A Review on sensor based communication kit for impaired society

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***Abstract*— A gesture is used to classify and recognize a signal that enables communication among the impaired community. It is a technique that has been in use to make people feel comfortable just like the normal people behave. In this article, the communication toolkit comprises a gesture recognition kit that comprises of an audio device, a display selective panel and an eyeglass with inbuilt camera. The camera captures the gesture 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 selective panel that depicts what the intended person want to communicate through various set of images stored in it and then speak out using the device. The need of action is depleted due an in built mechanism that would be much more efficient**.

***Index terms*— Sign Language; Display Panel; Human-Computer Interface (HCI);Kalman filters; Artificial neural network (ANN);Hidden Markov Models (HMM); embedded glass.**

I. INTRODUCTION

Gestures take back their usage to the ancient times back at the days when there were no effective means of communication known to the communities. Nodding the head or making some signs using hands were a liable means considered at that period which even exists in today's lifestyle. Sign language has been a part of life for the individuals born impaired. As a means of communication, Sign language has been used for years and for years to come by the deaf and dumb community of individuals for carrying out interactive communications. It emphasizes on manual and non-manual signals where the manual signs involve fingers, hands, arms and non-manual signs involve face, head, eye and body.

Gesture recognition has wide ranging [1] applications:

- Developing new standards for hearing impaired.
- Enabling people to communicate with computers.
- To detect the sign language.
- Communicating through video calls.
- To allow learning capabilities to be shared from two or more different places through telephonic conversations.
- Applying various methods for lie detection

Gestures exist in one to many mappigs from the concepts to expressions and vice versa. Gestures are completely unpredictable and unclear, that is they are totally random [2]. Gestures can be either static or dynamic. They include different types of gesture movements comprising of hand and arm gestures in which the expressions can be made through fingers and wrist including the arm movement. The another type is of hand and face gestures in which it can be done by just nodding the head, shaking of the mouth, raising the eyebrows, showing fear, anger, excitement, happiness and sadness etc. The another type is of body gestures that include full body motion for an instance walking style of a person and the way one person interacts with the other depicts body language. The another method of gesture detection is to use 2D projection of 3D hand gesture to collect clear image of the palm with full contrast to detect edges reliably [3,4].

To make these conversations between certain type of communities as well as some targeted individuals more successful and much more efficient, a different technique is presented in this paper comprising a toolkit with

detachable parts like wrist wearable tool. The toolkit in holds two bands that the impaired person will wear, one on wrist and other below elbow joint when needed. There will be LED light attached to the kit that signifies that it has been properly wore. An audio jack is also connected to the wrist band. This will work for those who are blind as well as dumb. The main motive starts with the toolkit which is carried along every time and used whenever the communication is to be carried out between the individuals. Depending upon the location of the environment, the setup provides proper light visibility. That particular activity is carried out by selecting particular gesture and seeking out an audio. After that the connectivity of the kit is established to check the validity of the gestures. After confirmation, of the image in the database the gesture will be considered to be recognized. The audio device will play sound regarding that particular gesture having particular meaning therefore, making the communication between the communities successful.

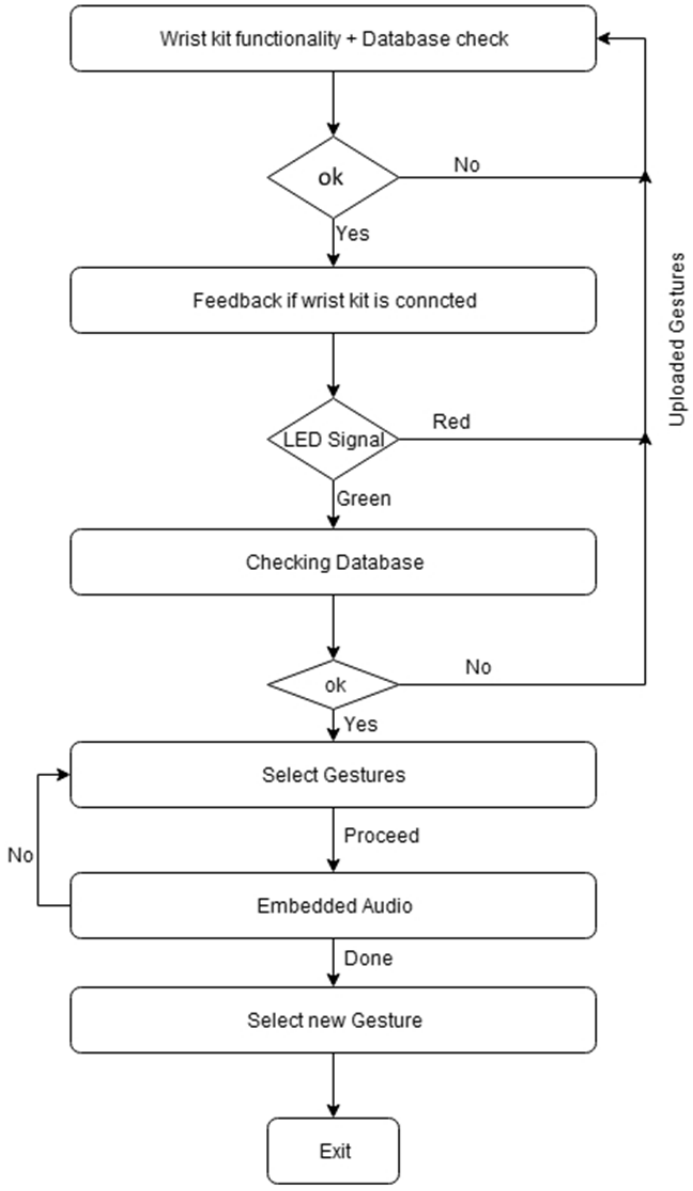

Figure 1: Flow of work

There are many techniques used to recognize gestures. Some of the techniques include mathematical operations using hidden markov model [5] and few approaches were based on soft computing [6]. The other approaches were carried out either by developing hand gloves or the body suits that were limited to human computer interaction and did not show any response in the virtual environment. [7,19].

A. Hidden Markov Model (HMM)

The Hidden Markov models were used for syntactical analysis to recognize hand gestures. It has been used to detect movements in motion that cannot be captured easily. So, various methods were deployed such as to draw graphic elements like triangle, rectangle, circle, arc, horizontal line, vertical line etc and edit the specified

elements such as copy, delete, swap, move, close, undo etc. to collect dynamic features of hand gestures. The another way to use HMM is visual interpretation of hand gestures using Indian sign language for human robot interaction. The various features were extracted from the Indian sign language to learn, classify, and interpret hand gestures. Here HMM is used along with FNN (Feed forward back propagation Neural Network) to achieve the desired results [8,16].

B. Kalman filter based recognizer modules

This technique involves both physical and control models for gesture performance and also called as model-based recognition approach. The technique includes the dynamic and control models of the physical motion involved with performing a particular gesture. These models are added up in the set of kalman filter based recognizer modules so that each bypasses the input data with an assumption that one of the gestures is being performed. The kalman filter based recognition technique was able to detect the motion of the arm in the planar type of gestures [14].

C. Magic gloves to recognize gestures

The glove was invented to capture the movements of deaf and dumb people. The gloves comprise of the flex sensors that can get folded during the movement of the fingers. The gloves can speak out the particular gesture after the expression has been made by the hand and the other person can hear what the impaired is trying to say. Along with the meaningful syntax of the hand movement, it can also work for the alphabets if they are drawn correctly. It can capture only the shape of the hand but not the other parts of the body such as elbow, arm, face etc. The technique was carried out using 3-axis accelerometer which is connected to the wrist that is responsible for the output of the specific gesture [12,17].

D. EMG signal based recognition

The Electromyography (EMG) signal based hand gesture recognition is carried out using Artificial Neural Network (ANN). The EMG technique generally measures the activity of the muscles represented as function of time. It was proposed to develop a better human computer interface to raise the quality of life of impaired. The different predefined hand gestures were detected using Artificial Neural Network (ANN). ANNs are particularly used in the complex cases converting the non-linear arbitrary functions as input to be suitable for the pattern recognition. The EMG signals were captured from the signals for each hand movement and ANN employ those EMG signals which were based on features [15,19].

II. RELATED WORK

Peter Vamplew[7] described the structure and performance of SLARTI sign language recognition system developed using a modular architecture consisting of multiple feature recognition neural networks and a nearest neighbor classifier to recognize Australian sign language hand gestures.

Byung-Woo Min et al.[8] proposed a different term to recognize gestures using visual images. The purpose was to draw and edit graphic elements using hand gestures. The planar hand gesture was considered in front of camera and 8-directional chain codes as input vectors. Hidden Markov Model (HMM) was applied to draw graphic elements such as triangle, rectangle, circle, arc etc.

Meide Zhao et al.[9]presented a recursive inductive learning scheme that is able to acquire hand pose models in the form of disjunctive normal form expressions including multivalued features. The recursive induction learning scheme was designed to escape local minima in the solution space. It was able to extract compact rule sets from any set of feature vectors describing a set of classifications.

Sharon Peperkamp et al. [10] compared spoken and sign language by looking at data concerning either cortical representations or early acquisition. The research was surveyed on earliest stages of acquisition of spoken language and considers the two stages in the acquisition of sign language. Under favorable circumstances, the deaf children deploy the sign input to gain entry into the language system with the same facility as hearing children did with spoken input.

Hyeon-Kyu Lee et al. [11] developed a new method using the Hidden Markov Model based technique. To handle non-gesture patterns, the concept of threshold model was introduced to calculate the likelihood threshold of an input pattern and provided a configuration mechanism for the provisionally matched gesture patterns.

Masumi Ishikawa et al.[12] proposed a method of recognizing a hand gesture based on self organization of the Data Glove. This was usually carried out by measurement of joint angles, segmentation, adjustment of data length, generation of an input vector in self organization and clustering of hand gestures.

Claudia Nolker et al.[13] proposed gesture recognition based on finger tips. The idea was to recognize continuous hand gestures from the gray level video images. The approach resulted in full identification of finger joint angles. This allowed a full reconstruction of 3-D hand shape using an artificial hand model with around 16 segments and 20 joint angles.

Greg S. Schmidt et al. [14] proposed another technique for gesture recognition that involved both physical and control models of gesture performance. The models were used to augment a set of kalman filter based recognizer modules so that each filters the input data under prior assumption that one of the gestures is being performed. The recognized gesture is the filter output that closely matches with the output of an unaugmentedkalman filter. The gestures made with the right arm were only treated and only the position of hand was tracked.

Md. RezwanulAhsan et al**.** [15] used a technique named electromyography for observing the activity of the muscles while capturing the hand gestures. The main purpose was to detect different predefined hand gestures using artificial neural network (ANN). The capability to learn from examples, the ability to reproduce non-linear functions of input and highly parallel and regular structure of ANNs made them suitable for pattern recognition tasks.

Shekhar Singh et al.[16]described the sign language gesture based recognition interpreting learning system using Indian sign language for performing human-robot interaction in real time. The sign language based gesture communication was developed with humanoid robot. The classification, recognition, learning, interpretation process is carried out by the extracting the features of Indian sign language gestures. Hidden Markov Model (HMM) technique and feed forward back propagation neural network (FNN) were deployed to achieve recognition accuracy.

Shoaib Ahmed V[17]developed an electronic device named magic glove for dumb people that can translate sign language into speech in order to make the communication take place between mute communities and general public. A wireless data glove is used which is fitted with flex sensors along the length of each finger and the thumb. Dumb people can use the gloves to perform hand gesture and it will be converted into speech so that normal people can understand their expression.

PingalePrernaRambhau et al.[18] presented the implementation and analysis of real time stereo vision hand tracking system that can be used for interaction purpose. The main motive was to ease the communication between normal and deaf people. This was done by segmentation of finger spelling recognition that involved the segmentation of finger spelling hand gestures from images sequences. The finger spelled word was converted to text as well as speech. Another phase includes text to image conversion process. In this sentences were scanned entered by user and then alphabets were separated from sentences and corresponding image is displayed to viewers.

ChetanDhule et al.[19]proposed about gesture-based human computer interaction (HCI) that allows people to control the application on windows by moving their hands through the air and make devices and computers easier to use. The method is based on real time controlling the motion of mouse in windows according to the motion of hand and fingers by calculating change in pixel values of RBG colors from a video without using any ANN training to get exact sequence of motion of hands and fingers.

Neha S. Chourasia et al.[20]used a hybrid feature descriptor which combines the advantages of SURF and Hu moment invariant methods to achieve good recognition rate along with low time complexity. The methodology which recognizes the Indian sign language and translated into normal text is presented. The methodology consists of three stages, namely a training phase, a testing phase and a recognition phase. Combined parameters of Hu invariant moment and structural shape descriptors were created to form a new feature vector to recognize sign.

ChaowananKhundam et al. [21]presented a Human-Computer Interaction (HCI) with the connection of Oculus Rift and Leap Motion new technological devices for Virtual Reality. Oculus Rift is Virtual Reality headset or head-mounted display devices that have small display optic in front of each eye. It can track head movement and change view point follow it. Leap motion is in-air controller that can track hand gesture of the user. The combination of them will make users feel like immerse to Virtual Reality. Users can move avatar any way in virtual reality by their hand interact through the system via these devices.

III. COMPARISON OF TECHNIQUES

Technique	Critical Analysis	Results
Hand Gesture data glove	• A wearable glove that speaks up when a gesture is made using hand. • Efficiency is displayed using seven segments display on glove.	Provides efficient and to the point results for the performed gestures.
Virtual Reality Headset	• It generally tracks head movement. • It also use leap motion in-air controller that traces hand gesture of the user.	It will allow users to capturing hand gestures whether in acceleration through virtual reality.
SURF and Hu moment invariant methods	• The concept of derived features from the available feature set was introduced. • Recognize the Indian sign language and translate into normal text.	Achieved a good recognition rate along with low time complexity.
Artificial Neural Network (ANN)	• Electromyography (EMG) pattern signatures are extracted from the signals for each movement. • ANNs recognize complex patterns and classification tasks. • A back-propagation (BP) network is used along with the algorithm for the detection of the gesture.	Different predefined hand gestures were detected to develop good human computer interface.
Hidden Markov Model (HMM) and Feed Forward back propagation Neural Network (FNN)	• Interpreting and imitating learning through Indian sign language for performing human robot interaction. • Chain code and fisher score is considered as a feature vector for classification and recognition process.	FNN gives fast and accurate recognition and provides better results for interpretation of sign language between human robot interactions.

IV. CONCLUSION AND FUTURE SCOPE

The main motive is to provide an efficient communication between the impaired and normal human being. This covers wide number of audience like there is not always the case that the person interacting with the disabled might not be normal so it takes into account the deaf and dumb community through variety of cases included in the toolkit itself. The wide number of gestures in the database can store a limited number of gestures depending upon the provided memory. This allows a numerous gestures to be stored as well as making the use of audio device alongside their functionality.

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