International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 07 | July 2019 www.irjet.net p-ISSN: 2395-0072

Hand Talk- Assistant Technology for Deaf and Dumb

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Abstract – *In this paper we represent smart glove for deaf and dumb patient. About nine billion people in the world are deaf and dumb. The communication between a deaf normal visual people. This creates a very little room for them with communication being a fundamental aspect of human life. The blind people can talk freely by means of normal language whereas the deaf-dumb have their own manual-visual language known as sign language. Sign language is a non-verbal form of intercourse which is found amongst deaf communities in world. The languages do not have a common origin and hence difficult to interpret. The project aims to facilitate people by means of a glove-based communication interpreter system. The glove is internally equipped with five flex sensors. For each specific gesture, the flex sensor produces a proportional change in resistance. The processing of these hand gestures is in Arduino-Uno Board which is an advance version of the microcontroller and the LABVIEW software. It compares the input signal with predefined voltage levels stored in memory. According to that required sound is produced which is stored is memory with the help of speaker. In such a way it is easy for deaf and dumb to communicate with normal people.*

Keywords – *Deaf and Dumb Patient, Sign Language, Flex Sensor*

1. INTRODUCTION

"Communication Is the Fundamental Human Right". Communication is a two-way interactive process and it plays a major role in daily life. Communication strategies can affect one's ability to engage in interaction and cope up with social conflict, but this communication is not possible for the people who are deaf and dumb. About nine billion people at intervals the planet unit of measurement dumb.

The main aim of this project is to build a bridge between them by developing a portable communication in the form of gesture glove. The gloves help in interpreting the sign language through gestures. Language is also a non-verbal form of intercourse that's found among deaf communities. The languages haven't got a typical origin and hence hard to interpret. A Dumb communication interpreter is also a tool that interprets the hand gestures to sensibility speech. Gestures play a major role in the daily activities of human life, during communication providing easier understanding. In other words, Gesture recognition refers to recognizing meaningful expressions of motion by a human, involving the hands. Between all the gestures performed, hand gestures play an important role which helps us to express more in less time. For each hand gesture created, a symptom is formed by the sensors appreciate the gesture and the microcontroller matches the gesture with pre-stored inputs. The device exclusively interprets alphabets, numbers and few phrases of American sign language. A training mode is gettable on the device therefore it fits every user and accuracy is inflated.

The Gesture glove is a normal, cloth driving glove fitted with flex sensors along the length of each finger and the thumb. The sensors output a stream of data that varies with degree of bend. The output from the sensor is analog values it is converted to digital and processed by using microcontroller and then it will be transmitted wirelessly through Bluetooth module HC05 to the android mobile application where the received data will be displayed and converted to speech where the audio can be heard

Sign Language is the means of communication among the deaf and mute community. Sign Language emerges and evolves naturally within hearing impaired community. Sign Language communication involves manual and non-manual signals where manual signs involve fingers, hands, arms and non-manual signs involve face, head, eyes and body. Sign language is a complete natural language that uses different ways of expression for communication in everyday life. The aim of the sign language recognition system is to present an efficient and accurate mechanism to transcribe text or speech, thus the "dialog communication" between the deaf and hearing person will be smooth. There is no standardized sign language for all deaf people across the word. A person who can talk and hear properly (normal person) cannot communicate with deaf &

dumb person unless he/she is familiar with sign language. Same case is applicable when a deaf & dumb person wants to communicate with a normal person or blind person.

ASL is a language completely separate and distinct from English. It contains all the fundamental features of language—it has its own rules for pronunciation, word order, and complex grammar. While every language has ways of signaling different functions, such as asking a question rather than making a statement, languages differ in how this is done. For example, English speakers ask a question by raising the pitch of their voice. ASL's has all of the features of any language; that is, it is a rule- governed system using symbols to represent meaning. In ASL, the symbols are specific hand movements and configurations that are modified by facial expressions to convey meaning. These gestures or symbols are called signs. It is a unique and distinct language, one that does not depend on speech or sound. ASL has its own grammar, sentence construction, idiomatic usage, slang, style, and regional variations-the characteristics that define any language. American Sign Language is the shared language that unites Deaf people in what is known as the Deaf community.

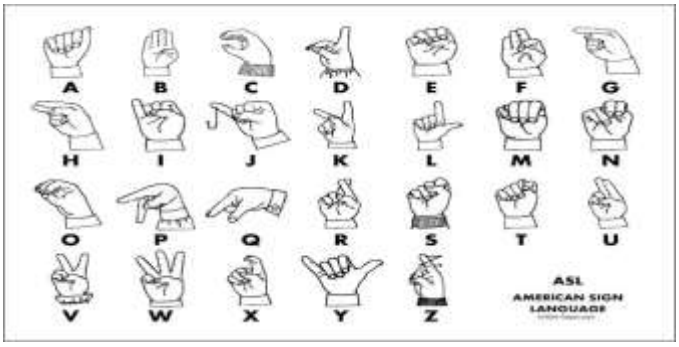

Fig -1: ASL hand gestures for alphabets

Fig-2: ASL hand gestures for numbers

Fig-3: ASL hand gestures for emotions

2. LITERATURE SURVEY

[1] A group of engineering students at Carnegie Mellon University, Bhargav Bhat, Hemant Sikaria, Jorge L. Meza and Wesley Jin demonstrated their project **„Hand Talk" a sensor equipped glove that translates finger and hand gestures into spoken words.** This is the first demonstrator model to show the functionality based on a limited vocabulary of 32 words. Sensors in the glove pick up gestures and transmit the data wirelessly via Bluetooth to a cell phone which runs Text to Speech software. The sensor data are converted first into text and then to voice output. A person not knowledgeable in Sign language can listen via the cell phone what the other person is saying in Sign language form. The main advantage with this design was its simplicity and the cheap components these students used to create this amazing and truly interactive glove that could help to improve greatly the communication barrier between deaf persons and people. The latest sensor being used for the Hand Talk glove is the accelerometer. Instead of working in two planes (X and Y) like in the flex sensors, it works in X-Y, Y-Z and X-Z planes. It is more reliable than the flex sensors and only one accelerometer is required for one glove. More number of programs can be fed into it so it can accommodate more number of sounds in it.

[2] **Hand Gesture Recognition System For Dumb People:** Authors presented the static hand gesture recognition system using digital image processing. For hand gesture feature vector SIFT algorithm is used. The SIFT features have been computed at the edges which are invariant to scaling, rotation, addition of noise.

[3] **An Automated System for Indian Sign Language Recognition** in: In this paper a method for automatic

recognition of signs on the basis of shape based features is presented. For segmentation of hand region from the images, Otsu's thresholding algorithm is used, that chooses an optimal threshold to minimize the within-class variance of thresholder black and white pixels. Features of segmented hand region are calculated using Hu's invariant moments that are fed to Artificial Neural Network for classification. Performance of the system is evaluated on the basis of Accuracy, Sensitivity and Specificity.

[4] **Glove-based systems**: Glove-system is composed of an array of sensors, electronics for data acquisition or processing ,power supply and a support for the sensors that can be worn on the user's hand. Sayre glove, LED glove, data gloves (used here) and cyberloves are the different types of gloves used. Gesture- based applications of glove systems involves extraction and classification of features to automatically understand gestural languages used by the deaf community.

[5] **Glove Talk Neural networks**: were used to implement an adaptive Digital Electronics interface, called Glove Talk, which maps hand gestures to control the parameters of a parallel formant speech synthesizer to allow a user to speak with his hands. It is used to implement an artificial vocal tract.

[6] **Real-time gesture recognition**: A prototype system has been implemented with a lexicon of 250 vocabularies in Taiwanese Sign Language (TWL). On detecting the beginning of posture holding, the system extracts features, including position, orientation, and posture, and also starts tracking motion trajectory.

[7] **American sign-language interpreter**: When the user makes a hand gesture, the binary values of fingers were checked for 5 times and if they matched, then the microcontroller indicated the gesture as valid and perfect match and displayed the corresponding codes on LCD.

[8] **Gesture-deployed system:** We present our prototype for a gesture recognizing glove (data glove). We use low cost packaging material for making piezoresistive sensors. These flex sensors detect a bend in fingers and we map this data to a character set by implementing a Minimum Mean Square Error machine learning algorithm. The recognized character is transmitted via Bluetooth, to an Android phone, which performs a text to speech conversion. Our motivation for Hand Talk is to compare hand configurations with sign language charts and generate artificial speech which articulates the gestured words. This technology also has further applications as a 3D mouse, virtual keyboard, control for precision control of robotic arms

[9] **Sign Language Translator Gloves:** Hand motion tracking and gesture recognition are a fundamental technology in the field of proactive computing for a better human computer interaction system. In this paper, we have developed a 3-D hand motion tracking and gesture recognition system via a data glove (namely the KHU-1 data glove consisting of three tri-axis accelerometer sensors, one controller, and one Bluetooth). The KHU-1 data glove is capable of transmitting hand motion signals to a PC through wireless communication via Bluetooth. Also we have implemented a 3-D digital hand model for hand motion tracking and recognition. The implemented 3-D digital hand model is based on the kinematic chain theory utilizing ellipsoids and joints. Finally, we have utilized a rule-based algorithm to recognize simple hand gestures namely scissor, rock, and paper using the 3-D digital hand model and the KHU-1 data glove. Some preliminary experimental results are presented in this paper

[10] **Mister Gloves:** Gesture recognition system is a system to interpret movement of hand or head via algorithms. Algorithms to interpret gesture are in the form of software, hardware or combination of both. The main goal of gesture recognition system is to enable humans to communicate with machine. This paper present the development of wireless Bluetooth hand gesture recognition system using six 3-axis accelerometers embedded in a glove and a database system in a computer. This system can recognize any sampled data saved in the database while promoting maximum portability and mobility to the user via wireless Bluetooth technology. Analyses such as static data, dynamic data, and average recognition rates relationships are discussed in this paper

[11]. **Smart Glove Project:** Dumb persons communicate through gestures which are not understood by the majority of people. Gesture is a movement of part of the body, especially a hand or the head, to express an idea or meaning. This paper proposes a system that converts gestures given by the user in the form of English alphabets into corresponding voice and translates this English voice output into any other Microsoft supported languages. The system consists of MPU6050 for sensing gesture movement, Raspberry pi for processing, three button

Keypad and speaker. It is implemented by using trajectory recognition algorithm for recognizing alphabets. Raspberry pi generates voice output for the text in multiple languages using voice RSS and Microsoft translator. When tested, the system recognized A-Z alphabets and generated voice output based on the gestures in multiple languages.

[12]. **Magic Glove :** The primary objective of the paper is to construct and test a low-cost, minimally supervised gesture recognition system which identifies static gestures efficiently and accurately. The proposed system uses ADXL335 accelerometer sensors which track the gestures and these sensors are interfaced with an Arduino ATMega 2560 micro-controller for data processing and gesture recognition. The software of the system implemented in the micro-controller, features a computationally feasible algorithm which requires only nominal resources to recognize the gestures. The paper further elucidates on minimizing the number of accelerometers to reduce the cost and power-consumption of the system. The performance of the system is assessed using static gestures in the alphabets of the American Sign Language (ASL) across data-sets obtained from 3 trained ASL signers

3. METHODOLOGY

The gesture gloves should be worn by deaf and dumb people. Gloves is attached with five flex sensors. For every gesture in sign language there is change in finger position and bending. This change or bending of the fingers corresponds to change in resistance of flex sensors. This data from flex sensors is processed in Arduino UNO microcontroller. The flex sensor used is Arduino UNO compatible and it is connected to Arduino UNO through wires. Arduino UNO is powered with power module which supply 5V.

This data is wirelessly transmitted by Bluetooth module (HC05), present on the gesture glove. This data is received by the Bluetooth module of mobile. The android mobile application is designed such that it receives the processed data through the blue tooth and displays the received data on the mobile screen and also simultaneously converts the text received into speech and the audio can be heard. The output obtained is both display and audio of the corresponding gesture made by the differentially abled people.

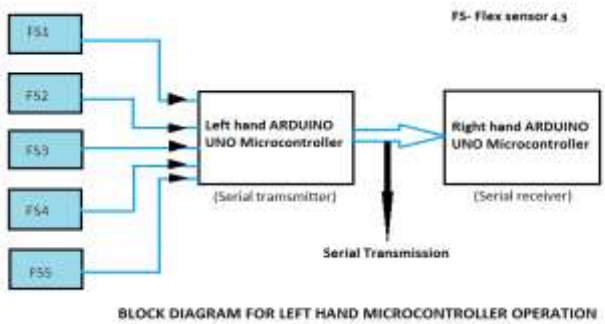

Fig-4: Block diagram for left hand microcontroller operation

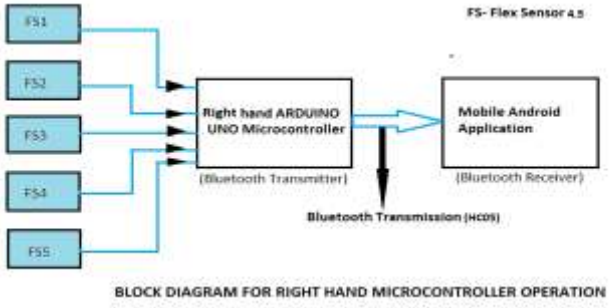

Fig-5: Block diagram for right hand microcontroller operation

3.1 Description of left hand flow of the project

Each sign in ASL has particular gesture. Five flex sensors are attached to gesture glove to identify the change in resistance value of the flex sensor when bending of fingers is encountered. Whenever there is change in the resistance of the flex sensors is encountered, the resistance converted voltage value which is seen as the output of flex sensors will be received by the Arduino UNO and will be sending the same to the right hand Arduino UNO serially through serial port. If there is no change in resistance value if flex sensors encountered, then the wait condition comes into picture.

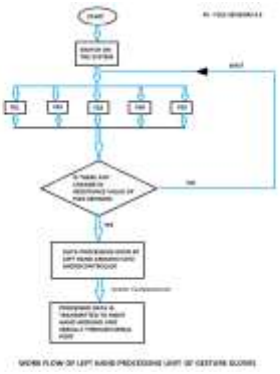

Fig-6: Work flow of left hand processing unit

3.2 Description of right hand flow of the project

When the system is turned on, the condition whether the Arduino UNO is in GROUND mode and 5V mode is checked. There are two modes which we use in this project

GROUND mode: both Left and Right hands are in operation.5V mode: only Right hand is in operation. If the GROUND mode is on, then the right hand Arduino UNO receives data from left hand Arduino UNO too and the same processing is done.

If the 5V mode is on, then only right hand flex sensors data is received. The processed data is then transmitted to mobile application which displays the data received and also converts and received data to speech where the corresponding audio is heard.

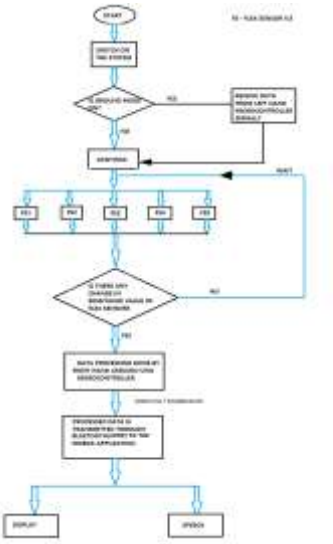

Fig-7: Work flow of right hand processing unit

3.3 Arduino Code Description

1.Firstly the right hand code.

2.We declare the variables for all the 10 fingers.

3.We declare a variable for mode and initialized as zero.

4.We declare variable for string input and initialized it as zero.

5.We declare a variable for string output and initialized it to null.

6.We define a function called split where it accepts the string value until the in value count is specified where the count is increased by one whenever it comes across a "," and finally returns the complete string.

7.The next part of the code runs in the loop where the analog input from the flex sensors are read continuously.

But there are two modes to be considered which are high and low.

8.When the mode is high, it's the phrase mode and the number mode where it accepts 10 inputs until there is a next line command.

9.The function that converts the strings accepted into integers which has to be displayed on the serial monitor. If the integers match the range of values for a particular phrase or number, then it displays the same on the serial monitor or it prints the values as it is.

10 .If the mode is low, then it's the alphabet mode. It only accepts the 5 inputs and search for any matches in the range of values assigned for the different alphabets and prints the same in the serial monitor. Otherwise it displays just the values.

11. Lastly the left hand Arduino code, As the complete processing is done in the right hand controller, the work of left hand controller is to just accept the 5 inputs from the flex sensors and display it on the serial monitor.

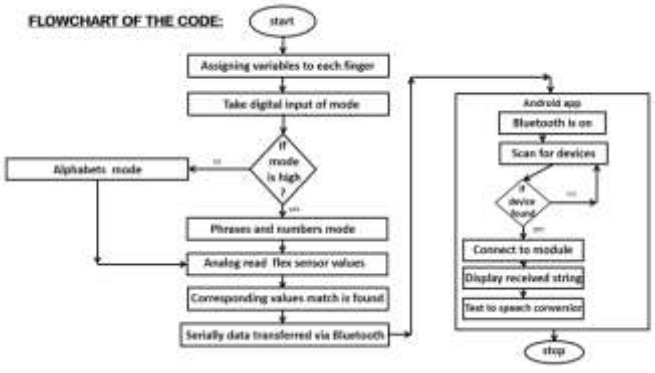

Fig-8: Flow chart of Arduino code

3.4 System Algorithm

Arduino IDE is used for coding in the proposed system. The syntax and the statements in Arduino IDE is similar to C syntax. Hence it is easier to understand and debug the code. Some of the important algorithms and syntaxes are discussed below.

The steps in the algorithm are as follows:

Variables Initialization: The flex sensors attached to each finger is assigned with the variable. The gestures are trained based on the values attained by these variables.

Mode setup: The two modes are defined using the switch operation. They are alphabet mode and, number and phrase mode.

Pattern defining: Each pattern is defined first with respect to the values taken from the flex sensors in accordance with the American Sign Language and pattern matching algorithm is used.

Pattern matching: The gloves are trained with some of the gestures according to the American Sign Language. To the corresponding values of the gesture, the gesture is identified using the pattern matching algorithm.

EXPERIMENTAL RESULTS

The project developed focuses mainly to achieve the day-to-day communication among the normal and, deaf and mute people in an efficient and simple way, as the normal people cannot understand the American Sign Language which is used by the challenged people.

The Gesture gloves project has successfully trained the gloves with 26 alphabets, 9 numbers and frequently used phrases. The gloves employ the gestures using both the hands which has made the project unique and is more reliable than the existing projects. The Bluetooth module used make the system portable as it is wireless.

Mobiles have become the essential necessity for being. Hence, the application being developed using android studio displays the message and speech is obtained. This eases the process of understanding.

The ambiguity is very less when compared to the gesture gloves project employed using accelerometer as the flex sensors give out the apt values and is easy to train.

Test results show that the recognition of the gesture with accuracy than the existing systems.

Future implementations would be employing the gestures being trained with the prediction of the further conversation using the suitable modules and algorithm for easy communication of deaf and mute people with the normal people.

CONCLUSIONS

American Sign Language (ASL) is a complete, complex language that employs signs made by moving the hands combined with facial expressions and postures of the body. The gesture gloves project which is trained according to the American sign language. Deaf people rely on sign language interpreters for communication. However, they cannot depend on interpreters in everyday

life mainly due to high costs and difficulty in finding and scheduling qualified interpreters. Hence, this project enables communication with deaf and is one of several communication options used.

In order to express the wanting, or in the case of emergency or to express the feelings, communication plays a major role, this project is a useful tool for speech impaired and partially paralyzed patients which fill the communication gap between patients, doctors and relatives.

The gestures in the ASL will mostly use two hands. This project helps the deaf and speech impaired to sign their expression and enable the communication with the common people. The dumb gets a voice to express himself. As Arduino Uno is used instead of other bulk microcontroller or bulk electronic circuit, which makes it user friendly and compact and satisfies our memory requirement to the project. Arduino Uno is most compatible with flex sensors.

Thus the project is a useful and fully functional real-world product that efficiently translates the movement of the fingers for the fingerspelling of American Sign Language (ASL).

Use of Bluetooth module eliminates the bulk circuit at the receiver. Using an android application which receives the text from the Bluetooth module connected to Arduino displays the text and converts it to speech. The application model becomes more compact and efficient as it developed as a simple user friendly application.

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