Deliverable D

Conceptual Design

Raphael Pinto, Jaeden Dulaney, Joey Weng, Janna Barkawi, Angelo Pool Rodriquez

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Abstract

This report forms the basis for the first stage of concept development for a simulation intended to raise awareness about climate change in virtual and augmented reality environments. The overall purpose of this work is to develop an immersive and engrossing simulation not only educating its attendees about the critical issue of climate change in a scientifically sound manner

but one that engages at an emotional level, and with an overall narrative weaving everything together. By combining scientific accuracy, emotional nuance, and an effective narrative, this simulation aims to deliver meaningful and lasting experiences for participants that could engender long-term behavior change over time. To accompany this report will be an analysis explaining the conceptual model, justifying each of its design decisions, specifying technical requirements, resolving usability issues, and describing future work in developing a working prototype. In addition, the report will include information about software and infrastructure requirements, strategies for enhancing access, and a full examination of narrative factors critical to simulation success.

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1.0 Introduction

Climate change is one of humanity's most important and immediate concerns at present, shadowing a plethora of factors including ecosystems, society, and economies worldwide. Historically, traditional educational approaches have failed to instill in learners a proper realization regarding the urgency with which one must act in regard to such a critical issue, and for this reason, no meaningful and proactive interventions have been initiated in an attempt to drive change. In an attempt, therefore, to face and overcome such a critical issue, our project utilizes the powerful capabilities facilitated through use of the technology of VR/XR, effectively immersing learners in real-life and meaningful scenarios with direct pertinence to the issue posed through climate change. By such an innovative use, learners can actually see, encounter, and understand its consequences firsthand, and in so doing, gain a heightened level of awareness about its ramifications. As learners make their way through such immersive virtual environments, they will have the chance to develop a heightened level of awareness concerning such serious ramifications posed through increased worldwide temperatures, impending sea level rise, and growing occurrences and severity of extreme weather events. Building on Deliverable C, this report continues through a thorough review of the significant work accomplished to date. Included in such a review is a thorough examination of such considerable work, including an in-depth review of such a conceptual model, a thorough requirements compliance analysis, theoretical underpinnings of such an initiative in terms of scientific theory, and a thorough review of such a general purpose and objectives of such a project.

2.0 Conceptual Design Approach

The simulation is framed within a carefully crafted narrative to maximize user engagement and educational impact:

→ Introduction Scene: Participants start in a neutral environment, a futuristic laboratory or educational briefing room, where they are provided with necessary background information relating to climate change. Visual and audio stimuli will set the context for the experience that follows.

Main Scenarios: Participants will then enter three separate environments, each representing a particular aspect of climate change's impact:

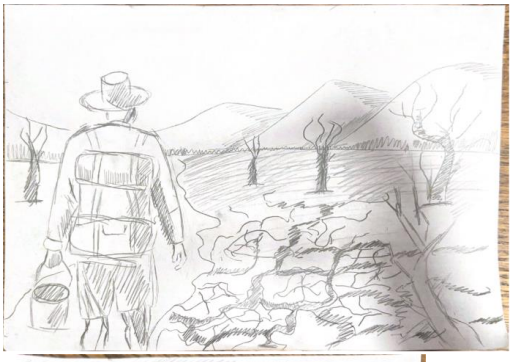
→ Indigenous Community Story: This section presents a first-person view of how climate change affects traditional ways of life, biodiversity, and everyday experience of indigenous communities. It will include indigenous voices and stories, creating a deep emotional connection.

- → Antarctic Scene: In this desolate and icy environment, a polar bear struggles in its search for its shrinking habitat in the face of melting ice caps and reduced food resources. Participants will be able to move within this environment and witness the secondary effects of habitat loss.
- → Drought Scenario: In a water-scarce environment, participants are faced with the extreme consequences of restricted water supplies, dry landscapes, and the socio-economic effects of drought. This section will emphasize the human consequences of climate change, including forced migration and the breakdown of agricultural systems.

Reflection Space: After completing the main scenarios, participants will enter a large cosmic environment, allowing them to appreciate the large-scale scope of climate change. In this environment, interactive questions will challenge participants to reflect on possible actions and alternatives for making change in the real world.

User Choice Mechanisms: Participants will be given the ability to make a variety of decisions within the simulation, allowing them to personalize their experience and feel a sense of agency and personal stake in the issue at hand.

3.0 Design Justifications



3.1 Unity Technical Justification

Unity is an excellent choice for this VR project because it provides easy-to-use tools for creating **realistic environments** and **interactive experiences**. With Unity, we can build **three different scenes** (polar region, Indigenous village, and drought-stricken land) with simple 3D models, lighting effects, and basic physics to make the world feel real. For example, in the **polar bear scene**, we can use Unity's **water and ice shaders** to show melting ice and floating icebergs. The **lighting system** can make the environment feel cold and harsh, enhancing the emotional effect. In the **Indigenous village**, Unity's **fog and fire effects** can help set the atmosphere, making it feel like a real storytelling session around a campfire. In the **drought scene**, we can use Unity's **terrain tools** to create cracked ground and a dry landscape. Even with basic Unity features, we can still create a strong emotional impact by making the environment visually clear and easy to understand. Unity also has built-in **sound effects** that allow us to add ambient noise, like the sound of cracking ice, burning wood, and dry wind, making the experience feel more immersive.

3.2 User Interaction Justification

Our goal is to make the player **feel connected** to the virtual world by allowing them to **walk around, look at details, and interact with objects**. In **VR mode**, players can **move and explore each environment**, seeing climate change effects up close. In the **polar region**, players can step on ice that **shakes and breaks**, making them experience how unstable the environment is. In the **Indigenous village**, players can sit near an NPC storyteller and listen to their explanation of climate disasters, making them feel part of the story. In the **drought scene**, as players walk, they can see the **ground cracking beneath them**, making the experience more intense. We can also add **basic interactions**, like letting the player "touch" the polar bear to see its weak condition or allowing them to pick up objects in the village. These simple interactions help players understand the impact of climate change, making them more engaged. The experience does not need to be complex—just by allowing movement, observation, and small interactions, we can create a powerful emotional connection that encourages players to think more about environmental issues.

4.0 Technical Considerations

The technical considerations for developing a VR climate change simulation must align with the client's needs. Technical considerations for this VR climate change simulation span multiple domains, including performance optimization, hardware compatibility, user experience, and accessibility. The simulation must foster empathy, emotional engagement, and education, while ensuring accurate, immersive, and accessible experience. To achieve this, the simulation must illustrate high environmental modeling, that accurately represents climate change impacts, such as rising sea levels, habitat loss, and extreme weather. This requires accurate data, derived from proper research from real life situations to accurately represent the endurance through climate change.

To maximize emotional engagement, immersive storytelling should be prioritized, which includes first-person perspectives, interactive dialogue, and decision-making mechanisms that give users control in shaping their outcomes. This will highlight the ongoing decisions that society continues to make affects the outcome of future generations. Additionally, realistic audios and sounds should be used to reinforce the experiment of living through climate change. To ensure broad accessibility, the simulation should include subtitles, voiceovers, and user-friendly controls such as hand-tracking, gaze-based selection, and controller input, making it accessible to a diverse audience.

It is important to emphasise the importance of performance. Performance optimization is crucial to ensure smooth frame rates and low latency. The simulation must be compatible with various VR headsets, requiring adaptability in rendering resolutions and support for hand tracking, voice commands, and controller-based navigation. sensory immersion is another key aspect, integrating spatial audio and haptic feedback (e.g., vibrations for extreme weather, tactile responses to environmental changes) to enhance realism. Sensory immersion is another key aspect, integrating spatial audio and haptic feedback (e.g., vibrations for extreme weather, tactile responses to environmental changes) to enhance realism.

Overall, the technical approach must prioritize scientific accuracy, immersive engagement, accessibility, and performance optimization to deliver a compelling, empathy-driven VR experience that aligns with the client’s mission of climate education and advocacy.

5.0 User Experience

The VR/XR simulation, designed with a view to raising awareness about climate change, has been particularly designed to bridge gaps between educational approaches and emotional impact through purely immersive experiences that mimic real-life scenarios of climate change. In meticulous detail, this report outlines technical requirements, design constraints, and benchmark testing evaluations to validate that the simulation meets minimum requirements predefined for it.

The future development phases will involve enhancing overall user experience, compliance with user requirements, and usability in a variety of VR/XR platforms. Future work will include thorough testing with actual users and incorporation of feedback to make it more accessible, interactive, and emotionally powerful.

By seamlessly combining scientific information with narrative, this project aims to become a powerful tool for raising awareness and eliciting actions towards countering climate change.

6.0 Updated Task Plan

The task plan has been revised to account for newly identified project priorities and technical refinements.

Task	Status	Owner	Changes
Develop Initial Scene Concepts	Completed	Team	Finalized key scenarios
Refine Story Telling	In progress	Raphael, Janna	Integrating feedback from client
Implement VR environments	Upcoming	Alexander, Joey	Based on finalized specifications
Add interactive elements	Upcoming	Jaeden	Ensuring user engagement
Conduct user testing	Scheduled	All	To collect feedback and refine simulation

The process of developing a VR simulation based on climate change is shaped by the clients' criteria and needs. The client meeting significantly shaped the development of the simulation and the specifications. The client emphasized on fostering empathy within the user and shaping their ideologies based off advocacy and education. The priority for the simulation is to emotionally engage the user. The client stressed the importance of invoking an emotional response that will allow the user to develop a sense of urgency to act towards the ongoing issue of climate change. This emphasizes the priority of storytelling, illustrating the environmental degradation effects,

and allowing the user to make decisions. Moreover, the educational elements of the simulation should highlight interactive learning moments, where the user will observe real-world case studies and concepts. Additionally, the client highlights the importance of accessibility, ensuring the simulation is accessible to a wide audience, considering user experience. For instance, this can be done by adding subtitles for users who have a challenging time hearing.

Modifications are to be done from deliverable B, where the narrative can include personal stories or first-person perspectives to create a stronger emotional tie. Considering an emotional response, an interactive feature will engage the user, allowing them to have authority over their decisions, encouraging them to act. Additionally, the visuals must be realistic, based on research and data collected.

Therefore, meeting with the client clarified the direction of this simulation and refined the teams' priorities. The VR simulation will remain both, emotionally compelling and educationally effective. Moving forward, this update will be integrated to align with the client's vision.

In terms of specifics, our first visual prototype serves as a key step in practicing the essential skills needed to build a VR environment. By creating and testing this medium-fidelity prototype, we aim to make sure our system loads reliably, maintains the right size and scale, and transitions smoothly between scenes without any issues.

Along with ensuring that everything runs properly, we also want to check how good the environments look and whether they match the story we're trying to tell. The goal is to see if the visuals make sense for the narrative and help create an immersive experience for the user.

To measure how well our development process is working, we'll use simple criteria—essentially a pass/fail system—to see how effectively our team is learning the necessary skills, applying them to storytelling, and turning our ideas into a functioning VR experience. These early tests will help us identify what's working, what needs improvement, and guide us as we refine our approach moving forward.

We plan to begin creating the prototype between the 17th of March and the 23rd of March, with testing starting the following week. Nevertheless, testing can also be done asynchronously, as we will actively observe and document any bugs or issues that arise during the development process itself.

7.0 Next Steps and Future Work

The next steps to this project will focus on prototyping and testing our project, along with refining our ideas based on our client's feedback. Our team will present our ideas to our clients to ensure that their product best fits what they are looking for. Our initial prototypes will undergo user testing to gather feedback on the emotional impact, accessibility, and accuracy of our

project. These prototypes will help us get a grasp of what does and what does not work in our plan. Much of our future work will be done through Unity where we begin to code and design our VR/XR simulation. We will begin prototyping by designing our three scenes to get a sturdy base to branch our work off of. We may decide to add additional interactive features to help strengthen our user's engagement and empathy of our project. As we move for, we will also focus heavily on making refinements to environmental textures, animations of characters, and audio design aiming to enhance immersion and emotional impact. To conclude, our next phase will concentrate on finalizing the narrative with our team and clients, receiving and working with feedback, optimizing the performance and quality of our simulation, and testing prototypes looking for areas of improvement and errors.

8.0 Refrences

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