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A REVIEW PAPER ON EVOLUTION OF SMART GLOVE

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ABSTRACT
In this paper, we have presented the past attempts that were made to bridge the gap between the deaf & dumb community and the normal people. Majority of the attempts included converting the American Sign Language to the audible signals. Some designers used flex sensors while others used image processing algorithms and contact sensors for efficient gesture recognition. This review paper comprises of the brief introduction about the past attempts that were made for constructing a device which converts sign language to speech. All of the previous designers named it differently but the motive behind each was the same.

KEYWORDS: *Flex Sensors, American Sign Language (ASL), Deaf & Dumb, Hand Gesture, Glove, Bluetooth, SIFT.*

I. INTRODUCTION

About nine billion people in the world are deaf and dumb. How often we come across these people communicating with the normal world? [1] These people communicate with the help of sign language. Sign language varies from country to country and even from region to region. To bridge the gap between deaf and dumb community and normal masses, it has been given a 21st century technological upgrade using gesture recognition system. Gesture recognition is a widely explored field. A lot of work has been done in the past few years. This paper accentuates the improvement done over the years to increase efficiency and accuracy. In a narrow spectrum it acts as a language interpreter and provides a convenient way for communication and provides a simplified way for communication between deaf and dumb community and normal people. In figure 1, we have shown the sample for general Sign Language [3]. Gesture recognition is classified into two main categories i.e. vision based and sensor based. 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 sensor based technique offers greater mobility. In this paper we have presented brief summaries of different past attempts which were made for making smart glove using various technologies.

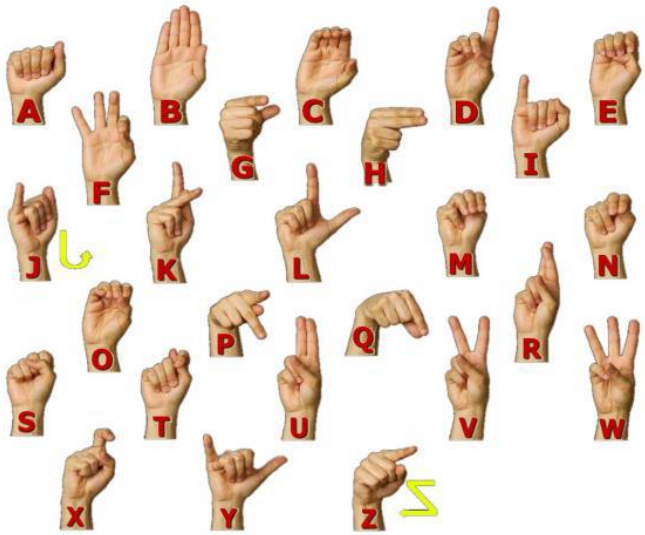

Fig. 1: Sample Sign Language

II. LITERATURE REVIEW

Anbarasi, et al [1] in their paper presented a system that can efficiently translate American Sign Language gestures to both text and auditory voice. The interpreter here makes use of a glove based technique comprising of flex sensor, tactile sensors and accelerometer. For each hand gesture made, a signal is produced by the sensors corresponding to the hand sign. The controller matches the gesture with pre-stored inputs. The evaluation of Deaf-mute communication interpreter was carried out for ten beginners for letters 'A' 'B' 'C' 'D' 'F' 'I' 'L' 'O' 'M' 'N' 'T' 'S' 'W'. Word formation from letters is also performed using an end signal. The overall gesture recognition for the letters showed accuracy of about 90%.

Gunasekaran. K, et al [2] in their paper proposed a system using the data glove technique. It consists of flex sensors that used to detect finger gestures and transmit the information to a PIC microcontroller. He also used gyro sensors for providing a signal corresponding to the orientation of the motion of the hand. PIC microcontroller processes the gesture of the user and plays the audio file corresponding gesture. The voice signals are stored in APR9600. It is a single chip used to store high quality voice recording and Non-volatile flash memory, playback capacity for 40 to 60 seconds. APR provides random and sequential multiple messages and designers can adjust storage time depending upon user needs. Basically, he used pre-recorded voice and for communication between the transmitter and receiver side and used RF module.

Pallavi Verma, et al [3] in their paper presented a system in which a pair of gloves with flex sensors along each finger, thumb and arm is used to capture the movement of user. With the help of flex sensors, degree of fingers, thumb and arm are calculated in voltage terms using voltage divider rule. PIC microcontroller is used for various functions like analog to digital conversion of data from flex sensors. Then digitized data is encoded in encoder and transmitted. Received data is decoded by decoder and gesture recognition system matches the incoming data with pre fed data. If data is matched then it is given to speaker using voice section.

Vajjarapu Lavanya, et al [4] implemented a design using copper plate. This glove can be made using small metal strips that are fixed on the five fingers of the glove. A copper plate is fixed on the palm as ground. It is better to use a ground plate instead of individual metal strips because the contact area for ground will be more facilitating easy identification of finger position. The copper strips indicate a voltage level of logic 1 in rest position. But when they come in contact with the ground plate, the voltage associated with them is drained and they indicate a voltage level of logic 0. Thus necessary gestures are formed.

A digital pattern generated by the glove is directly given to PIC16F877A micro-controller. A firmware is inserted in the microcontroller such that each gesture is assigned a particular character. So, as per that code characters corresponding to the gesture are transmitted via RF transceiver. The transmitted characters are received by RF transceiver at the receiver side and it is sent to an LCD display as well as an EMIC module (text to voice IC) simultaneously.

The EMIC - 2 Text-to-Speech Module is a multi-language voice synthesizer that converts a stream of digital text into speech. It is a simple command-based interface that makes it easy to integrate with any embedded system. Software used includes

MICRO IDE- Micro C is powerful and rich development tool for PIC microcontrollers to develop firmware for it. We have to write the C code in built-in code editor (Code and Parameter assistant, Auto correct, Syntax highlighting and more).

PROTEUS 7 PROFESSIONAL- The Proteus Design Suite combines schematic capture, SPICE circuit simulation, and PCB design to make a complete electronics design system. Add to that the ability to simulate popular microcontrollers running your actual firmware.

Jan Fizza Bukhari, et al [5] named their prototype as Sign Speak which translated American Sign Language into text and speech. The various parts of their module were glove design, data acquisition system, wireless link and android application.

In glove design module selection of appropriate sensors and their location was finalized. Three types of sensors were basically required to detect bending movement of fingers, contacts when two fingers are in contact and acceleration of hand. Flex sensors of 2.2 inches were used for measuring the bending movements. To detect a contact, a simpler logic of using conductive plates connected to the input voltage through pull-up resistors was used. Whenever any conductive plate connected to 0V or ground was touched to positive plate, a contact was detected. Hence, whenever one finger was in contact with the other, value of contact sensor (which was initially 1 due to pull-ups) for that particular finger became zero. To detect and measure the acceleration of hand ADXL 345 was used in I^2C mode. Specifically, ADXL 345 was used to recognize the alphabet Z and to distinguish between alphabet I and J. By placing all these sensors on a glove at appropriate locations, a data glove as an input device to our main controller was made.

In data acquisition module to acquire multiple samples of gestures for the purpose of extracting important features and training algorithm, a Data Acquisition (DAQ) system was setup, which was able to capture data from the flex and contact sensors.

C-05 (Bluetooth to Serial Port Module) was used because of its ease of availability in Islamabad and its low cost. Service Discovery Protocol (SDP) was used to allow devices to discover what services each other support, and what parameters to use for connecting them. Each service was identified by a universally unique identifier. The default setting of serial port of HC05 was: baud 38400 and our serial communication in the Arduino was happening at a baud rate of 9600, thus baud rate of Bluetooth module of Sign Speak was needed to be matched. To change it, a command was entered through the AT mode on the module. The module was set as Master mode.

The application was written in Java using Eclipse, by modifying the Bluetooth Chat sample code from Android. Two APIs Bluetooth API (for scanning of other Bluetooth devices and paired Bluetooth connections) and Text to Speech API (for conversion of text into speech featuring more than 30+ languages and implementation of different features such as voice, speed and pitch) were used.

Sagar P. More, et al [6] used image processing based technique for gesture recognition and conversion into text and speech. It consists of four basic steps such as, Image acquisition, Pre-processing, Feature extraction and classification. Their objective was to create accurate recognition for the detected hand postures using SIFT algorithm. The advantage of using the algorithm is high processing speed which can produce efficient recognition results.

The computation of SIFT image features is in four basic steps

1. *Scale-space Local Extreme Detection:* The first step computes the locations of potential interest points in the image by detecting the maxima and minima of a set of difference of Gaussian filters applied at different scales all over the image.
2. *Keypoint Localization:* The keypoint localization of the set of interest points found in Step 1, a stable set is selected and further localized in image space.
3. *Orientation Assignment:* For all stable interest points selected, an orientation is then assigned to each key point based on local image features.

4. *Key point descriptor:* Finally, a local feature descriptor is computed at each key point. This descriptor is based on the local image gradient, transformed according to the orientation of the key point to provide orientation invariance.

The sign for all alphabets A to Z will be recognized using SIFT. The advantage of using the algorithm is high processing speed which can produce better results. The SIFT featured in their implementation will compute at the edges which will be invariant to scaling, rotation, addition of noise. These features will be useful due to their distinctiveness, which enables the correct match for key points between different hand gestures. Also computation time will be less. This work can further be extended to text to speech conversion.

The disadvantages associated with this technique is as follows-

1. More light intensity exposure on hand gesture images affects the result accuracy.
2. Proper hand gesture image should be taken.
3. Hand gesture, image resolution, pixel density should be moderate.

III. CONCLUSION

The main barrier coming between the interaction of deaf & dumb community and the normal persons is how to communicate each other's sentiments and emotions. It is required for both the parties to have a deep knowledge of sign language. In most of the cases, it is seen that the deaf & dumb community has sign language as their saviour but the normal persons face the difficulty in understanding them. In this paper, we reviewed numerous attempts and initiations taken by different persons to overcome this social issue. Gloves were made using flex sensors, contact switches, accelerometers, image processing and many other logics were implemented but each had some or the other drawback. To take into account whole of the sign language, a huge library of functions is required which is a very tedious job in itself. Researches are still being made to invent new and cost effective ways to create such a device which converts sign language to speech.

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