**EUROPEAN UNIVERSITY OF LEFKE**

FACULTY OF ENGINEERING

Graduation Project I

Converting American Sign Language to words using Machine Learning

### Abdulganiy Lawal

### 20140002

**The project I'm developing turns American Sign Language (ASL) into readable words. The fundamental concept is that it can assist those who are hard of hearing or deaf in communicating with those who are not familiar with sign languages.**

**The objective of this project is to develop a technology that translates sign language into English words, facilitating communication for hearing-impaired individuals. Using the app to interact with patients who are hard of hearing or deaf would be one possible application for this project in a healthcare setting.**

**Supervisor**

Dr. Vesile Evrim

Publish Date

27/12/2022

**Table Of Contents**

[Your Name Surname i](#_Toc54759951)

[Your Student Number i](#_Toc54759952)

[Your Supervisor Name i](#_Toc54759953)

[Publish Date i](#_Toc54759954)

[1.Introduction 1](#_Toc54759955)

[1.1 Problem definition 1](#_Toc54759956)

[1.2 Goals 1](#_Toc54759957)

[2. Literature Survey 2](#_Toc54759958)

[3. Background Information 3](#_Toc54759959)

[3.1 Required software 3](#_Toc54759960)

[3.2 Other software 3](#_Toc54759961)

[3.3 Hardware 3](#_Toc54759962)

[4. Modules 4](#_Toc54759963)

[5. Risk Analysis 5](#_Toc54759968)

[6. Ethics 6](#_Toc54759969)

[7. Conclusion 7](#_Toc54759970)

[7.1 Benefits 7](#_Toc54759971)

[a. Benefits to users : 7](#_Toc54759972)

[b. Benefits to me : 7](#_Toc54759973)

[7.2 Future Works 7](#_Toc54759974)

[8. References 8](#_Toc54759975)

# 

# 1.Introduction

## 1.1 Problem definition

The purpose of this project is to develop a technology that translates sign language to English words, allowing deaf individuals to converse more readily.

A potential use for this project would be in a health care setting, where physicians and nurses might use the app to interact with deaf or hard of hearing patients. Another possible application is in a classroom setting, where a kid can speak with his or her instructor or classmate. Another use for my app may be in a circumstance when a group of individuals is attempting to converse, but one of them is deaf or hard of hearing. In this situation, the person who is deaf or hard of hearing could use my app to follow along with the conversation and understand what is being said, even if other people in the group do not know sign language.

It will be useful to facilitate communication and promote inclusivity and understanding between individuals with hearing disabilities. In addition, my app can be used as an interpreter, when a sign language interpreter is not available.

My app will be designed to convert American sign language to words. The working logic to create these are:

* First the app will use the front camera to capture the user signing in ASL
* The app would then use an image recognition technology to identify the individual sign language and gestures being used in the video.
* Once the signs and gestures have been identified, the app would use a trained ASL machine learning model to convert the signs and gesture to text.
* The app would then use augmented reality to display the converted text, so that the user can see and read it.

## Goals

* To give people who are hard of hearing or deaf a means of communication with those who do not understand asl.
* To promote acceptance and comprehension among people with various levels of communication ability.
* To increase accessibility for those with hearing impairments by making it easier for them to access written content.

# 2. Literature Survey

They are a couple of application that are similar to mine but still different. Here are some of them

* Hand Talk Translator
* Signily

Signily: Is a keyboard app that translates American sign language into text as the user types. It uses machine learning algorithm to recognise asl signs and translate them into text and it can be used to communicate in messaging apps or other text-based platforms[2]. It is available for iOS and android devices. Here is a comparison between my app and signily

* Supported Languages: Both apps will support American sign language
* Supported Devices: Signily works for Both iOS and android, my app will be specifically design for only iOS device.
* Output Mode: My app output mode for communication will be augmented reality while signily uses messages to communicate to the user.
* Input Mode: While signily uses keyboard has way to collect information, my app uses computer vision to take information from the user.

Hand Talk Translator: Led by Hugo and Maya, the world’s most lovable 3D translators, the Hand Talk app automatically translates text and audio to American Sign Language (ASL) and Brazilian Sign Language (Libras) through artificial Intelligence [3]. Here is a comparison between my app and handtalk

* Supported Languages: Both apps will support American sign language
* Supported Devices: HandTalk works for Both iOS and android, my app will be specifically design for only iOS device.
* Output Mode: My app output mode for communication will be augmented reality while Handtalk uses 3d character to communicate to the user.
* Input Mode: While Handtalk uses the keyboard or audio has way to collect information, my app uses computer vision to take information from the user.

In conclusion my app, signily and hand talk translator are similar because they facilitate communication between users who uses sign language and individual who do not. However, they are different in terms on how they take their data and represent them.

# 3. Background Information

## 3.1 Required software

* **XCode:**

A code editor to write swift and compile the code into an app

* **Swift and Swift UI:**

The programming language that will be use to develop the app

* **Image Recognition and Computer Vision libraries:**

To capture and analyse frames of the user signing. Software that will be used are Core ML and the Vision framework

* **Natural language libraries:**

Use this framework to segment natural language text into paragraphs, sentences, or words, and tag information about those segments, such as part of speech, lexical class, lemma, script, and language.

* **Create ML:**

To train and deploy the Asl recognition and translation algorithm

* **Augmented** **Reality:**

To display the translated text. Software that will be used Apple Arkit

## 3.2 Other software

* **Figma:**

For design icons.

* **Bitbucket:**

Used for repository.

## 3.3 **Hardware**

* **Ios Devices:**

To capture the user signing using the front camera.

* **Computer:**

To train the machine learning algorithm.

# Modules

In order to accomplish the conversion of ASL motions to text or speech, a machine learning ASL to text app often comprises of many modules that function together. Typical modules in such an application include:

* ASL recognition: This module is in charge of identifying ASL movements and signs from user input, including photos or videos taken with the device's camera. To find it, this module may employ machine learning methods and models that have been trained on asl. This module will identify and analyse each frame that contains a symbol using technologies like vision framework.
* Text translation: Using a trained ml algorithm, this module is in charge of translating the identified ASL signs into text. Techniques for natural language processing may also be used in this module.
* User interface: This module is in charge of giving the app a clear and user-friendly interface that enables interaction with the app and access to its settings. This module could have sliders, menu items, and buttons. It might also be made to work well with various device sizes and orientations. In this module, the ui will be designed and implemented using tools like swift ui and figma.
* Data storage: The data created by the app, such as the user's preferences and history, must be stored and managed by this module. A cloud-based storage provider like Firebase, Superbase, or AWS amplify will be used for this module.
* Augmented reality: Using the device's camera and display, this module is responsible for generating the text output in an augmented reality environment. It may render text as 3D objects, allowing the user to perceive it in context. This module will utilize Apple Arkit to show the translated text.
* Camera and sensors: The app will record and track the user's ASL motions using the device's built-in camera and sensors. The camera and sensors may be utilized to detect the user's hand motions and location, as well as to provide input to the machine learning model for translation, with the camera acting as the augmented reality module to show the translated text.

# Risk Analysis

The potential risks associated with developing an American Sign language converter to text app, including:

* + Model Accuracy: Because the program will employ machine learning, there is a risk of model accuracy, which may result in poorly translated content.
  + User Privacy: Because the app will need to use the front camera, there is a danger that user privacy will be infringed, particularly if the program does not ask for permission and simply continues to use the front camera.
  + Data privacy: Once the software has finished interpreting gestures and sign language, there is a possibility that the data will be utilized without the user's permission.
  + Data Bias: Because training data may not be representative of the diversity of ASL gestures, biases and erroneous recognition may occur.
  + Computational Power: The app may not perform well on older devices, due to the computational power required to run the machine learning model.
  + Device compatibility: The app may not run-on older devices that have a poor front camera.

# Ethics

The use of machine vision as the main means of communication in the app raises possible ethical concerns. As with any technology, there is a chance of misuse or abuse, as well as the possibility of bias or discrimination in the algorithms and data used by the app. In order to make sure that the app is created and utilized ethically, it is crucial to take these issues into account and handle them.

* Legal Consent Violations: Facial Recognition has been used to collect personal data without consent, resulting in violations of privacy laws uch as Illinois’ Biometric Information Privacy Act (BIPA) and the California Consumer Privacy Act (CCPA), prompting a multitude of class action lawsuits. Due to a public outcry against privacy violations, Apple delayed the launch of its controversial CV-driven software designed to detect and report Child Sexual Abuse Material (CSAM) found on personal devices. Users feared that their personal images could be misused for government surveillance or false prosecution. [1]
* Ethical Consent Violations
* Facial Bias

Now Let’s discuss ethical issue concerning my app

* The app's impact on sign language interpreters and other professionals: The work of sign language interpreters and other professionals could be disrupted or replaced by the app.
* Privacy and data security: The software will handle delicate personal information, such talks in sign language, thus it's crucial to make sure that this information is safeguarded and not used inappropriately.

# Conclusion

## Benefits

### Benefits to users:

### Improved Communication: The app can help user communicate more effectively and accurately with people who do not understand asl.

### It helps the user be free on how they communicate with others. This means that the user can communicate without an interpreter.

### This can help users participate in social activities, this means that the user who uses sign language can participate in group activities that requires a lot of communication.

### Real time translation of sign language in visual and interactive manner.

### Benefits to me:

* The opportunity to develop a useful tool for deaf or hard of hearing people to improve their communication abilities.
* The app's potential to promote communication and understanding between those who use sign language and those who do not.
* The chance to make a significant contribution to the deaf and hard of hearing population.
* The opportunity to hone and present technical talents in machine learning and augmented reality.
* A chance to learn how to train a machine learning model.

**Why did I choose this project?**

As a developer, I've always wanted to create creative and useful technologies that help people's lives. One area in which I am particularly interested is enhancing communication for deaf or hard of hearing people. That is why I am enthusiastic about the prospect of creating an augmented reality ml asl converter to text app. Individuals who are deaf or hard of hearing could use this software to communicate visually and interactively with others who do not know sign language. This would increase their accessibility and inclusion in social settings and daily situations. I feel that this app has the potential to improve the lives of people who are deaf or hard of hearing and I am eager to begin working on it.

## Future Works

Yes. The improvements that I will like to this project are

* Adding a two-way communication app. This indicates that a deaf or hard of hearing person can communicate with a non-deaf person and vice versa.
* The possibility for users to train their own sign language variants, which may then be deployed to a database and used by others.
* A learning component, in which a non-deaf person can learn sign language through the use of augmented reality.
* The ability to receive notifications or alerts when the app is used in their presence.
* The ability for users to choose the font, size, and color of the translated text displayed in augmented reality.
* Integration with speech-to-text technology to allow individuals who are deaf or hard of hearing to communicate with others using voice as well.
* The ability to translate sign language from multiple languages, not just English and train the system on multiple sign languages.
* Make an android variant of the app.

# References

**[1] Ethical Issues in Computer Vision and Strategies for Success — Innodata. (2021, November 9). Innodata Inc. Retrieved December 27, 2022, from** [**https://innodata.com/ethical-issues-in-computer-vision-and-strategies-for-success/**](https://innodata.com/ethical-issues-in-computer-vision-and-strategies-for-success/)

**[2] *Signily: American Sign Language Keyboard App*. (n.d.). Signily: American Sign Language Keyboard App. Retrieved December 27, 2022, from** [**https://www.corada.com/products/signily-american-sign-language-keyboard-app#:~:text=Signily%20is%20a%20sign%20language,American%20Sign%20Language%20(ASL)**](https://www.corada.com/products/signily-american-sign-language-keyboard-app#:~:text=Signily%20is%20a%20sign%20language,American%20Sign%20Language%20(ASL))**.**

**[3] Hand Talk: your website accessible in ASL. (n.d.). Hand Talk - Learn ASL Today. Retrieved December 27, 2022, from https://www.handtalk.me/en/**