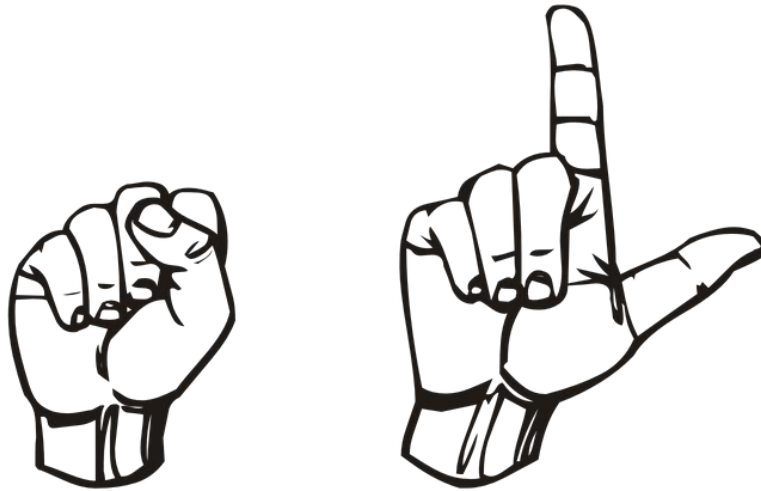


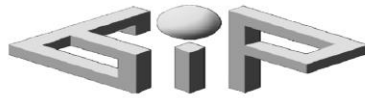
המעבדה לעיבוד גיאומטרי של תמונות  
Geometric Image Processing Laboratory

## SignLens



**By: Leen Srouji  
Aseel Sakas**

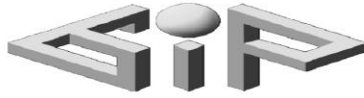
**Supervisors:  
Boaz Sternfeld  
Yaron Honen**



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## Introduction

Sign Languages are languages that use hand gestures and signs to express things and are used usually by deaf, hard of hearing and the people around them to communicate with each other.

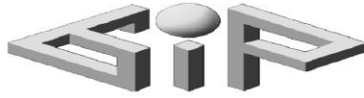
In addition, Sign language is not universal and although there are some similarities among them, each country generally has its own native sign language, and some have even more than one.

There are somewhere between 138 - 300 different types of sign language used throughout the world today and New sign languages frequently evolve amongst groups of deaf children and adults.

So, it's not possible that a person can speak all the variations of sign Languages and not to mention that even many people can't speak any of them, which makes communicating with people with disabilities hard.

As a result, we developed an AR application which translates Sign Language, it captures the sign from the Gloves, translates and projects it live in Microsoft HoloLens headset.

We had focused on ASL - which is the American Sign Language but using the same model we can extend to another varieties.



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## Technologies & Platforms

The Project was developed using:

### Hardware:

- Microsoft HoloLens
- Manus VR Gloves + Dongle

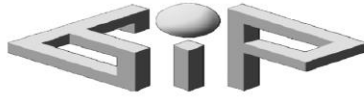
### Software:

- Unity 2018.3.0f for developing HoloLens and desktop application.

### plugins and libraries:

- HoloToolkit – for HoloLens Application Developments
- Sharing Services – for communications between PC and HoloLens
- Manus Library and plugin for gloves' integration with Unity





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## Features and Implementation

### Scheme:

SignLens consists of Two Applications :

- 1.HoloLens App
- 2.Desktop App

The HoloLens app is responsible for displaying the live translation as subtitles through augmented reality.

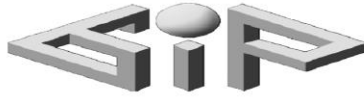
The Desktop app is responsible for receiving the data from Manus glove and identify the letter/sign then sends the result as text message to HoloLens.

The two apps interact using the Sharing Service through the Network.

In order to let this communication work, the two devices (PC and HoloLens) must be on the same network.

Manus Gloves are connected via the dongle to the PC and using Manus SDK we can connect the gloves to Unity.





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## Interaction with ManusVR gloves

Manus-VR provides an SDK written in C# that is used into the code to integrate the gloves in the project.

Manus keeps the data in the following structure:

1. each finger is defined as the two joints that constituent it.
2. each joint gets a value from [0,1]: 0 means closed and 1 means open.
3. these data are stored in the object “manus\_hand\_t” in the array “raw.finger\_sensor”

- 0,1 refer to the pinky.
- 2,3 refer to the ring finger.
- 4,5 refer to the middle finger
- 6,7 refer to the index.
- 8,9 refer to the thumb

4. the sign/letter is calculated according the values of each finger in approximation.

## How to start the sharing service:

1. Unity → the Hierarchy go to Managers → Sharing → click on sharing service.

2. in the objects that uses sharing service (like textSender and textSharingManager.cs) we must set the Ip address of the computer running the sharing service in the inspector.

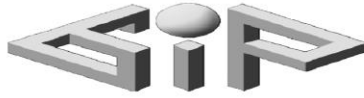
## Code Files:

textSender.cs – a class responsible for the sending Messages.

textSharingManager.cs – in Holo app handles the received messages and set translation on screen with timing considerations.

CustomMessages.cs – a class for the custom message that holds the translation which the PC app sends.

HandData.cs – processes the data received from the glove into a letter/sign.



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## Results and obstacles

We succeeded to translate a few letters in ASL and one sign (I love you).

- We had some trouble translating all the letters in ASL because of the limited data received from the gloves.

For instance, the thumb movement is different from the other fingers since it allows a circular motion and the sensor of this motion lacks accuracy.

We came across this problem while trying to correctly identify similar signs with minor difference of this movement mentioned above.

(example: identification if thumb position is under the other fingers or above them)

In addition, the glove cannot identify signs which include movement or gesture of the hand because it doesn't include spatial position and the ASL language depends very much on such movements.

- The glove did not suite small hands such as ours, therefor there was a difficulty capturing accurate measurements.
- We faced some difficulties in the integration of the gloves with the HoloLens, which was caused by different backend scripting language of the Manus SDK and HoloToolKit
- Unity had over 10 updates since the beginning of the semester, each update effected functionality of the HoloLens, with different code and API's, in addition the HoloToolKit was also updated accordingly

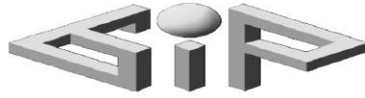
\*\*\*Windows and Visual Studio updates broke the project

- Many words of the ASL language depends on the movement of both hands but we were provided with only one glove that didn't function well most of the times therefor we focused on singular hand sign words.
- firewall issue: the firewall in the faculty lab, didn't allow the sharing service to work, so we had to use WIFI antenna and connect to the Hotspot from our phone's network.

## Conclusion And Recommendations

We had made a proof of concept to the idea of translating ASL to English.

the project can be more practical and efficient with the use of better and more accurate technology/tools which could mean gloves with more sensors on the thumb joint and for the spatial position



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## Sources and Links

<https://github.com/microsoft/MixedRealityToolkit-Unity>

<https://github.com/microsoft/MixedReality213/tree/master/Assets/HoloToolkit/Sharing>

<https://resources.manus-vr.com/>