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# Intersign Glove: A Communication Interface for the Aid of Deaf and Mute Community

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**Abstract:- " Intersign Glove " is a groundbreaking innovation designed to address the communication barriers faced by the deaf and mute community. With the aim of revolutionizing traditional methods of communication, this paper introduces an innovative approach that utilizes gesture recognition technology to interpret Indian Sign Language (ISL) in real-time. The paper endeavors to eliminate the dependency on sign language interpreters by creating an embedded system comprising both hardware and software components. By leveraging advanced sensors strategically placed on a glove, the system captures intricate gesture parameters and translates them into code for computation. This code is then processed by a microcontroller board integrated into the glove, which generates corresponding speech output through an attached speaker, facilitating seamless communication between the user and non-sign language speakers. The wearable nature of the device ensures portability and ease of use, empowering individuals with hearing and speech impairments to communicate effectively in various social settings. Furthermore, by bridging the communication gap between the deaf and mute community and the wider population, this paper opens up new opportunities for inclusion and collaboration. "Intersign Glove" represents a significant advancement in assistive technology, promising to enhance the quality of life for individuals with hearing and speech disabilities while fostering greater understanding and integration within society.**

***Keywords:-*** *Intersign Glove, Sign Language.*

## I. INTRODUCTION

Considering the world's total population, 5% of the present population numbers i.e., 40 Crore people are Deaf & Mute out of the 8 billion people. For every 20 people, 1 person is Deaf or Mute. In India, out of the 2,68,10,557 persons with disabilities, there are 19,98,535 people who have speech impairments and a total of 50,71,007 people who have hearing impairments. For these differently abled people to access critical information in locations like hospitals, train stations, and courts, interpreters are required. Additionally, this requirement is not just restricted to emergency alerts but also necessary in lengthy tasks like teaching. There are fewer schools that need this capability. The inability of modern technologies to support Indian Sign Language (ISL) poses a severe challenge for those who use it to communicate. Additionally, these systems have been built using simplistic, unrealistic graphic standards, which is crucial for communication.[1] Since the beginning of time, communication has been crucial to the development of our species. Today, it is impossible to imagine conducting daily affairs and living without a language that all parties can understand. Hearing-impaired people have created sign languages to get over the spoken language barrier, but they still encounter numerous difficulties in daily life. If there is no other physical handicap present, two deaf persons can communicate with one another using sign language. However, there are several impediments to communication when a hearing person needs to speak with a deaf person or vice versa. In these situations, a translation procedure is necessary, which may convert sign language from the deaf person to the hearing person's spoken language and vice versa.[2]

So, as a responsible Electronics & Communication Engineer, it is my duty to support my fellow citizens with the knowledge and skills that I possess. In this paper we will be combining the use of both hardware and software to build the communication interface. This paper is based upon an embedded system of Hardware and software. To eliminate the difficulties experienced by Deaf & Mute people, a communication interface is aimed to be designed which will make it easier for the Deaf & Mute community to interact with other people who are not aware of the sign language. This paper will help replace the requirement of a Human sign language interpreter. It will be very user-friendly and will allow the user to communicate with others without any difficulty. A sensor-based glove will be collecting the necessary data of the hand gestures of the respective sign language. It will transmit the data to a microcontroller. The required processing of the collected data is done by the microcontroller and sends to the output device in the form of text or speech. The main objectives of this paper are to develop a portable, user-friendly communication device, implement multiple sensor technology for capturing sign language gestures, develop a model for real-time sign language interpretation, integrate text-to-speech technology for spoken language output, Provide an intuitive user interface for customization and ease of use and Ensure affordability and accessibility for a wide range of users.

- *Key Features*

Flex Sensor Array: The core of the system utilizes a flexible sensor array worn on the user's hand to detect hand and finger movements during sign language communication.

Real-Time Interpretation: A machine learning model is employed to interpret the sign language gestures in real time.

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The model will be trained to recognize a broad spectrum of sign language gestures and expressions.

Text-to-Speech Integration: The interpreted sign language is converted into spoken language using text-to-speech technology, enabling communication with individuals who do not understand sign language.

Customization: Users can customize the interface and the machine learning model to cater to their specific sign language dialect or style, ensuring a personalized and accurate experience.

Portability: The device is designed to be lightweight and portable, allowing users to carry it with ease and use it in various social and professional settings.

- *Working Model*

The main aim of this approach is to provide an essential interface for Deaf and mute people with the use of embedded systems. Various hardware sensors are used, and the data collected by them are computed through software to produce the necessary speech output. All the components are mounted in an ergonomic placement over a wearable glove. Each flex sensor is placed over the fingers of the glove so that the bending movement of the fingers is captured. The ADXL 335 Sensor which is a combination is also placed over the hand glove. The main function for which the ADXL 335 Sensor is added to collect the data of hand gesture in the 3-Dimensional space. Because sign language is not only just based upon finger movements but also on hand movements, so it becomes mandatory to include a gyroscope/accelerometer-based sensor to perform that task. The flex sensors and the ADXL 335 Sensor are connected to the Arduino Micro-controller board. These sensors simultaneously send the collected data to the Arduino micro-controller board. The Arduino board is pre-programmed according to the requirement using the Arduino IDE which provides the coding platform to write the appropriate code to make the components work as per the required use. The written program code is transferred to the Arduino micro-controller. The Micro-controller saves and runs the program when the board is given supply voltage. When the Board is given supply voltage, it starts to run the program and the gesture data produced by the flex and ADXL 335 sensors when received by the micro-controller is accordingly processed. This processed data is analysed, computed, and converted into text. The received text is converted to speech signal and given at the output through the PAM8403 module to the speaker. In this way the entire system works and executed. We can see a brief description of the prototype setup through the given Block diagram above.

- *Components:*

Table 1 Components Table

| S. No. | Component | Function |
|---|---|---|
| 1. | Arduino Nano Micro controller Board | The brain of the prototype, responsible for executing instructions and controlling all operations. |
| 2. | Flex Sensors (5) | Provides data of finger bending movements of the hand gestures |
| 3. | ADXL 335 Sensor | Provides data of hand position in 3-Dimensional space of each hand gesture |
| 4. | PAM 8403 Module | Amplifies the speech signal from Arduino board |
| 5. | Mini Breadboard | Provides connection point to hold PAM 8403 Module and ADXL 335 Sensor |
| 6. | Universal Prototype PCB | Provides a platform for assembling and soldering electronic circuits and extension terminals. |
| 7. | 3-watt 4-ohm speaker | For output of speech signal |
| 8. | 9V battery | Power source for prototype |
| 9. | Jumper wires | Connecting various components of the prototype |
| 10. | Hand glove | Provides the base to hold all the components as a wearable technology |

- *Methodology*

The prototype flow diagram provides a structured path for data transformation and signal generation. Initially, the flex sensors and ADXL335 sensor capture raw data, reflecting real-time movements or inputs. This raw data stream is then directed to the Arduino, the central processing unit of the system. Within the Arduino, algorithms process and analyze the incoming data, adjusting it according to predefined parameters and programmed logic. Once the data is refined, the Arduino generates a speech signal, translating the processed information into audible output. This signal is then passed to the PAM8403 modules, which serve to amplify the audio signal to a suitable level, considering the characteristics of the connected speaker. Through this amplification process, the audio signal is optimized for clarity and volume, ensuring effective communication. Ultimately, the refined speech signal is delivered through the speaker, completing a continuous cycle wherein the system remains responsive to input and generates appropriate output. This cyclic process ensures the functionality and adaptability of the system over time.

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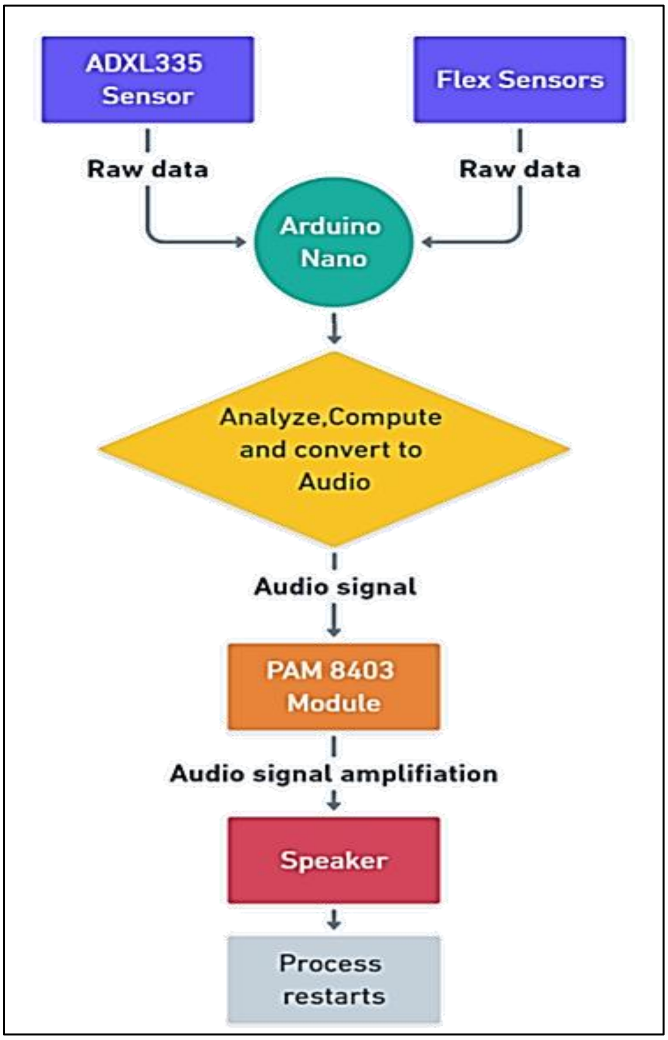


Fig 1 Prototype Flow Diagram |}+[-kjhysWz

## II. LITERATURE REVIEW

➢ *Sign Language Interpretation System with Sensors Fusion:*

Using an integrated SVM classifier, the researchers in this work successfully created and implemented an innovative and intelligent wearable hand device as a sign interpretation system. A smartphone application for Android was created to showcase the wearable smart device's usage, complete with a text-to-speech feature. Regarding comfort, versatility, and portability, the participants highly rated the suggested smart wearable sign interpretation system. The device holders don't need to be custom-made because they can accommodate a variety of hand and finger sizes thanks to their 3D printing technology and flexible filament.[3]

➢ *Interpretation of Sign Language using NLP Techniques:*

The interpretation of sign language in appropriate English sentences is the main goal of this suggested approach. Sign recognition is used with several NLP approaches. A video of sign language is provided as input, which is then framed and segmented. P2DHMM is utilized for hand tracking and the CamShift algorithm is used for tracking. For sign identification, the Haar Cascade classifier is employed. Following sign recognition, the POS tagging module receives the continuous words associated with the corresponding sign as input. It uses a WordNet POS tagger, which has its own WordNet dictionary. Finally, the sentence is framed using the LALR parser. The output of the suggested sign language interpreter model is therefore provided in a coherent English sentence and is accurate.[4]

➢ *Dataset based Large Scale Sign Language Interpretation:*

Several research teams have tried their hand at creating automatic translators using machine learning experiments. These efforts have mostly been limited to signed material or small enough signers or limiting vocabularies. For this reason, they presented CSLD, a sizable Chinese continuous sign language dataset that would be particularly beneficial in enhancing machine learning methods. And, they provide the biggest sign language dataset yet assembled, which consists of 50,000 video clips selected from a pool of 10,000 distinct utterances signed by 50 signers. We also provide a number of sequence-to-sequence deep learning techniques for translating written material from Mandarin and English to Chinese sign language automatically. These techniques make use of finger articulation, face expressiveness, and body joint position. Models may overfit on training sets, but with real-world data, generalization to unexpected utterances is still difficult. The presented dataset and techniques show how deaf and hearing persons may communicate more effectively thanks to contemporary machine learning techniques.[5]

➢ *Sign Language Interpretation Using Convolutional Neural Network:*

The authors of this work described an image-based comparison method for identifying models from the ASL finger spelling dataset that can read sign languages far more effectively. Two bespoke models and numerous convolutional neural network-based transfer learning models have been created for this purpose. After that, two methods were examined for training and verifying the network: using simply RGB images in one method and using both RGB and depth information in another. they outperformed all previous models in their RGB picture classification. J and Z will be added to the video dataset, which will be used to identify continuous hand signs, to enhance the system even more.[6]

➢ *Study of Sign Language Recognition:*

This method is limited by the viewing angle and greatly influenced by surrounding conditions. Furthermore, CV typically uses machine learning, which raises the application cost in practical settings and necessitates the cooperation of a team of experts and the use of expensive hardware utilities. Consequently, the goal of this model is to develop and deploy a deep learning-based wearable American Sign Language (ASL) interpretation system that "fuses" six inertial measurement units (IMUs). The suggested method is not limited by the field of view because the IMUs are affixed to all fingertips and the back of the hand to detect sign language gestures. According to the study, this model can recognize dynamic ASL motions with an average recognition rate of 99.81%. Additionally, by further integrating the suggested ASL recognition system with ICT and IoT technologies, a workable solution to help hearing-impaired people communicate with others and enhance their quality of life can be offered.[7]

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➢ *IoT Based Sign Language Interpretation System:*

In this research, we use a multiclass classifier to effectively design and construct a wearable gadget that is both smart and outstanding for sign interpretation for both hands. A smartphone application with an Android platform has been created to recognize the motion made with two hands while wearing sensor gloves. Because the sensors are integrated into a cotton glove, anyone can wear it comfortably. Additionally, the mobile application has a text-to-speech function for easier communication with an audible output.[8]

## III. RESULT AND DISCUSSION

The raw values of all the sensors are measured by the Arduino board and those values are recorded for the various hand gestures of the Indian sign language. Once the data of the sensors is gathered then it is coded in the Arduino code to generate the appropriate output. The data of the sensors are coded in such a way that when the data of the sensors match with pre-measured values of the sensors as per the sign language hand gesture it returns the interpretation of the gesture. This working model incorporates the text to speech feature in the Arduino code itself, where the output is generated through the speaker connected to the Arduino microcontroller board. The text to speech feature is achieved by using the talkie library in the Arduino library section. In this way the speech signal is generated and thus our agenda to allow interpretation of sign language without the involvement of a sign language interpreter is achieved.

Below is the table representing the raw values of the sensors for some of the sign language gestures in the Indian sign language. The term Value in the above table represents the raw values of each sensor placed on the hand glove. And based on these raw values the hand gestures of sign language are coded and programmed in the Arduino. When the code is once loaded in the Arduino nano board it matches these values and generates a response. And as we have incorporated the text to speech feature in the Arduino code itself when the all the parameter values match with the values of the gesture the corresponding speech signal is generated through the digital pins of the Arduino board. Hence completing the agenda of producing a prototype model for interpreting the Indian sign language using technology avoiding the need for a human sign language interpreter.

Table 2 Sensor Raw Values

| S.no | Thumb | Index | Middle | Ring | Little | X | Y | Z | Gesture |
|---|---|---|---|---|---|---|---|---|---|
| 1 | VALUE <250 | VALUE >250 | VALUE <250 | VALUE <250 | VALUE <250 | 350<VALUE<380 | 330<VALUE<360 | 400<VALUE<420 | ONE |
| 2 | VALUE <250 | VALUE >250 | VALUE >250 | VALUE <250 | VALUE <250 | 350<VALUE<380 | 330<VALUE<360 | 400<VALUE<420 | TWO |
| 3 | VALUE <250 | VALUE >250 | VALUE >250 | VALUE >250 | VALUE <250 | 350<VALUE<380 | 330<VALUE<360 | 400<VALUE<420 | THREE |
| 4 | VALUE <250 | VALUE >250 | VALUE >250 | VALUE >250 | VALUE >250 | 350<VALUE<380 | 330<VALUE<360 | 400<VALUE<420 | FOUR |
| 5 | VALUE >250 | VALUE >250 | VALUE >250 | VALUE >250 | VALUE >250 | 350<VALUE<380 | 330<VALUE<360 | 400<VALUE<420 | FIVE |
| 6 | VALUE <250 | VALUE <250 | VALUE <250 | VALUE <250 | VALUE >250 | 350<VALUE<380 | 330<VALUE<360 | 400<VALUE<420 | SIX |
| 7 | VALUE <250 | VALUE <250 | VALUE <250 | VALUE <250 | VALUE <250 | 400<VALUE<420 | 340<VALUE<360 | 360<VALUE<380 | C |
| 8 | VALUE >250 | VALUE >250 | VALUE <250 | VALUE <250 | VALUE <250 | 410<VALUE<421 | 340<VALUE<360 | 350<VALUE<370 | L |
| 9 | VALUE <250 | VALUE >250 | VALUE >250 | VALUE <250 | VALUE <250 | 400<VALUE<420 | 340<VALUE<360 | 365<VALUE<385 | V |

## IV. CONCLUSION

This paper is based upon the implementation of sign language interpretation which helps the Deaf and mute people to communicate their needs with other people. This paper is based upon an embedded system of Hardware and software. To eliminate the difficulties experienced by Deaf & Mute people, a communication interface is aimed to be designed which will make it easier for the Deaf & Mute community to interact with other people who are not aware of the sign language. This paper will help replace the dependency on Human Sign language interpreters for communication. It will be very user-friendly and will allow the user to communicate with others without any difficulty. The gestures are recognized by the hardware and sent to the software to be processed. The software reprocesses the information and transmits the converted data as speech output through the speaker connected to the microcontroller board.

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## REFERENCES

[1]. Vasani, N., Autee, P., Kalyani, S., &Karani, R. (2020). Generation of Indian sign language by sentence processing and generative adversarial networks. *Proceedings of the Third International Conference on Intelligent Sustainable Systems [ICISS 2020]*, 1250-1255. https://doi.org/10.1109/ICISS49785.2020.9315979

[2]. Kahlon, N. K., &Singh, W. (2021). Machine translation from text to sign language: a systematic review. *Universal Access in the Information Society*, 1-36. https://doi.org/10.1007/s10209-021-00823-1

[3]. B. G. Lee and S. M. Lee, "Smart Wearable Hand Device for Sign Language Interpretation System With Sensors Fusion," in IEEE Sensors Journal, vol. 18, no. 3, pp. 1224-1232, 1 Feb.1, 2018, doi: 10.1109/JSEN.2017.2779466.

[4]. Sampada.S. Wazalwar & Urmila Shrawankar (2017) I nterpretation of sign language into English using NLP techniques, Journal of Information and Optimization Sciences, 38:6, 895-910, DOI: 10.1080/02522667.2017.1372136

[5]. T. Yuan et al., "Large Scale Sign Language Interpretation," 2019 14th IEEE International Conference on Automatic Face & Gesture Recognition (FG 2019), Lille, France, 2019, pp. 1-5, doi: 10.1109/FG.2019.8756506.

[6]. Paul, P., Bhuiya, M.AUA., Ullah, M.A., Saqib, M.N., Mohammed, N., Momen, S. (2019). A Modern Approach for Sign Language Interpretation Using Convolutional Neural Network. In: Nayak, A., Sharma, A. (eds) PRICAI 2019: Trends in Artificial Intelligence. PRICAI 2019. Lecture Notes in Computer Science(), vol 11672. Springer, Cham. https://doi.org/10.1007/978-3-030-29894-4_35

[7]. Lee, B.G., Chung, W.Y. (2021). Study of Sign Language Recognition Using Wearable Sensors. In: Singh, M., Kang, DK., Lee, JH., Tiwary, U.S., Singh, D., Chung, WY. (eds) Intelligent Human Computer Interaction. IHCI 2020. Lecture Notes in Computer Science(), vol 12615. Springer, Cham. https://doi.org/10.1007/978-3-030-68449-5_24

[8]. Golda Jeyasheeli P and Annapoorani K Miss 2019 *J. Phys.: Conf. Ser.* **1362** 012034**DOI** 10.1088/1742-6596/1362/1/012034