International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 06 | June 2019 www.irjet.net p-ISSN: 2395-0072

SMART SPEAKING GLOVE FOR SPEECH IMPAIRED PEOPLE

Meghana A S[1], Niveditha M[2], Prathibha K[3] , Raksha G R[4], Dr. H C Sateesh Kumar[5]

[1,2,3,4]U G Students, Dept. of Electronics and Communication Engineering, Sapthagiri College of Engineering, Bangalore, Karnataka, India
[5]Professor and Head, Dept. of Electronics and Communication Engineering, Sapthagiri College of Engineering, Bangalore, Karnataka, India

---

Abstract - *This paper describes a SMART SPEAKING GLOVE to impart an easier means of communication between speech impaired people and normal people using synthesized speech. A smart glove is incorporated with flex sensors whose, resistance value changes according to the gesture specified by the user. This gesture information is processed by the Arduino Mega 2560 microcontroller and corresponding voice output is given through speaker in the desired language. In case of emergency, the location of user can be tracked through GPS and a message is sent to the guardian through GSM.*

Key Words: **Flex sensors, Arduino, APR33A3, Speaker.**

1. INTRODUCTION

According to the world health organization about 300 million people are deaf and 1 million people are dumb in the world. They use sign language as their only means of communication. Sign language uses both hand gestures and facial expressions to convey the essence of what an individual is trying to say. Each country generally has its own, native sign language, and some have more than one. The 2013 edition of Ethnologue lists 137 sign languages. Fig-1 represents the sign language been used in India. As there are many sign languages it is quite a challenge for normal people to understand as the knowledge of sign language is limited to a fewer number of people.

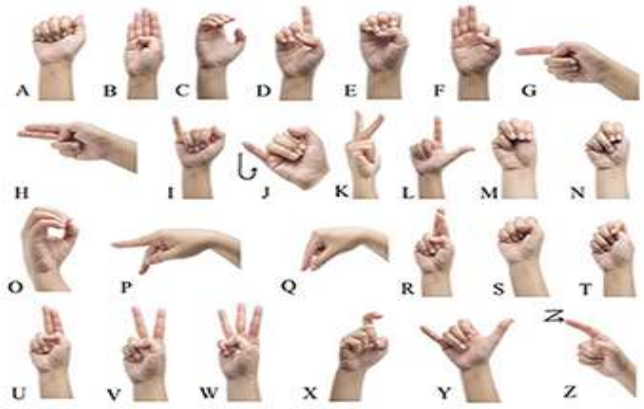


Fig-1: Indian Sign Language

Hence there is a need to develop a sign language recognition system to facilitate easier means of communication between speech impaired and normal people. The objective of this paper includes the following:

- To develop a hand gesture recognition system to convert gestures into voice output.
- To select the desired language for communication.
- To Track the location of the user under emergency situations by the use of panic switch.
- To send an emergency message to the caretaker.

2. RELATED WORK

Many researchers have found out a number of possible solutions:

Subhankar Chattoraj et al., [1] have introduced a hand gesture recognition system to recognize the different gesture made by deaf person to communicate using scale-invariant feature transform (SFIT) algorithm that bridges the gap between deaf and dumb people and normal public. This system will focus on hand gesture recognition and development of human computer interface (HCI) system which will achieve accuracy, real time implementation of gesture processing. Here, the light intensity plays a key role in the precision of the result, more light intensity causes blurring of the image and affects the output result. This can be further developed by implementing the database and speech conversion.

Abhinandan Das et al., [2] here an effort has been made to develop a smart glove using Intel Galileo Gen 2 lOT kit for real-time gesture recognition. The custom built glove uses flex-sensors that are used to measure how much each finger is bent, deformed and the MPU-6050 gyroscope that provides the yaw, pitch and roll values, and both orientation and rotational movement details of the hand. These sensors are read and discretized using the Intel Galileo Gen2 and Arduino microcontrollers. Then serial data is sent to a PC, where the flex and orientation data are processed using a python script. The received data is used to classify each gesture into the corresponding letter c1ass/ word class.

S Yarisha Heera et al., [3] in this proposed system, sensors are incorporated on a glove to detect the gestures and converted it to speech with the help of a Bluetooth module and an Android Smart Phone. This will help in producing

artificial speech which provides an environment similar to daily communication which is hard to achieve for speech impaired people. Flex sensors and MPU6050 are used to determine the gesture and once the corresponding values of the accelerometer and gyroscope along with the flex sensors are obtained, with the help of a Bluetooth module, the readings are sent to an Android application. The Android application is accompanied with SQLite database that consists of database of words in the Indian Sign Language. The readings obtained from the sensors are mapped into the corresponding words with the help of the database. Once the match is found for the reading, the output is produced in the form of speech. This work could have been extended by using human voice for communicating and by using alternative device for bluetooth as it has very short range.

M.S. Kasar et al., [4] in this approach, flex sensors are fitted on glove to sense the finger movements. According to the finger movement made, ATmega328 microcontroller will display message on LCD. Sensor based recognition technique. Development of a module which converts finger movement to sound using embedded system. The text message is converted into voice using speak jet and amplifier and voice is heard via speaker. In future it can be used in application like remote handling, smooth traffic control.

Sakunthala Vegunta et al., [5] proposed a system called gesture based sensor device for dumb people. In order to overcome the complexity the gesture based voice device is introduced for the dumb people. This system makes use of flex sensors. For every gesture a message is associated. Programming of microcontroller is done using MP lab software. The associated message is displayed on LCD and the same message is given as voice output through speaker by using APR (audio playback recorder) module. The use of GPS and GSM helps to track the user location and send a message to the caretakers of the user.

Abjhijt Auti, V. G et al., [6] they have developed a glove equipped with multiple flex sensors for each specific gesture, internal flex sensors produce a proportional change in resistance when it is bent, it is fed to an operational amplifier (LM324) which boosts the circuit current and makes it comprehensible for the PIC microcontroller to proceed further. A speak jet IC aIVR341N is used which is pre-programmed to speak desired sentences. As the recorded voice output from aIVR341N is not much audible to human ears therefore it is fed to an amplifier (LM386Y,1/4 W) that enhances its volume.

Sudarshana Chakma et al., [7] they have developed a gesture to speech conversion system using flex sensors which are stitched to the gloves and the output from the flex sensors is fed into the Arduino Mega 2560 development board. Arduino Mega 2560 converts the analog signal to digital and then the data is send to LCD display and Android phone via bluetooth where the speech output is obtained using an android phone. MIT app inventor has been used to make an app that gives the speech output.

A.Y.Satputeet al., [8] developed an ELECTRONIC SPEAKING GLOVE, the glove is internally equipped with multiple flex sensors that are made up of "bend-sensitive resistance elements". For each specific gesture, flex sensors produce a proportional change in resistance of various elements. The processing of this information sends a unique set of signals to the PIC (Peripheral Interface Controller) microcontroller which is pre-programmed to speak desired sentences stored in a IVR where Voice data and user selectable options must be set up and combined together to create a DAT file for programming into the aIVR chip which is a complex procedure.

Bachkar Y. R et al., [9] have designed the project that focuses on ease of communication between the speech impaired patients or people with the others. The project consists of the glove that translates the bending movement of the fingers into voice or speech signal using Flex sensors. AVR Microcontroller processes the data from flex sensors and further the voice module RVM 01 processes on the microcontroller output to produce speech signal. The message spoken through the speaker is displayed on the LCD.

Syed Faiz Ahmed et al., [10] proposed a system in which flex sensors are used to recognise the gesture and analog output of sensor is fed to ATMEGA32L which has a built in ADC and controller detects the hand gesture that has predefined meaning. If the finger movements made by the user is matching with predefined resistance value then the message will be produced according to predefined data.The output is sent to speak jet which generates synthesised voice that is audible to humans.

3. PROPOSED SYSTEM

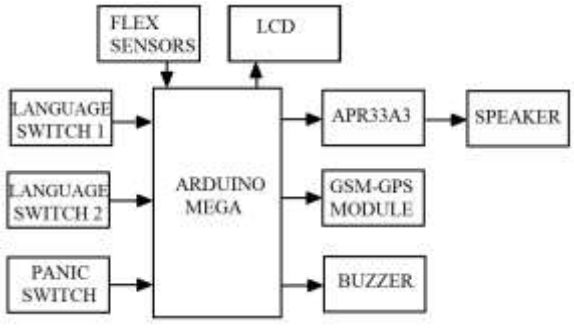


Fig-2: Block diagram

The block diagram of smart speaking glove for speech impaired people is as shown in Fig-2. The system has both hardware and software. Hardware part includes flex sensors, Arduino, LCD display, language selection switches, panic

switch, GSM and GPS module. Software includes the programming of Arduino according to the gestures.
The proposed system is divided into three parts:
1. Gesture input
2. Processing the data
3. Voice output

- **Gesture input:** flex sensors are used as gesture input . They are placed on gloves which can be easily operated by the user by making gestures. According to the gesture made by the user the resistance values will change and sensor produces voltage correspondingly.
- **Processing the data**: The output voltage of flex sensors is in the analog form which is converted into digital form by using inbuilt ADC of Arduino Mega 2560. Predefined gestures with corresponding messages are stored in the database of the microcontroller in different languages. Arduino Mega 2560 checks whether the input voltage from the flex sensors exceeds the threshold value that is stored in the database.
- **Voice output:** The output from the Arduino is sent to APR33A3 and LCD. LCD displays the message that was assigned to the gesture in the database. Speech signal is produced using APR (Auto Playback Recorder) through speaker.

The user is given a choice of selecting a desired language for communication through the switches. A panic switch is also provided in case of emergency situations to track the location of the device user. When this panic switch is pressed a message is sent to the guardian as "EMERGENGY" with the location in the form of Google maps.

4. HARDWARE COMPONENTS REQUIRED

ARDUINO MEGA 2560: The Arduino Mega 2560 (Fig-3)is a microcontroller board which is based on the ATmega2560. It has 54 digital I/O pins (out of which 16 are analog inputs), a 16 MHz crystal oscillator, and a reset button. It is used for processing the data.

Fig-3: Arduino Mega 2560

FLEX SENSORS: Flex sensors (Fig-4) are the sensors that measure the amount of deflection or bending. They are often used in gloves to sense finger movement. They act as the source of input to the microcontroller.

Fig-4: Flex sensor

LCD 16×2: Liquid Crystal Display (Fig-5) screen is an electronic display module. A 16x2 LCD displays 16 characters per line and there are 2 such lines. This LCD consists of Command registers and Data registers. The command registers store the command instructions given to the LCD. The data registers stores the data to be displayed on the LCD. It is used for user interface.

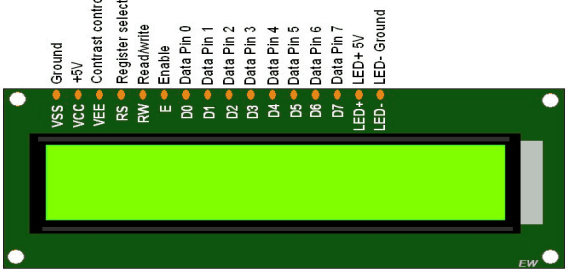


Fig-5: LCD

APR 33A3 (Auto Playback Recorder)**:** It is a single chip voice recorder and playback device with 8 channels. Each channel can store upto 1.3 minutes speech message and total 11 minutes speech can be recorded and stored in all the channels (Fig-6). It takes the input from Arduino mega2560 and gives the voice as output.

Fig-6: APR33A3

SPEAKER: The recorded voice output from APR33A3 is not much audible to human ears therefore; it is fed to a speaker that enhances its volume. It is makes the voice audible to human ears. Thus an 8Ω speaker (Fig-7) is used to get the final output.

Fig-7: Speaker

GSM and GPS MODULE: The GSM is used to send message to the guardian/ caretaker whenever the user is in emergency situation and GPS module is used to track the exact location of the user (Fig-8). The latitude and longitude are the units that represent the coordinates of Geographic System. Just like every actual house has its address (which includes the number, name of the street, city, etc.), every single point on the surface of Earth can be specified by the latitude and longitude coordinates using GPS.

Fig-8: GSM and GPS MODULE

Buzzer: A buzzer (Fig-9) is a device that makes a buzzing sound. It is activated in emergency situation.

Fig-9: Buzzer

SWITCHES: Push button switches (Fig-10) are used. These switches act as a source of input for the selection of desired language. We have used two such switches in our project for selection of languages by the user and a panic switch is used in case of emergency situations.

Fig-10: Push button switch

5. SOFTWARE REQUIRED

ARDUINO IDE: It is a cross platform application to develop microcontroller based applications. The code is written in APL (Arduino programming language) which is based on C language.

There are two functions defined by the user to make an executable cyclic program. They are:
Setup ( ): This function is used to initialize settings and it runs only once at the start of a program.
Loop ( ): This function is called repeatedly until the power is switched off.

6. CIRCUIT DIAGRAM

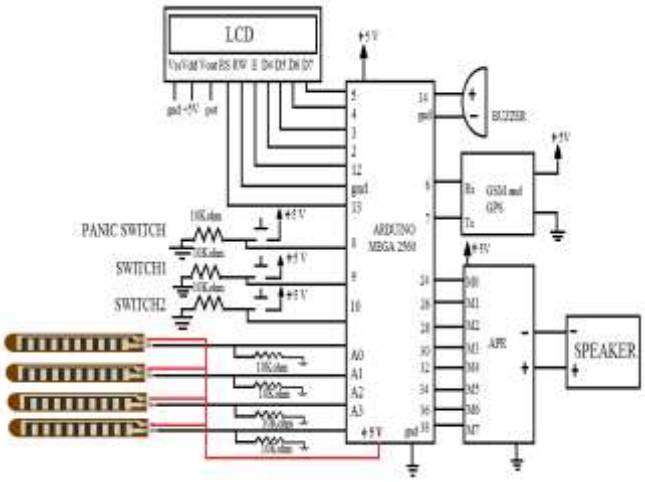


Fig-11: Circuit Diagram

From the circuit diagram represented in Fig-11, we can observe that the LCD is connected to Arduino in 4bit mode. Hence there are four input lines D4 to D7 of the LCD are interfaced with e Arduino pins from 5-2.

Flex Sensor: One end of the flex sensors F1, F2, F3 and F4 are connected to the ground while the other end are connected to the analog outputs A0, A1, A2 and A3 of Arduino respectively. A 10K ohm resistor is connected between analog outputs and +5V and this connection acts as voltage divider circuit. Thus the output is in the form of voltage.

APR Module: The REC pin is connected to Digital I/O pin 3 of the Arduino. The 8 message pins of APR are connected to Arduino.

The panic switch, language selection switches, buzzer, and the transmitter and receiver pins of GSM and GPS module are connected to Arduino as shown in the circuit diagram.

7. WORKING PRINCIPLE

In this system flex sensors are placed on gloves according to the gesture made by the user the resistance values will change and sensor produces voltage. The output voltage of flex sensors is processed using Arduino Mega2560. Predefined threshold values for each gesture and its corresponding messages are stored in the database of the microcontroller. When the input voltage of the microcontroller exceeds the threshold value, LCD displays the message that was assigned to the gesture in the database and the speech signal is produced using APR33A3 through speaker (English and Kannada) in our system. The user is given a choice for selecting a desired language through switches in the beginning itself. A panic switch is provided in case of emergency situations to track the location of the device user using SMS sent by the system.

7.1 FLOW CHART

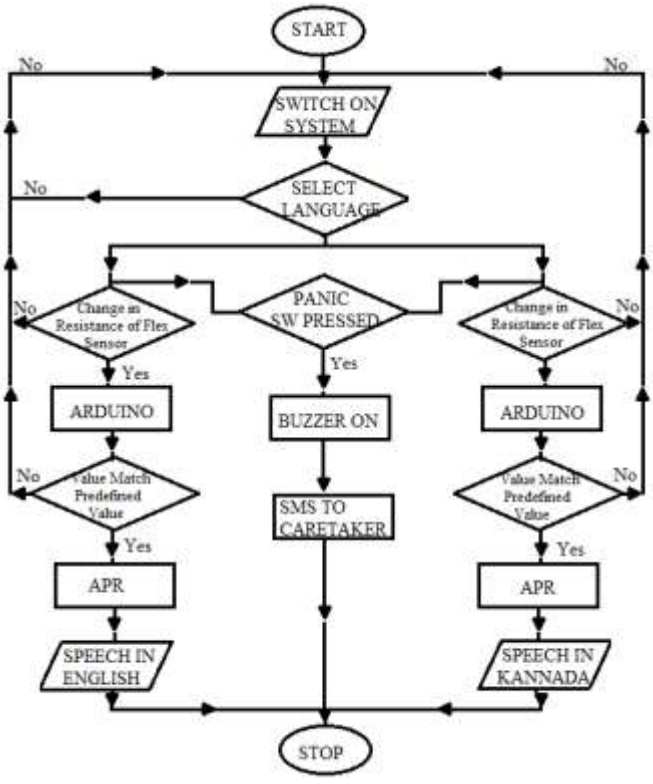


Fig-12: Flow Chart

- The flow chart is as shown in Fig-12. The user is given the choice of selecting the desired language, upon selecting the required language the gesture input is given to the Arduino.
- Flex sensors are placed on gloves which can be easily operated by the user by making gestures. According to the gesture made by the user the resistance values will change and sensor produces voltage correspondingly. The output voltage of flex sensors is in the analog form which is converted into digital form by using inbuilt ADC of Atmega 2560.
- Predefined gestures with corresponding messages are stored in the database of the microcontroller in different languages.
- Microcontroller matches the motion with the database and produces the speech signal using APR (Auto Playback Recorder). The output is given out through the speaker as per the language chosen by the user by operating the switches.
- For a Specific gesture the GPS module will track the location of the device user and GSM module is used to send a text message which consists of location address of user to guardians when he/she is in emergency situations.

8. IMPLEMENTATION AND RESULTS

Fig-13: Hardware Implemented

The hardware implementation is done as shown in Fig-13. For each gesture specified by the user corresponding message is displayed on LCD (Table-1) and the same message is heard through speaker in the desired language selected by the user. When the user activates the panic switch in emergency situation message is sent to the care taker/ guardian as "EMERGENCY" is represented in Fig-14 and location is sent through Google Maps as in Fig-15.

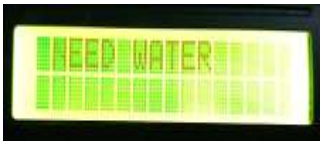
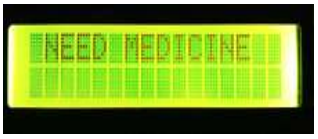
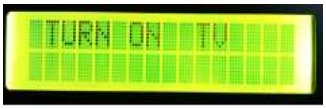
SL.NO	GESTURE INPUT	OUTPUT
1.		
2.		
3.		
4.		

Table-1: Results of gestures with corresponding messages.

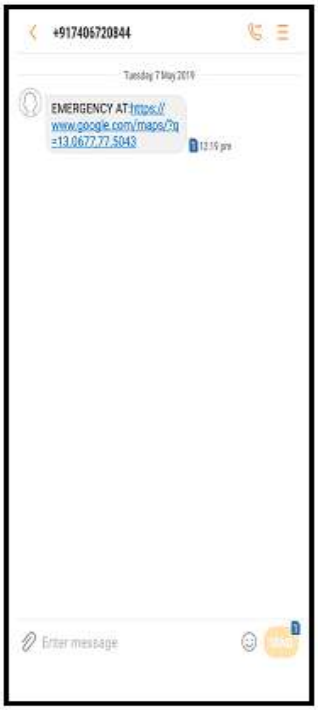


Fig-14 Cell phone Result

Fig-15 Google maps Result

9. APPLICATIONS, ADVANTAGES AND CHALLENGES

9.1 APPLICATIONS

- Useful for physically challenged people.
- Provides easy communication between the speech impaired people and the normal people.
- The user can record voice in any languages and facility is provided for the selection of desired language through which he/she likes to communicate with others.
- PANIC SWITCH helps in tracking the location of the user in emergency.

9.2 ADVANTAGES

- Easy to operate: Anyone can operate it easily.
- Easy to define gestures: we can add or define our own gestures.
- Communication is possible in any language.
- It requires fewer components so its cost is low.
- Small in size and Light weight.
- Flexible to users.
- It takes less power to operate system

9.3 CHALLENGES

- Facial expressions are not considered.
- Flex sensors are sensitive and to implement system with more gestures is difficult.

10. CONCLUSION AND FUTURE SCOPE

10.1 CONCLUSIONS

A Smart Speaking Glove for Speech impaired People is designed and implemented with four gestures. Each gesture specifies basic needs such as “NEED WATER”, “NEED MEDICINE”, “NEED FOOD”, “TURN ON TV”. This system is more reliable, efficient, easy to use and a light weight solution to the user as compared to other proposed systems. This bridges the communication gap between speech impaired people and others. During this project we have faced various challenges and we have tried to minimize the problem. Since, we observed that they cannot handle bulky and delicate in structure. We have minimized the communication problem as:

- The output is in the form of speech which is easily understood by others.
- This system will provide assistance to the speechless people to express their needs using gestures.
- The voice output can be manipulated in any language according to the user.

10.2 FUTURE SCOPE

The completion of this prototype suggests that more gestures can be employed to recognize full sign language as

we have implemented four gestures. A handy and portable hardware device with the pair of data gloves can be manufactured so that a deaf and dumb person can communicate to any normal person anywhere. This device has applications in home automation which can be implemented in future.

REFERENCES

[1] Subhankar Chattoraj, Karan Vishwakarma, Tanmay Paul, "Assistive System for Physically Disabled People using Gesture Recognition", IEEE 2nd International Conference on Signal and Image Processing, 2017

[2] Abhinandan Das, Lavish Yadav, Mayank Singhal, Raman Sachan, Hemang Goyal, "Smart Glove for Sign Language Communications", vol. 5, Issue 3, pp. 1589-1594, March 2016

[3] S Yarisha Heera, Madhuri K Murthy, Sravanti V S, Sanket Salvi, "Talking Hands – An Indian Sign Language to Speech Translating Gloves", ICIMIA, pp. 746-751, 2017

[4] M.S.Kasar, AnvitaDeshmukh, Akshada Gavande Priyanka Ghadage, "Smart Speaking Glove-Virtual tongue for Deaf and Dumb", IJAREEIE, Vol. 5, Issue 3, pp. 1588-1594, 2016

[5] Sakunthala Vegunta, A.B.Bhavani, M.Mallikarjun, "Gesture Based Sensor Device with GPS and GSM Technology for Dumb People" ,ICCES, 2017

[6] AbjhijtAuti, V. G. Puranik, Dr. A. K. Kureshi, "Speaking Gloves for Speechless Persons", International Journal of Innovative Research in Science, Engineering and Technology, Volume 3, Special Issue 4, pp. 282-290, April 2014

[7] Sudarshana Chakma, Sushith Rai S, Sushmita Pal, Uzma Sulthana K, H S Kala, "Development of Device for Gesture To Speech Conversion For The Mute Community" ,International Conference on Design Innovations for 3Cs Compute Communicate Control, pp.97-99, 2018

[8] A.Y.Satpute, A.D.Bhoi, "Electronic Speaking Glove for Speechless Patients A Regional Tongue to a Dumb", International Journal of Electronics Communication and Computer Engineering Volume 4, Issue 2, ISSN (Online): 2249–071X, ISSN (Print): 2278–4209, pp. 507-511, 2013

[9] Bachkar Y. R, Gupta A.R, Pathan W.A, "Smart Speaking Gloves for Speechless", IOSR Journal of Electronics and Communication Engineering (IOSR-JECE), e-ISSN: 2278-2834, p-ISSN: 2278-8735, pp. 10-14

[10] Syed Faiz Ahmed, Syed Muhammad Baber Ali, Sh. Saqib Munawwar Qureshi, "Electronic Speaking Glove for Speechless Patients A Tongue to a Dumb", IEEE Conference on Sustainable Utilization and Development in Engineering and Technology, pp. 56-60, 2010