

# Assignment 1 - Proposal

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**Abstract**—My product is the ‘Haptic Glove Lite’ (‘HG Lite’ for short), which is a haptic feedback glove for virtual reality. VR is designed around creating an immersive user experience, so the haptic glove would serve to enhance said environment by creating physical feedback from user interactions in the virtual world. Said glove would not have any hand tracking or force feedback functionality, but would be small and inexpensive so that regular consumers could easily get into it. Ideally, this would attract more people to VR, and help with growth of the VR industry.

**Index Terms**—virtual reality (vr), haptic feedback, force feedback

## I. INTRODUCTION

This is my report for assignment 1 of the ‘INFR 3380U: Industrial Design for Game Hardware’ course, which is a proposal for the hardware piece I plan to make. The market opportunity, my hardware idea, and my plans for the project shall all be explained with this report.

## II. PROJECT DESCRIPTION

The project description is gone into with this section, which is to explain both the problem, and why said problem is worth addressing.

### A. Problem Definition

[1]–[4] Virtual reality is a system by which a user is brought into a digital world that takes advantages of the said user’s senses to make the world as immersive as possible. While such technology has grown significantly in recent years, it does have many faults and limits that hinder this motivation. There are elements that are difficult to emulate in a virtual world, which thus hinders the user experience and makes it harder for the user to feel fully immersed in their virtual environment. One such problem is the lack of physical feedback from interactions in VR, which makes perceiving depth and weight difficult for VR users, thus making the experience less immersive. There exist tools to try and mitigate such issues, but they still have their limits, and along with the already high cost of personal VR equipment, such tools may be out of the reach of average people. This project aims to improve one element of VR, which is haptic feedback. Haptic feedback refers to the physical feedback one gets from an action, which can encompass different sensations based on how versatile said haptic system is. In this context, said feedback refers specifically to physical feedback from VR environments. My solution to this problem is a haptic glove that provides such

feedback to the user to some extent, which will be further explained later in the report.

### B. Justification

The problem of haptic feedback needs to be addressed to further virtual reality’s development, and to make the VR market more accessible. Without haptic feedback there is considerably less weight to a user’s movements, thus making their VR experience less immersive than it can be. Furthermore, some haptic solutions do exist, but they may not be available for regular consumers, may be too expensive, and/or may be too cumbersome for average consumers to use. If this problem persists, then it will hold back the VR industry, and make companies less willing to invest into it if the profits are not substantial. Continually, the appeal of VR can only go so far without applications to support it, especially when it comes to VR gaming. As such, VR applications and tools must be accessible to the average consumer to avoid stagnation in the industry, and to get more people comfortable with using virtual reality. While current VR technology may not match up to what disengaged people have envisioned, having haptic feedback is a big step towards that goal, and starting off with the hands is the best bet for such a case.

## III. DESIGN THINKING PROCESS

Starting off with my hardware idea, I call my product the ‘Haptic Glove Lite’ (‘HG Lite’ for short), which has its logo shown below. It is a haptic glove that would be used in combination with other VR tools for virtual reality applications. Since it is just meant to be an enhancer for the VR experience, there is no movement tracking or force feedback component. The product would be aimed at average people interested in using VR, which is the market opportunity the HG Lite would be designed to address. With that said, it is now time to go through the 5-step design thinking process behind the product.



### A. Empathise

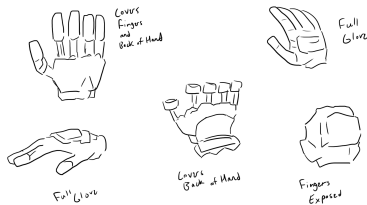
VR is an expensive medium to interact with, but with time it will naturally become cheaper and more accessible to general audiences. As such, it is important to address possible hurdles that would prevent people from getting into it. One such issue is the lack of haptic feedback, which makes the experience less immersive. Someone may have a view of VR that is not represented by what is on the market, so trying to get as close to that view of VR as possible is needed for the industry to thrive.

### B. Define

As mentioned before, the issue with doing VR without haptic feedback is that it makes the simulated interactions less impactful. Without proper feedback the world feels weightless and separate from the user, which goes against what VR is supposed to do. The addition of haptic feedback, even if in tandem with a standard game controller, will serve to address these problems.

### C. Ideate

The idea behind my tool is to have a slim, compact haptic glove that is inexpensive for the average consumer. While the hardware side has not been explored much, it is the intention to keep things small. In addition, the amount of coverage the glove will provide (full glove, fingers only, fingers exposed, etc.) has not yet been finalized. The design will become more concrete as the project continues.



### D. Prototype

A small physical prototype will be made as part of a separate assignment, which will serve to approximate the size and rough look of the glove. As for the final product, the plan is to have a digital representation of it demoed in Unity, which will be produced by the software provided in class. Unless requirements change, there is no intention to make a fully-fledged physical version of the product.

### E. Test

Since the final product is a fleshed-out 3D model with an accompanying simulation, there will likely be no significant testing for this project. Personal testing will be done to make sure everything works as intended, but no testing with outer participants is planned at this time.

## IV. PRODUCT COMPARISON

Haptic technology goes back several decades, and has existed in various forms, from full exoskeleton suits to just individual gloves. This timeline comparison just highlights major glove examples in the haptic industry, which often have an association with virtual reality as is.

### A. Teletact I and Teletact II (1990 – 1991)

[5] The Teletact was an early prototype haptic glove released in 1990 as part of a collaboration between the UK's National Advanced Robotics Research Centre of Salford and Airmuscle Ltd. of Cranfield. This glove used 20 small air pockets and adjustable air pressure to simulate haptic feedback. Its successor, the Teletact II, had more dense air pockets, and used both inflation and deflation to generate haptic feedback in response to a virtual environment.



### B. Cyber Glove Systems (1990 – Present)

[6]–[8] Cyber Glove Systems is a company founded in 1990 that specializes in haptic hardware and software. The company's tools appeal to a variety of industries, such as the VR industry, the military, and the engineering industry. Some major products include the CyberGlove II and III (hand movement tracking gloves), the CyberTouch II and III (motion tracking and haptic feedback gloves), and the CyberGrasp (a motion tracking, haptic feedback, and force feedback glove). Shown below are all the mentioned products in their respective order.



Fig. 1: Existing and Upcoming Haptic Glove Products

### C. Senso Gloves (2018 – Present)

[9], [10] The Senso glove is a USA produced haptic glove released by the company Senso in March 2018. The glove provides interaction for all five fingers via a vibration motor for every finger. Although it lacks the precision levels of other haptic gloves, it is cheap, easy to calibrate, and has a high refresh rate. It works for both virtual reality and augmented reality systems.



#### D. HaptX Glove DK2 (January 2021)

[11]–[13] Produced by HaptX, the HaptX Glove DK2 is an advanced haptic glove that displaces the user's skin as if they are touching a real object. This comes along with the existing haptic and force feedback technology that comes with the glove. It does this skin displacement using its 130 discrete points of tactical feedback, and possesses high accuracy for hand tracking. The product was announced in January 2021.



#### E. bHaptics TactGlove (December 2021)

[14], [15] The bHaptics TactGloves are slim haptic gloves made for use with existing VR tools such as the Quest 2 and HoloLens 2. They provide hand tracking capabilities, and have 1 actuator per finger for haptic feedback. It should be noted that these gloves do not have force feedback, so the user can go through any virtual instructions they interact with. This product was announced in December 2021, and has development kits set to be released in the second quarter of 2022. A full release is also planned for some point later in the year of 2022.



### V. PLANNING

This is a solo project, so there are no tasks to divide amongst teammates. As for the work schedule, shown below are all the assignment deadlines, which all contribute to the final project. The current plan is to have a digital representation of the hardware loaded in Unity, and demo the product through that. Outside of what is required, there are no plans to make a fully realized physical prototype. Though with that said, work plans will be adjusted and expanded as more assignment details become known, hence why only the pre-set assignment deadlines are being considered at this time.

- Assignment 2 – Electronic Prototype – 02/18/2022
- Assignment 3 – Design – 03/11/2022
  - Technical Drawings, Parts, and Assemblies
  - Simulation
- Assignment 4 – Progress Presentation – 03/18/2022

- Assignment 5 – Makerspace – 03/25/2022
  - Iterative Design and 3D printing.
- Final Presentation and Report – 04/14/2022

### VI. CONCLUSION

The haptic glove is a tool that can bring great contributions to virtual reality, not just by enhancing the user experience, but by also allowing for some new mechanics to be brought about. However, VR is already quite expensive, and consumer adaptation is something to consider, even if the technology naturally gets cheaper overtime. It is my desire for the 'Haptic Glove Lite' to be an affordable option that provides haptic feedback to enhance VR experiences. It does not have hand tracking or force feedback, as it is meant to work in tandem with existing VR tools. With such a tool the user would better interact with their virtual environment, and thus be more immersed in it. Be it for gaming or otherwise, it is my hope that more tools come about to streamline VR for regular consumers, which I believe will be best for the industry in the long run.

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