International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 07 | July-2016 www.irjet.net p-ISSN: 2395-0072

Hand Gesture recognition System for Speech Impaired People: A Review

Anagha J.Jadhav[1], Mandar P. Joshi[2]

1M.E Student, Department of electronics and telecommunication, R.H Sapat College of Engineering Management and research , Nashik , Maharastra, India
2Asistant professor, Department of electronics and telecommunication, R.H Sapat College of Engineering Management and research , Nashik , Maharastra, India

---

Abstract - *Communication is important part of human life. Communication helps in mutual understanding. All over world, deaf and dumb people struggle in expressing their feelings to other people. various challenges are experienced by speech and hearing impaired people at public places in expressing themselves to normal people. Gestures play a major role in the daily activities of human life. In other words, Gesture recognition refers to recognizing meaningful expressions of motion by a human, involving the hands, arms, face, head, and/or body. Between all the gestures performed .Hand gestures plays an important role which helps us to express more in less time. Now a day, Human-Machine interface has gained a lot of research attentions employing hand gestures.*

***Key Words*: speech impaired people, Gesture recognition, HMI, Gesture**

1.INTRODUCTION

The hand is one of the richest sources of tactile sensory data, enabling precise, and complex manipulation. It uses the delicate manipulation ability of the hand, human robot interaction systems which are operated by the hand have been actively researched for rehabilitation, virtual reality, entertainment, tele-operation, power assistance, and so on. For the development of such systems, measurement of unconstrained hand motion should be preceded. hand motion measurement systems have not fully been exploited yet.

Loss of hearing and speech can cause people to become isolated and lonely, having worse affect on both their social and working life.to represent themselves they make use of sign language, Sign Language is a well structured code gesture where every gesture has a meaning assigned to it. Sign Language is the only means of communication for deaf people. With advancement of science and technology many techniques have been developed not only to minimize the problem of deaf and dumb people but also to implement it in different fields. Sign language is a language which instead of voice or sound patterns uses manual communication and body language to convey the message. This involves mostly the combination of shapes, orientation and movement of the hands. Sign language is not only used by deaf but also who can hear, but cannot physically speak.

We are going to design a system which will translate sign language and at the output we are having playback voice module, such that we can get output in form of sound. Flex sensors and accelerometer will be used to sense the hand gesture. The device designed will portable and user friendly. It will be flexible to any common person. Several researches are made on hand gesture, some of the methods are discuss in next section.

1.1 REVIEW OF LITERATURE

- S. Sidney Fels and Geoffrey E. Hinton, 1997[1]

proposed a system which translates hand gestures to speech through an adaptive interface. Hand gestures were mapped continuously to ten control parameters of a parallel formant speech synthesizer. The mapping allowed the hand to act as an artificial vocal tract that produces speech in real time. The system have used several input devices like Cyber glove, Contact Glove, three-space tracker, and a foot pedal a parallel formant speech synthesizer, and three neural networks. The gesture-to-speech task was divided into vowel and consonant production by using a gating network to weight the outputs of a vowel and a consonant neural network.

- Chin-Shyurng Fahn and Herman Sun, 2005 [2]

presented the development of a data glove system using magnetic induction coils as finger movement sensor. These are small sensor coils, the magnetic field intensity varies with respect to time. It has capability of measuring ten degree of freedom of a hand with only five sensors which were arranged on the palmer surface.as these sensors are arranged on the finger phalange positions, there is no contact point between the sensors and the finger joints. Due to these the shape of the sensor does not change as the finger bends, which would maintain the quality of measurement and lifetime of the sensor. To make the use of gloves convenient, simple and efficient calibration process which consist of two steps is also provided, so that all required parameters can be determined automatically. They also adopted time division method to prevent the interference among the generator coils and the sensor. The experimental

results of the sensors performing linear movement and bending angle measurements were directly carried out using an oscilloscope in less noisy environments. As in this paper they have magnetic coils as sensors the systems is more immune to electromagnetic interference.

- Michiko Nishiyama and Kazuhiro Watanabe,2009, [3].

presented a wearable sensing glove with embedded hetero-core fiber-optic nerve, which uses hetero-core fiber-optic nerve as sensors that detect finger flexion to achieve unconstrained hand motion monitoring. As shown in fig.1 The sensor Hetro core consist of a transmission fibre line whose diameter is 9µm. single mode of transmission is used in Hetro core fiber sensor e back of the hand such that they are not affected by wrinkles in the glove joints.A laser diode of wavelength 1.31µm and an optical power meter are used to measure the transmission loss. Splicing machine is also used. The sensor after calibration is able to detect the joint angles of the fingers with differences in hand size and the hetero-core sensing technique allows the sensing glove to be constructed with a minimum number of sensor points. The hetro core sensors reveals monotonic chareteristic of optical loss performance with respect to the flexion angle of joints. But regardless of this some optical fiber loss can be observed using these sensors.

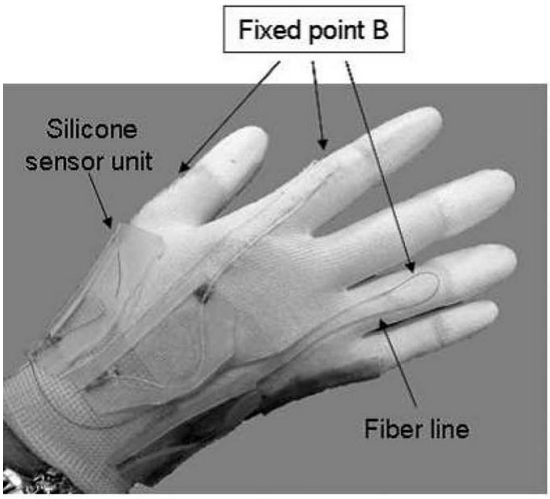

Fig1 : wearable sensing glove[3]

- Kotaro Tadano, Masao Akai,2010[8]

proposed a grip Amplified glove using pneumatic artificial rubble muscles (PARMs) as shown in fig 3 . The PRAM is suitable with total 10 degrees of freedom and consist of four units. To achieve power assist motion ,a PI control, which is based on pressure value from a balloon sensor is performed .balloon sensor makes the the applied part free from the electricity. EMG patterns of muscles are measured to evaluate the power assist performance. The system becomes more complicated and bulky.

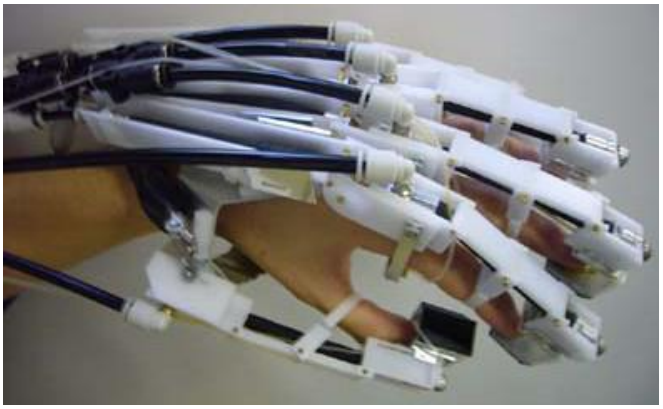

Fig 2:- Developed power amplified glove [4]

- Kang Li, I-Ming Chen, Song Huat Yeo,2010,[5]

proposed the design and validation of a wearable glove-based multi-finger motion capture device (SmartGlove) with a specific focus on the development of a new optical linear encoder (OLE) as shown in fig 4. The OLE has a compact size, light weight and low power consumption. The characterization tests also show that the OLE's digital output has good linearity and accuracy. The first prototype of Smart Glove which uses ten OLEs to capture the flexion/extension motion of the 14 finger joints is constructed based on the multi-point sensing method. A user study for the evaluation of Smart Glove using a standard protocol shows high repeatability and reliability in both the gripped and flat hand positions compared with four other evaluated data gloves using the same protocol. Sensor used in OLE is Avago's optical mouse sensor product ADNS-3530. Smart gloves uses the Arduino Diecimila/Bluetooth based on Atmega 168. They carried out two tests ,the Grip test and the Flat test to analyze the repeatability and reliability

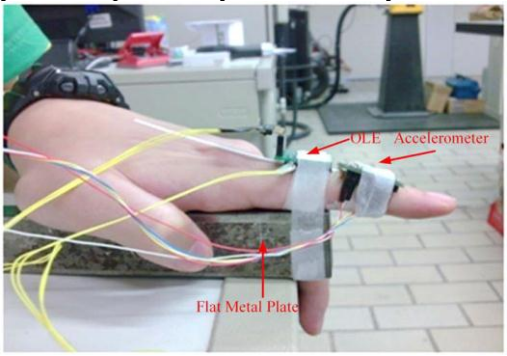

Fig 3: Set-up of OLE's Human finger Test[5]

- Ali Karime, Hussein Al-Osman,2011, [6]

proposed a system for patient of post stroke with wrist disabilities. this system provides a cost effective home rehabilitation solution for patient who stay far away from the treatment centers. The system extends the functionalities of the current passive rehabilitation devices by transforming them into digital ones that could be used as interfaces with computer games designed for training purposes.it mainly aims on translating the wrist movement

into gaming actions meant to provide entertainment and thus motivate the patient to spend more time for exercising. They have used 3D accelerometer for the wrist movements, for communication RS232 is used.

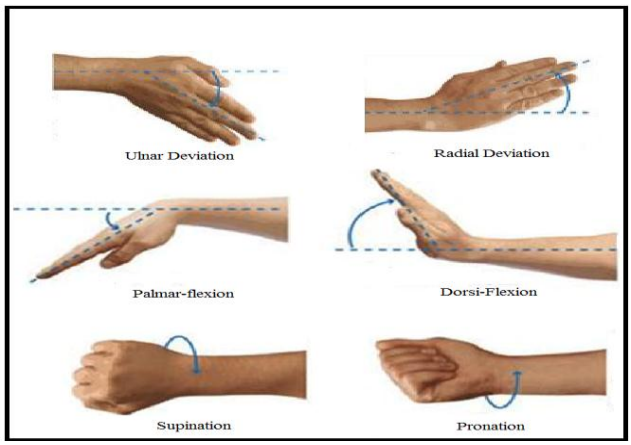

Fig 4:- Motions of Wrist and Forearm supported by E-glove[6]

- P. Subha Rajam, Dr. G. Balakrishnan,2011,[7]

proposed a method that provides basis for the development of south Indian languages. A set of 32 signs, each representing the binary 'UP' & 'DOWN' positions of the five fingers was defined. The palm side of right hand images are taken and are loaded at runtime i.e. dynamic loading. The method has been developed with respect to single user both in training and testing phase. The static images have been pre-processed using feature point extraction method and are trained with 10 numbers of images for each sign. by identifying the finger tip position of static images using image processing techniques the images are converted into text. The images in RGB color is converted into grey scale images which are converted into black and white image. Canny Edge Detection technique is used to extract the outline images of palm. MATLAB is used to obtain the experimental results.

- Geetha M, Rohit Menon ,2011 [8]

proposed a method to recognize symbols from (A-Z)which have static gesture. In this they have used polygon approximation method with Douglas-Peucker algorithm. Douglas-Peucker algorithm is used to approximate the boundary of gesture image. In this the edges of the gesture is approximated, each edge of the polygon is assigned to the difference Chain Code Direction. There are two phases in first phase finger count is detected and in second phase shape of the gesture is recognized. Canny edge detection algorithm is also used. The proposed system also recognizes the open fingers and close fingers gesture. The system becomes more complex.

- atoshi Ueki, Haruhisa Kawasaki,2012 ,[9]

presented a virtual reality (VR)-enhanced new hand rehabilitation support system that enables patients to exercise alone. This system consist of a multi degrees- of-freedom (DOF) motion assistance robot as shown in the below fig.2, a VR interface for patients, and a symmetrical master slave motion assistance training strategy called self-motion control, in this the stroke patients healthy hand on the master side creates the assistance motion for the impaired hand on the slave side. To assist in performing some fine exercise are needed for the functional recovery of the impaired hand, the robot was constructed in an exoskeleton with 18 DOFs, to assist finger and thumb independent motions such as flexion/extension and abduction/adduction, thumb opposability, and hand wrist coordinated motions. To enhance the effectiveness of the exercises, the VR technology was designed for audio-visual instructions of each training motion designed with the input of clinician researchers. This system was specially developed for the patients who need hand rehabilitation and are disabled only by one side.

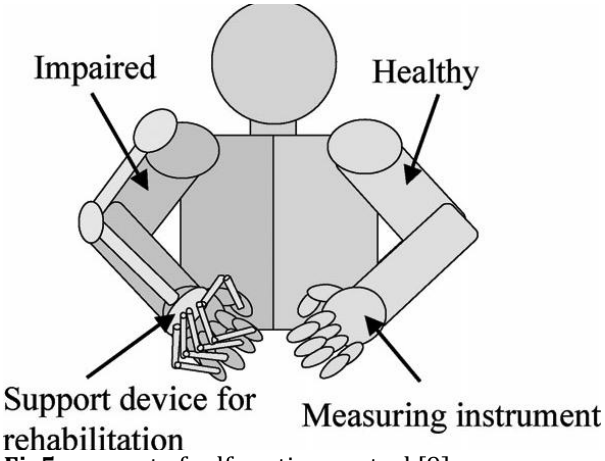

Fig5: concept of self-motion control [9]

- Yun Li, Xiang Chen,2012[10]

proposed the Data Identification of constituent components of each sign gesture which can be beneficial to the improved performance of sign language recognition (SLR), specially for large-vocabulary SLR systems. In this they have two sensors namely accelerometer(ACC) and surface electromyography(sEMG)sensor ,accelerometer is used to capture kinematic information and sEMG measures the electrical activity produced by skeletal muscles. Both hands are used, mainly right hand is used to produce the main words and left hand produce the supported words. A sentence is divided into sub word namely the hand shape, orientation, and movement. The detected sub-word segment, average is calculated for the 4 channels of left side, threshold level is set, lower threshold may produce false alarm and higher one is likely to increase the dealay. Fuzzy k- means algorithm is also used.

- C. S. Weerasekera, M. H. Jaward ,2012[11]

proposed a robust approach for recognition of bare handed static sign language. They have used novel combination of features which include Local Binary Pattern (LBP) histogram feature based on color and depth information and geometric

features of hand. Linear binary Support Vector Machine (SVM) classifiers are used for recognition. In case of multiple matching it is coupled with template matching. Kinetic depth sensor is also used to accurately measure hand segmentation. The results were obtained by performing gestures by 12 non-trained signers.

- Celestine Preetham, Girish Ramakrishnan,2013 [12]

proposed a prototype for gesture recognizing glove. They have used low cost material velostat for making piezoresistive sensors. These sensors are used to detect the bend in the fingers and to map the data into to a set of character by implementing a Minimum Mean Square Error machine learning algorithm. The recognized character is then transmitted via Bluetooth to Android Phone, which transforms text to speech,MSP430 microcontroller is used ,MATLAB is used for testing the results.

- Watcharin Tangsuksant, Suchin Adhan, Chuchaert Pintavirooj,2014, [13]

They translated ASL from static postures. In this they have designed the glove with six different colored markers and developed algorithm for alphabet classification. They have set the system by set by two cameras in order to extract 3D coordinate points from each marker. There are three main important processes for algorithm consisting of marker detection by using Circle Hough Transform, computation of all feasible triangle area patches constructed from 3D coordinate triplet, and feature classification using feed forward back propagation of Artificial Neural Network. In this paper, they have installed black glove with 6 makers which is designed and constructed. Five makers are attached on the fingertip leaving one maker on the palm center. The person wearing the black shirt and the black glove will be captured with two USB cameras installed on the desk. The 640x480 pixel color image acquired from two camera are used for 3D extraction of maker coordinates using a DLT algorithm.

- Imran Hussain, Anjan Kumar Talukdar ,2014,[14]

proposed a hand gesture recognition system for Ameriacn Sign Language recognition using important features of hand such as fingertips, palm center etc. The system is able of recognizing hand gestures even when the fore-arm is involved and it can tolerate a certain rotation of palm and fore-arm. They have implemented principal component analysis to remove ambiguity between two similar types of gestures and given emphasis to detect movement epenthesis by means optical flow technique.

- Yeongyu Park, Jeongsoo Lee, and Joonbum Bae ,2014[11]

proposed the system which consists of linear potentiometers, flexible wires and linear springs, which make the whole system compact and light not to interfere with the natural finger motion. The finger joints are smoothed to avoid wrinkles ,when the finger is flexed, a flexible wire is attached on the back of the finger. As the flexible wire is moved by the finger motion, the joint angles are calculated by measuring the length change of the flexible wire. A linear potentiometer with a linear spring are used for maintaining wire tension which is applied to measure the joint angle. Because the motion of the proximal interphalangeal (PIP) is dependent on the distal interphalangeal (DIP) joint, only two linear potentiometers are applied for each finger. A compact sensing module including ten linear potentiometers and springs is attached on a glove. By simply wearing the sensing glove, the finger motions can be easily measured with an intuitive program interface. Results are first verified by using wooden hand. IMU sensors are used, which are able to measure joint angles of aperpendicular three axis, but only flexion/extension motion angle is measured and compared with the potentiometer measurement .here the systems becomes complicated and bulky as the components are mounted on the upper surface of the hand.

2. OVERVIEW OF SURVEY

The table 1 shows a overview of survey, it shows which hardware software are used in particular design, also specifications are mentioned.

Table -1: Survey Overview

Ref no.	Hardware used	Software used	Specification
[1]	• Three space tracker • foot pedal • contact gloves	--	Vowel and consonants are detected
[2]	• Magnetic induction coil as sensor • Angle measurement device • Distance measurement device	--	Bending angle and linear movements of the hand
[3]	• Fiber optic nerves	MATLAB	Finger flexion

[9]	• Hand motion assist robot • Finger motion assist mechanism • HRP-3P-CN control board		Self-motion control
[10]	• Accelerometer • surface Electromyography(sEMG)	MATLAB R2009b	Chinese sign language recognition
[13]	--	• Circle Hough Transform • Feed forward back propagation ANN	A-Z letter Recognition

3. CONCLUSION

Hand is the most richest source for communication between the people. speech impaired people uses sign languages to interact with people. To reduce the communication gap between speech impaired people and normal people the above survey was carried out. the above survey also shows some drawbacks such as in many systems image processing is used which is very tedious process. In some papers bulky and complicated hardware is used which is difficult to carry and also less portable.in some cases optical fiber is used as a sensor but optical losses can be observed. To avoid this we are going to design a portable system using flex sensors. Also the system will become less complicated and user friendly.

REFERENCES

[1] S. Sidney Fels and Geoffrey E. Hinton," Glove-TalkIIA Neural-Network Interface which Maps Gestures to Parallel Formant Speech Synthesizer Controls"IEEE Transactions On Neural Network, Vol. 8, No. 15,,pp.977 , September1997

[2] C. Fahn and H. Sun," Development of a Data Glove With Reducing Sensors Based on Magnetic Induction" IEEE Transactions On Industrial Electronics,Vol.No.52 ,pp.585-594 , April 2005

[3] M.Nishiyama and K.Watanabe ,"Wearable Sensing Glove With Embedded Hetero-Core Fiber-Optic Nerves for Unconstrained Hand Motion Capture" IEEE Transactions On Instrumentation and Measurement, Vol. 58, No.12, December 2009, pp. 3995-4000.

[4] K. Tadano, M. Akai," Development of Grip Amplified Glove using Bi-articular Mechanism with Pneumatic Artificial Rubber Muscle" IEEE International Conference on Robotics and Automation, 2010

[5] K. Li, I.M. Chen, S. H .Yeo," Design and Validation of a Multi-finger Sensing Device Based on Optical Linear Encoder" IEEE International Conference on Robotics and Automation, May 2010, pp. 3629-3634

[6] A. Karime, H. Al-Osman," E-Glove: An Electronic glove with Vibro-Tactile feedback for wrist rehabilitation of post-stroke patients" IEEE International Conference,2011

[7] P. Subha Rajam, Dr. G. Balakrishnan," Real Time Indian Sign Language Recognition System to aid Deaf-dumb People", IEEE International conference, 2011.

[8] Geetha M, R. Menon," Gesture Recognition for American Sign Language with PolygonApproximation"IEEE International Conference on Technology for Education,2011.

[9] S. Ueki," Development of a Hand-Assist Robot With Multi-Degrees-of-Freedom for Rehabilitation Therapy" IEEE Transactions On Mechatronics, Vol 17 No.1,pp.136-146, Februrary 2012.

[10] Y. Li , " A Sign-Component-Based Framework for Chinese Sign Language Recognition Using Accelerometer and sEMG Data" IEEE Transactions On Biomedical Engineering, Vol. 59, No. 10,pp.2695-2704,Octoboer 2012.

[11] C. S. Weerasekera, M. H. Jaward, and N. Kamrani "Robust ASL Fingerspelling Recognition Using Local Binary Patterns And Geometric Features" IEEE International Conference,2013.

[12] C.Preetham,G. Ramakrishnan," Hand Talk-Implementation of a Gesture Recognizing Glove", IEEE conference on Texas Instruments India Educators' Conference, 2013.

[13] W. Tangsuksant , "American Sign Language Recognition by Using 3D Geometric Invariant Feature and ANN Classification", IEEE International Conference on Biomedical Engineering, 2014.

[14] I.Hussain, A.Kumar Talukdar, K. Kumar Sarma" Hand Gesture Recognition System with Real-Time Palm Tracking" IEEE India Conference (INDICON),2014.

[15] Y. Park, J. Lee, and J. Bae," Development of a Finger Motion Measurement System using Linear Potentiometers" IEEE International Conference on Advanced Intelligent Mechatronics, 2014.