

Deliverable C - Design Criteria and Target Specifications Report

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Group 01

January 29, 2025

Abstract

This deliverable outlines the prioritized design criteria, technical benchmarking, and target specifications necessary for the development of our final engineering solution. The document begins by defining a set of design criteria derived from the team's interpreted needs, encompassing both functional and non-functional requirements and constraints. Additionally, this document describes the technical benchmarking process where we compare existing products that have similar needs and include user feedback on them to help us better understand their strengths and weaknesses from a user's perspective.

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1.0 Design Criteria

The following design criteria outline the foundational requirements for the successful development of our XR experience focused on climate change. These criteria are informed by insights gathered during our initial client meeting and are categorized into functional and non-functional requirements to ensure a clear understanding of both the core objectives and the supporting elements that will enhance the user experience.

1.1 Functional Requirements

Based on our first client meeting we came up with the following minimum requirements for the successful completion of the project.

- Immersive XR experience to inform about climate change.
- Something that tells a story and is engaging
- 3-minute, interactive experience.
- Targets a specific audience that needs to show a change in perspective after the experience.

1.2 Non-Functional Requirements

- Fancy colors and graphics are secondary.
- A learning period in the experience, (slide show about climate change/ an additional part).

Not necessary but might pair well with the game.

- User friendly platform, very simple game play that focuses on learning rather than challenging.
- Performance high-speed graphics, (not a functional aspect but bad or slower graphics will not work for the project).

2.0 Benchmarking

Benchmarking involves comparing existing products or solutions that meet similar needs to our project. This process helps identify best practices, performance standards, and design features that can be integrated into our final engineering solution. Benchmarking also provides valuable insights into user experiences with similar products, guiding us in refining our design criteria.

Table 1: Benchmarking summary

Product Name	Key Features	Strengths	Weaknesses	User Feedback
Monument Valley	stunning minimalist art style, unexpected visual puzzles, and serene gameplay.	Visually stunning, unique puzzle mechanics in 3D, short but tightly crafted.	Price, limited interactivity, limited replay value.	It's a very good game, is just MV2 needs better level design, and it rarely utilizes new game elements.
Beast Saber	Rhythm-based gameplay, intuitive controls, neon-themed environments.	Visually striking, adjustable difficulty, regular updates.	dangerous for the wrists, tracking issues on some VR setups, repetitive gameplay.	It's very simple and is relatively fun. For someone who wants more re village or full game experiences it's only fun for a day or two.
Among Us VR	Social deduction, proximity voice chat, interactive tasks, atmosphere and suspense.	The core mechanics of deception, teamwork, and suspicion, intuitive VR controls, update map design.	Technical bugs, high hardware requirements, moderation issues.	the transition to VR looked slick and well done, but when you randomly match, you will encounter some toxic people who say bad things.

Several important lessons were learned from the survey, which helped improve game design, user experience, and technical performance. First, it became clear that balancing good visuals with fun gameplay is important. For example, in Monument Valley, the beautiful graphics needed to be matched with clever level design to keep players interested. In addition, user feedback emphasized the need for replay ability and content diversity. However, given the theme and length of this project, it would be more realistic to focus on visuals and interactions to create a game like Monument Valley. Technical stability is another key factor, especially in VR, where testing is crucial. The lessons learned will help guide future improvements, making sure that upcoming projects focus on reliable performance and better visual experiences.

3.0 Target specifications

3.1 Performance

- To reduce the latency the headset will be hooked up to the main PC
- A meta quest 2 VR headset will be used with a resolution of 1832 x 1920 pixels per eye
- A gaming laptop with an RTX 3060 laptop GPU
- 16GB DDR4 Ram

3.2 Sounds

- To maintain player orientation audio effects must match the actual environment positions.
- The volume of loud sounds that mimic building get on fire needs to vary according to distance from the source.
- When impactful events occur such as earthquakes or when debris strikes them VR controllers ought to provide vibrational feedback to users.

3.3 How Players interact

- Virtual reality interfaces must allow participants to perform natural hand motion and handle physical items.
- There should be two ways to move: Players must select between traditional movement control or an instant teleport mode which can stop motion sickness.

- Virtual reality players should possess the ability to handle objects within the game environment with movements that correspond accurately to those of real life.

3.4 VR Headset & Controller Support

- The system needs to receive input from VR controllers together with hand tracking features so that controller use remains optional.
- The system will operate effectively for users who either stand or maintain a seated position.

3.5 Effects making the Forest Fire Feel Real

- Visual realism: High-quality texture of the environment and the fire, using realistic lighting to simulate the impact of the forest fire and make the wooden house in the forest or objects get on fire during the disaster.
- Dynamic sound effects: Add appropriate sound effects and voices according to the distance and situation, such as the sound of fire burning trees, to make users more immersed.
- NPC: NPCs should have realistic reactions, when the forest fire starts, they should have survival behavior, have animations of run away from the forest.

4.0 Constraints

4.1 Performance & Rendering

- Graphics Limits: The RTX 3060 is decent for VR, but complex shaders, high-poly models, and real-time lighting may cause frame drops.
- Optimization Required: Aim for 72Hz (native on Quest 2), 80Hz, or 90Hz for smooth gameplay.
- Foveated Rendering: If streaming from a PC, use Oculus Link or Air Link with fixed foveated rendering to reduce GPU load.

4.2 Quest 2-Specific Constraints

- Standalone vs. PCVR: If running standalone, performance is much more limited (Snapdragon XR2), requiring lower poly counts and baked lighting.

- **Battery Life:** Quest 2 has a 2-3 hours of battery life considers external power options for longer sessions.
- **Tracking Limitations:** Inside-out tracking works well but struggles in low-light or cluttered environments.

4.3 Input & Interaction Constraints

- **Controller vs. Hand Tracking:** Quest 2 supports hand tracking, but it's less precise than controllers.
- **Limited Haptic Feedback:** The controllers provide basic vibration, but no force feedback or finger tracking like Valve Index.

4.4 Connectivity & Latency

- **Air Link vs. Wired:**
 - **Wired (Oculus Link):** Lower latency but requires a high-quality USB-C cable.
 - **Wireless (Air Link):** Needs a 5GHz Wi-Fi router close to the headset to prevent stuttering.
- **Compression Artifacts:** Air Link uses video compression, which may reduce visual clarity in high-motion scenes.

4.5 Development Constraints

- **Engine Choice:** Unity and Unreal Engine work well, but Unreal's Nanite/Lumen aren't supported on Quest 2.
- **Experience shouldn't last more than 3 minutes**

5.0 Reflection on Client Meeting

In our first client meeting, we learned invaluable insights into the expected results and goals for the VR experience. The client emphasized the need for an immersive and interactive environment while using storytelling to create an emotional bond with the user. The broad goal behind the VR experience is to educate the user about climate change, thereby boosting the sense of accountability and inducing a sense of action for him/her.

The client provided certain factors to be included in the design:

- **Immersion and Interactivity:** The VR experience is to be extremely immersive, rendering the user capable of full investigation of the environment and the story being analyzed. Interaction would be truly critical so that the users could connect with the experience and could feel involved in an involved way. For example, our topic is forest fire, we will simulate the forest fire scene in detail to give players visual impact and immersion.
- **Narrative:** It is important to tell the story regarding climate change and showcase the effects it can bring upon the user in a relatable way, surrounding how climate change has varied effects on an individual's life.
- **Easy Navigation:** The interface by itself should be quite basic, allowing a person to navigate through it simply and efficiently, enabling any technical skilled user to take part without getting oppressed in any form.
- **Realistic Disaster Simulation:** To get the requisite message regarding the nature of these disasters, the simulation of disasters will need to be as realistic as possible effectively conveying the very seriousness of these events.

Table 2: Client needs priority

Factors	Immersion and Interactivity	Narrative	Easy Navigation	Realistic Disaster Simulation
Priority	1	2	4	3

1 = Most important and 4 = Least important

These insights are substantial to our design criteria, based on our focus on creating a technically viable experience that yet strikes an educational and emotional chord.

Accessible and usable will be the key words in the experience terms. Potential technical challenges such as motion sickness and performance optimization are incorporated into any VR experience feedback iteration. The client's feedback has reinforced the importance of balancing technical specifications with the overarching goal of fostering awareness and accountability regarding climate change.

6.0 Resources

<https://www.youtube.com/watch?v=hZy2d8fJs1M>

<https://itch.io/games/made-with-unity/tag-virtual-reality>

[https://www.reddit.com/r/PSVR/comments/14cw21c/is beat saber really that good i see a lot of/](https://www.reddit.com/r/PSVR/comments/14cw21c/is_beat_saber_really_that_good_i_see_a_lot_of/)

[https://www.reddit.com/r/AndroidGaming/comments/7ch3sz/unpopular opinion monument valley 2 is a/?rdt=50058](https://www.reddit.com/r/AndroidGaming/comments/7ch3sz/unpopular_opinion_monument_valley_2_is_a/?rdt=50058)

7.0 Task Separation Table

Sections	Author(s)	Editing
Abstract	T.Z.	-
Design Criteria	M.B.	-
Benchmarking	T.Z.	-
Target Specification	R.K.	O.O., J.D., T.Z.
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