SMART GLOVE TRANSLATOR

Capstone Project Proposal

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Mentor Consent Form

I hereby agree to be the mentor of the following Capstone Project Team :

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Project Overview

In order to improve communication accessibility, a wearable gadget that can translate Indian Sign Language (ISL) motions into real-time text and vocal output is being created by our project, the Smart Glove Translator. The glove combines accelerometers, flex sensors, and Arduino microcontrollers to detect hand movements and gestures correctly. By concentrating on ISL, the unique requirements of the deaf and hard-of-hearing members of the Indian community can be better met and their capacity for interpersonal communication can be improved.

The Smart Glove Translator keeps a database of frequently used words and phrases in its memory to facilitate smooth communication. A certain motion connected to a sentence that has been saved is identified by the glove's built-in processing power, and then the relevant text is pulled out of memory. The intended message can then be clearly and audibly sent using a Bluetooth-connected speaker that receives the synthesized text. This novel method ensures adaptability and ease of use for users in various communication contexts.

User-centered design and practicality, in addition to technological innovation, are prioritized in our project. The accuracy and reactivity of the Smart Glove Translator to work well in everyday situations are aimed to be improved by us. This will be done by iteratively testing and soliciting feedback from fluent speakers of ISL. People with hearing impairments are aimed to be enabled to participate more boldly and inclusively in everyday encounters, therefore encouraging accessibility and creating a more inclusive society by utilizing developments in sensor technology and signal processing algorithms.

Problem Statement

For those who are deaf or hard of hearing in India, their primary communication method is Indian Sign Language (ISL). However, a substantial barrier to communication is posed by the absence of accessible technology that meets their demands. Traditional communication techniques like lipreading or written notes are frequently found difficult and unproductive by ISL users, which can cause misunderstandings and marginalization in various social and professional contexts. In addition, the communication gap is exacerbated by the need for interpreters proficient in ISL, making it more difficult for people with hearing impairments to express themselves and communicate with others.

The deaf community in India faces significant difficulty due to the lack of accessible technology solutions that are specifically made to understand ISL gestures and enable real-time communication. The wide range of requirements and preferences of ISL users are frequently not satisfied by current translation systems in terms of accuracy, timeliness, and customization possibilities. The communication gap encountered by people with hearing impairments is further exacerbated by the high cost and restricted availability of these technologies, which limit their accessibility to a larger audience.

Given these obstacles, a creative and cost-effective solution is desperately needed to enable ISL users to interact inclusively and successfully in a range of social, academic, and professional contexts. A viable way to improve accessibility and close the communication gap for those who use ISL as their native language is presented by a Smart Glove Translator with flex sensors, accelerometers, Arduino microcontrollers, and Bluetooth connectivity. The goal is to promote equal participation, empowerment, and inclusivity for people with hearing impairments in Indian society by creating an accurate and user-friendly translation system that is specifically designed to meet the needs of ISL users.

Need Analysis

In order to promote inclusivity and accessibility in society, access to efficient communication tools must be provided for deaf and hard-of-hearing people. Although the Indian Sign Language (ISL) is mainly used for communication by the deaf community in India, a significant gap in accessible technology for ISL users is still observed. To close this gap, the creation of a Smart Glove Translator, which can translate ISL gestures into text and vocal output, is the aim of our project. This research examines the difficulties faced by ISL users and determines what should be included in a technological solution to improve their communication ability.

Conventional communication methods such as lipreading and written notes often fail, leading to frustration and misunderstandings. The scarcity of ISL interpreters exacerbates the communication gap, particularly in professional and educational environments. Developing accurate translation systems is hindered by the complexity of ISL gestures and regional variations.

Requirements for a Smart Glove Translator:

The glove will be integrated with flex sensors, accelerometers, and Arduino microcontrollers to precisely detect hand gestures and movements. The glove’s memory capacity, which allows for storing various statements and phrases, makes personalized and contextually appropriate communication possible. Moreover, integrating other speakers with ease and producing crisp, audible speech output are made possible through Bluetooth connectivity. The glove must be lightweight, ergonomic, and easy to use to meet the various needs of ISL users of all ages and skill levels.

The creation of an ISL Smart Glove Translator is seen as a significant step toward improving inclusivity and communication accessibility for those hard of hearing or deaf, as well as toward closing the gap between the able and impaired. The development of a game-changing tool that advances equality, compassion, and respect for India's deaf-mute community through cooperative efforts and user-centred design principles is what we aim for.

Literature Survey

India is recognized as a multilingual nation, encompassing many different languages and dialects. The topic of smart communication for the deaf and hard of hearing has been the focus of numerous research projects. How the deaf community uses different sign languages in different geographical areas is often emphasized by researchers. In addressing the issue of the hard of hearing, many patent applications have been filed using various strategies.

Ahmed J Abougarair's[1] was utilized to develop a sign language translator using wearable technology. The device made by them was capable of converting sign language into text and speech. The glove-based device could read the movements of one arm and five fingers. The device was constructed using five flex sensors and an accelerometer. This device allowed for the translation of certain motions corresponding to the alphabet in American Sign Language (ASL) into speech and text based on the interaction of these sensors. The device could be attached to a mobile application for increased ease of use. Based on preliminary trial results, the device achieved an average translation time of 0.6 seconds for sign language into speech and text.

Jason Parry [2] attempted to develop a portable and affordable sign language-to-speech translator. The focus was on fingerspelling in American Sign Language (which translates into any language based on the Latin alphabet) and converting a pangram into speech. The system was comprised of three subsystems: text-to-speech, gesture classification, and gesture detection. It relied on a power bank as its power source. A three-axis accelerometer and five flex sensors were used, each attached to a gloved finger, for gesture detection. A supervised machine learning approach was employed for gesture classification; five different algorithms were compared to identify the optimal configuration for this system. Various machine learning classifiers were utilized to achieve this purpose. The system achieved a practical repeatability of 85.51% with the best machine learning classifier. The Espeak engine was used to perform text-to-speech translation of the classified gestures. The system's net cost was approximately 35$, which was lower compared to similar systems available in the market, costing around 100$ on average.

Woei Sheng Wong [3] designed a CBAM-ResNet model for translating Malaysian Sign Language in his research. a. This model was developed to help the Malaysian deaf-mute community, people with hearing impairments, and people who cannot speak to communicate freely. He used image and video recognition techniques; two studies were carried out for static and dynamic signs. A Malaysian Sign Language video dataset consisting of 19 dynamic signs was recorded. Nineteen dynamic signs were recorded in a video dataset of Malaysian Sign Language. The research focused on two distinct CBAM integration approaches, the "Within Blocks" and "Before Classifier" methods. The model reported an accuracy of approximately 90%. The best classifier is CBAMResNet "Before classifier," which performs better in classification on video recognition trials and requires less computing power. It also trains 2.52 times quicker than CBAM-ResNet "Within Blocks."

Amal Dweik [4] designed a smart glove that only uses one hand to translate the Arabic Sign Language (ArSL) alphabet. It used a Printed Circuit Board (PCB) on a textile glove. The PCB detected and classified the hand gestures using a microcontroller and sensors. It used flex sensors, an accelerometer, and pushbuttons with an Arduino Nano microcontroller to sense the right-hand gesture for the Arabic Sign Language Alphabet. The outputs of the flex sensors and accelerometer, which are analogue values, were converted to digital signals. They used Bluetooth module CH-06 to connect the Arduino and the mobile. The results were sent via Bluetooth as text to a mobile application. The system's success rate was approximately 88.21%.

A.HARITHA[5] is developing a glove that will be used to convert sign language (ASL) to speech. The parts used in the system are 3 flex sensors, a power supply, an Arduino, an ARP33A Module, a speaker and an LCD display. The system developed by him consisted of two parts; sign language recognition and conversion to text and further to speech. The sign language gloves have flex sensors that control the amount of bend on the fingers. They connected flex sensors attached to the fingers of the glove to the Analog pins of the Arduino UNO board. After providing a 5V supply, A4 & A5 pins of Arduino are connected to the LCD display and the digital pins to the ARP33A module, which is the voice processor used. They stored the text equivalent of the voice command already present in the ARP33a Module to be seen on the LCD display. The glove can be easily worn on the hand, and on giving hand gestures, flex sensors, which are connected to each finger of the glove, can bend, and values are obtained. Their project has various applications in hospital patients and differently-abled people.

Divya P S [6] is developing a system to translate American sign language into speech. For this purpose, they have created a smart glove that converts sign language into text and then voice. The team trained and tested their model on an appropriate dataset. They used IR sensors and accelerometers to make the smart gloves. The smart gloves have IR sensors that can detect how the fingers flex. The role of the accelerometer is to detect the hand movements, acceleration, and tilt of the glove. A Microcontroller board called the Node MCU, based on the ESP8266 Wi-Fi module, is deployed in their project. First, the accelerometer and IR sensor are connected to the NodeMCU device. After that, code is written to decipher the data from the accelerometer and IR sensor. Using a mobile application, the team tested their model on various English alphabet letters like A, B and C and converted it to text and audio. This system helps blind, deaf, or dumb to communicate with each other. The team focuses on improving the accuracy of smart language translator gloves in the future, as there is still room for improvement.

Novelty

An innovative tool called the Smart Gloves Translator was created to help people who speak spoken language and those who utilize Sign Language to communicate. This concept is unusual because it combines state-of-the-art technology with well-considered design components, setting it apart from previous solutions in several essential ways.

Inclusivity and Cultural Sensitivity:

Through its emphasis on Indian Sign Language, the project acknowledges the diversity of cultural communication demands. The system is customized to the unique language and cultural quirks of the Indian deaf and hard-of-hearing community thanks to this cultural sensitivity.

Adjustment to Regional Situation:

Current systems typically support American Sign Language (ASL) and other global sign languages. The creative application of ISL shows that the significance of contextualizing technology to make it more useful and relevant for the intended user base is understood.

Specific Requirements for Gesture Recognition:

ISL contains unique expressions and movements, unlike other sign languages. Because of the project's emphasis on ISL, new criteria for gesture identification are introduced, which calls for a particular method to identify and translate these unusual gestures correctly.

Tailoring for Local Speeches:

India has numerous regional dialects and linguistic minorities. The project's emphasis on ISL offers a more inclusive and flexible approach, which gives potential for modification to regional languages within the Indian subcontinent.

Objectives

Develop a functional prototype:

Make a working prototype of the Indian Sign Language (ISL) to text and speech translation system. Ensure the software and hardware components integrate properly to deliver precise translations in real time.

Accurate Recognition of Indian Sign Language Gestures:

Attain a high degree of precision in identifying and interpreting Indian Sign Language motions. Use other methods, such as machine learning algorithms, to ensure the system can translate various ISL gestures efficiently.

Cultural Sensitivity and Adaptability:

Consider the subtle cultural differences in Indian Sign Language by building a database that faithfully captures various movements and facial expressions. Ensure the system can accommodate various regional ISL variations, considering the wide range of sign languages spoken in India.

IoT Integration and Connectivity:

Integrate Internet of Things (IoT) features into the smart glove system. Examine ways to link to other platforms or devices to expand the system's capabilities and possible uses.

Methodology

We aim to develop a model enhancing communication by translating gestures into voice output. This aids deaf individuals who cannot hear but can see gestures, and those with speech impairments who understand through listening and gestures. Our technology merges hardware and software, with a microprocessor interpreting user gesture and generating voice output. The glove, equipped with infrared sensors and accelerometers on fingertips, detects finger motions accurately. The project intends to provide voice guidance and hand sign symbols for user ease.

Data Collection:

Utilize MPU6050 to collect data from the 3-axis accelerometer and GyroSensor to track hand movements. Gather readings for each axis (X, Y, Z) to determine the hand's position. Incorporate flex sensors to monitor changes in resistance, indicating hand gestures.

Data Interpretation:

Analyze the collected data from MPU6050 and flex sensors to determine hand position and gesture. Combine the data obtained from both sources to ascertain overall hand movement.

Transmission:

Connect the left-hand glove to the right-hand glove via Bluetooth HC-05 for data exchange. Using Bluetooth, transmit the combined data from the right-hand glove to the local system.

Data Processing:

Receive the combined data.Compare the received data with a predefined database of alphabets and words stored in the application. Match the values with the database to identify the corresponding text.

Text-to-Speech Conversion:

Convert the identified text into speech.

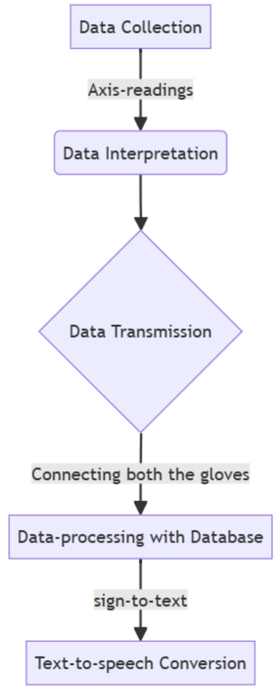

Fig 1

Work Plan

S.No.	Activity	Month	Jan	Feb				Mar		Apr				May	Aug				Sept				Oct			Nov			
		Week No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	Team Formulation andInitial Idea	Plan																											
		Actual																											
2	Research and Feasibilty Analysis	Plan																											
		Actual																											
3	Setting Objectives	Plan																											
		Actual																											
4	Figuring out assumptions and	Plan																											
		Actual																											
5	Project Proposal	Plan																											
		Actual																											
6	Hardware Requirements and	Plan																											
		Actual																											
7	Preparing Project Design and	Plan																											
		Actual																											
8	Hardware and Software	Plan																											
		Actual																											
9	Hardware and Software Integration	Plan																											
		Actual																											
10	Testing and Improvements	Plan																											
		Actual																											
11	Meeting Industry Standards	Plan																											
		Actual																											
12	Finalizing Project	Plan																											
		Actual																											

Fig 2

Project Outcomes

Improved Accessibility: The SMART GLOVE TRANSLATOR attempts to enhance accessibility by facilitating communication between users of Indian Sign Language (ISL) and those unfamiliar with it. The technology improves accessibility for the deaf and hard of hearing people by translating ISL gestures into spoken English in real-time, aiding communication in educational institutions, workplaces, and social interactions.

Efficient Communication: This project aims to enhance communication efficiency by allowing users to communicate in ISL and automatically turning their gestures into spoken language. Enhanced efficiency can result in more production, fewer misunderstandings, and improved inclusion in many settings.

Technological Innovation: These smart gloves incorporate advanced technology such as flex sensors, accelerometers, Arduino microcontrollers, and Bluetooth connectivity. The initiative showcases innovative solutions to real-world difficulties and contributes to the improvement of assistive technologies for those with disabilities by utilizing these breakthroughs.

Customizability and Adaptability: This device provides configurable functionality, allowing users to store and access pre-defined statements or phrases from an SD card. Users can customize their communication experience to suit their tastes and specific conversational requirements, which improves user pleasure and usability.

Community Engagement and Collaboration: The project team interacts with stakeholders from the deaf and hard of hearing community, such as individuals, educators, and activists, during the development process. The project guarantees that the SMART GLOVE TRANSLATOR fulfills the true requirements and preferences of its intended users by requesting feedback, incorporating user input, and encouraging co-design principles. This fosters a sense of ownership and empowerment within the community.

Scalability and Sustainability: The SMART GLOVE TRANSLATOR may be a scalable and sustainable platform for future versions and modifications due to its proper documentation, open-source code availability, and modular design principles. The initiative contributes to global innovation and the progress of accessible solutions by sharing knowledge, resources, and best practices with the wider assistive technology community.

Individual Roles

1. Sezalpreet Kaur: Idea finalization, Documentation, Hardware Implementation
2. Yatharth Gautam: Idea finalization, Documentation, Integration of hardware and software, Hosting
3. Mannat Sadana: Idea finalization, Documentation, Hosting, Hardware Implementation
4. Arshiya Kishore: Idea finalization, Documentation, Hardware Implementation
5. Aakarsh Walia: Idea finalization, Documentation, Hosting, Integration of hardware and software

Course Subjects

1. Computer Programming
2. Electrical Engineering
3. Electronic Engineering
4. Applied Physics
5. Numerical Analysis
6. Machine Learning
7. Software Engineering

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