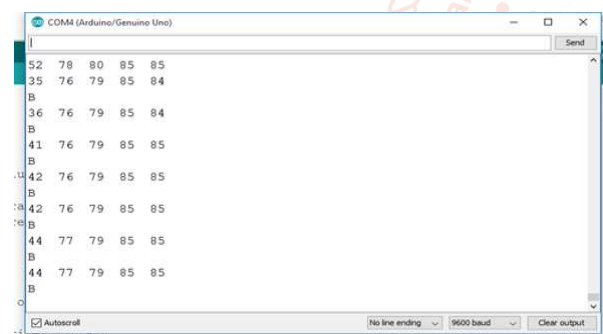


Fig7: Testing Alphabet B

Testing for Alphabet D

This testing is alphabet D for the robotic hand and LCD.

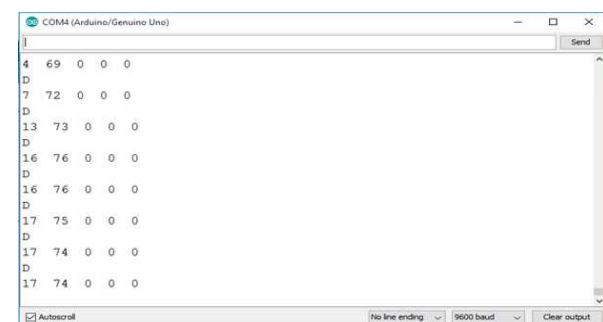


Fig 8: Testing Alphabet D

Testing for Alphabet F

This testing is alphabet F for the robotic hand and LCD.

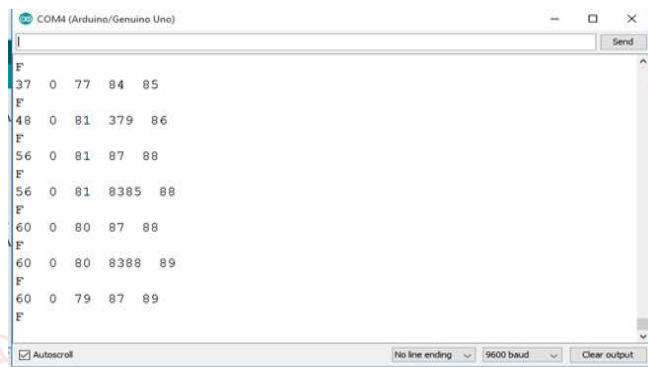


Fig 9: Testing Alphabet F

Testing for Alphabet G

This testing is alphabet G for the robotic hand and LCD.

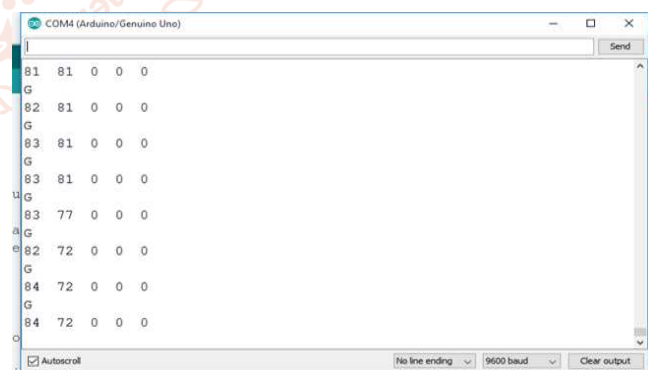


Fig 10: Testing Alphabet G

Testing for Alphabet K

This testing is alphabet K for the robotic hand and LCD.



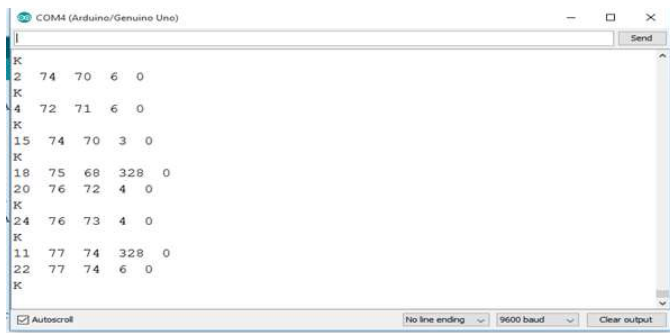


Fig11: Testing Alphabet K

V. Conclusion

Sign language helps to bridge the gap between those who can hear and those who cannot. All those people are not understanding about this language. People use Bluetooth device for the communication whose range is descent for 30 m. Hence, this device works wirelessly used for around 30 m. The design and construction of this device were properly manufactured at a very low price with high usability. This is a very noble approach to communicate bidirectional between normal and disable person. This is very useful for the disable person as with the help of this device. The results of the flex sensor have also been displayed at the robotic hand wirelessly using Bluetooth in future Wifi technology that has been used to increase the range of the device.

VI. REFERENCES

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