SMART GLOVES FOR HEARING AND SPEECH IMPAIRED

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Abstract - **People have the ability to interact with the surroundings, hear and speak. But not all are fortunate enough. Deaf and dumb is that population that cannot hear or speak. They usually find it difficult to interact with other people. They use hand gestures for this purpose or we can call it the sign language. Even after using this language people find it difficult to understand. This causes difficulties for the differently abled people for interaction even in educational and professional fields. Hence to overcome these problems we have designed a project called SMART GLOVE FOR HEARING AND SPEECH IMPAIRED. This will help the deaf and mute people to remove the communication barrier. Smart glove is a wearable technology. It is a device which consists of specific sensors with great temperature stability. All the sensors are pasted on a glove which measures the different analog parameters associated with the movement and orientation of fingers and hands if any gesture is done. These sensors read the particular analog values and according to these values coding is done to recognize the gestures. The aim of this project is to develop a communication system and to convert or translate these gestures into sound and speech.**

Keywords – **Atmega 2560, MPU6050, Flex Sensor, Random Forest Classifier, Machine Learning.**

I. INTRODUCTION

By and large we meet numerous individuals those are not ready to talk serenely with us like, hard of hearing and mute individuals. They are conveying information by methods for communication through gesture or signs. Gesture based communication is the language utilized by hearing impaired and quiet individuals and it is a correspondence ability that utilizes motions rather than sound to pass on significance at the same time consolidating hand shapes, directions and development of the hands, arms or body and outward appearances to

communicate smoothly a speaker's actions. Signs are utilized to impart words and sentences to crowd. A motion in a communication through signing is a specific development of the hands with a particular shape made out of them. A communication through gesture as a rule gives sign to entire words. It can likewise give sign to letters to perform words that don't have relating sign in that communication via gestures. Flex sensors will be sensors that change the resistance relying upon the measure of bend on the sensor. Right now propose a Sign Language Glove which will help those individuals who are experiencing any sort of imperfections to impart through signals for example with the assistance of independent communication via gestures the client will be ready to make motions of letter sets. The glove will record all the motions made by the client and afterwards it will make an interpretation of these motions into visual structure or sound structure.

II.NEED OF THE PROJECT

Correspondence between a hard of hearing and ordinary individual is as same as that of two distinct individuals from various nations who are utilizing two unique dialects for correspondence which prompts issue in correspondence. Gesture based communication is the main specialized apparatus utilized by hard of hearing individuals to speak with one another. Be that as it may, typical individuals don't comprehend gesture based communication and this makes a huge correspondence boundary between hard of hearing individuals and ordinary individuals. Moreover, the communication via gestures is additionally difficult to learn because of its normal contrasts in sentence, structure and syntax. In this manner, there is a need to build up a framework which can help in making an interpretation of the gesture based communication into content and voice so as to guarantee that successful correspondence can undoubtedly occur in the network.

III. LITERATURE SURVEY

Enable Talk was one such proposal, where the main idea was to convert sign language or gesture into speech. The project was presented at the Microsoft Imagine Cup competition in 2012 and it stood first in that competition. Glove Talk II was a system that converted sign language into speech, which is based on the signal to format model created by the Sidney Fels and Geoffrey Hinton, Department of Computer Science of University of Toronto[1]. To implement this neural networks was used. Glove-Talk-II was a system which converts hand gestures into speech. The current version i.e the best version of Glove Talk II has many inputs (which consist of a Cyber Glove, Contact Glove, speech equalizer and three neural network systems. The signal-to-speech translation task is segregated into vowels and consonants by using gating network to check output weights of a vowel and a consonant neural network system. With the help of the inputs given by the user the gating as well as the consonant network are trained. The vowel network shows a user-defined relation between the hand-gesture and vowel sound and it does not need any training inputs given by the user. The volume fundamental frequency and stop consonants are the outputs with a fixed mapping from the inputs given by the user. Tushar Chouhan designed an interactive glove consisting of wires, associated with softwares like MATLAB or some other software like OCTAVE, with maximum degree of accuracy[2]. The glove will take a call on the orientation of the gestures or signs with the assist of bends or curves of the flex sensor, hall effect sensor and an accelerometer to find speed. The data is then sent to a PC utilizing Automatic Repeat Request (ARQ) which helps with dealing with the blunders that have occurred. The structure is built or constructed for the people having hearing and speech issues to help them convert into the sign languages speech or textual messages. Speak jet was a audio equalizer which was utilised to convert the text data into voice audible data It uses the Mathematical Sound Architecture (MSA) technique to deal with a five channel sound equalizer to make a discourse signal[3]. It has seventy two discourse segments, forty three sound outcomes and twelve DTMF prod tones. With the use of MSA part and furthermore pitch, rate, measure of twist, and sound volumetric structure the client can create different sound outcomes. They worked on to creating an electronic speaking gesture glove, designed to help an ease in the communication through equalised speech for the advantage of the people who cannot hear and speak. Usually, a person who is unable to speak communicates through signs or gestures which is not interpreted by the people who are mot differently abled. The actual system was implemented to resolve this difficulty. Gestures or signs by the person given to this glove will be changed or converted into synthesized speech to inform the people so that they can understand the message, for example in an important communication with a doctor. The glove is equipped with various flex sensors from inside which are made up of “resistance elements” which are sensitive to bends or curves. For every unique sign, the flex sensor will construct a change proportional to the resistance of different components. The executing of this content will impart a specific measure of signals to Peripheral Interface Microcontroller and speakjet integrated circuit which is as of now customized to give the necessary sentence or lines. Harmeet Kaur explained in brief about the previous trails that were done to convert sign language to user comprehensible form[4]. In that paper, they have analysed inn depth about the work on the previous trials done about this technology and also gave different suggestions to implement the design of the glove which recognises gesture. Abhishek Tandon, in that paper showcased a brief information of their created plan of ‘Smart Glove for hearing and speech impaired’ in addition with the past trials tried in the part of augmentative and alternate communication (AAC). The actual model of the glove changes or translates the Indian Sign Language (ISL) into message and voice. The proposed model consists of five flexes, which is placed on each finger of the hand. These flex sensors are in contact with the five inputs of the microcontroller. They utilized the microcontroller to work on the voltage given by the user to the flex sensors and transmit the required message output to the android tool with the help of the Bluetooth module. The android gadget had the software application which can change or translate the message signals into speech signals.

IV. OBJECTIVES

The main objective of the project is to help the Deaf and Mute to put forth their views and interact with the rest of the world.

The objectives of the project are listed as follow:

1. To design and develop a system which lowers the communication gap between speech-hearing impaired and normal world.
2. To help not only the Deaf and Mute but also others who are deprived of this privilege or aren’t in the state

of doing the same. For example, any patient who cannot ask for things easily can also make use of this product.

V. METHODOLOGY

A. *Hardware Assembly*

Five flex sensor are placed on the pinky, ring, center, index, and thumb fingers so as to record the twist of the fingers and the grasp of the hand, then MPU6050 that comprises of both the gyroscope and accelerometer was placed on the back of the hand in order to determine the position and movement of the hand. Flex sensors, and MPU6050 were interfaced with Arduino Mega 2560. Arduino Mega has been programmed so that it sent 11 informations or datas from all the sensor which are 5 flex sensor information, 3 accelerometer information and 3 gyroscope data taken at duration of 500ms to its serial port. Along these lines, in 1 second duration there were 22 data at the serial port. Arduino was connected to the serial port of the computer and by the use of python programming language the data at the serial port was gathered.

B. *Dataset Preparation*

1) *Dataset Collection*

Due to unavailability of the datasets for training the machine with our sensors data, the dataset of the model to be trained was created where data collected at the serial port for each and every signal representing some the most commonly used words were gathered and saved in the comma separated values(csv) file format.

2) *Data pre-processing*

The information that was gathered with various features as per the signs were then segregated with their respective word as the final or expected value, and the final data which was collected was randomized so as to reduce the change and to ensure that the model stays general and overfits less.

C. *Machine Learning*

1) *Random forest algorithm*

Random decision forest algorithm is an ensemble learning technique or supervised classifying algorithm for classifying, regression and other tasks, that operate by creating a great number of decision trees during the training and outputting the class that is the mode of the classes i.e classification or mean of the individual trees i.e regression.

In this classifier, maximum number of trees in the forest results in maximum accuracy when getting the outputs.

Random forest classifier helps in producing a set of decision trees from randomly selected subset of training set and then it checks the votes from different decision trees to decide the final class of the test object.

Random forest prediction pseudo-code:

- It considers the test features, and uses the order of each randomly generated decision tree to predict the result, and stores the predicted output.
- For every predicted target, the votes are calculated.
- The target with the maximum number of votes is considered to be the final output.

Random forest is considered to be very accurate and a powerful method. It does not suffer from the problem of over fitting and this algorithm can be used in both mode or classification and mean or regression problems. The model is tough to clarify or explain compared to a decision tree, where you can easily take a decision by following the path in the tree.

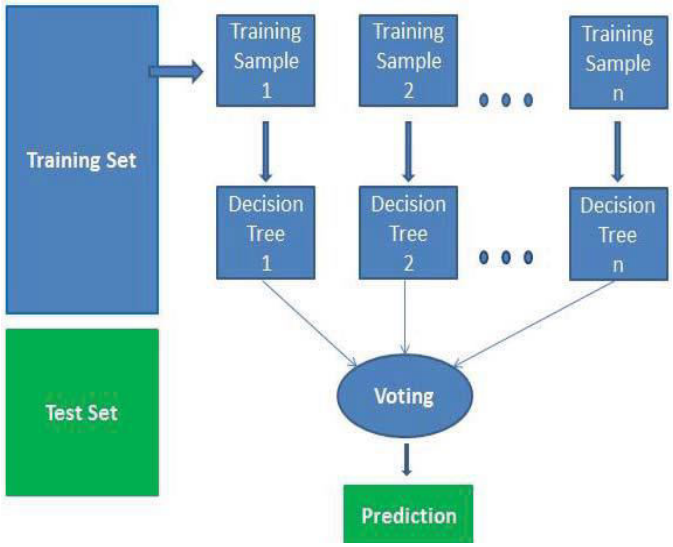


Figure 1 : Working of Random Forest Classifier.

D. *System Architecture*

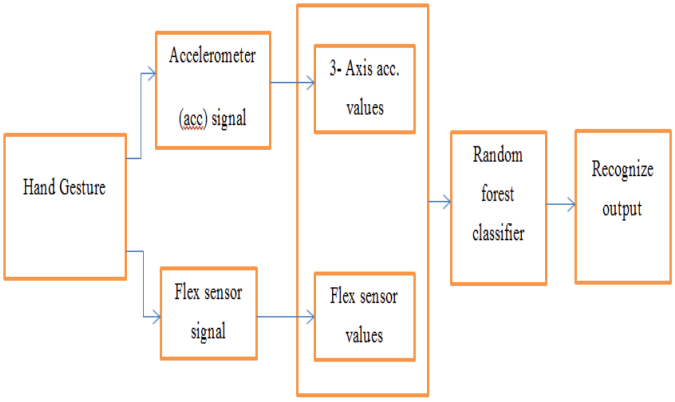


Figure 2 : Extracting the features and passing the extracted feature values through machine learning algorithm.

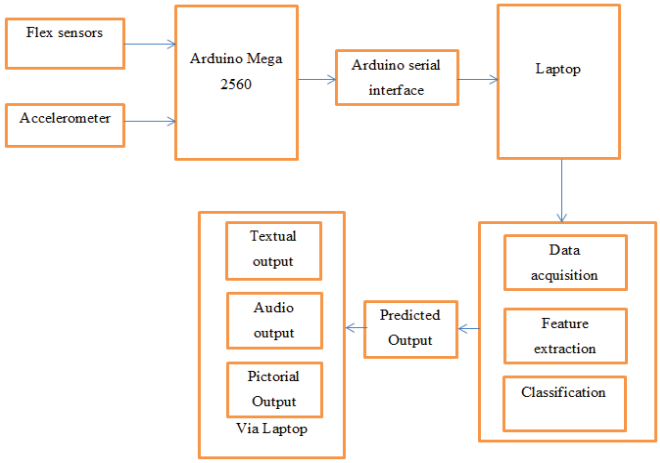


Figure 3 : Block diagram of the system

E. Explanation of block diagram

When hand motion is made by the handler, user gives eleven inputs from the glove controller to the system which consists of three- axes accelerometer signal, three- axes gyroscope signal and five flex sensor signals. These eleven values that are taken from the user acts as a key in identifying a specific signal. These features of the gestures is then passed through random forest classifier, and then the gestures are classified according to the features, and the output is predicted.

With the machine being trained with those datasets, for the real time application of the trained machine, for a specific motion the flex sensor and accelerometer data were collected from the glove movement and processed by the Arduino translating those raw data into meaningful data. These values help in feature extraction method. Those data has sent from the Arduino to the serial port, has collected by the python through the serial interface and saved as temporary dataset (CSV format) form. Lastly, the temporary dataset passed through the machine such that the machine extracts the features of those dataset and predicts the appropriate output for that gesture with reference to the Random Forest Classifier model. As the output has recognized by the model, laptop screen and speaker has used to display the output to the user.

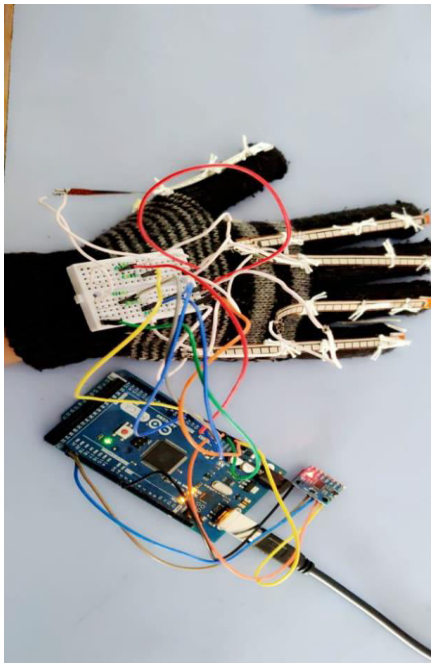
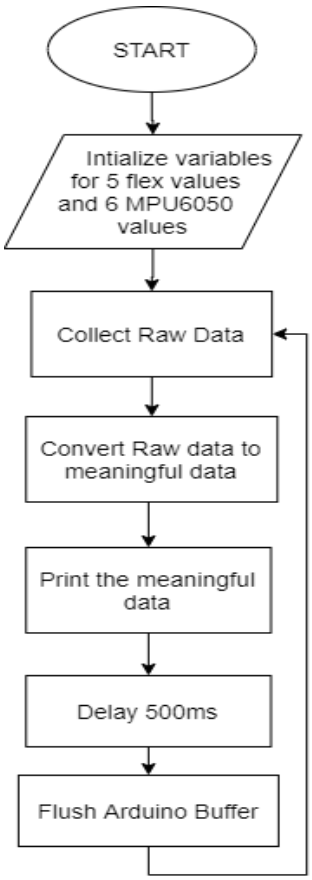


Figure 4: Smart glove

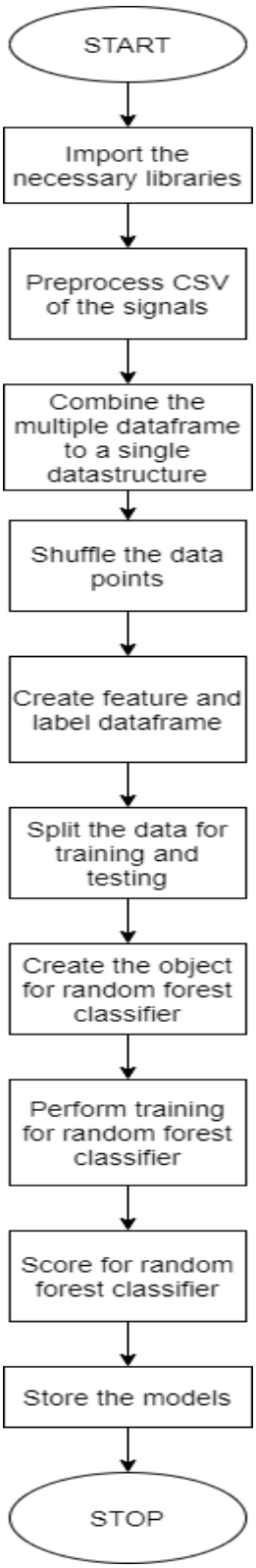
VI. ALGORITHM AND FLOWCHART

1) Flowchart for Dataset preparation using Arduino Mega 2560

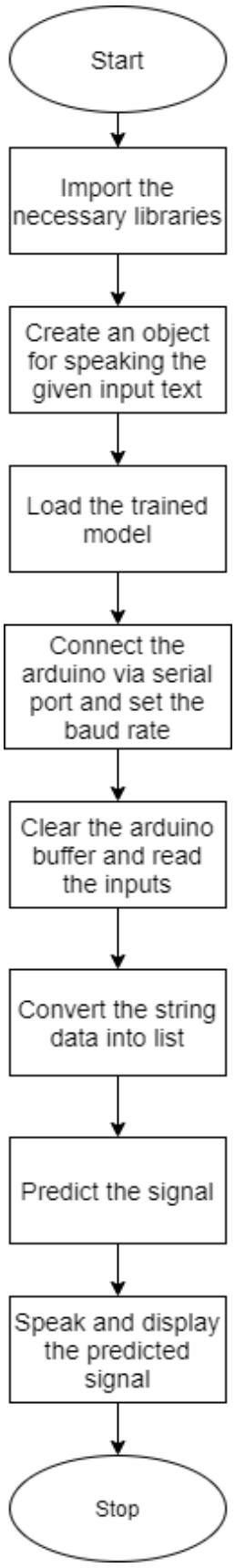


Creation of csv file
Save the data as log using teraterm in .csv format.

2) Flowchart of data set preparation using python



3) Flowchart of real time application



VII. RESULT

The dataset for the words which are most commonly used were made. Considering those datasets the machine was prepared and the model was made. At that point, dataset for all the letters in order were joined and rearranged so as to prepare the machine with diminished change and to ensure that the model stays general and overfits less. At that point the information obtained was taken for communication via gestures of the letters or words, it went through the prepared machine and the nearest estimation was played and shown.

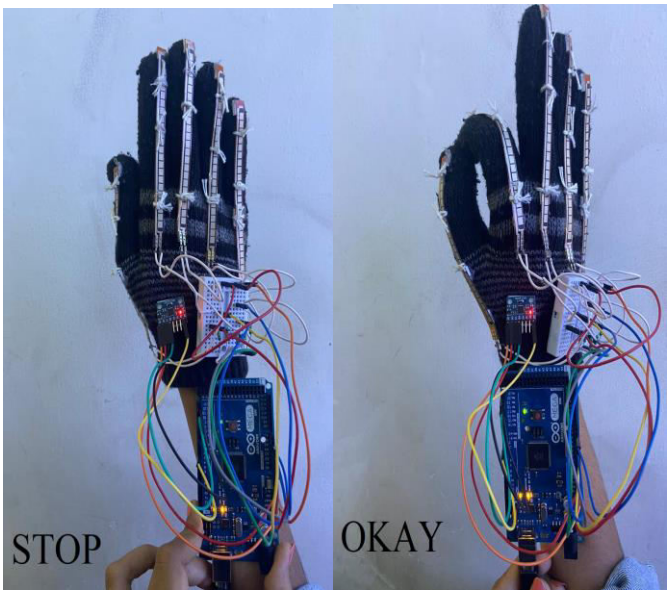


Figure 5: Hand gesture and output for sign STOP

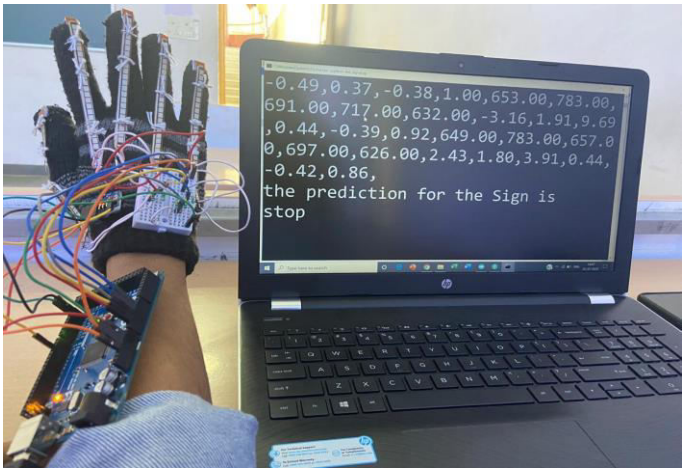
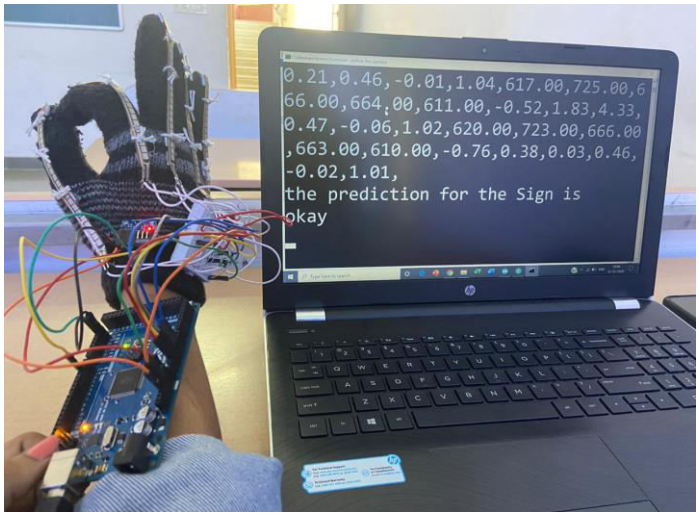


Figure 6: Hand gesture and output for sign OKAY



VIII. CONCLUSION

This paper focusses on the project about smart gloves for hearing and speech impaired people. Our focus was to make a device that could read the sign language and help the deaf and dumb people communicate more efficiently with other people. Machine learning was used to train the datasets for the sign language. Hard of hearing individuals depend on gesture based communication mediators for correspondence. Relying completely upon the translators in day to day existence for most part because of significant expenses and difficulty in finding and booking qualified translators creates a major issue for the differently abled people. This framework will help them in improving their personal satisfaction significantly. A gigantic flaw of this model is the closeness of dataset of various alphabets with one another. As the quantity of dataset builds the exactness likewise increments. Notwithstanding the issues referenced, the structured glove could help connect correspondence hole between hard of hearing individuals and ordinary population to a specific level.

VII. REFERENCES

[1] E. Hintom,, S. SidenyFels and Geoffrey. Glove Talk-A neural network interface which maps gesture to parallel format speech sysnthesis controls. [IEEE Transactions on neural networks]. 9(1):891-921,1998.

[2] Tushar Chouhan, Ankit Panse, Anvesh Kumar Voona and S. M. Sameer. Smart Glove with Gesture Recognition Ability for the Hearing and Speech Impaired. [IEEE Global Humanitarian Technology Conference]. South Asia Satellite (GHTCSAS), 2014.

[3] Speakjet: Magnevation Speak Jet Inc. USA, 2017 http://www.speakjet.com/

[4] Harmeet Kaur, Amit Saxena, Keshav Mehrotra and Khushboo Kashyap. A Review Paper on Evolution of Smart Glove. [International Journal Of Scientific Research]. 3(3):124-128, 2014.

[5] Adarsh Ghimire and Bhupendra Kadayat. A Conference Paper on Smart Glove. [Office Of KEC Research and Publication]. Kathmandu, Nepal 2019.

[6] S. N. Pawar, D. R. Shinde, G. S. Alai and S. S. Bodke. ”Hand Glove To Translate Sign Language”. [IJSTE - International of Science Technology And Engineering]. 3(9),2016.

[7] A. K and R. P. J”Hand Talk-A Sign Language Recognition”. [International Journal of Innovative Research]. 3(3),2014.

[8] Github Website https://github.com

[9] Arduino Mega: Arduino Mega Board https://store.arduino.cc/usa/mega-2560-r3