

‘Design & Implementation of Sign Language Using Wearable Gloves’

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Abstract— A gesture is used to classify and recognize a signal that enables communication among the disabled person. It is a technique that can be used to make people feel convenient similar to the behavior of normal people. In this article, the communication toolkit abides by a gesture recognition kit that further consists of an audio device and hand gloves with sensors. The sensor captures the gesture and passes it to the display panel where the audio device recognizes and speaks up the gesture making proper two-way communication between persons. In this paper, we talk about the use of a selective panel that depicts what a concerned person wants to communicate through various sets of images stored in it and then speak out using the device. The need for action is reduced due to an in-built mechanism that would be much more efficient.

Keywords — Sign Language; Display Panel; Human-Computer Interface (HCI); Flex Sensors; American Sign Language (ASL); Hand Gesture

1. INTRODUCTION

Human beings communicate and know each other through thoughts, ideas. The best way to present the idea is through speech. Some people don't have the power of speech; the only way to communicate with others is through sign language. The problem with sign language is that it is confined to the people who are also deprived of the power of speech. These people are often termed as deaf and dumb. It is limited to the same set of persons that cannot speak. Deaf and hard of hearing people have the right to choose what they wish to be called, either as a group or on an individual basis. Overwhelmingly, deaf and hard of hearing people prefer to be called "deaf" or "hard of hearing". Nearly all organizations of the deaf use the term "deaf and hard of hearing", and the National Association of the Deaf (NAD) is no exception. The World Federation of the Deaf (WFD) voted in 1991 to use "deaf and hard of hearing" as an official designation. Yet there are many people who persist in using terms other than "deaf" and "hard of hearing". There are various terms used for deaf and dumb people.

- **Hearing-Impaired--** A term much preferred by hearing people, largely because they view it as politically correct. "Hearing-impaired" is a well-meaning word that is much resented by deaf and hard of hearing people. Deaf and hard of hearing people feel that the words "deaf" and "hard of hearing" are not negative in any way at all.
- **Deaf and Dumb--** A relic from the medieval English era, this is the granddaddy of all negative labels pinned on deaf and hard of hearing people. The Greek philosopher, Aristotle, pronounced us "deaf and dumb," because he felt that deaf people were incapable of being taught, of learning, and of reasoned thinking. To his way of thinking, if a person could not use his/her voice in the same way as a hearing person, then there was no way that this person could develop cognitive abilities.

1.1 Sign Language

Sign language is a language which is used for communication between the normal people and disabled people. Sign language relies on sign patterns, i.e., body language, orientation and movements of the arm to facilitate understanding between people. In all around the world about 9.1 billion peoples are deaf and dumb. In their day to day life they faced lot more problems on their communication. Sign language is used by dumb people for the means of communication. Sign languages are used to convey different symbols, different objects etc. They also convey combination of words and symbols. Wherever communities of deaf people exist, sign languages have developed, and are at the cores of local deaf cultures. Although signing is used primarily by the deaf, it is also used by others, such as people who can hear but cannot physically speak, or have trouble with spoken language due to some other disability (augmentative and alternative communication).

Sign language varies from country to country with its own vocabulary and grammar. Even within one country, sign language can vary from region to region like spoken languages.

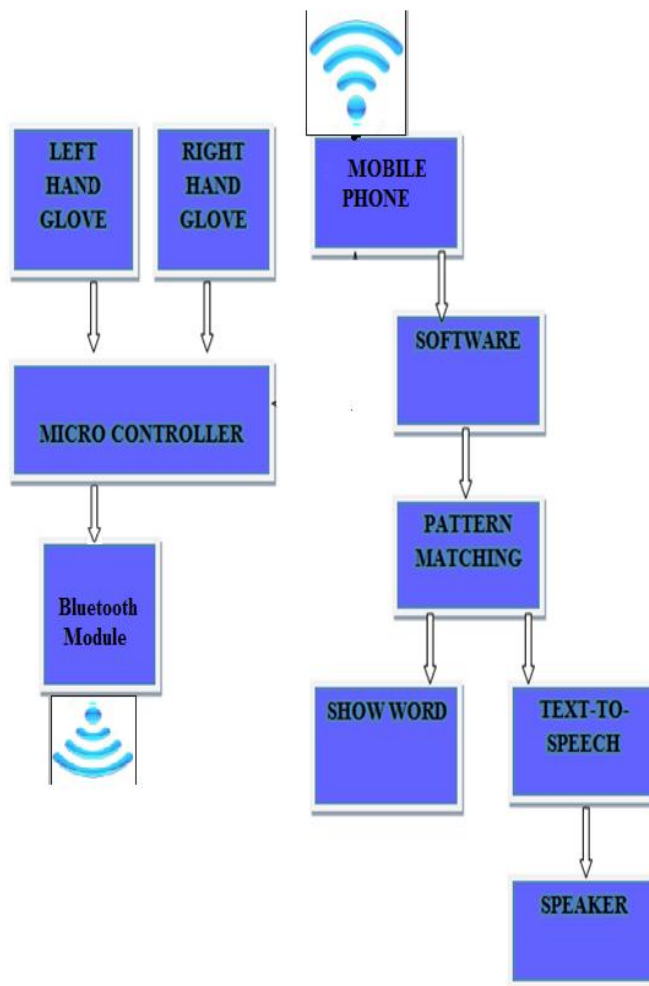
1.1.1 American Sign Language (ASL):

American Sign Language (ASL) is a complete, complex language that employs signs made by moving the hands combined with facial expressions and postures of the body. It is the primary language of many North Americans who are deaf and is one of several communication options used by people who are deaf or hard-of-hearing. American Sign Language (ASL) is a natural language that serves as the predominant sign language of Deaf communities in the United States and most of anglo phone Canada. Besides North America, dialects of ASL and ASL-based creoles are used in many countries around the world, including much of West Africa and parts of Southeast Asia. ASL is also widely learned as a second language, serving as a lingua franca. ASL is most closely related to French Sign Language (LSF). It has been proposed that ASL is a Creole language of LSF, although ASL shows features atypical of Creole languages, such as agglutinative morphology.

1.1.1 Comparison of ASL with Spoken Language

In spoken language, words are produced by using the mouth and voice to make sounds. But for people who are deaf (particularly those who are profoundly deaf), the sounds of speech are often not heard, and only a fraction of speech sounds can be seen on the lips. Sign languages are based on the idea that vision is the most useful tool a deaf person has to communicate and receive information.

ASL is a language completely separate and distinct from English. It contains all the fundamental features of language—it has its own rules for pronunciation, word order, and complex grammar. While every language has ways of signaling different functions, such as asking a question rather than making a statement, languages differ in how this is done. For example, English speakers ask a question by raising the pitch of their voice; ASL users ask a question by raising their eyebrows, widening their eyes, and tilting their bodies forward. Just as with other languages, specific ways of expressing ideas in ASL vary as much as ASL users do. In addition to individual differences in expression, ASL has regional accents and dialects. Just as certain English words are spoken differently in different parts of the country, ASL has regional variations in the rhythm of signing, form, and pronunciation. Ethnicity and age are a few more factors that affect ASL usage and contribute to its variety. Following figure shows the letter of alphabets in ASL.



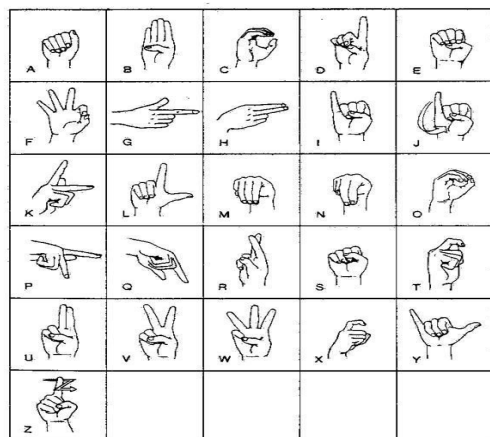


Fig.1.1: The letters of the alphabet in American Sign Language.

1.2 Hand Gesture Recognition

Gesture is defined as an expressive movement of body parts. Gestures are different postures made by the finger curls and bends. Gestures are the medium for communication. In this system the gestures are the basic necessity which are required as the input. Hand gestures may be static or dynamic.

- **Static hand gestures:** Static hand gestures are fixed with respect to time, these gestures do not depend on motion
- **Dynamic hand gesture:** In dynamic hand gestures movement of some portion of the hand is involved with respect to time. These gestures require motion and are based on the trajectory that is formed during the motion in question.

1.3 Sign Language Detection Techniques

Technology has reduced the gap between normal people and hearing impaired people through the systems that converts sign language into speech.

These systems can be broadly classified in two types based on the mechanism used to convert sign language into speech. These are glove based system and vision based system.

1.3.1 Glove based systems: In Glove based systems, a person sign's while communicating are transferred to the computer using gloves worn on hands. The real time sign is compared with the database that contains all the signs added initially to the system. After matching with the correct sign, the data is transferred to text to sound converter system where the data is converted to sound.

1.3.2 Vision based systems: In vision based systems a camera is used to track the persons hand and then based on feature extraction, template matching a decision is taken. It is more complex then glove based mechanism.

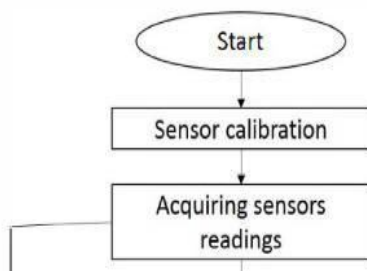
2. System Architecture

The figure shows the overall system architecture flow chart. The system will work in two part.

- (1) Gloves with microcontroller
- (2) Android phone with Bluetooth based text to speech app

1) **Gloves with Microcontroller :-**The gloves from right hand and left hand by pressing the flex sensors will make one gesture which is detected by microcontroller. The microcontroller send one number via Bluetooth module.

(2) **Android phone with Bluetooth based text to speech app.-** The android application is developed to detect the number. The number is detected and match. According to the number a pre defined sentence is displayed on Screen. The same sentence is speak by using text to speech library.



The Flowchart to recognize the alphabets of sign language is shown in Figure. It works on the simple principle that when the device is powered on, the sensors are calibrated. Then the microcontroller acquires the readings from the sensors. The values are matched with a database stored. If the values matches the given letter that is found the character is forwarded to the display unit and the result is displayed and the program stops the process for once else if the character is not matched then the process still goes on and is in the loop till a character is matched from the database.

3. PROBLEM DEFINITION

It was always a serious problem for deaf and dumb people to communicate with each other but somehow they come up with sign language as a solution. Deaf and dumb people face problem in communication to normal person. As for communicating to each other, both need to have knowledge about sign language and this is bit difficult scenario. Normal person can communicate with deaf and dumb people but as they are not aware of all the signs and terminologies it is difficult for them to communicate. Normal speed of any deaf and dumb person of talking is more than normal person after normal person learn sign language. There must be an intermediate system.

4. PROPOSED SYSTEM

In this system two hand gloves is implemented to capture the hand gestures of a user. The data glove is fitted with flex sensors along the length of each finger . The flex sensors output a stream of data that varies with degree of bend. The analog outputs from the sensors are then fed to microcontroller. It processes the signals and perform analog to digital signal conversion. The gesture is recognized and the corresponding text information is identified. The user need to know the signs of particular alphabets and he need to stay with the sign for two seconds. There are no limitations for signs it is hard to build a standard library of signs. The new sign introduced should be supported by the software used in the system. These sensors are attached along the fingers . The degree of bending of fingers and thumb produces the output voltage variation which in turn on converting to analog form produces required voice. A pair of gloves along with sensors enables mute people or old people to interact with the public in the required sentence which is very much helpful for them.

How it works.

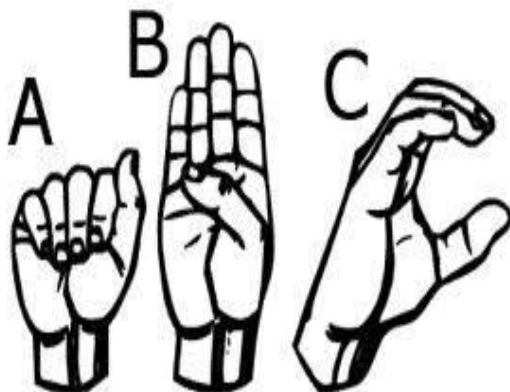
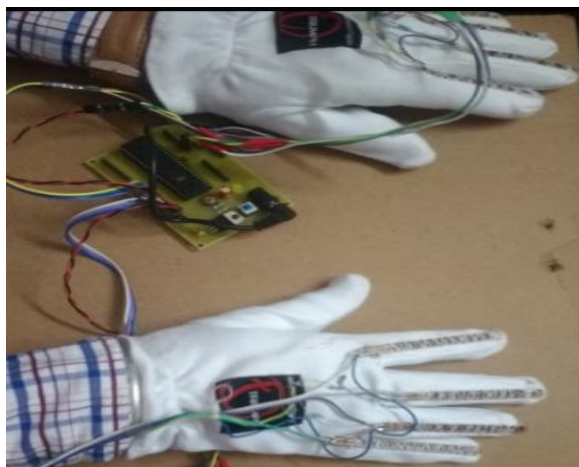


Fig.5.1: American sign language symbols

As per shown in image every word / character has predefined pattern of finger and palm combination. Proposed system is to identify this type of pattern or combinations electronically.

4.1 Hand Gloves

Flex sensor and microcontroller are mounted with the gloves. These flex sensors are attached with micro controller via jumping cables and data send to android phone via a Bluetooth module.



4.2: Glove side

Fig.4.1: Hand gloves

for particular gesture. Initially the flex sensor are having value 0 signaling and if flex sensor bends it turns value 1.

Fig.4.2 Training mode

While training user learn practice patterns in the database, First it read pattern values and check in the database that the inserted values already stored in database or not if the value is already stored in data base then it show message as the value is already stored. As shown in the above figure user bend right hand ring finger particular value is generated which is compared and send signal to android mobile phone via Bluetooth module .Once the number is received the text message is displayed on the mobile screen. The text message is converted into speech by speech application program interface.

. If the threshold value of flex sensors is greater than 750 k-Ω then it indicates that flex sensor is not bend but if the threshold value of the flex sensors is less than 750 k-Ω then it indicates that the flex sensors is bend. Greater than 750 threshold value which means there is no bend, and if the threshold value is less than 750 then it shows there is bend in flex sensor.

4.3 Text To Speech

- At last, Text to speech conversion engine will convert the word in to audible format
- Sign -> Word -> Speech

SAPI (Speech Application Program Interface) is an application program interface (API) provided with the Microsoft Windows operating system that allows programmers to write programs that offer text-to-speech and speech recognition capabilities. Interfaces are provided for the C, C++, and Visual Basic programming languages. Using Microsoft's COM (Component Object Model) architecture, SAPI is the most widely used speech application program interface used today. In the future, Microsoft plans to embed speech technology using SAPI into their operating system. SAPI has seven main components:

1. Voice Command: Voice Command is a high-level interface that provides command control speech recognition for applications. Voice Command allows a developer to create a Voice Command menu that contains voice commands, such as "new file" or "send mail to someone@anywhere.net" that a user speaks into a microphone or other Audio device. The user can control the computer without needing a keyboard or mouse.

2. Voice Dictation: Voice Dictation allows the user to dictate into any application that supports speech recognition. An invisible or virtual edit box receives the text the user dictates and displays the text in an application window. Voice Dictation allows text formatting such as capitalization, translation of punctuation words into punctuation symbols, built-in glossary entries, and correction of the last word spoken or a selected word. Applications that use Voice Dictation classify speech by topics that use different language styles. Topics include e-mail speech, formal writing, or programming speech. Voice Dictation stores the information for each topic on your hard drive.

3. Voice Text: Voice Text converts text into speech that is played over computer speakers or sent over a telephone line. The speech played has several different modes, each with a different voice.

4. Voice Telephony: Voice Telephony uses telephony controls that are similar to Windows controls. Windows controls include buttons, list boxes, sliders and other objects that can be manipulated by a mouse or keyboard. Telephony controls are codes that recognize spoken responses such as Yes or No, your phone number, the date, and the time. Telephony controls create a dialogue between the user and the computer. For example, a user calls a vendor to order an item. The user then answers several questions by speaking into the telephone receiver. The telephony controls recognize these responses and sends them to the application that processes responses. Telephony controls also handle error

In Training mode user can learn different pattern

conditions (these are common with spoken numbers or when the caller does not respond) and variations of answers such as "January 4th" or "tomorrow."

5. Direct Speech Recognition: This is a low-level interface similar to Voice Command. The main difference is Direct Speech Recognition speaks directly to the speech engine.

6. Direct Text To Speech: This is a low-level interface similar to Voice Text that also speaks directly to the speech engine.

7. **Audio Objects:** An Audio Object tells the speech engine where to get its audio.

5. EXPERIMENTAL RESULT

The figure shows typical picture of the glove consist of Flex sensor, Micro controller and mobile interface by using Bluetooth module. The glove is connected to the mobile by the bluetooth.

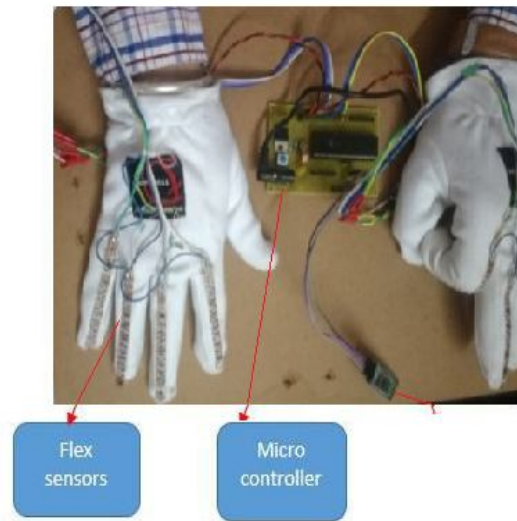


Fig 5.1: Typical picture of the glove



Fig 5.2: First pattern & its result

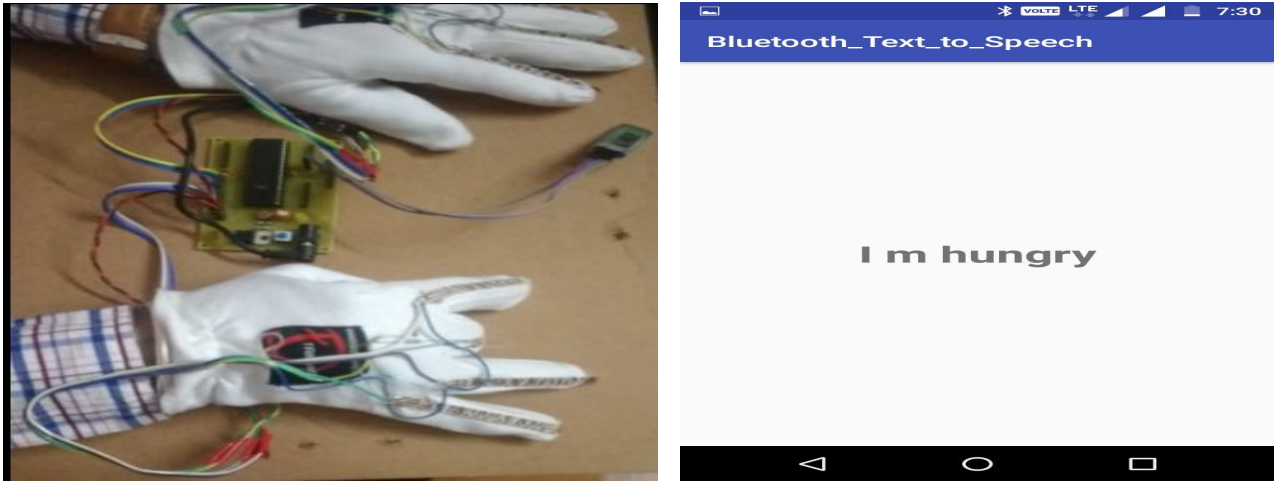


Fig 5.3: Second pattern & its result

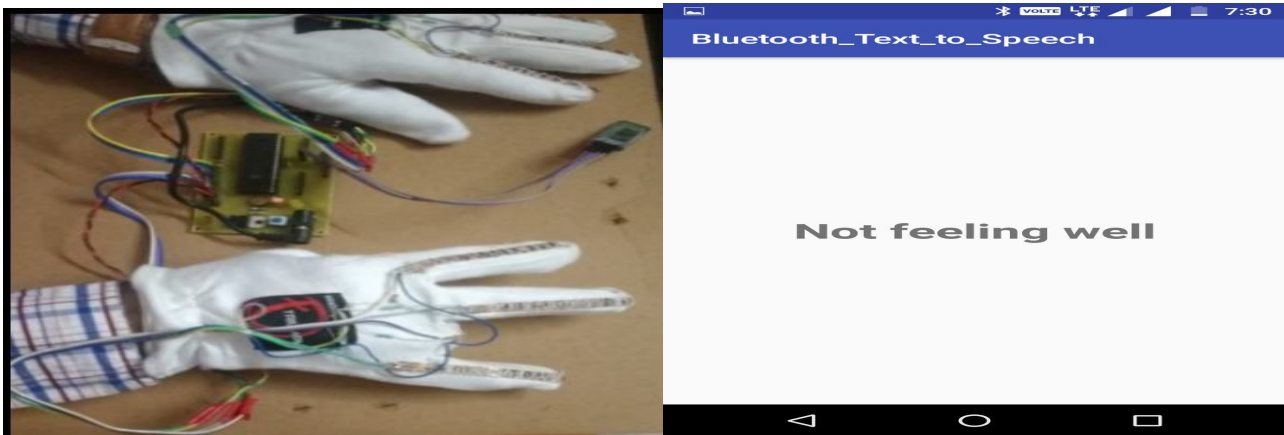


Fig 5.4: Third pattern & its result

6. CONCLUSION

As a sign language is a method to convey the thoughts of Deaf and Dumb people, this system provides the medium which is more reliable and helpful. Here sign gesture gets converted into text and speech so that communication is not limited between them only, utilizing data gloves communication barrier between two different communities is eliminated. Here, the system converts the sign gesture into text as well as speech, using the Gloves. It also facilitates to add more Gestures into the database. And as , the microcontroller is used which is portable and light weighted which makes deaf and dumb people to carry this glove easily.

7. FUTURE SCOPE

In this system, more sensors can be embedded to recognize full sign language with more perfection and accuracy. The system can also be designed such that it can translate words from one language to another. To make this system portable user can also run this system through mobile application. Due to this mobile application the system become more flexible for deaf and dumb people because the bulkiness of the system is very less than the previous version.

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