

## Multi-Party MR

*Keywords: Mixed Reality, Immersive Experiences*

### Introduction



Figure 1

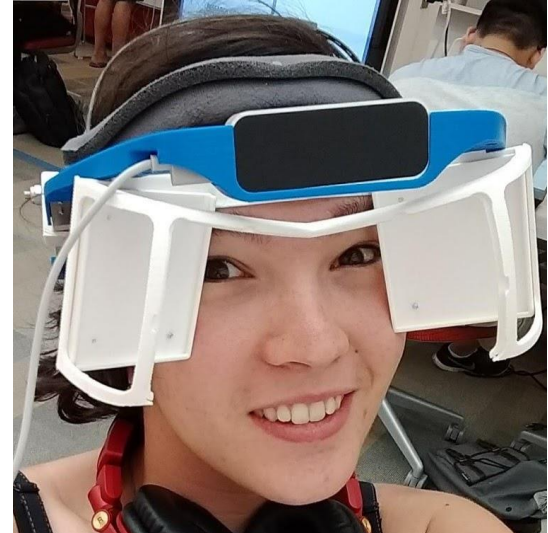


Figure 2

The challenge that mixed reality (MR) currently faces as an industry is a lack of accessibility. Headsets are not only prohibitively expensive, but lack content designed for multiple users. For example, the Magic Leap One, an augmented reality (AR) headset set to release in 2018, can range between from \$2,500 to \$3,000, while the Microsoft HoloLens, one of the older AR headsets released in 2016, can cost anywhere between \$3,000 and \$5,000. Each of these technologies are proprietary.

In addition to the sheer cost, most immersive content across virtual reality (VR), AR, and MR is geared towards single users only, intended for isolated individuals with minimal interaction from others. There are some solutions to this issue in VR such as VRChat, but there isn't an equivalent for headset-based MR.

### Research Objectives

Creating a low-cost and affordable MR headset with multi-party networking capabilities is one of the things I would like to pursue in my graduate program. So far, I have assembled the 3D-printed portion of an open-source headset called the North Star [1], and am looking forward to continuing the project. Project North Star is a MR headset released in June 2018 by Leap Motion (distinct from Magic Leap) that offers a precise hand tracking system in MR against the competitor headsets in the market (Microsoft HoloLens and Magic Leap). Figure 2 shows my printed headset with the Leap motion sensor versus the commercial product as seen in figure 1. During a graduate program, I would be interested in finishing multiple headsets and beginning to design experiences for one or more simultaneous users of these headsets.

A comparable project is HoloRoyale [2], a large-scale high-fidelity MR game. Based in Nara, Japan, their team is working on creating campus and city-wide experiences that employ the HoloLens and involves pre-scanning relevant areas of play. In contrast, my proposal would focus on utilizing more affordable and interactive tools.

### **Hypothesis & Expected Findings**

As the project has multiple aspects, there will be multiple user studies, backed up with usability and efficacy surveys that I will use to test my affordable multi-party platform. I'll be testing the hardware and its usability, intrusiveness and accessibility as well as the multi-party game and its networking components such as shared interaction, shared touch experiences, etc.

In my final study, I will compare my multi-party game system to related multi-party games such as HoloRoyale or any similar projects that have not yet been fully developed. The hypothesis is that my proposed multi-party game will be comparable to or even outperform other state-of-the-art multi-party MR games.

It is expected from my current research that my multi-party MR experience with in-house headsets will outperform competitors by offering:

1. natural and precise interaction experience with hands
2. non-intrusiveness by offering a lower weight headset than Microsoft HoloLens
3. affordability against the current generation of MR headsets
4. an immersive experience due to a wider field of view
5. natural shared experience in a MR simulation

### **Experimental Approach and Methods**

The project will have multiple phases. The first phase involves creating a functioning affordable headset. I would like to begin by constructing three North Star headsets utilizing 3D printing technologies available at my university and the source technology from Leap Motion. This keeps costs down while in the prototyping stages of the project.

I will then work on networking and multi-party game development using the skills that I've previously acquired during my summer research, in-industry internships, and leadership experience. I'll be using many of the same tools used for the VR experiences that I'm currently working on to create simulations for networked MR experiences.

### **Intellectual Merit & Broader Impacts**

Creating low-cost MR headsets is just one step in the direction of widespread adoption. This technology has the potential to completely change how society interacts with computers and information in general. This proposal is a nudge towards the goal of getting MR into people's hands to find out for themselves what it can become for their work and interests.

For example, complex mathematical concepts such as quaternions and 3D vector math would be vastly easier to explain and teach given proper visualization in mixed reality. Learning these concepts can prove to be difficult and non-intuitive when students must work with 2D media, like whiteboards and paper. Implementing educational tools using MR technologies will make teaching these concepts, and many others, more intuitive and engaging.

### **References**

1. Leap Motion. 2018. *Project North Star is Now Open Source*. <https://blog.leapmotion.com/north-star-open-source/>
2. Rompapas, Damien, et al. 2018. *HoloRoyale: A Large Scale High Fidelity Augmented Reality Game*. <https://dl.acm.org/citation.cfm?id=3271637>