GESTURE VOCALIZER

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project "**GESTURE VOCALIZER"** isthe bonafide work of "**MADHUMITA. B (111523104083), KARUNYA. V (111523104066)"** who carried out the project work under my supervision.

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INTERNAL EXAMINER

ABSTRACT

Hand-Gesture Recognition System helps the dumb people finding difficulty in communicating with the society. These people give some gestures to communicate with the normal people but all the gestures given by the dumb cannot be understood. So, there is a need to have some media between the dumb and normal people. The system recognizes the gestures given by the dumb and display the message on the LCD according to the gesture. The glove with flex sensors is worn to the hand of the dumb and when the gesture is given it is sensed by the flex sensor then the system recognizes the gesture. Paraplegics are the persons whose body parts below the belly will not work and find difficulty in using the appliances. The system also consists of an accelerometer controlling the fan and light. The appliances can be controlled by tilting the accelerometer. An alert message with the help of a GSM can be sent to the concerned person of the paraplegic when the paraplegic is in trouble.

THEME OF THE PROJECT

1. Health Low-cost Indigenous Digital Healthcare System

INTRODUCTION

The people who are unable to speak come across many problems while communicating with other persons. The speech impaired person uses sign language instead of speaking to represent themselves. Deaf persons can communicate only by using gestures. The significant drawback of sign language is that only the dumb person can understand gestures but not normal people. This gadget transforms gesture into speech i.e., gives voice to the silent community who cannot speak . In this project, Flex Sensor plays a big role. The hand glove is stitched with the flex sensors/accelerometer sensor.

The flex sensors deliver output in the shape of voltage variation that varies with the degree of bend. The Microcontroller contains an ADC channel, which receives output from flex sensors/accelerometer sensors. It processes the output and converts it from analog to digital signal. Furthermore, the process information is dispatched in a wireless way to the receiver section. The gesture is diagnosed in this phase, therefore corresponding output is displayed in the LCD, and concurrently speech output is playback via speaker.

The major advantage of this assignment is its portability. Thus, the difficulties humans face in interacting with society can be greatly reduced with the assistance of this project [6].

LITERATURE REVIEW

Author, Year, Journal Name	Title & Journal	Inference
B.Shubankar *et al.* (2019) *ICRTAC*	IoT Device for Disabled People	This development of an IoT device for disabled people, focusing on those who are deaf, dumb, or blind. The device aims to bridge the communication gap between disabled individuals and those without disabilities. It utilizes hand gloves with flex sensors to recognize gestures and convert them into audio and visual output.
Yeresime Suresh *et al.* (2016) *IEEE*	MUDRAKSHARA - A Voice for Deaf/Dumb People	The system uses Canny Edge Detection for accurate edge detection in the frames and a Convolutional Neural Network (CNN) model for predicting hand gestures into text and voice. The system also includes an auto-correct module to rectify any inaccuracies in the predictions. flexural strength, whereas ductility is decreased

Khan Sohelrana el al. (2020) ICRITO	A Review on Smart Gloves to Convert Sign to Speech for Mute Community	The smart glove projects have future scope for enhancements, such as introducing multiple languages for flexibility and improving precision by incorporating more flex sensors. The use of NodeMCU for data processing can also lead to a reduction in the size of the system, making it more portable and user-friendly.
Chhaya Narvekar el al. (2020) ISSN	Sign Language To Speech Conversion Using Image Processing And Machine Learning	The system described in the document aims to enable communication between dumb individuals and others using natural hand gestures. It involves features like finger sign recognition, image recognition, color recognition, and machine learning for gesture recognition and translation.

Ankita Shinde (2020) IJERT	Two-Way Sign Language Converter for Speech-Impaired	Deployment on cloud and creation of an API for using it. Increasing the vocabulary of the model to recognize more words and gestures. Incorporating a feedback mechanism to make the model more robust.
Muhammad Saad Amin el al(2020) IEEE	Gesture Recognition of American Sign Language using E-Voice Smart Glove	Comparing results obtained from a developed prototype with literature review based results, sign recognition capability in terms of accuracy is enhanced effectively. Accuracy of previously used algorithms on the ASL dataset is compared with results obtained after implementing KNN, SVM, and DA based classification algorithms on the ASL dataset. Accuracy comparison is mentioned

D.Maneendra el al. (2021) JES	Development Of A Communication Medium For Deaf And Dumb People Using Flex Sensors.	Subsequent to building a fruitful correspondence way, hand glove gadgets will actually want to speak with every gadget. Every single finger is joined to a flex sensor. Thus, flex sensors will give information for any kind of finger development. Gyro sensors can detect the development toward any path. A gyro sensor was added to the hand glove. Thus, any development of hand glove, gyro sensors will give the sensor information.
Sarvottam N Katti, Sourabh S Sirsi (2021) IEEE	Talking Gloves: Sign Language to Speech Conversion for Deaf and Mute Person	The development of IoT-based Smart Gloves to bridge the communication gap between speech-impaired individuals and normal people. The motivation behind the system's development, including the need for natural

		communication similar to talking, independence, affordability, and sensor positioning
Amal S. El Soky el al(2020) ERJ	Arabian Deaf and Dumb Communication system using wireless Flexible Sensor	The data gloves with sensing elements have a lot of benefits than image-based ones and have become a promising tool for communication [18, 37, 38]. The hand gestures will play a major role in several fields such as artificial intelligence, Robotics and Automatic management[23, 39].Capacitive sensors and flexible resistance are mostly used in these applications .However, the limitation of information effects on system performance and speed.

Dr. Akey Sungheetha el al (2020) EEA	Design of Effective Smart Communication System for Impaired People	According to a survey, 2.42M people are deaf and dumb people in India, a large number in the society. Overall the world has around 15 – 20 % of the deaf and dumb population. The term "Augmentative and Alternative Communication" refers to speech components other than audible type communication. It consists of many symbols, figures, rising tones of synthesized speech, and drawing with sign language. Augmentative model communication comprises various datasets for limited abilities of their speech
Shreyas Viswanathan (2021) IRJMETS	Sign Language To Text And Speech Conversion Using CNN	The main goal of the Sign Language to Text and Speech Conversion Using CNN project is to facilitate easy and low-cost communication

		between individuals with hearing or speech disabilities and those without, by introducing an IoT device that converts hand gestures into text and then speech
Aditi Naik el al (2020) Multicon	CONVOE HAND – Smart Glove	In current technology we face the many problem • More reliable • Automatic system • Fast working • Less time consumes • Security • Base planning
R. San-Segundo el al (2013) INTERSPEECH	Developing an Information System for Deaf	This paper presents the SAILSE Project (Sistema Avanzado de Información en Lengua de Signos Española – Spanish Sign Language Advanced Information System). After this analysis, the paper describes the interactive system that integrates an avatar to represent the signs, a text to

		speech converter and several translation technologies. Finally, this paper presents the set up carried out with deaf people and the main conclusions extracted from it.
Dr. T. Ramaswamy el al (2022) IRJMETS	Smart Gesture To Voice Converter Using An Android Application Through Bluetooth	One of the first ideas in the sensor based systems was of the wired gloves. Using magnetic or inertial tracking devices, these can transmit information to the computer about the location and rotation of the hands. The Data Glove was the first commercially marketed hand-tracking glove that tracked the rotation of the hands. It was a glove-like device that could detect hand movement, finger bending.

Yash Jhunjhunwal el al (2017) IJRIER	Sign Language To Speech Conversion Using Arduino	Sign language is a natural way of communication between normal and dumb people. Sign language is mostly dependent on hand gesture recognition. It is sometimes not easy for normal people to recognize the signs properly and understand what they want to say. So the intension of the gloves is to make the life style of the dumb and deaf people easy. The gloves translates the hand gestures to text and further speech so that the normal people can read the recognized gesture and hear to the voice and understand what that person wants to tell, which will make the communication more efficient.

Ohnmar Win el al (2019) IJRIER	Hand Gesture to Text and Speech Conversion	A vision based hand gesture recognition system using MATLAB software for automatic conversion of text and speech has been presented. On the whole, the solution aims to provide aid to those in need thus ensuring social relevance. By using this system the deaf-dumb people can easily communicate with other normal people. The system can be used by the user without any difficulty and complexity. The application is cost efficient and eliminates the usage of expensive technology
Shagun Gupta el al (2020) ICISS	Sign Language Converter Using Hand Gestures	This System is developed in reference to the paralyzed, semi-paralyzed patient in hospitals and other surroundings. This system will allow users to convey

		their message via Hand Gestures created in front of a camera which will be mounted on a wheel chair or bed.• The system can be customized based on the preferences given by the user (Language Preferences - Hindi and English) • To help during emergency situations with an alert message. • To build a system that will be reliable and will work for people of all age groups.
Dinesh Raj Panta el al (2023) JMC	Breaking Barriers: Hand Gesture Vocalizer for the Deaf and Mute	The use of flex sensor amd the Random forest algorithm for hand gesture vocalization has shown promising results. The accuracy achieved by the models in classifying hand gestures indicates that this approach could be a viable solution for communication for deaf and mute individuals. The technology provides a

		simple and cost-effective solution that can be used in a variety of settings.
B.Yuva Srinivas Raja el al (2017) IJET	Hand-Gesture Recognition System For Dumb And Paraplegics	A property of bend sensors worth noting is that bending the sensor at one point to a prescribed angle is not the most effective use of the sensor. As well, bending of the sensor at one point to more than 90˚ can permanently damage the sensor. Instead, bend the sensor around a radius of curvature. The smaller the radius of curvature and the more the whole length of the sensor is involved in the deflection, the greater the resistance will be (which will be much greater than the resistance achieved if the sensor is fixed at one end and bent sharply to a high degree)

Muhammad Imran Saleem (2020) GC WOT	Full Duplex Smart System for Deaf & Dumb and Normal People	Over the past few years, smart gloves have the gesture's information with the help of sensor based smart systems. To get the information regarding the smart gloves based on orientation shape, movement and hand location. There are two systems one is vision based system and other is hand segmentation. Glove based systems are not comfortable for a person to wear the sensors. Computer vision based systems have supportable signs both manual and non manual. Different factors of human skin color are required for segmentation to get better result like hand and face .Other factors which are required is like surrounding environment

Kshirasagar Snehal P (2016) IJESRT	Gesture Vocalizer For Deaf And Dumb	The aim of this paper is to present a system that can efficiently translate American Sign Language is converted in to text and speech. Gesture recognition is classified into two main categories i.e. vision based and sensor based .Some disadvantages of vision based techniques such as it includes complex algorithms. Another challenge in image and video processing includes variant lighting conditions,backgrounds and field view constraints and occlusion .As compare to vision based technique sensor based technique have some advantages such as greater mobility.Mute people can use the gloves to Perform hand gesture and it will be converted into speech so that

		normal people can understand their expression. This paper provides the map for developing such a digital glove .
Setia wardhana (2015) IES	Sign Language Learning based on Android For Deaf and Speech Impaired People	The conclusion based on the test results is that within the palm of the hand the camera should be less than 50 cm so that the hand can be detected by the object detection system and hand it would be optimal if the hands are in the upright position on 00.
Radzi Ambar1 (2023) AETiC	Development of a Wearable Sensor Glove for Real-Time Sign Language Translation	This paper provides a comprehensive description of the design of a wearable sensor glove specifically designed for sign language interpretation. Additionally, an Android-based application was developed, which can

		display words in real time and generate speech based on translated gestures. The wearable device itself has five sensitive sensors and an inertial sensor. Together, these sensors accurately measure sign language gestures, which are then fed into an Arduino Nano microcontroller for translation processing into words, and then the processed data is sent via Bluetooth to a custom Android -based application called the Sign Language Translator application
Rajaganapathy. S (2015) ISBCC	Conversation of Sign Language to Speech with Human Gestures	The paper is not only aimed at converting the sign language into voice, it's well known that inability to speak and hear is one major challenge for human race. To overcome these disabilities there are a

		lot of research and development going in different fields. The paper is aimed to minimize the major complexions in the system for further extensions, the sensor comes with the feature of face recognition and voice recognition and therefore the next phase of the project would be adding face recognition for capturing the expressions which in turn increases the productivity of the application by adding a little more accuracy. Also for people with partial voice disabilities the speech recognition system will do further enhancement in speech systems for the disabled people.
Muneer Al-Hammadi (2020) IEEE	Hand Gesture Recognition for Sign Language Using 3D CNN	This study investigates the use of 3DCNN for hand gesture recognition. In the

		preprocessing phase, linear sampling was used to normalize the temporal dimension of hand gesture samples. For spatial dimension normalization, we used the length of the detected face and human body part ratios. Then, we used 3DCNN for feature learning in two approaches. In the first approach, a single 3DCNN instance was trained to extract the hand gesture features from the entire video. In the second approach, three instances of the 3DCNN structure were trained to extract the hand gesture features from the beginning, middle, and end of the video sample. These region -based features were then fused before being fed to the classifier.

SUMMARY OF LITERATURE REVIEW

- The device aims to bridge the communication gap between disabled individuals and those without disabilities
- The system also includes an auto-correct module to rectify any inaccuracies in the predictions
- The smart glove projects have future scope for enhancements, such as introducing multiple languages for flexibility and improving precision by incorporating more flex sensors
- Deployment on cloud and creation of an API for using it. Increasing the vocabulary of the model to recognize more words and gestures.
- An Android-based application was developed, which can display words in real time and generate speech based on translated gestures
- This not only aimed at converting sign language into voice, it's well known that inability to speak and hear is one major challenge for the human race.
- The aim of this is to present a system that can efficiently translate American Sign Language into text and speech. Gesture recognition is classified into two main categories i.e. vision based and sensor based
- Smart gloves have the gesture's information with the help of sensor based smart systems. To get the information regarding the smart gloves based on orientation shape, movement and hand location
- A vision based hand gesture recognition system using MATLAB software for automatic conversion of text and speech has been presented. On the whole, the solution aims to provide aid to those in need thus ensuring social relevance.
- The main goal of the Sign Language to Text and Speech Conversion Using CNN project is to facilitate easy and low-cost communication between individuals with hearing or speech disabilities and those without, by introducing an IoT device that converts hand gestures into text and then speech

RESEARCH GAP

Another research gap lies in the domain of cross-modal gesture recognition and visualization. While much of the existing research focuses on visual-based gesture recognition, there is a growing interest in incorporating other modalities such as audio and haptic feedback to improve gesture interpretation and visualization, particularly in contexts where visual input may be limited or unreliable. Exploring the synergies between different modalities and developing multimodal gesture recognition systems could significantly enhance the effectiveness and usability of gesture visualizers in various applications.

Furthermore, there is a need for research addressing the challenges associated with gesture visualization in dynamic and cluttered environments. Current gesture visualizers often struggle to accurately track and represent gestures in real-world settings with varying lighting conditions, occlusions, and background clutter. Research efforts aimed at improving the robustness and adaptability of gesture visualization techniques to such environments could significantly enhance their practical utility in applications such as augmented reality, human-computer interaction, and virtual collaboration.

In summary, while significant progress has been made in gesture recognition and visualization, several research gaps remain in areas such as robustness, cross-modal integration, and adaptability to real-world environments. Addressing these gaps could pave the way for more effective and versatile gesture visualizers with broader applicability across various domains.

PROBLEM STATEMENT

Define the Problem

Sign language is a vital means of communication for individuals with hearing impairments. However, there exists a communication gap between individuals who use sign language and those who do not understand it. To bridge this gap, there is a need for a reliable sign language to speech conversion systems. This system should accurately interpret gestures and signs from sign language into spoken language in real-time.

What core problem does your product / Service solve?

The core problem that Gesture Vocaliser solves is the communication barrier between individuals who use sign language and those who do not understand it.

For individuals with hearing impairments who primarily communicate through sign language, interacting with non-signers can be challenging, as not everyone understands or is proficient in sign language. Gesture Vocaliser addresses this problem by providing a solution that translates sign language gestures into spoken language in real-time.

By converting sign language gestures into spoken language output, Gesture Vocaliser enables effective communication between sign language users and non-signers, thereby breaking down barriers and fostering inclusivity in various social, educational, and professional settings. This technology enhances accessibility and promotes equal participation in communication for individuals with hearing impairments.

Is your product/ service – (Address the want / need of the potential user)

Product

Problem Statement/ Proposed Idea

This development of an IoT device for disabled people, focusing on those who are deaf, dumb, or blind. The device aims to bridge the communication gap between disabled individuals and those without disabilities. It utilizes hand gloves with flex sensors/accelerometer sensor to recognize gestures and convert them into audio and visual output. The gesture vocalizer utilizes an Arduino microcontroller and flex sensors/accelerometer sensor attached to the user's fingers. As the user performs sign language gestures, the flex sensors/accelerometer sensor detect finger movements and transmit corresponding data to the Arduino. The Arduino processes this data and triggers pre-programmed audio output representing spoken language equivalents of the sign language gestures. Through this process, the gesture vocalizer enables real-time conversion of sign language gestures into audible speech, enhancing communication accessibility for the Deaf and hard of hearing community.

OVERVIEW OF THE IDEA

Explain your idea(Product/Service)

One idea for a gesture vocalizer could involve using a combination of computer vision and machine learning algorithms alongside flex sensors /accelerometer sensor and Arduino. The system captures the user's sign language gestures, while the flex sensors provide additional input from hand movements. This data would be processed in real-time by the Arduino, which would then trigger a corresponding spoken output through a speaker or a text-to-speech module. This hybrid approach could enhance accuracy and adaptability, allowing the system to recognize a wide range of sign language gestures and variations in hand movements, thus improving communication accessibility for the Deaf and hard of hearing community.

What type of product/service is yours?

Hardware

Explain with Use Case – (A use case is a methodology used in system analysis to identify, clarify and organize system requirements).

The gesture vocalizer utilizes a combination of flex sensors/ accelerometer sensor, Arduino microcontroller, and machine learning algorithms to convert sign language gestures into audible speech. In a classroom setting, a Deaf student uses the gesture vocalizer to participate actively in discussions. As the student signs, the flex sensors detect hand movements and transmit data to the Arduino, which processes the information. The machine learning algorithms interpret the gestures

and trigger pre-recorded or synthesized speech output through speakers. This enables the student's sign language contributions to be instantly translated into spoken language, allowing seamless communication with hearing peers and the teacher. The gesture vocalizer enhances the student's engagement, fosters inclusive learning environments, and promotes equal opportunities for participation.

What stage (TRL level) is your idea now? (Ref: Reference Details)

TRL 3: Applied Research – First laboratory tests completed, proof of concept.

SOLUTION FOR THE PROBLEM STATEMENT

Solution to the problem

The gesture vocalizer employs an Arduino microcontroller and an accelerometer sensor. As the user performs sign language gestures, the accelerometer detects hand movements and orientation changes. The Arduino processes this data in real-time, interpreting the gestures based on predefined patterns or machine learning algorithms. Upon recognition, the Arduino triggers pre-programmed audio output representing spoken language equivalents of the sign language gestures. This converted speech is then played through speakers or a headphone connected to the system. The gesture vocalizer enhances communication accessibility for the Deaf and hard of hearing by translating sign language gestures into audible speech, fostering inclusivity and understanding in various settings such as education, social interactions, and professional environments.

The solution is a new one or an improvement on an existing one.

It's already an existing one but we have used another sensor called accelerometer sensor in place of the flex sensor.

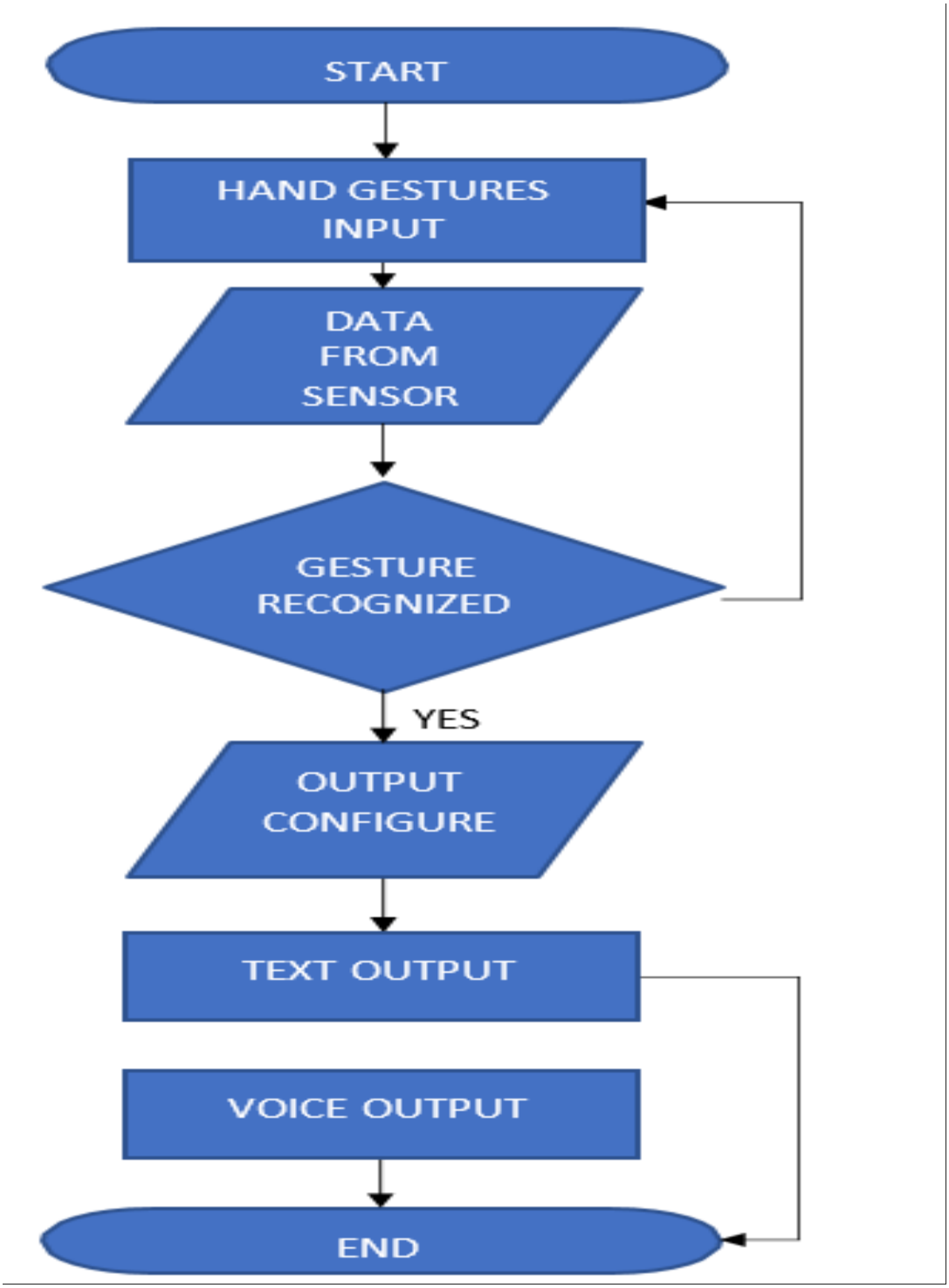
Explain the novelty of your solution.

Is already an existing one but we have used another sensor called accelerometer sensor in the place of flex sensor. Accelerometer sensors offer higher sensitivity and versatility compared to flex sensors in gesture vocalizers. They can detect a wider range of hand movements with greater precision, including gestures involving tilting and rotation. Accelerometers provide real-time data on hand

orientation, allowing for more nuanced interpretation of sign language gestures. Additionally, they are less susceptible to wear and tear since they don't rely on physical bending like flex sensors, resulting in increased durability. Moreover, accelerometer-based systems may offer better adaptability for users with varying hand sizes and mobility ranges.

FLOWCHART/PRODUCT WORKFLOW

Draw a simple flowchart showing how your product/business will work



IDEA – CURRENT STATUS/ FUTURE PLAN

The Development status of the Idea

Preparing the code for the gesture vocalizer.We are halfway in it.

Time period in months required for the idea to move to the next stages – PoC / Prototype / Trial Production/ Product Launch

It requires 5 months.

Component Details of the Prototype.

Flex Sensor: These sensors are attached to the fingers or hand to detect the bending of joints, crucial for recognizing sign language gestures.

NodeMCU: NodeMCU is a microcontroller based on the ESP8266 Wi-Fi module, facilitating wireless communication and data processing.

Accelerometer Sensor: This sensor detects the orientation and movement of the device, providing additional data for gesture recognition and refinement.

Sign Language: The core input method, sign language gestures are performed by the user and captured by the sensors for interpretation.

Android Device: Utilized as a user interface, the Android device hosts the application for displaying interpreted sign language and providing user interaction options.

Embedded System Bluetooth: Bluetooth module integrated into the embedded system facilitates wireless communication between the Node MCU and the Android device.

By combining these components, the gesture vocalizer system interprets sign language gestures captured by the flex sensors or accelerometer sensor. The NodeMCU processes this data, employing machine learning algorithms for gesture recognition. The interpreted gestures are then transmitted to the Android device via Bluetooth, where they are converted into spoken language or displayed as text, enhancing communication accessibility for the Deaf and hard of hearing community.

CUSTOMER SEGMENT

Who is facing the problem that you are solving?

Deaf and dumb people and paralyzed patients

Who is your target customer / Sector?

Deaf and Hard of Hearing Individuals

Educational Institutions

Healthcare Facilities

Who will pay for your product/ service?

Deaf/dumb people or paralyzed patients

VALUE PROPOSITION

Why should they buy your product/service rather than the existing one or similar one in the market, if any?

In the already existing one there have used flex sensor which is not cost efficient and has high sensitivity that is must be handled with care. Therefore we have found this new gesture vocaliser which can be operated with the help of accelerometer sensor which cost efficient offer greater stability.

Why should customers choose you?

Customers should us because of the following reasons:

Higher Accuracy: Accelerometer sensors provide more precise measurement of hand movements, resulting in more accurate gesture recognition.

Expanded Functionality: With accelerometer sensors, the system can detect not only finger flexion but also hand orientation and movement, enabling a wider range of gestures to be recognized.

Improved Reliability: Arduino and accelerometer sensors offer greater reliability in capturing subtle hand motions, minimizing errors in gesture interpretation.