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# A Review Paper on Smart Glove - Converts Gestures into Speech and Text

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***Abstract:***Generally people with hearing problem and speech disability use sign language based on hand gestures with specific motion to represent the language, they are communicating. Smart glove is an electronic device that translates sign language into text or speech in order to make the communication feasible between the mute communities with the general public. This glove translates the sign language gestures according to the American Sign Language Standard. This glove has been implemented with the help of flex sensors, accelerometer, microcontroller (Arduino Leonardo) and the Bluetooth chip. It Is a wireless data glove which is normal cloth driving glove fitted with flex sensors along the length of each finger.

***Keywords:*** *Gesture, Android, Smartphone, Bluetooth, Accelerometer*

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## I. INTRODUCTION

The deaf/mute peoplemake up 72 million of the world's population according to a report published by a World Federation of the Deaf. These people learn sign language to communicate. Unfortunately, most of the average people don't understand their gestures and thus are unable to identify what is being said by them. This paper is concerned with the solution to help those people having speech disability to have normal conversations in their daily lives.

In this paper, different approaches of gesture recognition are discussed, an already proposed design of a hand glove for gesture recognition into speech is shown.

Although some data gloves are available in the market but they are used for gaming and other virtual reality applications and there is no such complete system available in the market for the translation of sign language into speech.

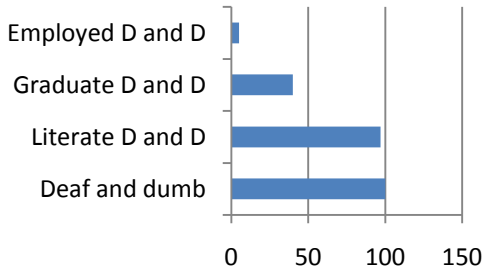


Fig. 1 Deaf and Dumb Work Survey

As evident from the fig. 1, the decreasing ratio of Literate and Employed Deaf and Dumb population is a result of the physical disability of hearing for deaf and speaking for dumb people so it yields to lack of communication between normal person and deaf and dumb person.

There are two main approaches to gesture recognition:-

A machine based approach which consists of taking the input through a single/set of cameras or a haptic based approach which consists of using a sensory device to take in physical values for processing.

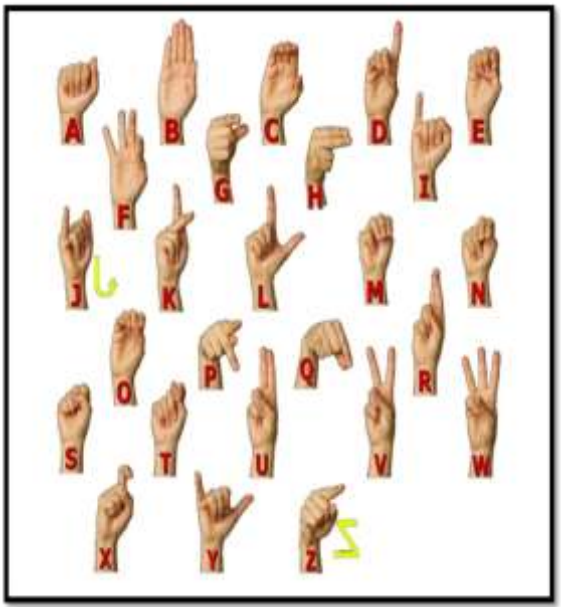


Fig. 2 American Sign languages

## II. Related Work

Using the concept of gestures, few attempts have been made in the past to recognize the gestures made using hands but with limitations of recognition rate and time which include:

1. Using CMOS camera
2. Leaf switches based glove
3. Copper plate based glove
4. Flex sensor based glove

### *A. Using CMOS Camera*

CMOS camera transmits image data via UART serial port. The UART performs serial-to-parallel conversions on data received from a peripheral device(CMOS camera in this case) and parallel-to-serial conversion on datareceived from the CPU (Microcontroller in this case).

Hand gestures were detected using CMOS camera by 3 steps

- Capturing the image of the gesture
- Edge detection of that image
- Peak detection of that image

Disadvantage: Highly expensive, latency and each image occupies 50KB of memories.

### *B. Leaf switches based glove*

These are similar to normal switches but these are designed in such a way that when pressure is applied on the switch, the two ends come into contact and the switch will be closed. These leaf switches are placed on the fingers of the glove such that the two terminals of the switch come into contact when the finger is bent.

Disadvantage: After prolonged usage, the switch instead of being open when the finger is straight, it will be closed resulting in improper transmission of gesture.

### *C. Copper Plate Based Glove*

In this prototype, a copper plate is fixed on the palm as ground. The copper strips indicate a voltage level of logic 1 in rest position. But when copper strips come in contact with the ground plate, the voltage associated with them is drained and they indicate a voltage level of logic 0.

Disadvantage: The use of copper plate makes the glove bulky which makes it unsuitable to use it for a long time.

### *D. Flex sensor based glove*

Flex means ‘bend’ or ‘curve’.Sensor refers to a transducer which converts physical energy into electrical energy. Flex Sensor is a resistive sensor which changes its resistance as per the change in bend or curvature of it into analog voltage.

This is a haptic based approach which consists of using flex sensors to take in physical values for processing. Discussed below is one recent technology of this prototype.

## III. OVERVIEW OF SMART GLOVE

There are two major parts developing the project.
These are:-

- Circuit Design and Construct
- Development of software and Algorithm

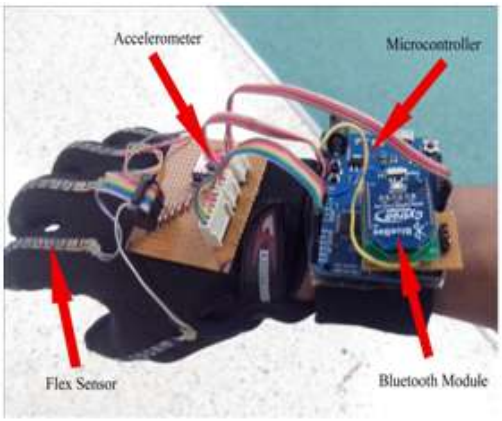


Fig. 3Gesture Recognition Glove

The Smart Glove has several components as listed below:-

### *A. Microcontroller (Arduino Leonardo)*

The main controller chosen for the project is the Arduino Leonardo. It is a microcontroller based board on the ATmega32u4. The microcontroller has 20 digital input output pins including 7 pins that can be used as PWM outputs and 12 pins as analog inputs.

### *B. Flex Sensor*

Flex sensor is the most suitable sensor to measure and capture the movement of the fingers. When sensor placed in gloves is bent, it produces a resistance output correlated to the bend radius- the smaller the radius, the higher the resistance value. The bending resistance range for flex sensor varies approximately from 45Kohm to 125Kohms.

### *C. Accelerometer*

Accelerometer is used to measure the amount of static acceleration due to gravity. Therefore, accelerometer can find out the angle of the glove at which it is tilted with respect to the earth. The accelerometer is attached in the middle of the glove to measure the angle of tilted glove. The accelerometer uses a single structure for sensing x, y and z axis.

### *D. Blue bee Bluetooth Module*

A Bluetooth module is used to transfer the data from microcontroller to smart phone. It comes with an on-board antenna. It acts like a transparent serial port, which works with a variety of Bluetooth adapter and phone. Operating voltage is 3.0-3.6V.

### *E. Arduino Software*

The Arduino IDE (Integrated Development Environment) is a cross platform application written in java, and is derived from the IDE for processing programming language and writing this prototype. It includes a code editor with features such as syntax highlighting, brace matching and automation indentation and is also capable of compiling and uploading programs to the board with a single click.

### *F. App Inventor Software*

It is the software to create a mobile application for smart phone using a web browser. It only supports Android

application design and testing for new application created. It uses graphical interface that allows users to drag and drop visual object to create an application that can run on the Android system.

## IV. WORKING OF SMART GLOVE

The components of glove have already been discussed above. Five flex sensors are attached on the back of the glove to detect human operator's finger activity and accelerometer attached on the back of the glove measures the bending of the hand. The sensors are connected to voltage divider circuit then connected to microcontroller for analog signal detection. The analog signal is then sent to Bluetooth module via its transmitter and receiver connected to receiver and transmitter pin of microcontroller respectively. The data is then collected by Smart phone application having the Bluetooth connectivity ON. The application then converts the received text into speech.

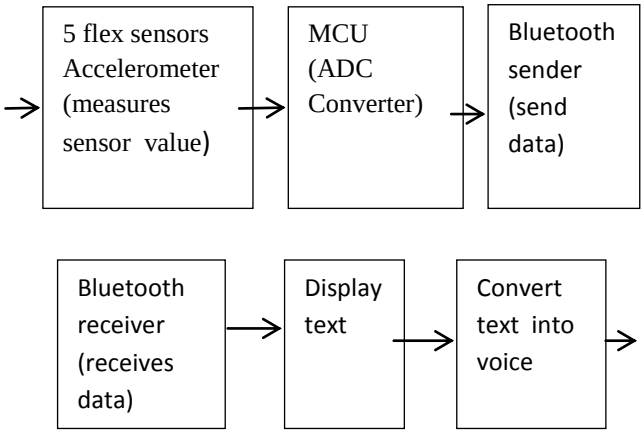


Fig. 4 Block diagram for working of glove

## V. CONCLUSION

To make a communication bridge, a highly accurate, cost effective and an independent glove was designed for deaf and dumb people. The glove is capable of translating their signlanguage gestures into speech through android phone. Smart Glove focuses the translation of gestures into alphabets. Comparing with other approaches, smart glove uses Principle Component Analysis to classify the real time input data for feature extraction.

## VI. ADVANCEMENTS

- The first problem of this Smart Glove is the accuracy of analog value reading from flex sensors is low. Therefore, some letters are hard to recognize. Besides that, letters M,N,O, R, S, T, V and X cannot be displayed because the gesture for those letters have similar gesture with another letters.
- Secondly, applications Text to Speech that used to display the text and convert it into voice only speak in English language.
- Lastly, The completion of this smart glove only can recognize some letters and some words of sign language. Therefore, more sensors need to be used to detect the other part of the body such as arm, elbow, shoulder etc. so that full sign language can be recognized.
- Moreover, the applications that use to convert the text to voice can be enhanced further by using real voice recorded by human to generate a huge speaking dictionary and more natural voice could be heard with ease.

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