Problem Statement and Goals
Mechatronics

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Table 1: Revision History

Date	Developer(s)	Change
9/26/2022	Everyone	Initial Revision
...	...	...

1 Problem Statement

1.1 Problem

Communication is a key component of both the professional workplace and personal life. Many difficulties can occur especially when the individual has a disability that prevents them from being able to speak properly. Sign language has been a method to help bridge those who are deaf/mute with other people, but as with language, both parties are required to understand it to clearly communicate with each other. The Sign Language Translator is a device to help further close that gap by introducing a sensor that can translate hand motions and gestures from the American Sign Language (ASL) into a text to speech application on their phones. This method will be able to provide real-time instant feedback to simulate a spoken conversation and can eliminate the need for a third party translator as the individual is able to express themselves freely, thus improving their quality of life in society.

1.2 Inputs and Outputs

The input of the sign language translator should be hand gestures demonstrated by people, the device is capable of converting hand gestures to words, phrases, or sentences in designated languages. The process of input to output should be as follows:

- An individual should be able to use sign language as usual
- A camera should capture those hand signals for the system
- The system should be able to generate an text-to-speech output based upon the initial signing

1.3 Stakeholders

The stakeholders for our project are people who have hearing problems and need to use sign language for their daily communication. This can also include various accessibility services for various companies, whether that be in education or entertainment. Our project can benefit anyone or anything that requires a sign language interpreter.

1.4 Environment

The software part of the sign language translator is a phone application or computer software that has real-time and non-real-time translating functionality. The application or software can identify hand gestures on a real-time basis, or from photos and videos uploaded by the users. The hardware parts consist of a camera, which captures hand gestures, and a hardware system based on Arduino, which does identification and translation processing.

2 Goals

Reliable and Accurate Translations:
The Sign Language Translator requires extensive training on the sensors to capture precise hand motion and ignore any human error on the user's part. The processing unit should be able to identify each letter within the American Sign Language using the data collected and transmit dialogue accurately to the user's request.

Real Time Translations:
User's should never be required to wait an extensive period of time for the device to process their hand motion and provide a translation. The Sign Language Translator should simulate a real time conversation between regular people to

deliver a seamless transition for other parties during presentations or social interactions.

Ease of Use:
The user experience is crucial for a communication device. The Sign Language Translator should require minimal time and effort to set up. Once set up, the device should not require much maintenance or updates. Most importantly, the device should not hinder the user's ability to perform the gestures and hand motions of sign language.

Affordability:
The Sign Language Translator should be affordable for the end users as to reduce the need of requiring an actual translator to accompany the user during their tasks. The device should remain functional whenever it is required to be used, and the hardware components of the device should be simple and cost-effective.

Customizable to User:
As with language, different people might have a certain way of pronouncing a phrase or word and likewise the same could be said with Sign Language with slightly different gestures. The device should be able to adapt to the user and recognize the unique motions instead of forcing the user to slow down for the device.

3 Stretch Goals

Portable:
The final device, while requiring OpenCV to scan and process hand motion, should become more portable and lightweight for the user to move around, so as to not interfere with the user's regular activities. The translator text to speech should become an application on all phone brands as for any user with the required equipment to be able to begin using.

Expanding to Different Languages:
As a universal sign language does not exist at the moment, there exists dead/mute individuals who use another form of sign language other than the American Sign language. These include the British, Australian and New Zealand Sign Language (BANZSL), the Chinese Sign Language (CSL), Arabic Sign language, and much more. The device should be able to understand and translate these new hand motions and generate a translation in their native language for this product to be used on a global scale.

Sign Language Education:
The final device should be able to recognize the different hand motions and gestures of sign language in order to accurately translate them. This would make the device an excellent educational tool for those looking to learn sign language. The device could provide feedback and tell users how to improve their gestures using it's accurate hand tracking to help teach those unfamiliar with sign language.

Non-real-time Translations:
The final product should be able to extract and recognize hand gestures from photos or videos uploaded by the users. In this case, if the users find online photos or videos related to sign language, they can upload them to the phone application or computer software to acquire text-based translation. This could help the users learn sign language from online sources.