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SIGN LANGUAGE INTERPRETER FOR DEAF AND MUTE

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Abstract: People have a characteristic capacity to view, hear and exchange information within their surrounding environment. Lamentably, few people with disabilities won't be able to utilize their senses to the most ideal degree. Such individuals rely upon different methods for interaction like gesture-based communication. Although the deaf and mute can be able to communicate with those who are having the same disability of being deaf and mute or who know their sign language, it provides a greater challenge for them when they try to communicate with those who hardly know what their gestures mean, when they are involved in any professional or social situations. Hence, there is a major need for an interpreter who can translate or interpret all the gestures into speech or text, or any device which has advanced technology to perform the work of an interpreter and convert the gestures into speech and text to make communication between both deaf and mute and abled people effective and efficient. This could help diversely abled individuals in their day-by-day lives by making an interpretation of their signals into significant English letters and words. The presented review paper showcases various devices as well as technologies to interpret the gestures into a form that can be understood by able people.

Index Terms **– Hand Gesture Recognition, Flex Sensor, Accelerometer, Speech Synthesis, Gesture Vocalizer, Digital Glove, Human Computer Interaction, Computer Vision.**

I. INTRODUCTION

Communication using sign language uses a visual form that includes hand gestures and signals, expression from the face, as well as body language while being considered as an organized and well-developed language. Although sign language can be helpful for other people, it serves as the basic means of communication among deaf and mute people. The primary disadvantage of usage of this form of communication in a world where the verbal form is dominant is that not enough people understand and comprehend sign language. Therefore, the best way to bridge this gap would be to implement a translator in between these two communities, where sign language would be translated into verbal form, making it an easier way of communication.

The main goal of gesture recognizers are to recognize particular gestures performed by humans and to use them for controlling the devices or to interpret the information into a form that can be understood by abled people. Two main methods to perform this are by [1] using data glove: Here a data glove is considered with all the required sensors to recognize the gestures are inbuilt in it, which can convert movement of fingers in to electrical energy to analyze the posture as well as the position of the fingers as well as the hand. And by [2] using the vision-based method: This technique is based upon how humans are able to interpret any message from the region around them and also it is non-invasive. A vision-based interface is feasible to be designed for a controlled environment although difficult for generic use.

II. LITERATURE REVIEW

[1]A data glove in which if a message is obtained, at first it is sent to a microprocessor, here it is Intel Galileo Gen 2 and is processed in it. Output is displayed on the Grove-LCD in the form of text and it is according to the sign given as input from any sign language. The text output is obtained by conversion of the sign language by the microcontroller during processing into the form of text. Grove-buzzer sensor is utilized to interpret this signal in the form of speech. The device proposed in this paper has found its usage in home automation where various gestures can be used to control variety of functions for example, switching any equipment on or off. This feature can be utilized in any basic electronic device.

[3]Sign language recognition system based on the leap motion sensor comes with Application Programming Interfaces (API) which is usually supported by the manufacturer of the product. The motion performed by the fingers or hand can be sent to user-designed programs to use the sensor as an alternative computer-human interface, by using the Application Programming Interfaces. In three dimensional medium, the sign language recognition using leap motion sensor is a miniaturized, low-cost sensor for sensing the gestures using the motion of hands and fingers. As the data transmission frame in terms of frames per second is assigned as 15, the device is pretty fast and responsive. The disadvantage of usage of leap-motion sensor is that for

gesture recognition, dynamic images cannot be considered but only static images are considered. Additionally, leap motion sensors cannot see-through the fingers making it difficult to infer the input data.

[4]A smart glove is proposed which includes components such as flex sensors, Arduino, APR33A3 Voice Playback module, transmitter, and receiver. This technology helps the user to provide input in order to control his/her home appliances if he/she cannot walk towards the switchboard, which can be considered as an advantage. The disadvantage of this technology is that the device is bulky, and has too many components, making it hard to be a portable one. The working of the device commences as soon as there is an input in the form of a movement of hand or fingers. The gloves are connected to the flex sensors and if there is any input gesture given, then the sensor value changes as a result of the bend in the flex sensors. The changing value of the flex sensor corresponds to the applied bending angle as well as the resistance, according to the input given.

[5]The proposed smart glove is wireless and is connected with flex sensors as well as accelerometer. These sensors are included to be able to recognize the user input which is in the form of change in position and posture of fingers and hands. LPC-2148 Microcontroller is connected to this device to process the input. To convert the input in the form of movement into voice, speech synthesizer unit is implemented. This unit will give the output in the form of speech in real-time. To provide a text output, a display unit is utilized, facilitating more gesture recognition. Keil Microvision 4 IDE and Flash Utility 2000 have been made use of to implement the proposed system. In emergency conditions, the GSM modem provides a major help. The disabled people are helped to control the home appliances easily by the home automation system, making use of this technology.

[6]Smart glove for the conversion of movements into speech and text involves a data glove connected to an accelerometer and flex sensors to recognize the change in posture and position of the fingers and hands. A high-performance Voice OTP aP8942A fabricated with Standard CMOS process is used as a speech synthesizer in the system. This speech synthesizer is used to convert the input which involves change of position or posture of fingers or hand into a real-time speech output. Additionally, a display unit is implemented to provide the text output for the corresponding input which is in the form of gesture. As the output is converted into the form of text and speech in English, an effective way of transferring information for both abled as well as deaf-dumb people is obtained. The major advantage of this proposed device is that it is portable, allowing users to carry it to different places.

[7]A hand gesture and speech recognition system using an image processing technique has a camera to record the input which is in the form of change in position and posture of hand and figures. The recorded input gestures are analyzed by making use of various algorithms used to recognize what a particular input in the form of a gesture means. MATLAB, being used as an image processing tool, can compare the captured image with previous templates to decide the output. The output when ready to be presented is displayed on the LCD. The drawback of the techniques using image-processing is that it requires the development of complex computational algorithms to be able to detect the gestures. Furthermore, the technology using image processing makes use of certain lighting conditions as well as proper backgrounds. This technique also has field of view limitations.

[8]Gesture vocalizer presented here includes a transmitter block consisting of a digital glove, an analog to digital processing device, and an RF Transceiver. The data gloves collect gestures using the flex sensors in the form of signals. These signals are then converted from analog to digital form and are further transmitted to AVR Microcontroller. The microcontroller analyses and fetches the meaning of each signal received and stores it into the memory buffer. These values are transmitted to the receiver block. The Microcontroller at the receiver end makes the data ready for output on the screen as well as on the speaker.

[9]A system which is dynamic and recognizes gesture is presented here. This system identifies the English Language letters and converts them into speech and text output. For this to be obtained, few processes such as acquisition of video, pre-processing of the acquired data, conversion of colour, localization of colour, processing of template, and detection of gesture are performed. The Colour pointer technique is used so that an accurate pattern is obtained. In this paper, concepts of human-computer interface, image processing, and conversion of gesture to text, and then text into speech are discussed in-depth. A gesture which is dynamic is performed in-front of a web-camera. This gesture might be any English language letter. The colour pointer is made to be connected to the finger when any gesture is performed. Then later, using the finger connected to the colour pointer, any English language letter is drawn. This is performed in the air in-front of the web-camera. To make the image smoother, an algorithm known as Gaussian Blur on the frames is performed.

[10]A data glove which is sensory is developed by utilizing flex sensors. This device is used for the recognition of a sign language known as American Sign Language. The four flex sensors require a voltage of +5v each. When power is ON, each flex sensor gets a +5v supply. When a user makes the gesture of any letter, the four signals coming from each flex sensor goes to the microcontroller. These signals are then converted from analog to digital values. The converted output in text form is then displayed on the LCD.

[11] The technology used to find the hand gesture consists of a glove which has flex sensors and an Inertial Measurement Unit (IMU) inbuilt in it. In order to recognize the input provided in the form of gesture, these sensors are implemented. To determine the posture and position of fingers as well as hand in a three dimensional space, the obtained values from the module of IMU and flex sensors are used. The proposed algorithm is segmented into two divisions namely, detection of finger orientation and three dimensional orientation. Here, different gesture movements are obtained as the input and are processed to produce voice assistance using the data estimation method.

[12]A device is proposed here which consists of flex sensors that are four in number. The input is given to the microcontroller in the form of resistance corresponding to the bend angle of the flex sensors. This input in the form of resistance is displayed with the help of a 16 bit LCD after being transformed into text form. Any abled person will be able to view this text from the LCD and will be able to understand the message conveyed by the deaf or mute using the device. If the one who has to get the message has blindness and is unable to read the text displayed, then the earphones or speaker in the device will be able to transmit the message which would be converted into voice form using a device that is based on APR 33A3 IC which can do voice recording as well as playback. The proposed device can be used in bio-medical applications in hospital wards for example in operation theaters or in Intensive Care Units (ICU).

[13]The device proposed here provides hard of hearing or speaking people an easier life by allowing them to utilize an interpreter which is glove based and can transform the message which is in the form of sign into a form which is understandable by the abled people. The device consists of a data glove to which flex sensors are attached which are four in number. When each movement of hand is made in the form of a gesture, the flex sensors connected to the data glove offers an output in the form of change in the resistance value in accordance to the position and posture of the hand and fingers. The controller analyzes these

input resistances and will be able to provide the corresponding output. This device provides two operational modes namely, operational and coaching mode. Using coaching mode, every user's degree associated can be understood. Additionally this device offers a module known as Text to Speech conversion (TTS) block. The TTS block is used to transform the gestures that are matched into a voice form from the text.

[14] Algorithms based on computer-vision and techniques based on gesture recognition is utilized in the system proposed here to develop an interface device which is of low-cost. Here gestures of the hand are used to interact in a virtual environment with any object. Support Vector Machine (SVM) and additional techniques based on extraction of features is used for the recognition of the hand and its gestures. Aspects which are dynamic in the recognition of gestures of the hand and various techniques which are effective for interaction between human and computer are proposed in the system presented here. Systems which require pre-processing of the images presented in the form of input are considered here and are very few in numbers.

[15]Methodologies effective for the spotting and validation of detection of gesture are presented here. When there is a presence of noise in the input image, or any kind of real-time hitch, the gesture of the hand of the person using the system is recorded and only those attributes are extracted which are considered as important. These attributes are observed to be distinctively associated with every user's uniqueness, who are making use of this system and are stored as a template in a storage unit such as a database. The gesture performed by a user is recorded and the attributes drawn from it is made to be compared with either every database recognition template or the templates which correspond to the verification of identity that states to be claimed.

[16]Flex sensors fixed on a cloth is proposed by naming it as the Hand Talk glove here. These sensors have an output which is a data-set which changes according to the change in the extent of bend made by user's fingers corresponding to the change in the input gestures. This further creates a change in the resistance value with reference to the gestures provided as input. The resistance produced as output is directly proportional to the bend angle of the flex sensor, that is, if there is more bend degree in the flex sensor, the output resistance will be more and vice versa. Later, the obtained output undergoes a transformation from analog to digital value. This is then sent to a microcontroller which processes the data and provides an output in the form of voice by making use of a speaker. Various attributes are presented by the sensors which are implemented here to work in two different planes, one for the change in the position of the fingers and the other for the thumb.

[17]A system is proposed here, in which few flex-sensors are connected to a glove used on a hand. There is an interface for the flex sensors utilized to monitor the movements of the slider as well as interior gadgets and hence transmitting the command to the computer by using only the signals or gestures made by the user's hand. By the utilization of this method, the sensors are able to send the instructions to the microcontroller. These instructions are sent by the transmitter in the later stage. The signals that are captured by the receiver are given as input to the PIC-microcontroller. These microcontrollers with the help of relays are able to monitor any applications. By utilizing MAX 232 as well as by creating an interface with a computer, movements of the sliders are controlled by it.

[18] Computer-vision technology that operates in real time is proposed here. This is a system that can recognize static gestures made by hand, based on any sign-language. It has an ability to determine the position and posture of the hand. When this process is done, the determined hand gestures are translated into the form of text for the vision, as well as into the form of voice for the hearing-abled people. Collection of the input data is performed with the help of a computer connected USB camera. In the system proposed here, hardware device such as a data glove is not required at all. Based on the Support Vector Machine (SVM), machine learning approach is utilized for the purpose of recognition in this system.

[19]The system proposed here is named as artificial speaking mouth for dumb people. The system here utilizes sensors involving Mems technology. At first, into the microcontroller, a template of a database is given as an input. Later, the sensor is fitted into a user's hand. When the user performs each gesture using their hand, the sensor will be activated and its output will be fed as microcontroller's input. When this is obtained, the microcontroller checks for any match between the inputs obtained as well as the fed signal in the database. If there is any match found, a signal of speech is provided by the microcontroller with the help of a speaker as an output. Proper updation of the database facilitates an easier way of communication for a mute person with a normal person by making use of the proposed system. The Text To Speech (TTS) conversion unit transforms the form of input into voice if the input is matched with the database.

III. METHODOLOGY

The proposed system consists of Arduino board, flex sensors, accelerometer, and Bluetooth module. When a user wearing the Data Glove makes a gesture, the bend angle of the gestures are sensed by the flex sensors. The tilt of the palm experienced while performing the gesture is detected by the accelerometer. These values are sent to the arduino board which converts the analog values sensed by the sensors into digital format. According to the obtained digital value from the arduino, the threshold for each sensor, for each gesture can be set. When the user gives the input in the form of gesture, the data is sent to the android device containing the application to interpret the data in the form of text and voice with the help of Bluetooth module present in the data glove. The Bluetooth in the android device receives the data and provides it to the application which shows the received gesture in the form of text and voice.

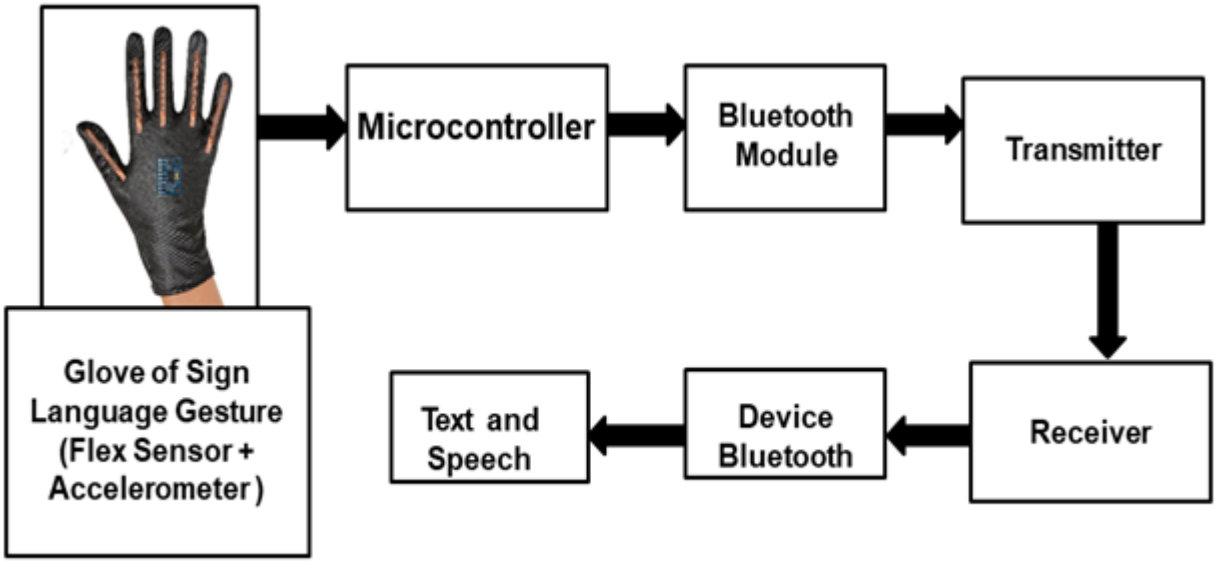

Fig.1 Functional block diagram of a Smart Glove

IV. CONCLUSION

Hard of hearing and mute people make use of the gestures or any sign language to communicate, which may not be common and able to be understood by common people. The data glove has the ability to convert the given input gestures into speech and text which makes normal people interpret the message easily. Data gloves can also be used to rehabilitate disabled people and also to monitor their hand movements. An advanced form of application of this method will be in telerobotic surgery and virtual interactive gaming. Although many methods are utilized to convert gestures into text and speech, glove based method is considered as effective as it requires no background, lighting, or environmental conditions, unlike vision-based methods. The proposed system of Data Glove is a compact and low cost data glove which can interpret the input gestures in the form of text and voice.

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