Gamified Sign Language Recognition for Children in Virtual Reality

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***Abstract*—Sign language is very important for many people because of hearing related issues. Many people are hard of hearing and sign language gives them a way to communicate with the world. We propose a system to better facilitate communication between hard of hearing people and people without those limitations at a younger age. Our project will focus on the creation of a game to allow the teaching of very basic sign language to young children using the a virtual reality platform. This is vital because without the ability to communicate they will have a hard time functioning in School. Our game will allow them to learn basic signs. We are addressing the problem of teaching children the basics of sign language. This is vital in helping them achieve success.**

In order to address the problem, we conducted a literature review focusing on sources related to the topics of gesture recognition, gesture tracking, and improving the process of learning sign language. Using virtual reality systems, we plan to combine ideas from these sources to create a more easily accessible gesture recognition and teaching software geared towards children, making use of the Leap Motion controller for accurate hand tracking.

***Index Terms*—Virtual reality (VR), Sign Language, Game, gesture recognition / sign language recognition**

I. Introduction

The nature of sign language, while similar to spoken languages, is different enough to cause some difficulties with the learning process. For example, in order to get across that an object is on a table, one would only need to sign for both the table and the object and physically put the hand signing for the object over the sign for the table [10]. These intricacies of the language make not only learning specific gestures important, but also things like the position of hands must be taken into account as well [10]. Thus, learning the language in a space that is able to track these positions and show how the language functions would result in a more effective and immersive experience. Our overall objective for the method presented in this document is to have a prototype of a system that can properly account for gesture recognition, hand positions, and if feasible, body language, all as necessary components of sign language.

With this goal in mind, we specifically plan on gearing our solution towards children. Children are able to absorb information about language at a much faster rate, partially due to their increased capacity for unconscious learning [11].

Overall, we plan on making a Virtual Reality game about teaching children how to understand signs at an earlier age. The objective is to allow the teaching of children at an much earlier age through an engaging VR experience.

II. Methods

We used a Design Thinking exercise to figure out which topic we wanted to focus on for our project; using VR to teach sign language. For the purposes of staying within the scope of this course and due to the varied nature of sign language, we will be focusing on American Sign Language (ASL). We conducted a literature review related to the topics of gesture recognition, gesture tracking, and learning strategies for sign language. Both of those helped us figure out what topic we wanted to focus on, as well as a minor gap in the research for us to develop our prototype for.

Our prototype will focus on teaching some signs for the alphabet, as well as some basic words and phrases as a proof of concept for our idea. While the exact amount of gestures we are able to teach through the software will depend on the amount of time it takes to implement them, we hope to have around five to ten distinct gestures for testing purposes.

We plan on creating a software capable of learning the positions of the hands and fingers for a few basic gestures as a prototype for our idea. The prototype will involve the use of the Leap Motion controller for accurate hand tracking, both for gesture recognition and position tracking.

If possible, we would like to have both a learning mode and a practice mode. For the learning mode, the software should be able to display the gestures on screen for the user to copy, as well as track the hand positions and finger positions to check if the user is correctly copying the gesture displayed. For the practice mode, the software should be able to track the hand and finger positions of the user and display the text at the bottom of the screen if the software recognizes it as a valid sign language gesture.

Within the Gantt Chart shown (Fig. 1), the responsibilities of the team are broken down into segments based upon the assignment requirements throughout the course. Each person who is mainly responsible for a specific segment has their name written across from the specific task, underneath the specified dates listed above, although if a member is struggling

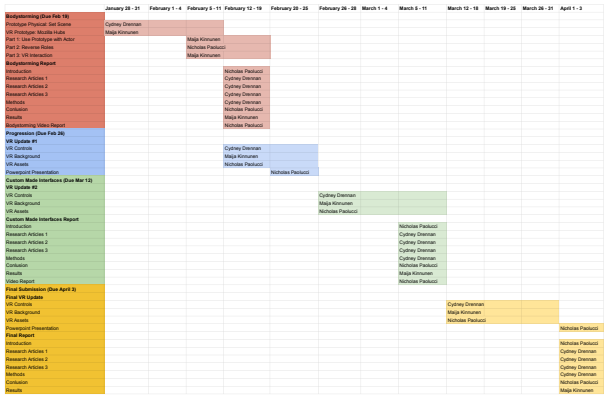

Fig. 1. Gantt Chart

either due to other responsibilities or the task being harder than anticipated then assistance will be given as needed. The colour codes match for different assignments, highlighting the urgency of each task. In addition to these tasks, we have assigned group leaders for each month, with Nicholas assigned for this month, Maija assigned for next month, and Cydney for the month after that. When in charge, the group leader will be responsible for making sure that tasks are done within a timely manner, as well as providing help, additional tasks, or deciding to scrap specific areas of the project as needed.

III. Results

While going through the Design Thinking process, multiple ideas were proposed for different areas of accessibility, ranging from how to better cope with stressful situations, helping with over-stimulation, and helping with better communication. Through our ideation process, we skewed towards ideas with an emphasis on the importance of communication, with most of our interest focused on sign language in particular, especially when our collection of ideas was narrowed down via determining their feasibility within our capabilities and time frame.

While going through multiple steps in the process, our Design Thinking was heavily influenced by both the empathize and ideate steps, although we were able to finally define our area of interest towards the end of the process. Our empathize step was long due to the number of proposed accessibility concerns that were brought up during the process, and our ideation step was long due to the number of ideas we had for those proposed concerns, although not all of the ideas were feasible for our scope, such as our idea for a terrain scanner in AR that could better differentiate between ground the user could walk on and any potential hazards. At the end of the process, we were able to choose a topic that was both within scope and an area of interest to our group.

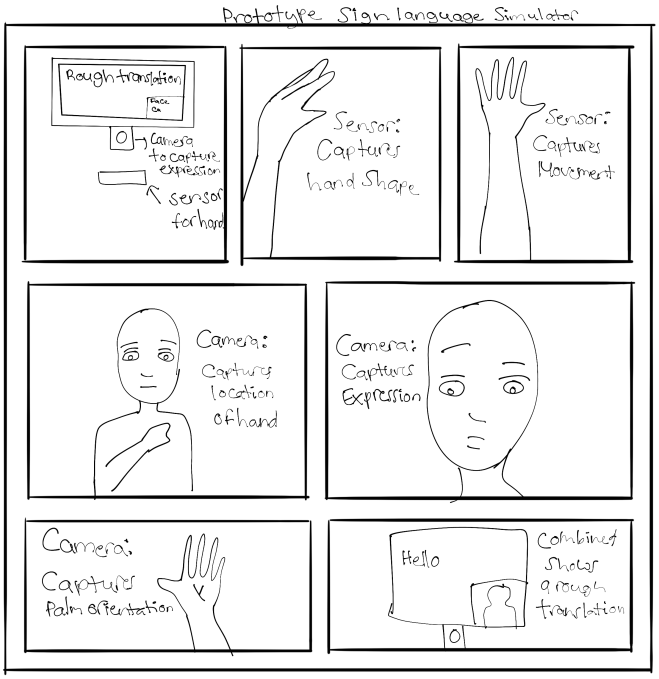

Fig. 2. Prototype

While conducting the literature review, we found that multiple sources delved into different methods for accurate gesture tracking and recognition, and others went over improving the process of learning sign language in an augmented reality context. However, not many sources related to gesture tracking and recognition mentioned learning applications of these methods. The sources going over learning methods mostly involved augmented reality applications, and most of those sources were testing with adults in mind. While these applications were able to increase the effectiveness of learning sign language by 65 percent [8], we hope that using the virtual reality space for a more immersive experience will lead to even better results, especially when introduced to students of a younger age due to their knowledge absorbent nature.

In order to solve the problem indicated from both the literature review and the Design Thinking process, we plan on prototyping with the Leap Motion controller to accurately track and recognize gestures. The computer should be able to recognize what gesture the user is making and how close they are to the example gestures the program would be trained with in the software. If communicating with another party in the virtual space, simple gestures should be displayed with text, allowing for some basic sign communication as is viable within the given scope for this course. If possible, we would like to use the position tracking of the Leap Motion controller as well for some rudimentary position based signs, such as the example described above involving the object and the table. Our prototype is shown in Figure 2.

IV. Conclusion

In conclusion, using our Design Thinking process and a literature review, we have found a gap in the research surrounding sign language and gesture tracking with VR, specifically when it comes to teaching the language using the benefits VR provides.

While our prototype is similar to other proposed solutions, the differences involved in combining the findings from other sources to create a gamified sign language learning virtual reality application should hopefully result in a more effective and immersive learning experience.

For potential future work with the prototype, we wish to have functioning facial gesture and body language tracking. Since sign language is such a physically expressive language, having a software able to take into account all of these intricacies of the language. Both current learning for sign language and our prototype will be lacking in regards to these areas, and it would be of interest to investigate this in the future.

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*References include both the ones referenced within the paper, as well as the references used when conducting the literature review.

V. Appendices

Cydney - Research, Diagrams, Contributed to writing and editing report*, Participated in Design Thinking process, Contributed to conducting a small literature review for the chosen topic (Read research papers, made point form notes)

Nicholas - Team leader this month, Research, Contributed to writing and editing report*, Participated in Design Thinking process, Contributed to conducting a small literature review for the chosen topic (Read research papers, made point form notes)

Maija - Research, Contributed to writing and editing report*, Participated in Design Thinking process, Contributed to conducting a small literature review for the chosen topic (Read point form notes, analyzed where the gap would be)

*We all contributed to each section of the report, through assisting with research, typing out sections, or editing