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# Two-way Communication for Deaf and Dumb People using a Smart Glove

**Alan P Binu[1], Chrisbin Thomas[2], Gadha Premdasan Malayil[3], Surya Sivan[4], Elizabeth Paul[5]**

UG Student, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India[1]

UG Student, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India[2]

UG Student, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India[3]

UG Student, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India[4]

Assistant Professor, Dept. of EEE, Mar Athanasius College of Engineering, Kothamangalam, Kerala, India[5]

**ABSTRACT**:
The most crucial life skill is the ability to communicate effectively.This paper outlines and deploys a clever glove for people who are hard of hearing or unable to communicate. There have been a few studies done with the purpose of finding a less demanding way for non-vocal people to communicate with vocal people and vice versa, and to convey what is required to the hearing scene. Advancements have been made in gesture-based communication yet basically in American Sign Language. This exploration plans to build up communication via gestures interpreter in view of savvy glove interfaced remotely with micro-controller and content/voice showing gadgets. An approach has been created and modified to hear gesture-based communication.

**KEYWORDS:**Gesture-recognition System, Special Glove, Accelerometer, Gyroscope, Neural Networks.

## I.INTRODUCTION

This project presents an approach for designing and implementing a smart glove for deaf and dumb people.The aim of this project is to find an easier way for non-vocal people to communicate with vocal people and express themselves to the hearing world and to develop a sign-to-language translator based on a smart glove interfaced wirelessly with a microcontroller and text/voice presenting devices. In this system, the sign recognition is performed by flex sensors-based glove interfaced to the microcontroller which converts the sensor output to a digital signal and is transmitted wirelessly. The receiver is also connected to a microcontroller and it will receive the text and convert it into speech. In this project, a content/discourse framework for communication through signing is created. As indicated by the best information of the creators, there is no business item for our own communication via gestures and this project is one of the activities investigates around there. The principle favourable circumstances of the created framework, as for others, are its straightforwardness, ease, low power, and its full versatility. Likewise, it is hand glove-based, and accordingly, it can be utilized even in dull conditions, and there is no confinement on the client's development. Moreover, just a single hand is utilized to speak to all signs, which makes it simpler and more agreeable. We have also added a speech to the Morse code system which helps the deaf and dumb people to understand what normal people are saying.

## .II.SYSTEMOPERATION

In this work, the sign recognition is done by flex sensors-based glove interfaced to Esp32. The Esp32 executes the created programto perceive the sign and actualize the relating lettersvocally and literarily.This is simpler than sign to word interpreter, which needs convoluted framework withhand, facial and body signals to pass the messages.The proposed framework focus on its capacity to make an interpretation of sign to letter, which has minimal effort and it can be utilized to speak to more extensivescope of words. This system also records the voice of the normal person and it is then converted into Morse-code, which could be identified with the help of a vibrator. The framework is less difficult and require less sensors andthis includes additional diminishment for the cost.

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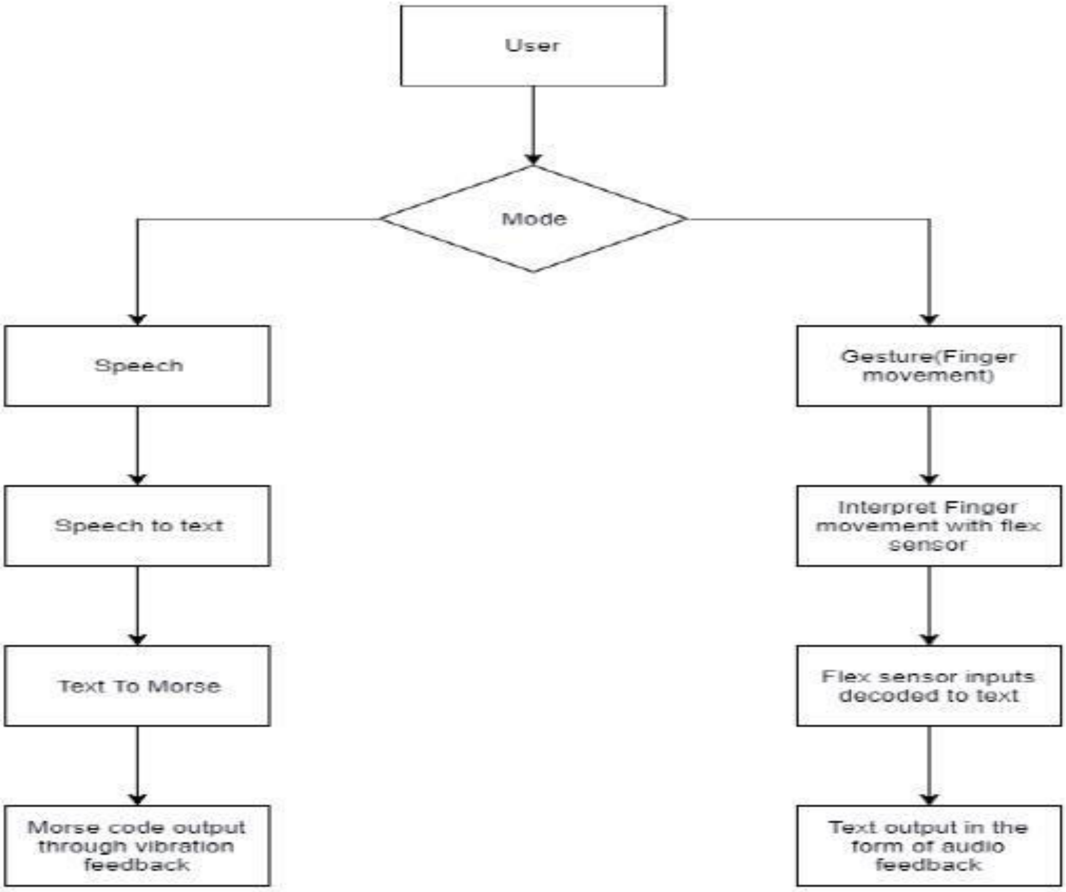


Fig. 1 Block diagram of the entire proposed system.

## III.DATASET COLLECTION AND TRANSFORMATION

Hand gestures are mapped to the corresponding sensor values recorded during the motion of the hand, i.e., accelerometer and gyroscope sensor values along x, y, and z axes. These 6 values were recorded 100 times for each gesture, i.e., 600 data points for one gesture. In the real-world implementation, the dataset would be recorded using mpu6050, esp32, raspberry pi, etc. like devices. The sensors in smartphones can also be used as an alternative in order to record the values. After reading the values, write them to a text file along with the corresponding gesture name. Each gesture was one line of the file with 601 values (600 sensor values and one gesture name). The text files were then consolidated using the CSVlibrary in python. The dataset was then normalized using the sklearn library, each sample independently (along axis 1). It has around 60 instances each of 8 recorded gestures – down-to-up, forward-clockwise, left-fall, up-clockwise, up-anticlockwise, left-to-right, right-to-left, forward-fall.

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| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 0.003022 | 0.093937 | 0.011679 | -0.000629 | 0.000282 | -0.000210 | 0.002838 | 0.093238 | 0.010267 | -0.000629 |
| **1** | 0.000798 | 0.096556 | 0.020467 | -0.000109 | -0.000561 | -0.001020 | 0.000401 | 0.095487 | 0.020298 | -0.000109 |
| **2** | 0.002546 | 0.090785 | 0.027262 | 0.000192 | 0.000018 | -0.000177 | 0.004073 | 0.091596 | 0.029648 | 0.000192 |
| **3** | 0.017293 | 0.095955 | 0.019115 | -0.000139 | 0.000187 | -0.000324 | 0.017862 | 0.096802 | 0.019986 | -0.000139 |
| **4** | -0.000055 | 0.095312 | 0.020812 | -0.000233 | 0.000047 | 0.000046 | -0.000883 | 0.095468 | 0.022240 | -0.000233 |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| **472** | 0.012845 | 0.098365 | 0.013678 | -0.000165 | -0.000197 | 0.000305 | 0.012250 | 0.099106 | 0.013836 | -0.000165 |
| **473** | -0.002079 | 0.080596 | 0.006062 | 0.000606 | 0.000420 | -0.000667 | -0.002528 | 0.080146 | 0.005661 | 0.000606 |
| **474** | 0.011863 | 0.095148 | 0.028367 | -0.000533 | -0.000350 | -0.000925 | 0.011118 | 0.095004 | 0.028283 | -0.000533 |
| **475** | 0.007047 | 0.093727 | 0.008762 | 0.000426 | 0.000409 | -0.000170 | 0.006576 | 0.094048 | 0.008969 | 0.000426 |
| **476** | 0.000861 | 0.093104 | 0.010468 | -0.000235 | -0.000126 | 0.000363 | 0.001809 | 0.093196 | 0.009577 | -0.000235 |

Fig. 2 Dataset Collection

## .IV.VISUALIZATION

The data was separated for each gesture andvisualization of the accelerometer and gyroscope datapoints is done separately for each gesturerespectively. Visualization was done with the help ofmatplotlib.pyplot.

A. For Gyroscope axes points:

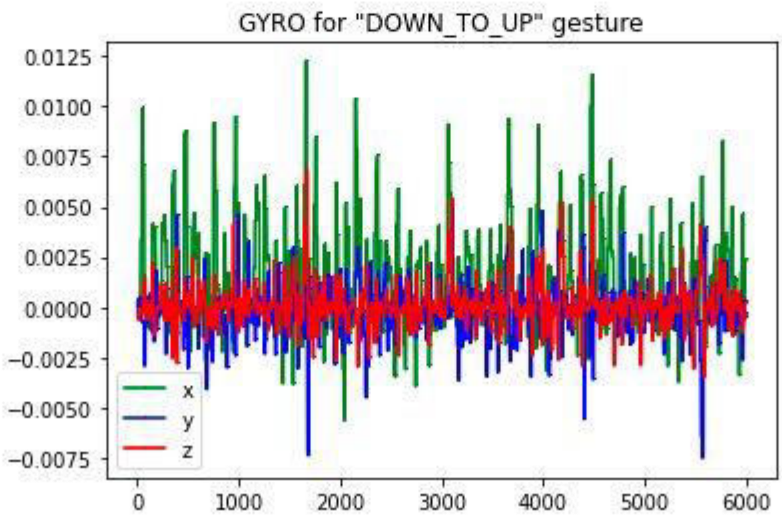


Fig. 3Visualization of gyroscope points of 'Down-to-up' gesture.

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B. For Accelerometer axes points:

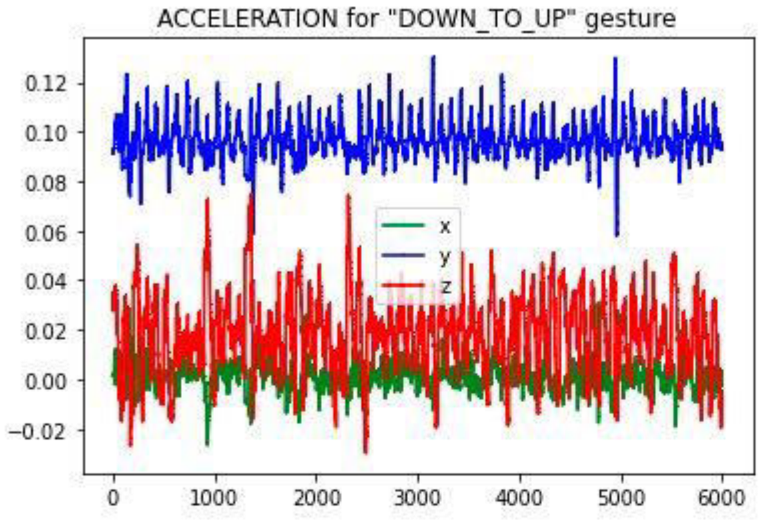


Fig. 4Visualization of gyroscope points of 'Down-to-up' gesture.

After visualizing, the data was analysed for any irregularities or outliers.As the class labels were categorical in nature, OneHot encoding was performed to convert them tonumerical data.

| | down_to_up | forward_clockwise | ... | right_to_left | forward_fall |
|---|---|---|---|---|---|
| 0 | 0 | 0 | ... | 0 | 0 |
| 1 | 0 | 0 | ... | 0 | 0 |
| 2 | 0 | 1 | ... | 0 | 0 |
| 3 | 0 | 1 | ... | 0 | 0 |
| 4 | 0 | 0 | ... | 0 | 0 |
| .. | ... | ... | ... | ... | ... |
| 471 | 1 | 0 | ... | 0 | 0 |
| 472 | 1 | 0 | ... | 0 | 0 |
| 473 | 0 | 0 | ... | 0 | 0 |
| 474 | 0 | 0 | ... | 0 | 0 |
| 475 | 0 | 0 | ... | 0 | 0 |

Fig. 5 Features after One Hot encoding

## V.MODELLING

A sequential model along with a system for sensor-based hand gesture recognition is created. The model is able to classify the hand gestures accurately from the sensory data produced by accelerometers and gyroscopes. The model has four layers, of which three of them are hidden layers, which are activated using 'relu' activation and the output layer is activated with 'softmax' activation. In our proposed approach, the neural network is trained to classify 8 hand gestures. The corresponding sensor values recorded during the motion of the hand, i.e., accelerometer and gyroscope sensor values along the x, y, and z axes, are mapped to hand gestures. For each gesture, these six values were recorded 100 times, totaling 600 data points. After the neural network is built, the training data is fit on the model with an epoch equal to 256 and with a batch size equal to 32. Later, predictions on test data were found by using the trained neural network model for which accuracy of 95.8% with a loss of 0.31 is achieved. After achieving a reliable accuracy, the model is saved using the .h5 extension.

## VI. RESULT AND DISCUSSION

The device converts normal people's voice inputs into Morse code vibrotactile output. The voice message is first converted to text, then to equivalent Morse code signals using a built-in Morse code conversion table in this method. Vibration motors embedded in the fingers of a wearable glove are driven by these signals. The vibration in the fingers

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of a deaf person wearing the glove detects the message and understands it. A mute person can use this device to send messages by bending fingers in the Morse code sequence. The gestures are detected by the flex sensors, gyroscope, and accelerometer on the glove, which generate equivalent electrical signals that are then converted to text and then pronounced and heard as audible messages using a text-to-voice synthesizer. The resulting device is a simple, low-cost, wearable solution that deaf and mute people can use as an effective communication tool in their daily lives.

## VII.CONCLUSION

This paper presents a glove-based sign-to-content/voice interpreting framework for hard-of-hearing and unable to speak individuals. The glove speaks to the gesture-based communication letters as a yield a sound through the speaker, which helps in restricting the correspondence boundary amongst tragically challenged vocal individuals. The critical of the exploration is identified with its intention to help this class of specially-abled individuals to speak with normal people and enhance their commitments to development and build their countries. The framework has been outlined, customized, executed, and tried with a decent outcome. The work could be reached out to cover more vast scope of the sign by using a mix of two gloves rather than one.

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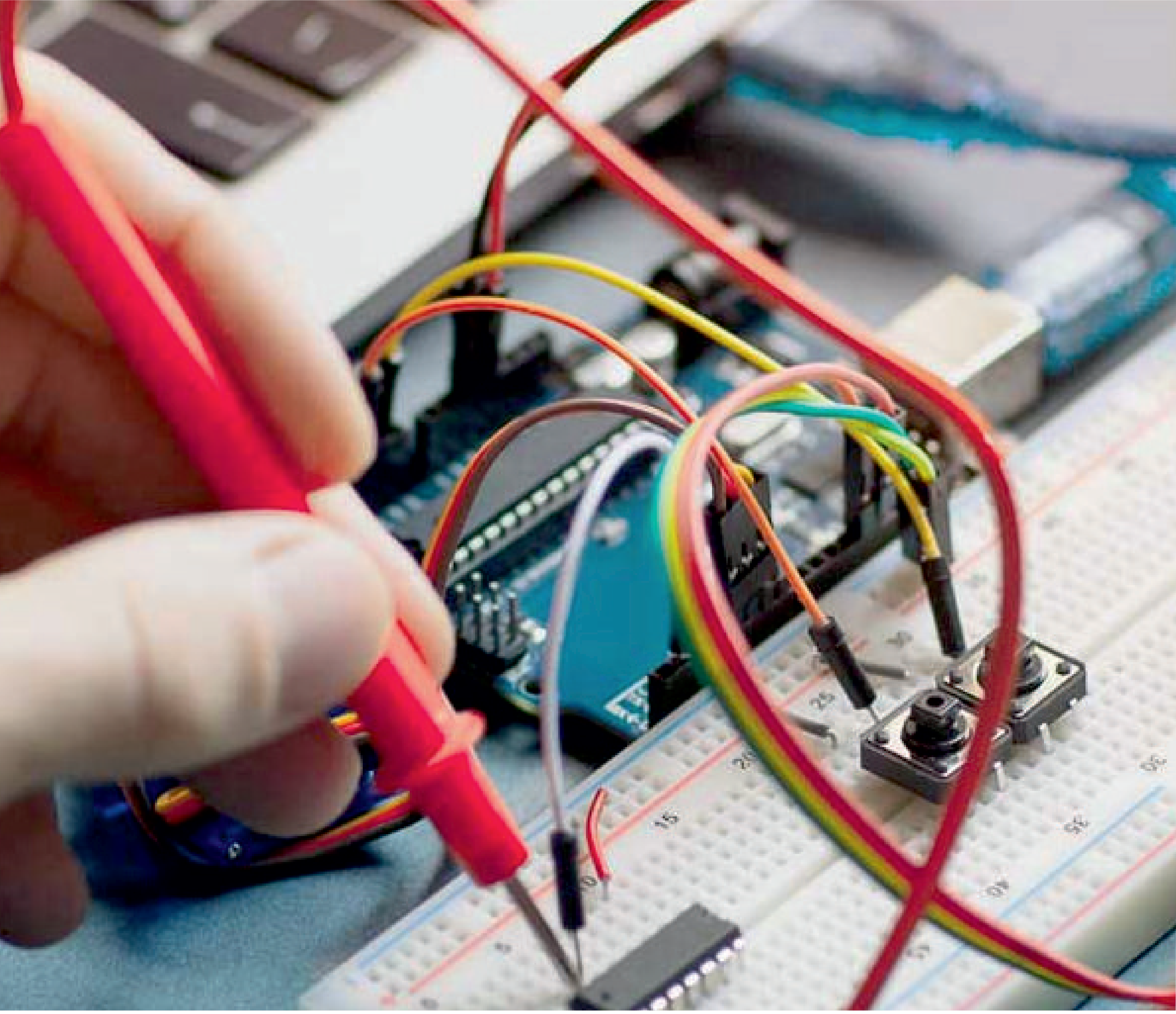

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