

Usability of Hand Tracked Virtual Reality User Interface Orientations

Martin Dunn 1705105 – BSc (Hons) Computing (Games Development)

1. Aims and Objectives

Aim:

To identify a preferred orientation for the user interface within virtual reality using hand tracking with the Leap Motion Controller.

Objectives:

1. Explore the literature of the field
2. Design and build a solution
3. Test with suitable users
4. Evaluate future possibilities

2. Introduction

Virtual reality and hand tracking hardware are both developing rapidly. If we look back on virtual reality and the technological advancements made in only 50 years, if the same progression is to be assumed to continue it could be a standard technology in any household. Current research into hand tracking can suggest that discomfort and arm fatigue can be caused by bad orientation of the interface [1]. The aim of this study is to identify a preferred orientation for user interfaces using Meta Quest 2 and Leap Motion Controller to help improve future user experience with this hardware.

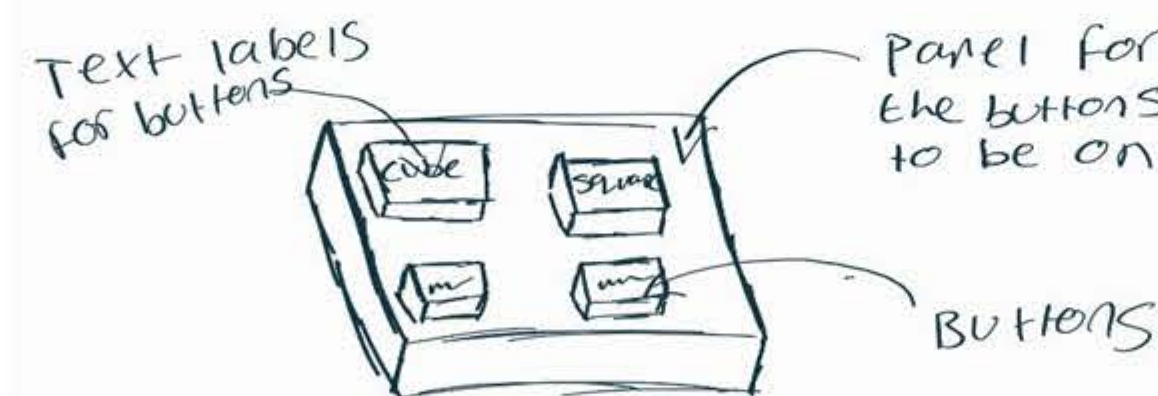
3. Research Summary

The early development of what is now known as VR can be dated back to the 1950's when Morton Helig created the Sensorama virtual reality machine [2]. In only 50-60 years we have moved from giant, expensive static machines to small, portable, and affordable VR devices available to the public. The advance of VR also connects to the advance of hand tracking as by the nature of VR hands require tracking, usually using a controller. However, Meta have been creating hand tracking for their Quest 2 headset. The Leap Motion Controller has a sub millimetre accuracy [3] making it a good choice for this study to prevent inaccurate tracking effecting results. This technology is already being utilised or researched in a vast range of fields to benefit many types of people, such as sign language recognition [4]. There is not a large amount of study that could be found regarding hand tracked UI in games making this study useful for future researchers, designers and developers of this technology.

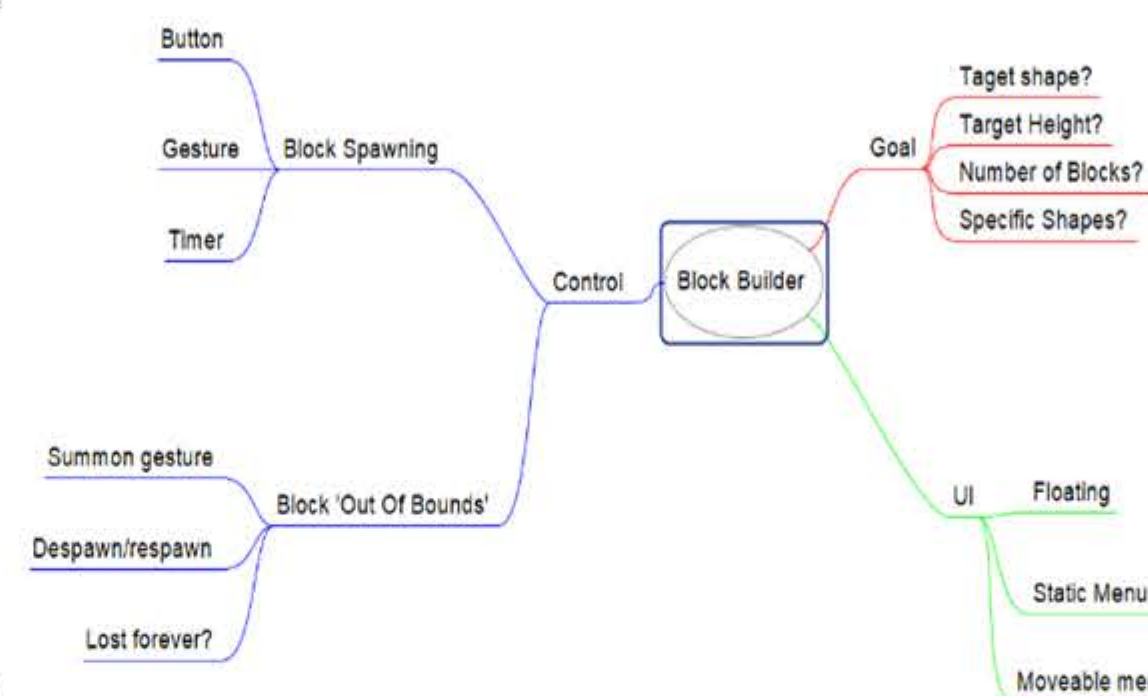
4. Design and Development

In the early phases of design mind maps were created to visualise any ideas. These were initially very broad and narrowed down over time to ensure that the scope of the implementation was only what was needed to prevent wasted implementation time and ensure the implementation would meet the deliverables.

The user interface began by sketching basic ideas using a tablet. These were basic design with a couple of buttons, with obvious labelling so it is clear to the user how it works but not cause issues when deciding how to proceed. There were buttons to spawn different blocks and change their colour as it was intended for the user to interact with the interface enough to observe any difficulties that they may encounter.



The user interface was created using Unity game engine and Microsoft Visual Studio 2019 for writing scripts using C#. There were 3 different UI orientations created named; Hand Anchored UI, World UI and Dynamic UI. Hand anchored UI, as the name suggests, is anchored to the left hand of the user but is only visible and interactable when the palm is facing the camera. This enables the user to always have the menu in reach and access it whenever it is needed. World UI is a static menu within the world that can be repositioned using a grab bar on the bottom if the user desires. Dynamic UI is a combination of the 2 previous implementations, when the left hand palm is facing the camera an icon appears enable the user to open a menu in the world, then when they are done they can place the menu back into the slot on the hand out of view. Leap Motion Unity plugins were required for the use of the Leap Motion Controller within Unity. These plugins also provided a number of valuable examples and prefabs that could be used or rebuilt to aid the development process.



5. Testing Results

With the implementation completed 5 users were asked to test each of the 3 UI orientations whilst observations were taken to identify any difficulties they faced. These sessions were also recorded for future evaluation if needed. The observations suggested that there was no clear preferred orientation of the UI from these tests. However, it did seem to suggest a least favourite of the 3 being the World UI. This was believed to be true as it is fixed in place where ever it is positioned meaning the user has to return to its location to interact with it as it does not follow them. Additionally, there was a number of interaction issues identified with the Leap Motion Controller when trying to interact with game objects users were struggling to release object that had been picked up. This also contributed to issues with the repositioning of the World UI.

6. Conclusion

The aim of this project does not have a definitive answer and need further research with the hardware to define a clear preferred orientation of UI. All of the objectives have been met throughout the course of this study. Timings taken from the testing of the levels indicated that the Dynamic UI was the fastest to complete being around 50% faster then previous orientations. This is believed to be due to the user gaining previous experience with the other orientations prior to this testing and being more comfortable with the hardware. This id not believed to be an indication of a preferred orientation. Additionally, users stated in additional comments of the questionnaires that this was the case. Future work needs to be conducted using a larger number of test subjects and longer testing sessions to determine any unintentional discomfort caused by the orientations. Additionally, exploration into the issues of releasing game objects whilst using the Leap Motion Controller is needed to help improve user experience.

7. References

- [1] A. H. a. C. G. Johanna Pirker. Mathias Pojer, "Gesture-based Interactions in Video Games with the Leap Motion Controller," 2017.
- [2] M. Helig, "The Cinema of the Future," pp. 239-251, 1955.
- [3] D. B. B. R. a. D. F. Frank Weichert *, "Analysis of the Accuracy and Robustness of the Leap," Sensors, vol. 13, no. 5, pp. 6380-6393, 2013
- [4] E. R. C. G. Ching-Hua Chuan, "American Sign Language Recognition Using Leap Motion Sensor," Florida.