Sign Speak Sign Language to Verbal Language

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Abstract:
This project aims to find a solution for speech and hearing impaired people generally speech and hearing impaired people use sign language for communicating with others. Our project is to lower this barrier in their way of communication. Here we use a Wireless data glove which is a normal cloth glove fixed with flex sensors is used along the length of each finger and the thumb. Flex Sensor plays the major role, the working of flex sensors are based on their variation in resistance. Their resistance changes depending on the amount of flexion experienced by the sensor. By the use of suitable circuit, responses of the sensors are given to the raspberry pi, based on the responses from the sensors. Raspberry pi is a small microcomputer is used for the working of the program in the hardware circuit which offers high reliability and fast response. Here the device recognizes the sign language Alphabets and Numbers. The main advantages of using this device are it recognizes words and sentences. It is in the process of developing a prototype to reduce the communication gap between differentiable and normal people.

Keywords: sign language; flex sensor, raspberry pi, data glove.

I. INTRODUCTION

Communication is the most important part of our life. About nine billion people dumb are in this world. Loss of hearing and speech can cause people to be lonely and isolated. This can cause some bad effect in their both social and working life. The advancement of embedded system provides a space for designing and developing a translator for sign language to assist in reducing the communication gap between speech and hearing impaired people and normal people. Hand gesture or sign language is a way to communicate between impaired and normal people. We commonly use American Sign Language (ASL). In last few years, there has been increased interest among researchers in this field of sign language, to find most efficient device for those people. Finding an expert interpreter for day to day activities is very difficult and unaffordable. Hence for ease of communication between impaired and normal people we employed various electronics and digital methods. But there are many ways to recognize and analyze the Hand movements. Figure gives the classification of Hand Gesture Recognition Techniques.

Figure 1. Classification of Hand Gesture Recognition Technique

The first Technique is the Hand Glove-based Technique uses a Glove equipped with different type of sensors like optical, electrical, etc. This sensor based Glove collects the data according to the Hand and wrist movements and then this data is analyzed. Finally, the corresponding predefined action to the data received is taken. The sensor based technique offers greater mobility. The second Technique is the Vision-based Technique that uses a camera to capture the Hand movements and then various image-processing techniques are employed to study the hand gestures and perform the particular tasks for every posture accordingly. The disadvantage of vision based techniques includes complex algorithms for data processing. Another challenge in image and video processing includes variant lighting conditions, backgrounds and field of view constraints and occlusion. The third Technique is the hybrid of the above two techniques. To make the system more reliable and accurate data from both the techniques are collected and analyzed. The sign language interpreter proposed in this paper uses a glove fitted with sensors. Sign is non-verbal form of language, which uses gestures to convey our thoughts. For this a particular movement of the hands with a specific shape made out of them is used. After processing, corresponding audio is produced. Signs are used to communicate words and sentences to audience. We make use of sign speak glove which is a normal, cloth glove fixed with flex sensors along the length of each finger and thumb. Output from the sensor is processed by the raspberry pi and is transmitted to pc side for further processing. The raspberry pi and sensor used in data glove will help to lower the communication gap between speech and hearing impaired person and normal person. This paper contains the map to develop the Sign speak. It gives the related works, explains the system architecture, characteristics and operations of each of the components in the system architecture. Also provides the applications and future works, of this device.

II. RELATED WORK

The Related Works Using the concept Sign language conversion, few attempts have been made in the past to recognize the Sign language made using hands but with limitations of recognition rate and time which include:

i) Gesture based HCI and sign language recognition using Kinect Sensor
A group of students from Jawahar Education Society’s Institute of Technology, Management and Research, Dhanashri Chaudhari, Chandani Patil, Mohini Magar, Gayathri Pagar
demonstrated their project in ‘Gesture based HCI and sign language recognition using Kinect Sensor’, this can be work in 2 ways. In first way it helps to talk to impaired person to normal person. The actions of impaired persons will be taken using Kinect camera. Then it displays corresponding skeleton. It is used to calculate the distance with respect to spinal cord; this gives numeric values when user performs gestures. If match is found corresponding audio will be generated. If not so actions can be added to database. In second case audio can be converted to text and sign. In this audio will be recorded using Kinect camera through microphones. This audio is transferred to text and matching images. The main drawback of this system is, it is not at all easy to handle. We should always need to carry a camera along with us where ever we go.

ii) CMOS camera based conversion
CMOS camera transmits image data by UART serial port. The UART performs the serial-to-parallel conversions on data received from a device and the parallel-to-serial conversion is done on the data received from the Microcontroller. Hand gestures were detected using CMOS camera there are 3 steps
- Capture the image of the gesture
- Edge detection of the image
- Peak detection of that image

iii) Leaf switches based glove
Leaf switches are similar to normal switches but these are designed in such a way that when pressure is applied on the switch, the two ends of it come into contact and the switch will be closed. They are placed on the each fingers of the glove. There will be two of them placed on one finger so that the two terminals of the switch come into contact when the finger is bent. The open and closed value of the switch is referred for this conversion. Disadvantage: After prolonged usage of this switch instead of being open when the finger is straight, it will be closed resulting in improper transmission of gesture.

iv) Copper Plate based glove
In this project they fix the copper plate on the palm as ground. The copper plates will indicate a voltage level of logic 1 in the resting position. When the copper strips placed on the fingers come in contact with the ground plate on the palm, the voltage associated with them is drained and the voltage level will indicate logic 0. Disadvantage: The usage of copper plates in the glove will make the glove bulky, so it is unsuitable to use for a long time.

v) Hand Sign Interpreter
The students Ajinkya Raut, Vineeta singh, Vikrant Rajput, Ruchika Mahale from Pune,”Hand sign interpreter”[1], they used Glove based method, that had sensor devices for digitizing hand and finger motions. This is similar to [4]. Mainly system hardware consists of an accelerometer and Flex sensor attached to the glove which are input devices. The output from the flex sensor is converting to voltage signal using voltage divider. The signals from input devices will give to voltage divider and then processor (heart of the system). Here five sensors were used. Accelerometer works on the gravity concept. Further the accelerometer output and voltage signal will give to ADC (analog to digital converter) of the processor. Sensor output will continuously monitor. The audio files previously recorded in the memory IC (which act as both input and output device) for the different hand signals. Processor checks the output from sensor and accelerometer and then checks the ADC count in the lookup table if an audio signal is there then fetch from the memory provided to the amplifier, thus to speaker. LCD displays the corresponding text.

Disadvantage: This can modified to wireless one actually it is not disadvantage.

vi) Eigen vector approach for gesture to text conversion
This project was implemented using Eigen vector approach for gesture to text conversion. Eigen vectors were provided with the direction along which the linear transformation acts by stretching, compressing. The Eigen vector and Eigen value are the functions of linear transformations. Here they are using 4 methods. The fore methods are gesture recognition, the approach of skin colour segmentation, gesture extraction and corresponding matching is analyzed. Then the output text converts into the voice which stored in the database. In gesture recognition sign is captured using high resolution web camera and then we have to specify the format for video otherwise a default value will be taken. The second phase is skin filtering that differentiates human body objects on the basis of skin colour pixels from the non-skin colours pixels. Image captured in the form of RBG. It’s converted into the HSV image by using this method.

Where $\delta=(\text{MAX-MIN}), \text{MAX}=\max(R,B,G) \ \text{MIN}=\min(R,B,G)$
After that feature will be extracted and corresponding gesture will be matched and given as output. This system is efficient for hand movements, face gestures recognition etc.

vi) Digital Vocalizer
Another student Kiran R, College of Engineering Trivandum, India, designed a system gesture vocalizer that is mainly consist of Sensors (flex) and accelerometer will placed on Dumb person’s hand, and a microcontroller for converting hand gestures to audio as well as visual data. Flex sensor will detect the bending of fingers, accelerometer for getting orientation of hand, audio processor chip for storing and playing the corresponding audio file and also LCD display for displaying the messages. It is same as [1].

Drawback: this system can be used only for partial sign language because in this project he used 2 flex sensors only (thumb and index finger). Another drawback of the system is only the cost, one can make the system is portable and handy by adding wireless features.

vii) Sign to voice using pic microcontroller
Senior assistant professor Manikandan. R from school of computing, sastra university, Tamilnadu, India designed a system same as [1],[2]. Only difference is the PIC microcontroller, this method is more precise on the hand movement and different languages can be installed without modifying the code in PIC microcontroller. And another difference is it uses wireless communication unit by adding Bluetooth on the system. Disadvantages: system efficiency can increase by PIC microcontroller, Bluetooth enable short range of communication.
III. DESIGN METHODOLOGY

Figure 2. Block diagram of Sign Speak

This system uses raspberry pi, which is the main part of the system. Raspberry pi is the heart of the system. We make use of flex sensors which are fitted to each finger. Flex sensors are analog resistors. They work as analog voltage dividers. Carbon resistive elements within a thin flexible substrate are present inside the flex sensor. When the substrate is bent, sensor produces a relative output proportional to the bent radius. Flex sensors are sensors that changes resistance depending on the amount of bend on the fingers. They convert the change in bent to electrical resistance. The more the bend, the more the resistance value. They work as variable analog voltage divider.

A. Raspberry Pi

The Raspberry Pi is a microcomputer, and from a connections point of view it doesn’t look much different to a normal desktop computer. Raspberry pi is the heart of this method. It has USB ports for connecting a keyboard and mouse, and a video output port for connecting up a display. Because it is more compact and lower cost than a large desktop PC, it becomes possible to use the Raspberry Pi or other small single board computers (SBCs) as they are known, for many scenarios where a desktop or laptop PC would not be feasible. Often you may want to connect up other ‘things’ to a computer. For example you may wish to use a computer to measure the brightness level and automatically control lights, or to sound an alarm if an intruder is detected. Broken down to more general terms, there is a desire to be able to use a computer to control (also known as to ‘output’) to electronic circuits, and to gain useful information (aka obtain ‘input’) from circuits. This is where the Raspberry Pi and other single board computers excel because one key difference between SBCs and desktop or laptop PCs is that SBCs usually have general purpose input/output (GPIO) capability. This is lacking on larger PCs.

B. Flex Sensor

Flex sensor is the most suitable sensor to measure and capture the movement of the fingers. Sensors that changes resistance depending on the amount of bend on the fingers. They convert the change in bent to electrical resistance. The more the bend, the more the resistance value. They work as variable analog voltage divider.

C. LCD display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

Figure 3. Raspberry pi pins

Figure 4. Flex Sensor

Figure 5. Pin out of LCD

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed
in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

D. APR Module
The APR9600 device offers true single-chip voice recording, non-volatile storage, and playback capability for 40 to 60 seconds. The device supports both random and sequential access of multiple messages. Sample rates are user-selectable, allowing designers to customize their design for unique quality and storage time needs. Integrated output amplifier, microphone amplifier, and AGC circuits greatly simplify system design. The device is ideal for use in portable voice recorders, toys, and many other consumer and industrial applications.

![Figure 6. APR9600 Voice Recording Playback](image)

APLUS integrated achieves these high levels of storage capability by using its proprietary analog/multilevel storage technology implemented in an advanced Flash non-volatile memory process, where each memory cell can store 256 voltage levels. This technology enables the APR9600 device to reproduce voice signals in their natural form. It eliminates the need for encoding and compression, which often introduce distortion.

IV. APPLICATIONS
The proposed system will bridge communication gap between impaired and common people. The main application of this is can be used at public places like railway station, bus stand and airport and also counters of hotels, banks etc. to communicate with different people. This can be even helpful in the case of fire extinguishing process. Mute people can even take seminars, presentations etc. through continuous lectures.

Ability to operate a PC is increasing now days. For a disabled person they found difficulties to operate a system. Through this it helps to manage a computer without using hand and any other physical touch. This device can be used for computer gaming, The system also has several advantages like low cost, flexible, portable, compact, handy and less power consumption.

V. CONCLUSION
From the survey, there are two types of methods to convert sign language to audio and text. One method is to Ca used at public places like railway station, bus stand and airport and also counters of hotels, banks etc. to communicate with different people. This can be even helpful in the case of fire extinguishing process. Mute people can even take seminars, presentations etc. through continuous lectures.

Ability to operate a PC is increasing now days. For a disabled person they found difficulties to operate a system. Through this it helps to manage a computer without using hand and any other physical touch. This device can be used for computer gaming, The system also has several advantages like low cost, flexible, portable, compact, handy and less power consumption.

VI. FUTURE WORK
After the completion of this review suggests that these wired gloves can support different language mode. Also one can add learn mode for learning sign language and make this system wire less so that it become portable and handy. Another future work is developing a mobile application of such system so that almost everywhere we can use. After this system this will be a golden opportunity to use in the schools, college, airports, hospitals, courts briefly everywhere around the world.

VII. REFERENCES
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