

Nature Realms: Heightening Immersion in XR Nature

Final Project Report

Team Hello Hyperreality: Bavo Debraekeleer, Philipp Parteder, Leire Lisón, Gabriel Copier & Victor Fernández

Client: AP Hogeschool Immersive Lab

Project Coaches: Hiram Bollaert and Erwin Listhaeghe

EPS Coordinator Team: Geert Marrin and Bie Dirkx

AP University of Applied Sciences and Arts Antwerp

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Summary

The purpose of this report is to describe and present the results of the project "Hello Hyperreality" developed by the EPS students during the 2022/2023 Spring Semester at AP University of Applied Sciences and Arts in Antwerp. This project has been commissioned by, and in cooperation with, the Immersive Lab.

The specific subject of this project is environmental immersion in a Virtual Reality nature experience. The aim is to research different ways to heighten the immersion of users in virtual reality experiences, specifically in nature environments. For this purpose, we have developed five different scenes in Virtual Reality (office, rainy forest, cave, beach and cliff) and matched it with a physical set-up, including various stimulus, such as, changing grounds (rock, sand, grass) or wind. We have also used already built environments.

These experiences have been tested by a wide range of volunteers during four user-tests in the months of March, May and June. All along the process we have also had other three courses that have complemented our work. It has been a journey where we learned not only to build a Virtual Reality project, but also to work in a multidisciplinary and multicultural environment.

Regarding our results, they show that users felt highly immersed in the environment thanks to the physical assets that accurately matched the realistic visuals of the headset. At the end of this report we suggest some ideas for further research based on our experiments.

Introduction

In this report we present the work done by Team Hello Hyperreality (*Team Hyper* or *Hyper* from now on) in the European Project Semester Programme (EPS from now on) [1] during the 2022/2023 Spring Semester at AP University of Applied Sciences and Arts in Antwerp [2].

EPS is an international program with the focus on inter-cultural and inter-disciplinary project work. It is offered by 18 European Higher Education Institutions throughout Europe. As it is presented by AP University itself:

“In the European Project Semester, students work together in an international team on a real-life project that matches their area of study and field of interest. All projects contribute to the United Nations Sustainable Development Goals. 21st century skills as well as sustainability competencies are therefore central to the learning outcomes.” [1]

The specific subject of our project is environmental immersion in a virtual reality nature experience. The aim is to research different ways to heighten the immersion of users in virtual reality experiences, specifically in nature environments. Based on this idea, we have rebranded our project with the name “Nature Realms”, just for promotional purposes.

As an end goal of the project a virtual reality prototype has been created for the Oculus/Meta Quest. This prototype consists of a natural environment with three different scenes: a forest, a cliffside with a cave tunnel connecting the two, and a beach.

The prototype has both a software and a hardware part. The software is the digitally built environment. For this purpose, the main tool that has been used is Unity. It is a platform for creating and operating interactive, real-time 3D content [3].

The hardware consists of a physical set-up where we recreate some stimulus of the natural environment. We have recreated the feeling of walking on sand, rocks and grass with a handmade platform that matches what the user is seeing through the VR headset. We have also added a ventilator that simulates wind.

These physical inputs have been tested with real users in various experiments and we have measured the immersive experience of the volunteers through questionnaires.

The results are meant to help us better comprehend how VR experiences can feel more immersive. The social benefits of this would be that through these kind of highly immersive experiences in virtual nature, people who no longer can access real nature (because of illness or physical limitations) can still feel it.

Our project has been commissioned by, and in cooperation with, the Immersive Lab [4]. This is a research group located in AP Hogeschool that experiments with innovative VR technologies and carries out projects in this field. The results of our experiments will eventually help in their wider research project “Environmental immersion” [5].

Our team is formed by four different nationalities (Belgium, Austria, France and Spain) and various study backgrounds (ICT, Media Design, Engineering and Humanities). Thus, it is a rich merge of cultures and disciplines that has been crucial for completing the different stages of the project.

In the following pages we will first explain the process followed through the past five months. We will then present the results of our project and the conclusions we draw from them. Finally, we will give some recommendations for our client and for future EPS students that will choose to further build on this project.

Project Process

In this section we will talk about the methodology and the process followed during the project.

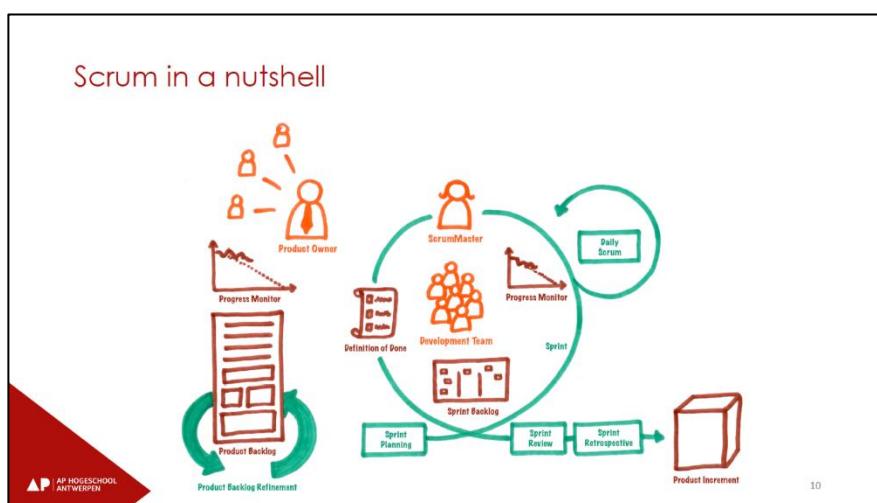
Methodology

The methodology we have used is called *Agile Project Management*. At the beginning of the project we received a crash course on this type of management with the lecturer Flor Holvoet.

Agile project management is an iterative and non-linear approach that focuses on breaking down large projects into smaller tasks that will be carried out in a short period of time called *sprint*, in our case, consisting of two weeks. At the end of each sprint the team reviews the work done and adds any necessary change to the project for the next sprint. Everyday a meeting takes place to check the tasks left. This is called *Daily Scrum*, and the person in charge of making sure this happens accordingly is called *Scrum Master*. With each sprint, the team is expected to deliver some value to the client.

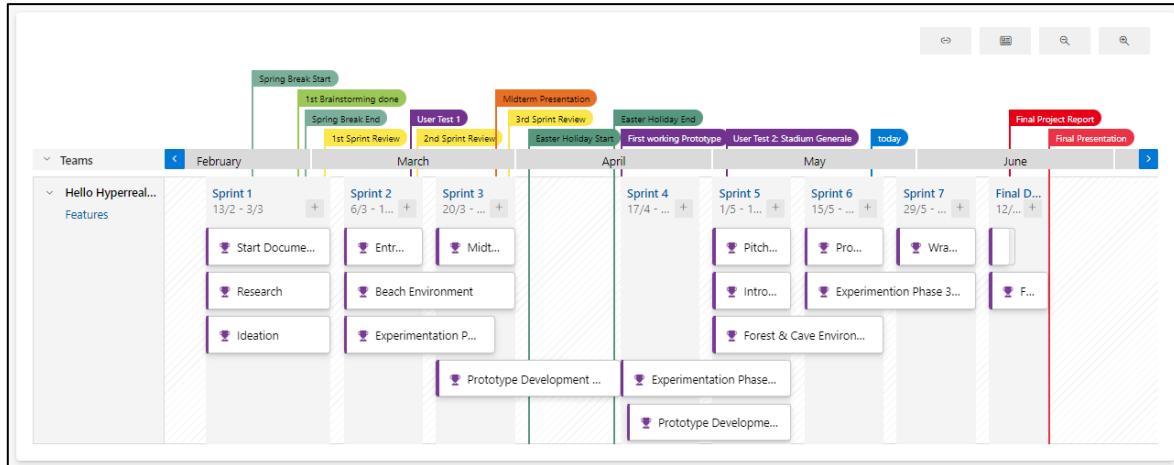
This methodology is specially used by software developers, because it gives teams flexibility to make changes to the product at any given moment and optimize the workflow, resulting in completing work faster [6][7].

This is a graphical representation of how a sprint works. This process is repeated over and over again, until the final product is delivered. The following picture was taken from the lecturer's slides.



Graphical representation of Agile Project Management

The platform we used for organising our sprints is Azure DevOps from Microsoft [8], because it is the one that the lecturer presented to us, and it fitted our needs. In this picture you can see an overview of our planning, with each sprint planned every two weeks and some important deadlines highlighted.



Overview of the Delivery Plan in Azure DevOps

The first two Sprint Reviews were conducted along with the lecturer and the other project-groups that were following the same methodology. We then carried out the rest of the reviews on our own. It is worth mentioning that there are two important presentations in the process: the Midterm and the Final Presentations. In the middle of the EPS programme we had to share with all the class and coaches the work done so far. In the Final Presentation we are due to present the final results of the project.

For every sprint we reorganised the *Backlog*, that is to say, the set of tasks to be completed. Here is a picture of the items of the Backlog for Sprint 5:

Order	Title	State	Assigned To	Remaining
1	> Project Summary	New	Bavo Debraeck...	
2	> User Testing Studium Generale	New		
3	Document Experiment Outcomes	New	Leire Lisón	
	Write report with questionnaire results	Done	Leire Lisón	
	Rethink the questionnaires	In Progress	Leire Lisón	
4	> Design Look and Layout	New		
5	Water shader	New	Bavo Debraeck...	
	Find depth node solution in VR	To Do	Bavo Debraeck...	
6	> Foliage and directional wind	New	Bavo Debraeck...	
7	> Beach Scene Redesign	New	Bavo Debraeck...	
8	> Forest Scene Design	New	Bavo Debraeck...	
9	> Cave Scene Design	New	Bavo Debraeck...	
10	Ice Breaker	New		
	Ideation	Done	Copier Gabriel...	
	Write text	Done	Leire Lisón	
	Find suitable sounds	Done	Leire Lisón	
	Edit sounds to accompany text	Done		
	Replan the timing of the sounds	To Do		
11	> Pitch	New		
12	Video	New	Philipp Parteder	
	Record video	Done		
	Add sounds of ice breaker on top of video, make audio st...	Done		

Backlog of Sprint 5

Apart from the Agile methodology, every Monday we had a meeting with our coaches, Hiram Bollaert and Erwin Listhaeghe, who helped us organising the workload and getting the resources we needed.

We also had regular meetings with the client, for giving them updates on the project and asking for suggestions. Although our client was the Immersive Lab, the staff members we had a closer contact with were Lowie Spreit and Jeroen Cluckers. They provided us with feedback on the project, and materials and spaces for carrying out our experiments.

Team

In the previous section we have mentioned that our team is composed of diverse backgrounds.

Bavo Debraekeleer is a Belgian student of Electronics and ICT. Gabriel Copier comes from France and he is an engineering student. Philipp Parteder studies Media Technology in his home country, Austria. The other two members come from Spain: Victor Fernández, an Industrial Design and Product Development Engineering student, and Leire Lisón, a student of Global Digital Humanities.

This diversity has been both very helpful and challenging for developing the project. This will be further explained in an upcoming section.

Taking into account the fields of expertise of each member, these are the roles that were assigned:

Bavo Debraekeleer: Lead Unity Developer. He is the most skilled person with the Unity Programme, so he has been in charge of developing the software.

Philipp Parteder: Media Designer and Unity co-developer. His task was double-fold: creating media content for the project (i.e. promotional videos) and helping Bavo in some tasks with Unity.

Gabriel Copier & Victor Fernández: Physical Platform Developers. Both have an engineering background and they have been in charge of designing and building the physical platform.

Leire Lisón: Scrum Master and Researcher. She has been the group coordinator and she has been in charge of the communications with people outside the team (i.e., coaches, clients, test-users...). She has also created the questionnaires for the tests and the reports.

Client

As it has already been mentioned, our client is the Immersive Lab from AP Hogeschool. Briefly explained:

"The Immersive Lab is a centre of expertise that centralizes all research projects, acquired knowledge and technology around XR technology (extended reality: virtual, augmented and mixed reality) and makes it available to students, researchers, companies and non-profit organizations. Researchers are brought into contact with XR producers, hardware and software developers, investors... but also education, cultural institutions and other interested parties from the region.

The lab focuses on the creation of high-quality content for commercial, educational, cultural and scientific applications by setting up integrated, practice-oriented research, developing tools that manufacturers can use and organizing user tests, workshops, lectures and demonstrations." [3]

The Lab is located in the floor -01 from Ellermanstraat Campus and it has two main rooms where they usually work. There they have plenty of VR equipment and installations: green key studio, photogrammetry, advanced computers, VR headsets (Oculus/Meta, HTC Vive) and cameras (also 360° cameras), but to name a few.



Green Key Studio



Photogrammetry

They are currently working on different projects and ours is part of their wider research project “Environmental Immersion”. The specific aim of this research project is to investigate which factors influence the quality of immersion of nature experiences in VR, so that this can help creating better immersive experiences and “stimulate inclusion: people with physical disabilities, hospitalized people and seniors can still visit places that are inaccessible to them virtually” [5].

At the beginning of the project our clients lend us two Meta Oculus Quest 1 and one Meta Oculus Quest 2 headsets, so that we could get familiar and experiment with the technology on our own.

During the project they have also let us use their spaces for working and doing our user tests. Our principal contacts with the Immersive Lab have been Lowie Spiet and Jeroen Cluckers. We have also had contact with Florian Stigter Van Thillo, an Intern Student who show us his virtual nature environment.

Besides, Laura Herrewijn has helped us with the proper development of the questionnaires for our user tests, so that we could gather data in a scientific way.

All along the process we have had regular meetings with our clients to get their feedback and ask for suggestions. Apart from that, we have been in constant communication through the email.

Process

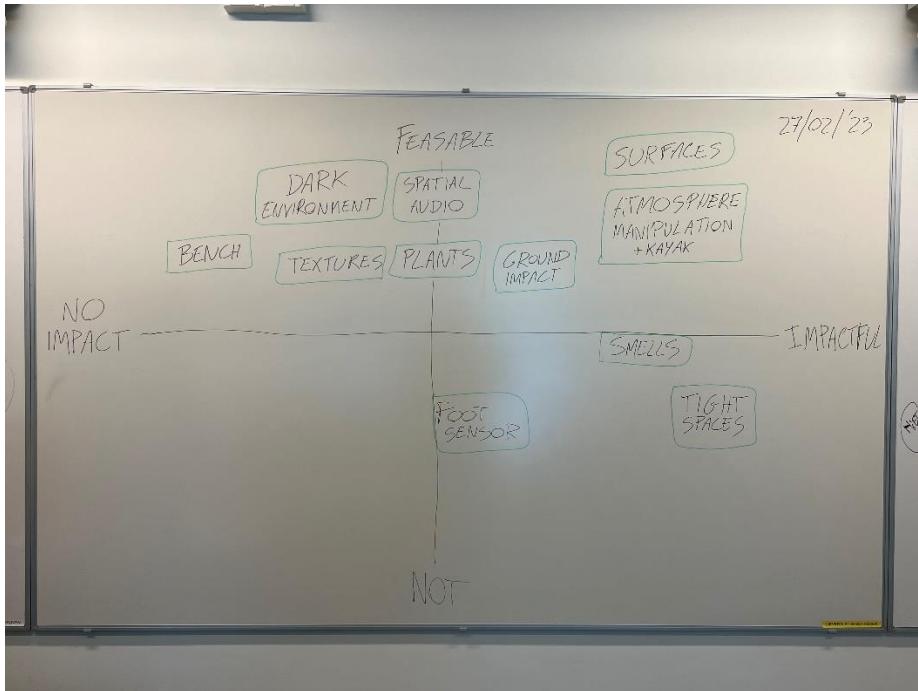
In this section we will explain the process that we have followed during the five months that this project has lasted. We will divide it into different stages, as to make it clearer.

1 Research and Ideation Stage

First of all, in the first two weeks (Sprint 1), we got to know each other and the project. We first met with our coaches and the client, and we spent some time experimenting with the technology, thanks to the VR headsets that the client had given us. We also started researching on the topic of *Environmental Immersion* and thinking of ideas for possible experiments. We did a big brainstorming that resulted in the idea of building a nature environment with three scenes (forest, cliff, beach) and doing different experiments in it including various physical inputs (i.e., wind, surfaces, smell, water...).

We first ranked the experiments depending on their feasibility and effectiveness.

After merging the ideas that were similar and discarding those we didn't really find doable, we made a second sorting of the ideas and made an order that we would eventually follow.



White board with first ideas-ranking

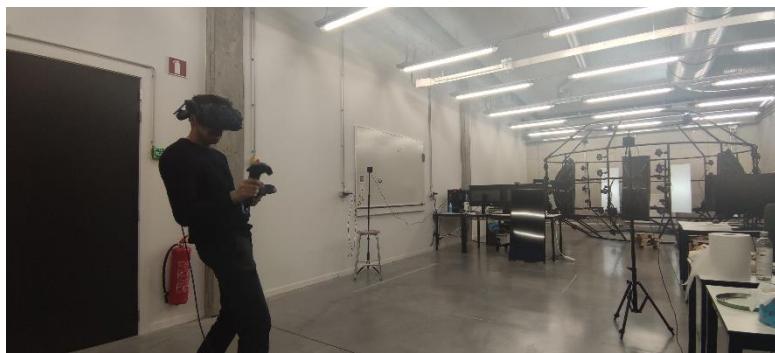
Order of Experiments:
Beach Environment
Atmosphere Manipulation
<ul style="list-style-type: none"> • create Environment with wind and cliffface
Surfaces
<ul style="list-style-type: none"> • add different patches of sediment to the scene
Textures
<ul style="list-style-type: none"> • add touchable treebark, stones, fur/fabric to the scene
Ground Impact
<ul style="list-style-type: none"> • add boulder that falls from the cliff
Forrest Environment
Create Environment with:
<ul style="list-style-type: none"> • Trees & Plants • Day & Night • Spatial Audio • Bench
Incorporate Smells
Foot Sensor

Final sorting of ideas (screenshot from DevOps Wiki)

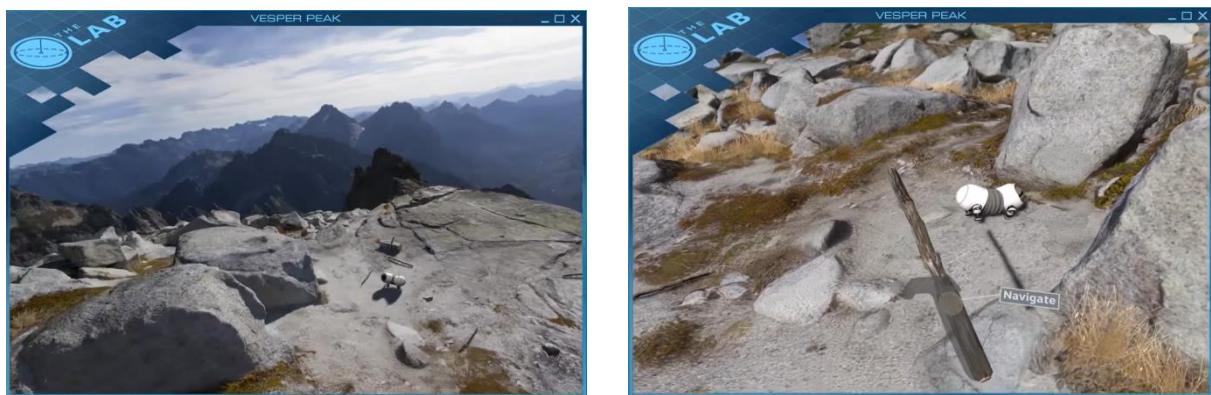
2 First experiment & Midterm Presentation

In the following four weeks (sprint 2 and 3), after we had built a common vision of what we wanted to create (a virtual nature environment and a physical platform), Bavo and Philipp started developing the beach scene in Unity. Gabriel and Victor started looking for ventilators for the first experiment, in which we would test the effect of wind. Leire got in contact with Laura Herrewijn from the Immersive Lab to create the first questionnaires and report.

For the first experiment, we wanted to immerse the user in a beach-like environment and test the effectiveness of the wind (ventilator) in making the user more immerse. Nevertheless, we didn't have enough time to finish the software, so we decided to use a demo experience that came pre-installed in the HTC-Vive headset, called The Lab. This demo, among many other games, recreated a mountain with a robot dog. Therefore, the experiment consisted of the user stepping into a virtual mountain and interacting with the robot dog, while feeling fresh air.



One of the users in our first test



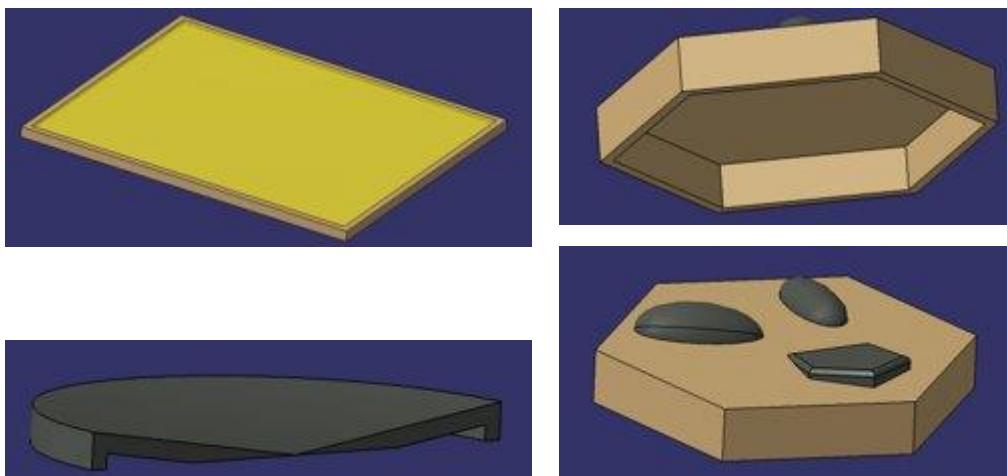
HTC Vice demo "The Lab" (Mountain experience with robot dog)

Meanwhile, we also had some important assignment for the course *Entrepreneurship and Corporate Communication*. As part of this, we had to make a market research of our field, some interviews to people from the VR industry and create our own brand. We will talk further about these assignments and other courses in the next section.

At the end of this stage we already have to make our midterm presentation, in which we had to show to the whole class what we had achieved so far.

3 Prototype Development and Course Assignments

The two following weeks after the Easter Break (sprint 4), we were busy further developing the virtual environment in Unity and making a 3D design of the physical platform, which we eventually presented to the client as a prototype.



3D models of the physical platform items

We also decided that we would introduce a story in our prototype. This means that the user would be guided through the virtual experience using a story. For that purpose, we created a draft of the storyboard, including images generated with AI. See Appendix 1 for the storyboard.

We also had some important assignments for the Entrepreneurship course, such as building our business model, attend an event about VR and network with participants, and create a prototype of a promotional video.

4 Second experiment and personal room

During the next four weeks (sprints 5 and 6) we had the opportunity to do another experiment and get a room for our personal use.

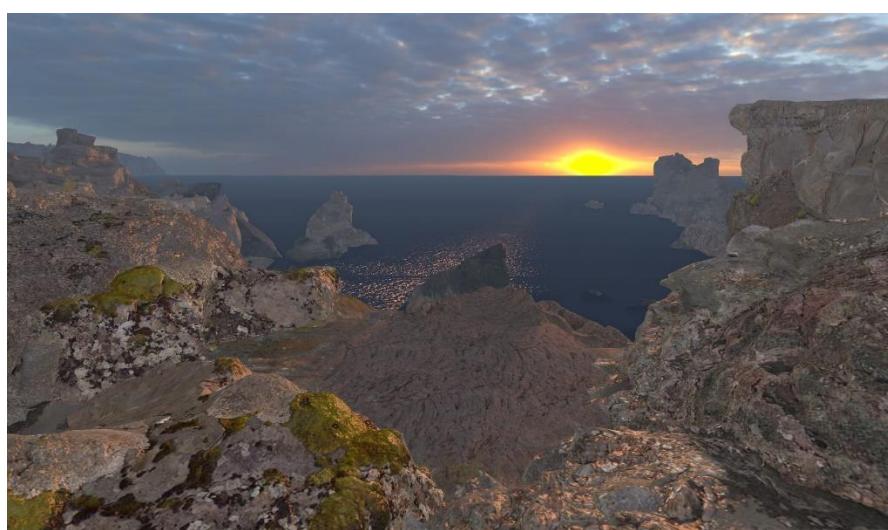
For our second user test we collaborated with the Immersive Lab team from AP University.

On the 3rd of May the Immersive Lab prepared a tour to the Immersive Lab and we thought it was a great opportunity to get some new volunteers for testing our new environment.

This user test differs from the previous one in that we tested the cliff scene with a little physical slope. We also included the big ventilator for simulating wind coming from below. It is worth highlighting that this time we used our own built virtual environment.



Second user-test



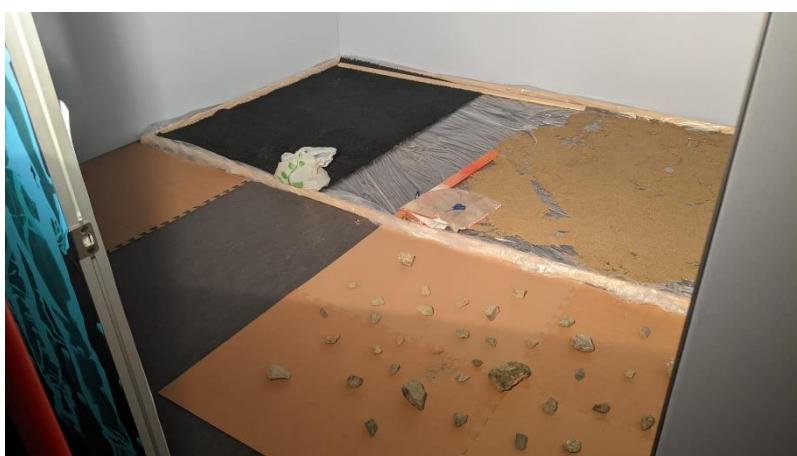
Cliff scene

Apart from that, at this stage of the project we got a room for storing our material and carrying on our experiments in there, instead of using the space of the main Lab. It was room NOO.-01.033, in the basement of the university. Nevertheless, this room had some inconveniences, which we accurately described for an assignment of English course:

Our VR research project consists not only of a virtual world but also includes physical real-world elements. We also need to do user testing at various stages. This requires a whole room-scale setup that takes up quite some space. Our clients, the Immersive Lab, have their own rooms which we can use, but we can't always leave our setup there. So we needed a room just for our project. After a few weeks of asking around we ended up in a basement room which we can use until the 14th of June. The thing is, this room is not empty. Far from it. It's actually a VR Lab of a different department with a whole setup and a bunch of equipment already taking up most of the room. It is a 4x4 metre projection cube setup. Luckily this is about the size we want to work with, so we have our own setup within the cube. This is far from ideal, but it's the only room where we can leave everything without being interrupted by classes taking place. Oh and also, there are no lights. Or rather, there is a ceiling light, but there is no light switch. There also aren't any windows because it's the basement. The only light sources available are a construction site lamp pointed at the ceiling and an automated light in a storage room in the back. We could also potentially use the four projectors in the cube setup, but we still have to figure out if and how we can use those.

After we had already set up our physical platform, we were told that we could no longer use this room and so we had to ask for help to the Immersive Lab, who they eventually let us use their facilities.

Regarding other courses, we had to deliver a video of us pitching our project and a first draft of our final promotional video for the Entrepreneurship course.



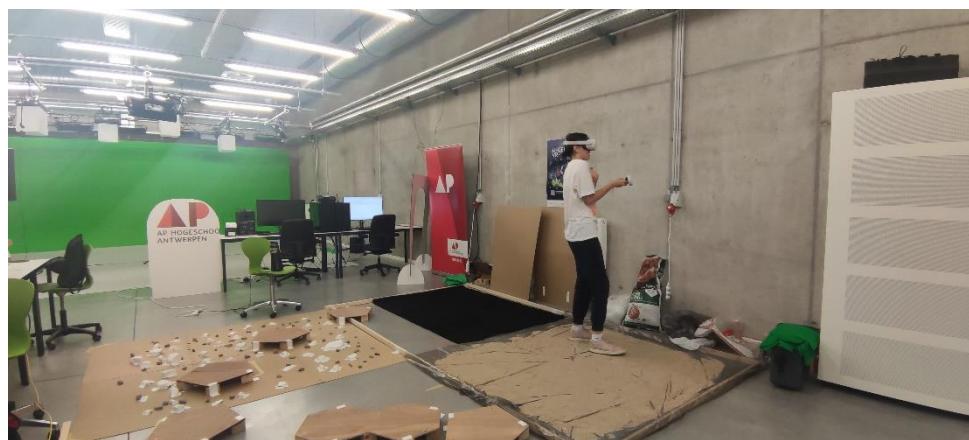
First physical set-up

5 Last experiments and final presentation

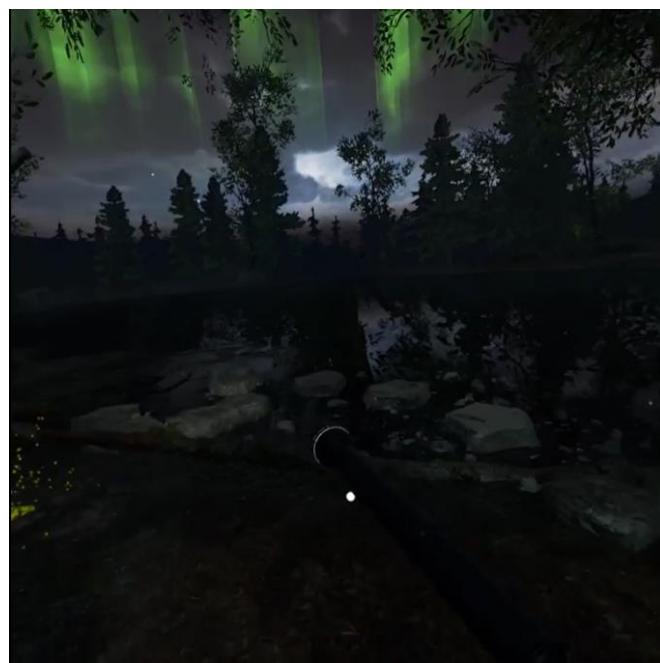
The last two weeks (sprint 7) comprises two experiments, the writing of the final report and the showcase of the final presentation.

This time, we displayed our physical set-up in the Immersive Lab, where we also carried out our third and fourth experiments.

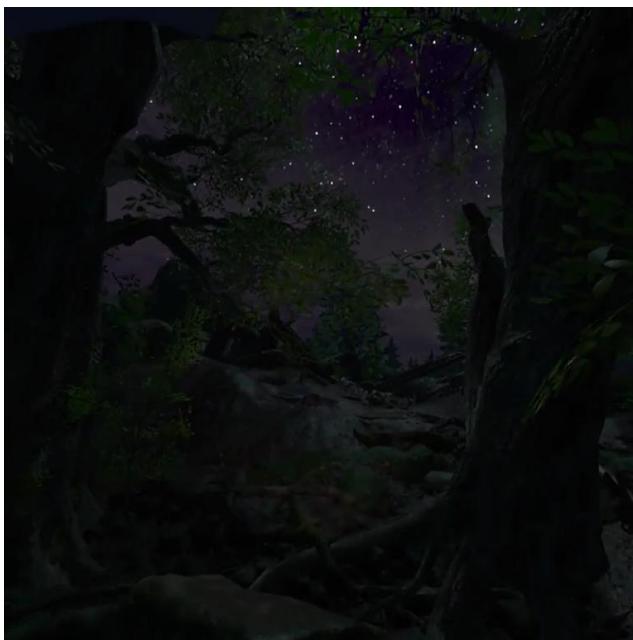
The third experiment was on the 5th of June and we tested our own forest environment, with different surfaces and wind.



Third user-test

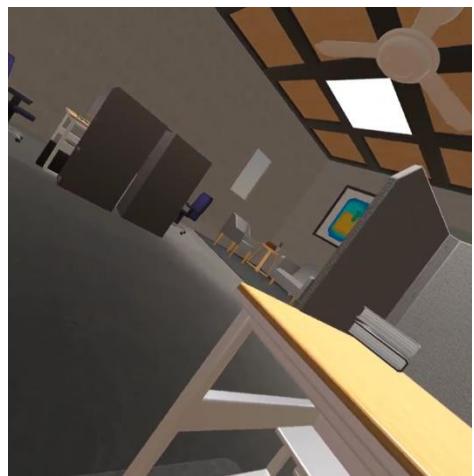


Forest environment with rocks, flashlight and umbrella



Forest environment with rocks, flashlight, umbrella and guiding lights

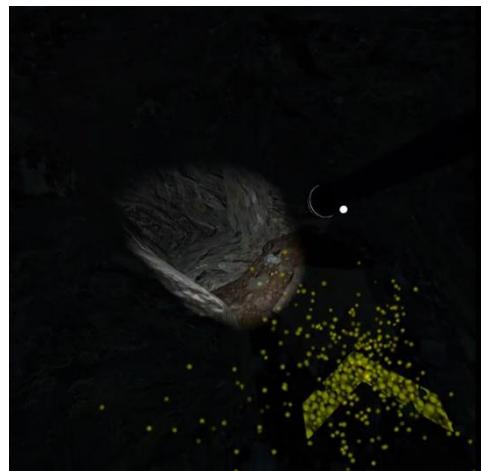
As for the fourth and last experiment, it was on the 13th of June and we got to test all of the scenes and the fully built physical set-up.



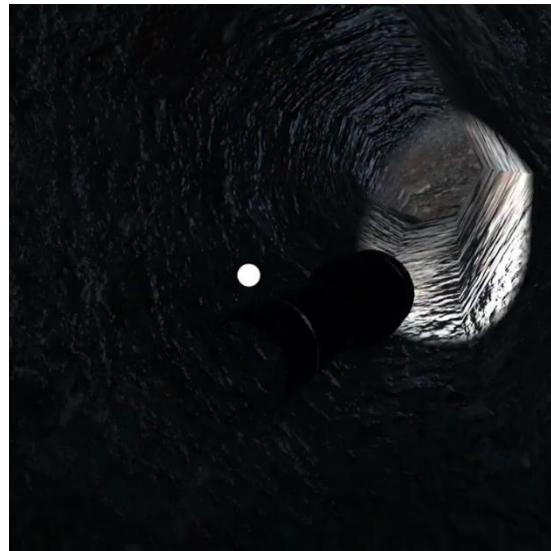
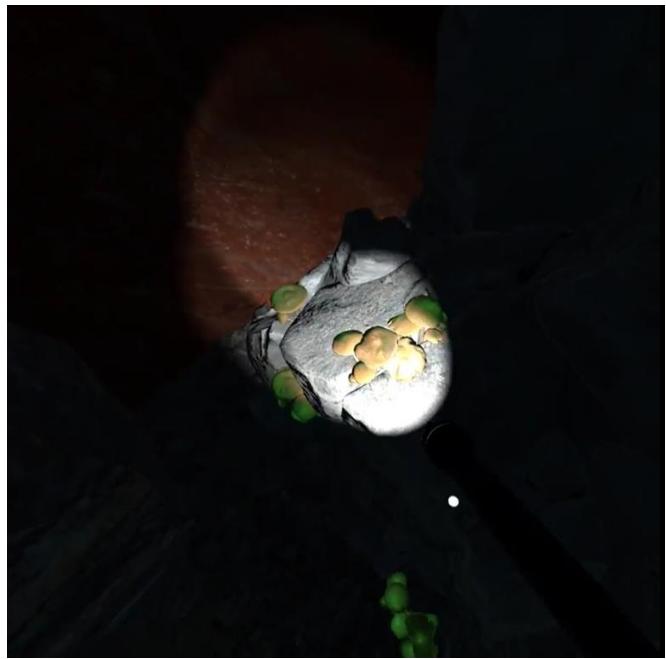
Office scene



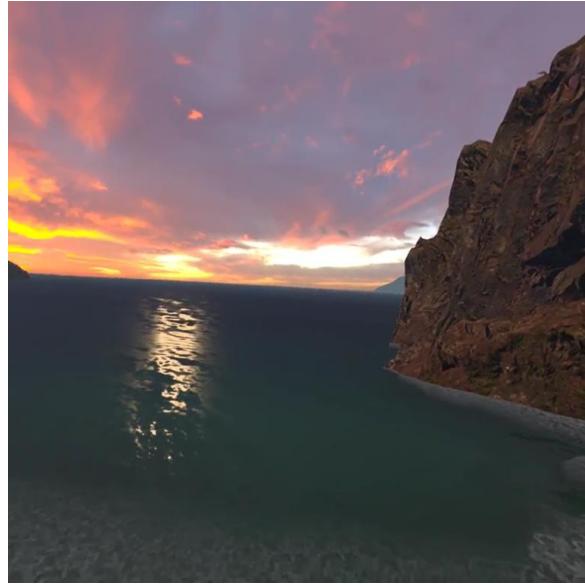
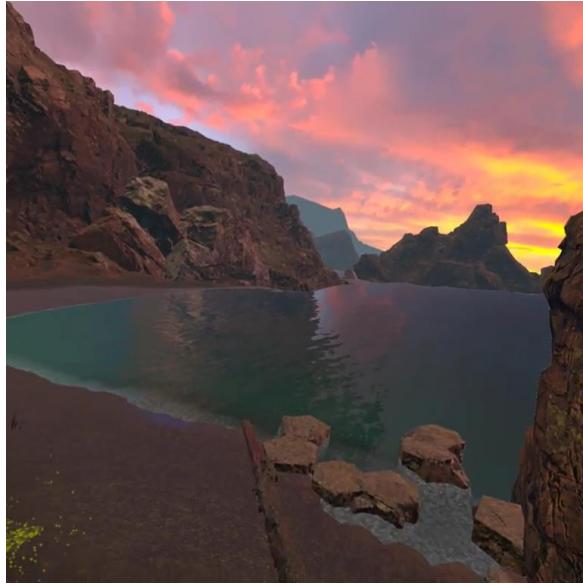
Forest scene



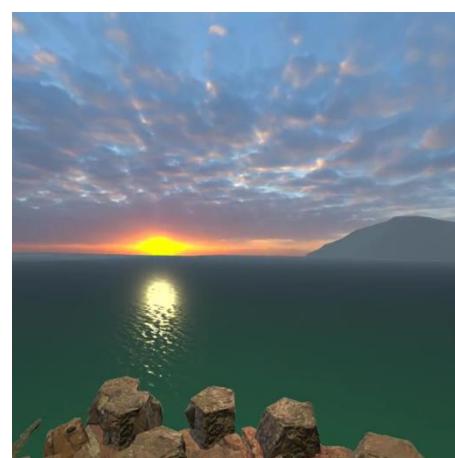
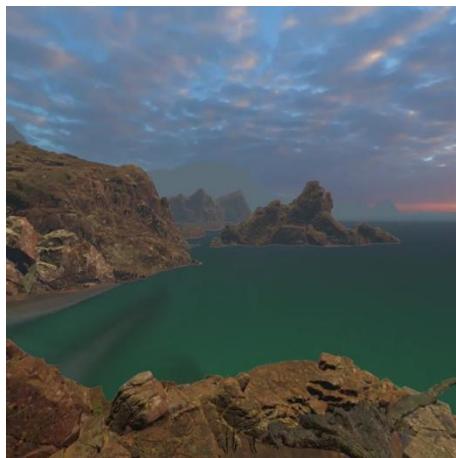
Cave scene, entrance



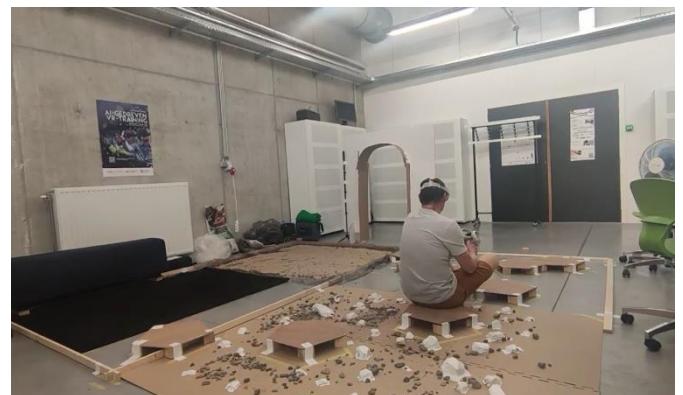
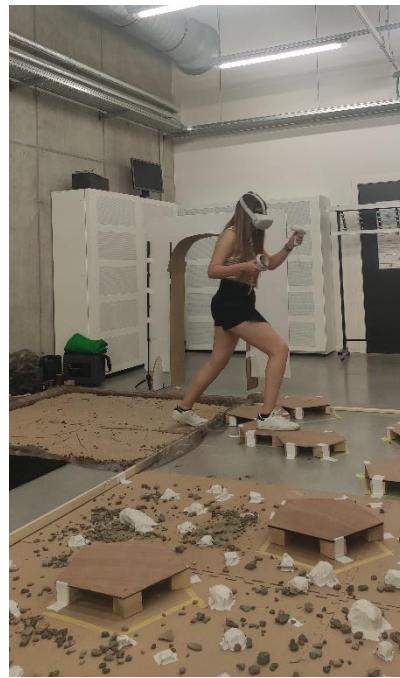
Cave scene



Beach scene



Cliff scene



Fourth user-test

Extra Courses

In this section we will explain how other courses have complemented our project.

As part of the EPS Programme we had to take three more courses, that are designed to help us develop our projects and also engage with other students. These courses are: Cross-Cultural Exploration, English Language and Presentation Skills, and Entrepreneurship and Corporate Communication.

1 Cross-Cultural Exploration

The aim of this course is to create various projects related to the interculturality of the class. The students built four projects: cooking group, cinema group, Mozilla Hubs group and selfie trip group. They all have to create three events connected to the topic

of their group and that it would also include some intercultural elements. For example, the cooking group made themed cooking-nights (i.e., Mexican, Italian and Greek food).

This course was an opportunity for us to build new relationships with the other students and get to know more about their culture.

Teacher: Hiram Bollaert.

2 English Language and Presentation Skills

In this course we reviewed some core concepts of English grammar and of how to make a good presentation.

It was thanks to this course that we created our first ice breaker and pitching video, which eventually will help us prepare a more engaging final presentation.

Teachers: Edward Vanhoutte, Nathalie De Schepper, Yasmine Pathijn and Laetitia Da Costa.

3 Entrepreneurship and Corporate Communication

In this course we had lectures about various topics. First of all, we had some classes about entrepreneurship and business management with Nathalie De Schepper. She taught us the fundamentals of entrepreneurship and gave us some important assignments, such as, making market research, interviewing referent people, building our own business model and networking with other people in the sector. We also had to build our own brand and for that purpose Lina Delafortry gave us some lectures on Cross Media. This same lecturer gave us audio-visual communication classes.

This course was, perhaps, the one that most helped our project, because many assignments were valuable for presenting our results (i.e., the promotional video) and meeting new people in the sector (i.e., the interviews and the networking event). However, since ours was a research project, the assignments around building a business model didn't suit us, because our aim was not to make any profit out of our results; it consisted just in doing experiments.

Teachers: Nathalie De Schepper and Lina Delafortry.

Strengths and challenges of the team

After the whole process, we can say that we have learned a lot as a team. There have been many upside-downs and challenges, and we have had to put a great effort in making the project to work.

During the programme, we have had two self- and team-evaluations, which have helped us reflect on how we were doing as a team. Here are the conclusions we draw from them.

1 Strengths

- Having different study backgrounds has helped us assign specific roles and this has made us more efficient when operating certain tasks.
- We had a skilled Unity developer, what made it a lot easier to develop the virtual environment.
- We had a member who was professional at making videos, and this was helpful for completing assignments and making the results of our research more visual.
- We had two members who knew how to build a 3D model of the physical platform and then find the most effective and cheapest way to bring it into reality.
- We had a humanities student who was very good at organising the teams work, communicating with stakeholders and making reports for both the clients and class-assignments.
- Once each member got a specific task to do, we were very efficient in working independently and then coming together to comment on results.
- We had a very good communication with the coaches and clients.

2 Challenges

- It was hard to get all the members to participate actively in the project, what made it more difficult to create a working environment and advance smoothly.
- At first it was difficult to assign a task to all members, because it was mostly the software part that needed to be developed.
- We really never had a specific location in which to leave our materials and carry out the experiments. Although we did have our own room for a short period of time, this was not the most appropriate place for us to work and we were eventually banned from entering it.
- Not all members of the group attended all the courses.
- Regarding the international composition of the team, it was sometimes hard for some members to express their ideas because they didn't have the same level of English as the rest.

Project Results

In this section we will present the results of the user-testing we carried out during the whole process.

In total, we did 4 user-tests, where we immersed the volunteers in a VR environment and measured how physical inputs impacted their immersion.

First User-Test: 16th of March, 2023

In our first user-test we wanted to try some of our own environments, but this was not possible, due to the amount of time needed for building it. Therefore, we used a pre-installed demo experience of a mountain landscape with a robot dog. The headset we used for the experiment was the HTC VIVE and the aim of the experiment was double-fold:

- To know the extent to which test-users are familiar with VR and see how this affects their immersion experience.
- To test the implementation of wind in a VR environment and see how this affects their immersion experience.

It was also our very first user-test, so we wanted to measure our ability as a team to set-up such a experiment and learn for the next ones.

First of all, we set out to look for volunteers to test our VR experience. Our team created a Google-Forms asking for the name and email of the person. This was sent via WhatsApp and Teams to all the students and staff members from the EPS programme.

The day of the experiment we went to the Immersive Lab and set up the VR equipment. Beforehand, we had sent a Google Sheet document to all the people who signed up for the experience, so that they could choose the time it best suited them to come.

For each user, we followed these steps:

1 Explanation of the experiment:

Once the volunteers were in the Immersive Lab, we explained the specifications and conditions of the experiment.

2 First Test, Personal Information and Previous Experience with VR:

We gave them the first survey (see Appendix 2), where some more personal and specific data was asked to know in which field each of the volunteers is studying or working, as well as their experience or knowledge of VR.

3 First Experience:

They then went on the first experience, where the users were immersed in a mountain-like environment, with some sticks and a robot-dog to play around. There was no external physical input.

4 Second Test, Virtual Experience without physical stimulus:

They were given the second test (see Appendix 2), where the user had to fill in some questions to tell his sensations in the first experiment.

5 Second Experience:

The user was immersed in the previous environment, but this time the user experienced wind (generated by a ventilator) and the touch of the robot-dog (with a stick with some fur attached to it). This second input was only tested with one user, so it is not taken into account in the results.

6 Third Test, Virtual Experience with physical stimulus:

In this survey (see Appendix 2) the user had to fill in some questions to tell his sensations in the second experiment.

7 Fourth Test, Experiment Feedback:

Finally, the user had to give feedback about the overall experience as a volunteer in our project (see Appendix 2).

8 Gift:

For thanking the users their participation, they were given a home-made chocolate cookie.

The description of the results that we obtained from the questionnaires can be found in the Appendix 3.

These are the conclusions we draw from the first user test:

- VR was known among the users.
- The experience was too short in time to make the user feel really immersed.

- The experience should include more interaction with the environment, for example: a storyline. Some of the users were very fast in discovering the environment and got bored easily.
- The ventilators were not successful enough in making the user feel more immersed; more and more intense stimulus should be included.
- Working with the controllers was not difficult, but the wire of the headset did disturb the users.
- The sound was very effective.
- The overall set up and organisation of the experiment was correct according to the users.

Second User-Test: 3rd of May, 2023

For our second user test we collaborated with the Immersive Lab team from AP University. Every year the University organises Studium Generale [9]. It is a lecture series that revolve around a central, socially relevant theme. They invite ten speakers to share their personal experiences, findings, reflections and ideas for the future with the audience. With this lecture series AP University encourages participants to reflect on current issues. Interdisciplinarity and social relevance are key in this **respect**. The Studium Generale lectures are open to all those interested and are held in Dutch or English. Each lecture is followed by a short debate with the audience.

On the 3rd of May the Immersive Lab prepared a tour to the Immersive Lab within this initiative and we thought it was a great opportunity to get some new volunteers for testing our new environment.

The headset we used for the experiment was the Oculus Quest 2 and we used our own virtual environment, designed by Bavo Debraekeler. This user test differs from the previous one in that we tested our own cliff scene with a little physical slope.

For an overview of the technical processes and tools used in the building of our own environments, from AI to VR, Bavo wrote a separate technical report you can find in Appendix 4.

The aim of this experiment was double-fold:

- To know the extent to which test-users are familiar with VR and see how this affects their immersion experience.
- To test the implementation of wind and a slope in a VR environment and see how this affects their immersion experience.

The day of the second user-test, the users were divided into two groups and each one entered the experiment room separately.

First of all, we explained them what our project was about. They then tested our VR experience one by one after some indications on how to use the headset. At the end of the experience, the users had to fill in three questionnaires: one with their personal details and their previous experience with VR, another one about the VR experiment itself and, finally, a feedback formular (see Appendix 5).

The description of the results that we obtained from the questionnaires can be found in Appendix 6.

These are the conclusions we draw from the second user test:

- There was diversity among the users: different age-groups, gender, studies, work-field...
- Virtual Reality was known to all of them and most had previous experience with it.
- The slope platform should be rocky/bumpy, so that it matches what the user sees in the virtual world.
- The immersion breaks a bit when the user looks down and sees no feet.
- The wind was in the correct position and added up to the experience.
- The sound should be louder.
- The users asked for smells.
- There should be only one questionnaire, because the users got bored of so many questions.
- Having more computers for doing the questionnaires would have also been helpful. There were just two and people ended up in a queue for filling out the questionnaires.
- The keyboard of the computer was an issue, because most of the users were from Belgium, but the keyboard was from Spain and it didn't feel as comfortable for them to use (because the keys are not in the same place).
- The language of the interface should better be in English, because until now it has been in Basque at it created some confusion among the users, who none understood Basque.

Third User-Test: 5th of June, 2023

In the third user-test we got to test our physical platform, built by Victor Fernández and Gabriel Copier, and our own forest environment, designed by Bavo Debraekeler. The headset we used for the experience was the Oculus Quest 2.

This experience differs from the previous one in that we used a completely different scene and we recreated different surfaces, along with wind. The surfaces consist of a grass-like carpet, tiles that represent flat rocks and sand.

The aim of this experiment was to test the implementation of different surfaces and see how this affects their immersion experience.

For the software of the experience, Bavo continued using the tools described in the previous section. Regarding the physical part, we used various materials.

	Material	Size	Amount	Use	Source	Price
1	Wooden sticks	210cm	6	Delimiting the surface	Brico store	34.99€
2	Plastic	4x5m	1	Putting the sand on it	Brico store	2.79€
3	Sandpaper	115x5cm	1 roll	Refining the wooden sticks	Brico store	19.49€
4	Cardboard	72x101cm	6	Putting the rocks on it	AP Makerspace	0€
5	Rocks			Simulate rocky surface	Street	0€
6	Wooden tiles	<ul style="list-style-type: none"> - Equal sided pentagon (30cm/side, 7cm height) - Equal sided hexagon (22cm/side, 7cm height) 	6 4	Simulate flat pentagons, rocks hexagons	AP Immersive Lab	0€
7	Sand	25kg	1 bag	Simulate beach sand and ground soil	AP Makerspace	0€
8	Clay pellets	40 L	1 bag	Simulate rocky surface	Erwin Listhaeghe	0€
9	Bench-like sofa	140x34x50cm	1	Simulate bench	AP Hogeschool	0€

10	Ventilator	1	Simulate wind	Erwin Listhaeghe	0€
11	Humidifier with scents	1	Simulate nature scents	Bavo Debraekeler	0€
12	Plastic bags 135x88cm	3	Carrying the sand and also for spreading the sand on it (because the plastic we bought broke)	AP Hogeschool	0€
13	Carpet 195X135cm	1	Simulate grass	Bavo Debraekeler	0€

The Immersive Lab staff told us that they could grant us 100€ from their budget for us to buy the materials. In total, we spent 57.27€. See Appendix 7 for the pictures of the materials.

Regarding the user-test, first of all, we set out to look for volunteers to test our VR experience. Our team created an Excell sheet for people to select their preferred time-slot, between 10:00-13:30, to come to the Immersive Lab and try out our VR experience. This was sent via WhatsApp to all the EPS students and other AP international students. In total, 5 people signed up.

We also created a quick guide for people to know how to arrive at the Immersive Lab, because for most of the students it is an unknown place (see Appendix 8).

The day of the experiment we went to the Immersive Lab and set up the VR equipment and physical surfaces.

For each user, we followed these steps:

1 Explanation of the experiment

Once the volunteers were in the Immersive Lab, we explained the specifications and conditions of the experiment.

2 Virtual Experience

Then, the users were immersed in a rainy forest-like environment, with different surfaces on which to step. These were: grass, sand and flat rocks.

3 Questionnaire

After the experience, each user would fill out a questionnaire that gathered data about their profile and the experience, and feedback for the research-team (see Appendix 9).

4 Gift

Finally, for thanking the users their participation, they were given a home-made chocolate cookie.

The description of the results that we obtained from the questionnaire can be found in the Appendix 10.

These are the conclusions we draw from the third user test:

- It was the first time that one person didn't know what VR was.
- Many students had experience with VR thanks to our user-testing, so we are contributing to getting people familiar with this technology.
- The visuals were realistic and people felt safe using our physical platform.
- Not everyone understood that they had to follow the lights, so more guidance will be needed for the next user-test.
- The majority didn't feel disturbed by the fact that they couldn't see their feet in VR, so this may not have affected their experience too much.
- The wind was not strong enough.
- Nearly half of the users kind of forgot that they were in a laboratory and most of them, at some point, did feel quite like if they were in a real forest. Most of the users didn't consider taking their headset off and also half of the volunteers had a stronger feeling of being in the virtual world than in the real one. This proves that there was high immersion in this experience.
- Half of the users felt they could fall into the lake and three quarters of them actually wanted to step into it. There were also suggestions to add water to the experience. Therefore, it is apparent that adding water would significantly heighten the immersion.
- There were some suggestions to change the umbrella for another thing, such as a stick.

- The feedback shows that the team performed well and that it was a positive experience for the users.
- There were three people asking for more questions, whereas just two wanted less and three felt indifferent about it. Maybe we should consider adding more questions that measure other aspects of the immersion or new physical inputs that we may add in future user-tests.

Fourth User-Test: 13th of June, 2023

The fourth and last user test merged all the scenes we had developed: office, rainy forest, cave, cliff and beach with sunrise. Philipp created the office scene and Bavo the rest. There were also various physical inputs: different grounds (grass, sand, rock, tiles), wind (with a ventilator), a bench and smell (although this one was not very notorious, so we didn't take it into account in our results).

The headset we used for this experience is the Meta Oculus Quest 2.

The aim of this experiment was:

- To test all the scenarios merged
- To test the implementation of different physical stimulus and see how this affects the user's immersion experience.

First of all, we set out to look for volunteers to test our VR experience. Our team created a Google Forms for people to select their preferred time-slot, between 12:00-16:00, to come to the Immersive Lab and try out our VR experience (see Appendix 11). This was sent via WhatsApp to all the EPS students and other AP international students. In total, 3 people signed up, but in the end, 10 turned up to our experiment.

We also created a quick guide for people to know how to arrive at the Immersive Lab, because for most of the students it is an unknown place (see Appendix 8).

The day of the experiment we went to the Immersive Lab and set up the VR equipment and physical surfaces.

For each user, we followed the following steps.

1 Explanation of the experiment

Once the volunteers were in the Immersive Lab, we explained the specifications and conditions of the experiment. The users entered the Immersive Lab with the eyes closed, so that they wouldn't see the set-up.

2 Virtual Experience

Then, the users were immersed in an office-like environment, where the experience began. They were then teleported to other locations: a rainy forest, a cave, a cliff and a beach.

3 Questionnaire

After the experience, each user would fill out a questionnaire that gathered data about their profile and the VR experience (see Appendix 12).

4 Gift

Finally, for thanking the users their participation, they were given a home-made chocolate cookie.

The description of the results that we obtained from the questionnaire can be found in the Appendix 13.

These are the conclusions we draw from the third user test:

- Only 3 people signed up, but in the end 10 came. This is because students told to other students that they have liked our VR experience. This shows that the best way of getting our project known is people to talk about it to other people.
- Nobody had any problem with being recorded.
- Men and women took part in equal amount in the user-test.
- It was the first time we had a lecturer testing our environment.
- Our user-tests have been the only VR experience of some users.
- It was the first time someone stated having used VR for class; it was Anatomy class.
- Although this time we used all the physical assets at the same time, most of the users felt safe, because what they were seeing accurately matched what they were physically feeling.
- The light-arrows were a good guidance for users to navigate the environment.
- The flashlight was very useful and immersive

- Some people noticed smells, although this was not very strong.
- A big tree trunk and more tree branches hanging would have been a good add-on.
- We tried to create some physical walls for the cave, but couldn't. Nevertheless, some users did actually feel these walls were necessary.
- The users felt relieved when they arrived at the sunrise, after they had passed through the dark cave. This shows that the effect of darkness plays a great role in the immersion of the user.
- Also, the fear of falling in the cave-hall was also very immersive.
- Users keep asking for water.

Conclusions and Recommendations

In this section we will write the general conclusions we draw from the results previously shown. Besides, we will also give some ideas for further research.

General Conclusions

The conclusions we have listed are with regards to the building of the VR experience.

- The experience should be long and guided. The users go through the experience very fast and can get bored easily if they don't know what to do. In our case, we guided the user with lights in the scene.
- The wind helps in the immersion, but you also need wind-animation in the scene.
- If you have physical platform with changing heights, it needs to be fixed and stable.
- Some people missed seeing their feet when stepping on physical platforms, but most didn't really mind.
- If there is water in the scene, there will be users that would like to touch it and feel it. Nevertheless, we wouldn't recommend it, because the disadvantages of setting it up are greater than the advantages
- Different surfaces were really convincing; even a simple carpet was immersive. It is better when they are uneven, with some irregularities, such as rocks.
- If there is any change of level in the ground (i.e. tiles or rocks to step on), there can be safety hazards when it's higher than 2cm. It all needs to match with the virtual environment, otherwise it can be risky for the user.
- There are people who are not stopped by the boundaries of the environment. If they can still see above objects, they will try to go to the other side. The sight of the user should be blocked above eye level if they are not supposed to cross a boundary. Any safety-hazard must be represented in the virtual environment.
- It was very immersive to have a dark environment where you needed to point a flashlight to see more clearly, but it would probably be best to leave the other hand free, so that the user can also touch physical things. Nevertheless, it was also good that they couldn't touch with the hands, just in case what they touched didn't match their expectations and the immersion broke.

- The physical boundaries we now have don't really add to the immersion, but is mainly to make set-up easier and keep the sand inside the boundaries. However, it should be a bit lower, to avoid the user from tripping.
- When teleporting to a different location or loading a new scene there should be a fade to black and then a fade in again, to help people against getting nauseous.
- It could have been useful to include teleportation in the office scene, so that navigation was already clear to the user before they enter the nature environments.
- Some users missed the opportunity to move backwards in the environment, because we only added the option of moving forwards.

Recommendations for Further Research

We have thought of some ideas that either our clients or future EPS students can carry out in an experiment.

- An idea would be to test how big an object must be for the user not to try to cross it.
- It would be a good idea to give users a layout of the different locations before the experience starts, to test whether this helps users navigating the environment and realize it's a connected whole. Also, they could test whether it is useful to show people where do they come from in each scene, or it is better to create closed-up locations, so that they don't go the wrong way.
- Test different height platforms. For example, increase the height of each platform so the user gradually goes up and down. In our case, we only had two height levels.
- Research on how to add smells effectively in the experience. Many of our users asked for it in the feedback forms.

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Appendices

In this section we present the following appendices.

Appendix 1: Nature Realms Story

Appendix 2: First User-Test Questionnaires

Appendix 3: First User-Test Results

Appendix 4: Technical Project Report

Appendix 5: Second User-Test Questionnaires

Appendix 6: Second User-Test Results

Appendix 7: Physical Set-Up Materials

Appendix 8: Immersive Lab Quick Guide

Appendix 9: Third User-Test Questionnaire

Appendix 10: Third User-Test Results

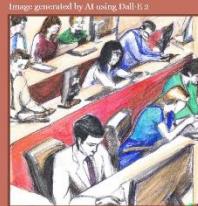
Appendix 11: VR User-Test Sign Up

Appendix 12: Fourth User-Test Questionnaire

Appendix 13: Fourth User-Test Results

Appendix 1: Nature Realms Story

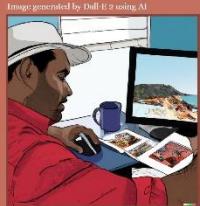
NATURE REALMS STORY -



SCENE 1

A busy office with workers behind their computers.
The workers don't look very enthusiastic about what they are doing and they seem stressed.

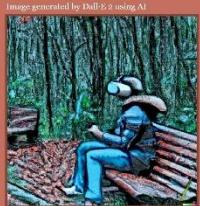
(This could be a 360° video)



SCENE 2

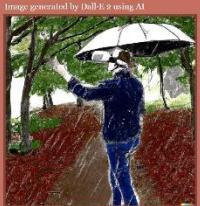
One of the workers starts looking at the pictures of his last trip to an exotic landscape.

(The worker is the user itself and is looking at some pictures on a table. These pictures can be screenshots from the created VR environment.)



SCENE 3

The user has to interact with the pictures (take one or look at one that is shining) in order the experience to begin.
The user teleports itself to a rainforest, where she/he is sitting on a bench.



SCENE 4

It starts raining a bit and the user has to take an umbrella that is nearby. For that, the user has to stand up and move towards the umbrella. The user has to open the umbrella and starts to rain (just sound and image).



SCENE 5

The user will start walking guided by some light ahead (glowwings).

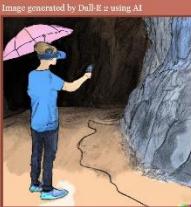
The user is sitting down with the headset on. There is no other physical stimulus than the touch of the chair/bench the user is on.

The user is sitting down with the headset on. There is no other physical stimulus than the touch of the chair/bench the user is on.

The user is sitting down with the headset on. There is no other physical stimulus than the touch of the chair/bench the user is on.

The user is sitting down with the headset on. A bit of water starts pouring over its head (not a lot, just some drops, enough for the user to feel the water and realize its starting to rain).
An umbrella will be laying down a couple of steps ahead (this needs to be tracked also in VR).

The user will experience grass and soil under its feet.



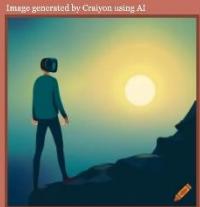
SCENE 6

The user arrives at a cave. In one corner there is a flashlight. The user has to leave the umbrella and pick up the flashlight to enter the cave. The lights are still guiding the user.



SCENE 7

The user goes through the cave following the lights and using the flashlight.



SCENE 8

The user reaches the end of the cave and appears on top of a cliff. The user sees the sun that's starting to set and feels the wind blowing.

The user has to leave the flashlight to continue its journey (?).



SCENE 9

The user arrives at a beach and sees the sunset.



SCENE 10

End of the experience.

The user has to find the flashlight (it can be shining, so as to catch the attention of the user). The flashlight needs to be tracked in VR too.

The user experiences the rocky ground and hard walls around.

The user experiences a rocky platform and wind (from fans).

The user experiences both rocky and sandy platforms. A bit of wind also comes from the seaside.

The image fades away until it turns black.

Appendix 2: First User-Test Questionnaires

1st Questionnaire

Personal Information and Previous Experience with VR

First User Testing of Nature Realms

by Team Hyper

16th of March 2023. AP Immersive Lab

First of all, thank you very much for participating in our experiment. You are playing a fundamental role in our research process and we hope you enjoy this experience!

To get started, please fill out the following questionnaire.

We won't share your information with anyone outside the project-team and it will only be used for research-purposes.

If you would like more information regarding the collection and processing of data, you can have a look at the [Privacy Statement for Research at AP University](#).

Full Name

.....

Age

.....

Gender (if you don't feel comfortable disclosing your gender, skip this question)

.....

Country of origin

.....

Are you a student? Yes No

If yes, what is your field of study?

.....

If not, what is your profession? (If you are unemployed, please disclose it as well)

.....

Do you know what Virtual Reality (VR) is?

Yes No

Have you already had VR-Experiences before?

Yes No

If yes, please, tell us a little bit about your prior experience with VR.

Was it a game?

An immersive experience like a roller coaster?

a 360° video?

please specify the approximate duration, how many times you have experienced VR, etc ...

.....
.....
.....
.....

Choose the option that best describes your experience

- It was a positive experience
- It was a neutral experience
- It was a negative experience

Why? Explain your previous choice

.....
.....
.....

Do you have a VR headset at home? (Google Cardboard or similar devices also count)

Yes No

If yes, please specify the model:

.....

2nd Questionnaire

Virtual Experience without Physical Stimulus

First User Testing of Nature Realms

by Team Hyper

16th of March 2023. AP Immersive Lab

Please answer the following questions regarding how you felt during the mountain experience.

We won't share your information with anyone outside the project-team and it will only be used for research-purposes.

If you would like more information regarding the collection and processing of data, you can have a look at the [Privacy Statement for Research at AP University](#).

- ### **1. To what extent did the virtual environment look like a mountain?**

Not at all 1 2 3 4 5 Very much so

- ## **2. Did the visuals make you feel more immersed in the environment?**

Not at all 1 2 3 4 5 Very much so

- ### **3. To what extent did you forget that you were in a laboratory?**

I totally forgot about it 1 2 3 4 5 I was totally aware that I was in
the laboratory

- #### **4. To what extent did you feel you were actually standing on a mountain?**

I never felt like 1 2 3 4 5 I completely believed I
I was on a mountain was on a mountain

- ## **5. How difficult was it to move around the place?**

Not difficult at all 1 2 3 4 5 Very difficult

- #### **6. Did this made you feel more immersed in the environment?**

Not at all 1 2 3 4 5 Very much so

- ## **7. How intuitive was it to interact with the robot-dog?**

Not intuitive at all 1 2 3 4 5 Very intuitive

- #### **8. Did the robot-dog make you feel more immersed in the environment?**

Not at all 1 2 3 4 5 Very much so

9. Did you feel any physical stimulus (any sound, smell, touch-sensation...)? If yes, please, describe it below

.....
.....

Did this make you feel more immersed in the virtual environment?

Not at all 1 2 3 4 5 A lot

10. Did you ever feel like taking the headset off to see what was happening in the real world?

Yes

No

11. To what extent did you feel as though you were separated from your real-world environment?

Not at all 1 2 3 4 5 Very much so

12. To what extent was your sense of being in the environment stronger than your sense of being in the real world?

Not at all 1 2 3 4 5 Very much so

13. To what extent did you notice events taking place around you?

Not at all 1 2 3 4 5 Very much so

14. At any point did you find yourself become so involved that you were unaware you were even using controls?

Not at all 1 2 3 4 5 Very much so

15. When interrupted, were you disappointed that the experience was over?

Definitely not 1 2 3 4 5 Definitely yes

16. Would you like to have the experience again?

Definitely not 1 2 3 4 5 Definitely yes

3rd Questionnaire

Virtual Experience with Physical Stimulus

First User Testing of Nature Realms

by Team Hyper

16th of March 2023. AP Immersive Lab

Please answer the following questions regarding how you felt during the mountain experience.

We won't share your information with anyone outside the project-team and it will only be used for research-purposes.

If you would like more information regarding the collection and processing of data, you can have a look at the [Privacy Statement for Research at AP University.](#)

1. To what extent did the virtual environment look like a mountain?

Not at all 1 2 3 4 5 Very much so

2. Did the visuals make you feel more immersed in the environment?

Not at all 1 2 3 4 5 Very much so

3. To what extent did you forget that you were in a laboratory?

I totally forgot about it 1 2 3 4 5 I was totally aware that I was in the laboratory

4. To what extent did you feel you were actually standing on a mountain?

I never felt like 1 2 3 4 5 I completely believed I was on a mountain

5. How difficult was it to move around the place?

Not difficult at all 1 2 3 4 5 Very difficult

6. Did this made you feel more immersed in the environment?

Not at all 1 2 3 4 5 Very much so

7. Did you feel any physical stimulus?

Yes

No

Did the physical stimulation match what you were seeing?

Not at all 1 2 3 4 5 It was very accurate

8. Did you feel the physical input as something external that was not part of the virtual experience?

No, it was totally 1 2 3 4 5 Yes, it felt artificial and didn't match the experience
related to the experience

9. Did this input help you feel more immersed in the virtual environment?

Not at all 1 2 3 4 5 Very much so

10. To what extent did it distract you from the virtual environment?

Not at all 1 2 3 4 5 Very much so

11. To what extent did you feel it as something you would experience in a real mountain?

Not at all 1 2 3 4 5 Very much so

12. Did you ever feel like taking the headset off to see what was happening in the real world?

Yes

No

17. To what extent did you feel as though you were separated from your real-world environment?

Not at all 1 2 3 4 5 Very much so

18. To what extent was your sense of being in the environment stronger than your sense of being in the real world?

Not at all 1 2 3 4 5 Very much so

19. To what extent did you notice events taking place around you?

Not at all 1 2 3 4 5 Very much so

20. At any point did you find yourself become so involved that you were unaware you were even using controls?

Not at all 1 2 3 4 5 Very much so

21. When interrupted, were you disappointed that the experience was over?

Definitely not 1 2 3 4 5 Definitely yes

22. Would you like to have the experience again?

Definitely not 1 2 3 4 5 Definitely yes

23. Would you change the perceived physical stimulus in any way? (Direction, intensity, duration...) If so, explain it below

.....
.....
.....
.....
.....

24. Did you feel any other physical stimulus (any sound, smell, touch-sensation...), apart from the one(s) intentionally made by the laboratory staff? Describe it below

.....
.....
.....
.....
.....

Did this make you feel more immersed in the virtual environment?

Not at all 1 2 3 4 5 Very much so

4th Questionnaire Experiment Feedback

First User Testing of Nature Realms by Team Hyper

6th of March 2023. AP Immersive Lab

Thank you very much for being part of our first experiment!
We hope you enjoyed it and that you are eager to continue exploring VR together with us,
Team Hyper.
Please, fill in this last questionnaire, so that we can use your feedback to improve our
future experiments.

We won't share your information with anyone outside the project-team and it will only be used for research-purposes.

If you would like more information regarding the collection and processing of data, you can have a look at the [Privacy Statement for Research at AP University](#).

1. Rate the overall communication of the experiment (WhatsApp, Email...)

Very poor 1 2 3 4 5 Near perfect

2. Was the time-frame appropriate for you?

Not at all 1 2 3 4 5 Very much so

3. Were the VR devices in good condition?

Not at all 1 2 3 4 5 Very much so

4. Rate the performance of the team-members

Very rude and unorganised 1 2 3 4 5 Very polite and organised

5. Did you feel comfortable during the experience?

Not at all 1 2 3 4 5 Very much so

6. Were the questions easy to understand?

Not at all 1 2 3 4 5 Very much so

7. Regarding the amount of questions

There were very few, 1 2 3 4 5 There were too much,
more would have been needed less would have been needed

8. Was the format of the questionnaire (online with Google Forms) easy to use?

Not at all 1 2 3 4 5 Very much so

9. Feel free to leave us any feedback, suggestions or comments you may have.

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Appendix 3: First User-Test Results

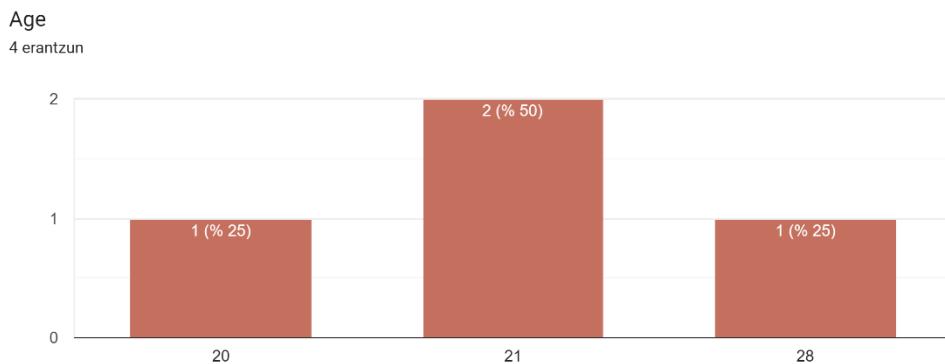
1st Questionnaire Results

Personal Information and Previous VR Experience

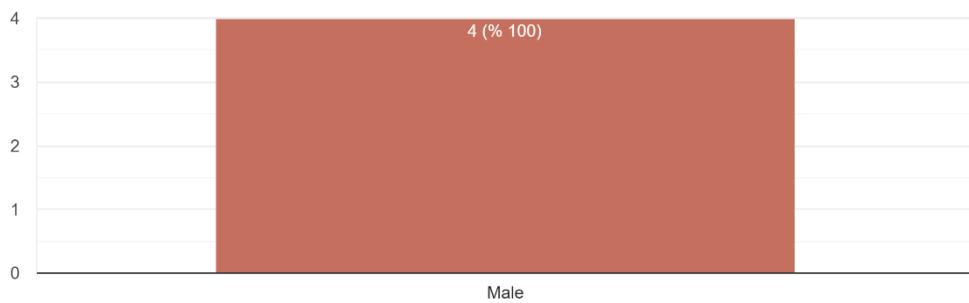
The first questionnaire of the user-test gathered personal data about the volunteers. The results show that there were 4 participants in total, all of them male and between the ages of 20 and 28. All of them were students, but from three different nationalities: Germany, Moldova and Spain (2 volunteers). The study-background of each of the students was also diverse: 2 were from the field of social sciences, one had an engineering background and another one business background.

Regarding their VR experience, all of them knew what Virtual Reality is, but one of them had never had previous experience with it. The ones that had previously tried VR, was with the Oculus Demo Games and an hour VR attraction experience. In all of the cases the users evaluated the experience as positive. When asked why it was positive, the volunteers stated that it was “cool” and “fun”, and that it was also a good experience because he could do things he can otherwise not do in real life. One of the participants confessed that it was positive because it was the first time he did it. Besides, just one of the users has a VR headset at home, a basic one that his home university gave him for using it with the smartphone on it.

These are some graphics with the answers of the participants.

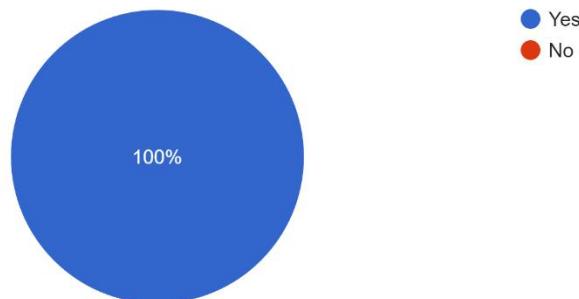


Gender (if you don't feel comfortable disclosing your gender, skip this question)
4 erantzen



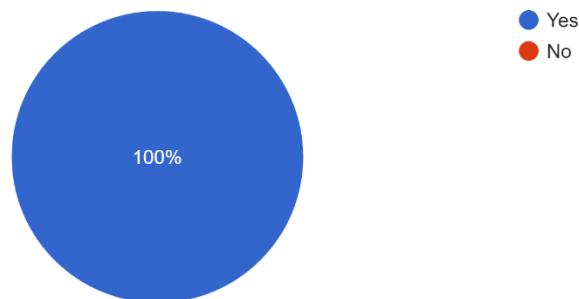
Are you a student?

4 erantzun



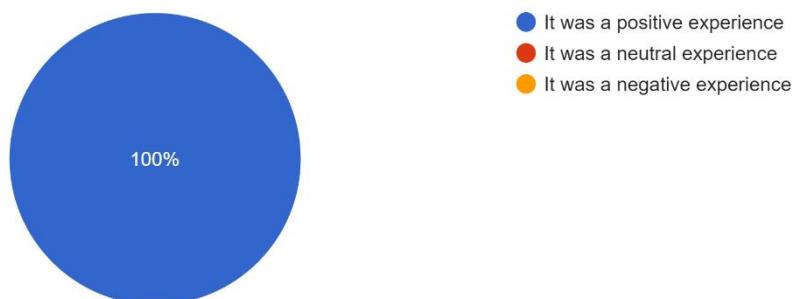
Do you know what Virtual Reality (VR) is?

4 erantzun



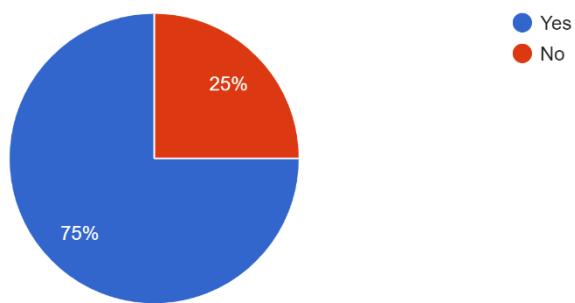
Choose the option that best describes your experience

3 erantzun



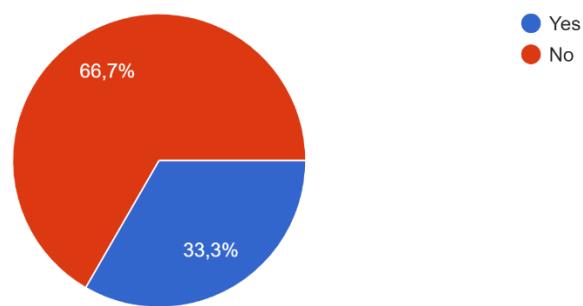
Have you already had VR-Experiences before?

4 erantzun



Do you have a VR headset at home? (Google Cardboard or similar devices also count)

3 erantzun



2nd Questionnaire Results

Virtual Experience: First Test

The second questionnaire of the user test aimed at measuring the level of immersion without any physical stimulus.

Regarding the imagery, the results show that the VR environment was realistic and contributed to the immersion. (See Graphic 1 and 2)

In questions 5 to 8 the user was asked about the usability of the controllers. All of the volunteers found it easy to move around and interact with the environment. Nevertheless, the impact of the ease-of-use of the controllers was diverse among the users, ranging from low to very high immersion. (See Graphic 3, 4, 5 and 6)

Finally, questions 3, 4, 9, 10, 11, 12, 13, 14, 15 and 16 measured the sense of being present in the virtual environment.

Half of the users forgot that they were in a laboratory and thought that they were standing on a mountain. The other half didn't feel as immersed. (See Graphic 7 and 8)

When asked about any physical stimulus, 3 out of 4 agreed that they felt something apart from wearing the headset. Two highlighted the impact of the sound and one the impact of the vibration of the controllers. This had a diverse effect on the immersion, ranging from neutral to very immersed. (See Graphic 9)

Three quarters of the participants never felt like taking their headset off while they were in the experience to see what was happening around them. Besides, one participant felt that he was to some extent separated from the real world, but the other three didn't feel it that much. Half of them had a stronger sense of being in the virtual world than in the real world and the other half didn't feel the difference that much. (See Graphics 10 and 11)

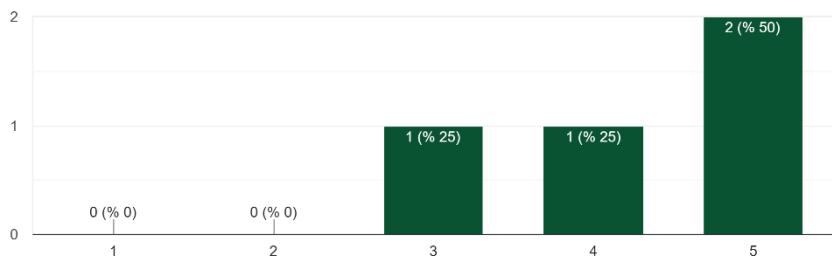
The volunteers hardly noticed events taking place around them and neither were they so involved in the experience that they forgot they were using controls. (See Graphic 12 and 13)

Last, but not least, they all felt at some extent disappointed that the experience was over and would like to repeat it. (See Graphic 14 and 15)

Graphics

To what extent did the virtual environment look like a mountain?

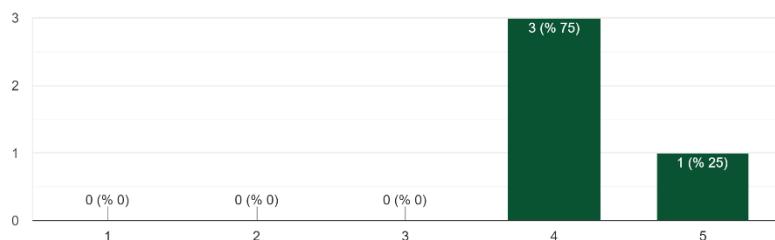
4 erantzun



Graphic 1

Did the visuals make you feel more immersed in the environment?

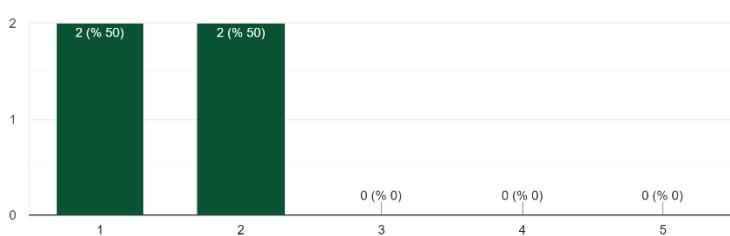
4 erantzun



Graphic 2

How difficult was it to move around the place?

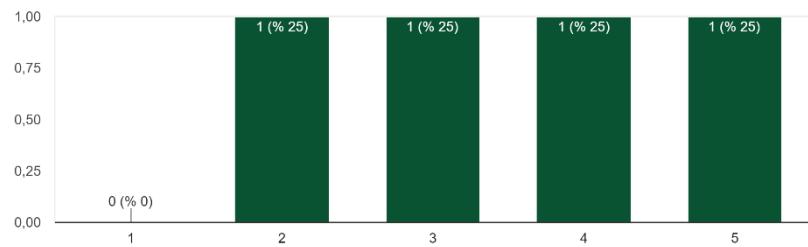
4 erantzun



Graphic 3

Did this make you feel more immersed in the environment?

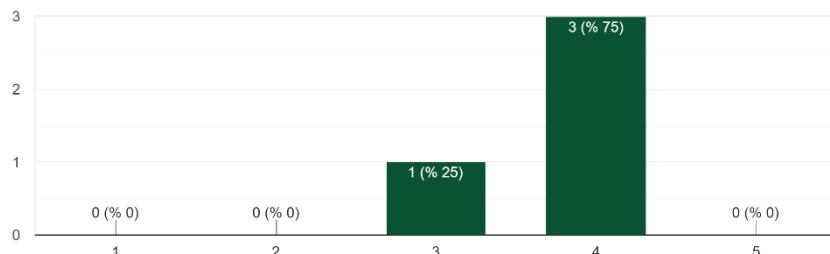
4 erantzun



Graphic 4

How intuitive was it to interact with the robot-dog?

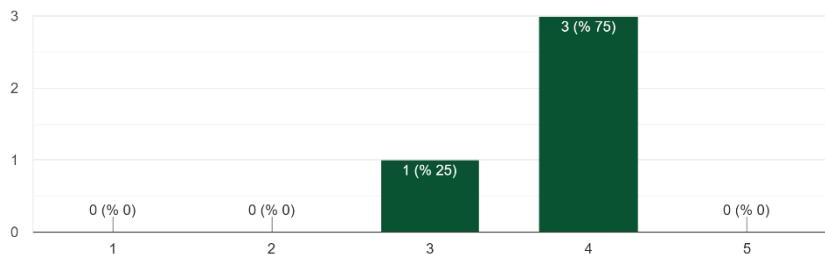
4 erantzun



Graphic 5

Did the robot-dog make you feel more immersed in the environment?

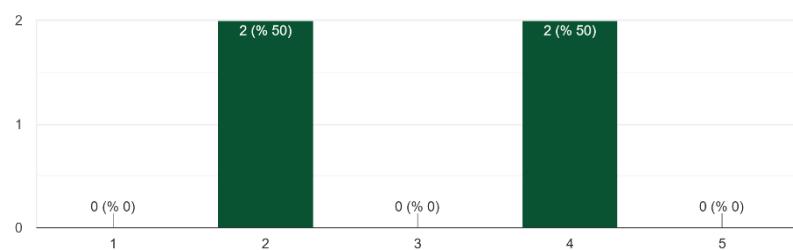
4 erantzun



Graphic 6

To what extent did you forget that you were in a laboratory?

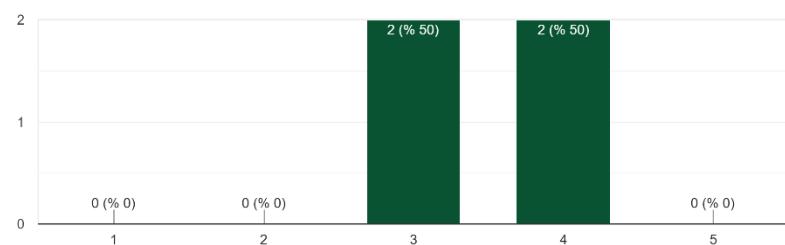
4 erantzun



Graphic 7

To what extent did you feel you were actually standing on a mountain?

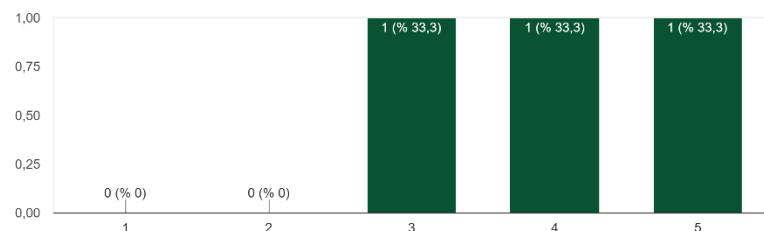
4 erantzun



Graphic 8

Did this make you feel more immersed in the virtual environment?

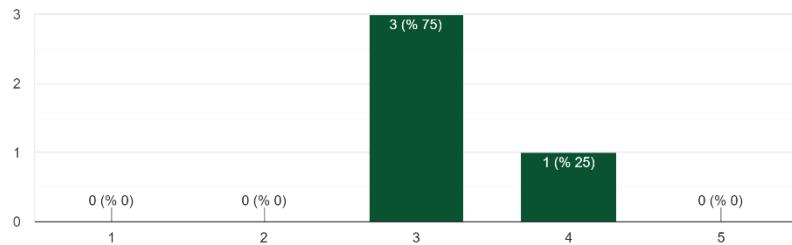
3 erantzun



Graphic 9

To what extent did you feel as though you were separated from your real-world environment?

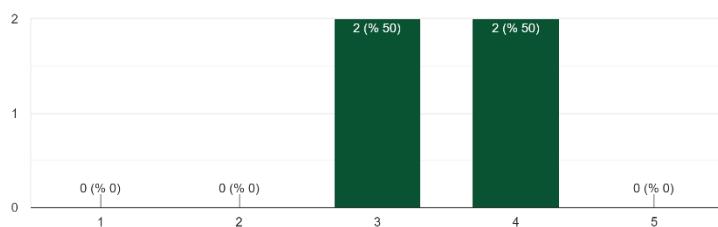
4 erantzun



Graphic 10

To what extent was your sense of being in the environment stronger than your sense of being in the real world?

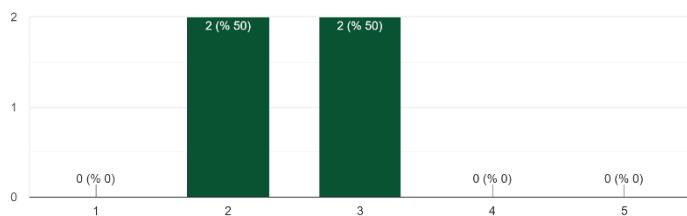
4 erantzun



Graphic 11

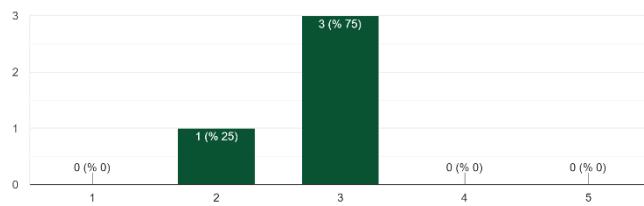
To what extent did you notice events taking place around you?

4 erantzun



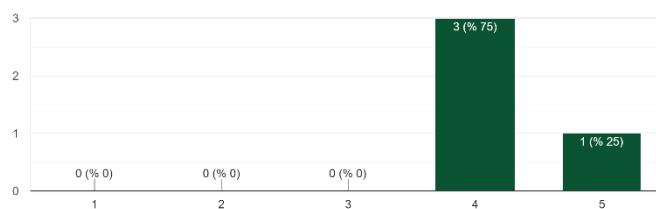
Graphic 12

At any point did you find yourself become so involved that you were unaware you were even using controls?
4 erantzun



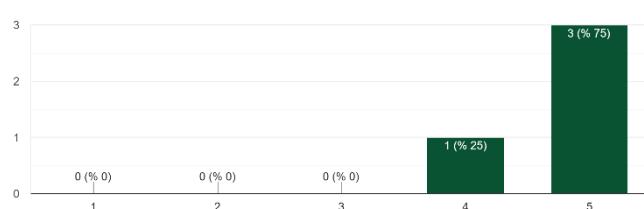
Graphic 13

When interrupted, were you disappointed that the experience was over?
4 erantzun



Graphic 14

Would you like to have the experience again?
4 erantzun



Graphic 15

3rd Questionnaire Results

Virtual Experience: Second Test

The second questionnaire of the user test aimed at measuring the level of immersion with physical stimulus. This physical impact were two ventilators positioned accordingly so that when the user is with its back to the mountain and facing the open landscape, it feels air blowing.

Some of the questions in this questionnaire are the same as in the first questionnaire.

For instance, questions 1 and 2 evaluated the impact of the visuals. All of them rated that the environment looked very similar to a real mountain, and 3 out of 4 stated that this made them feel more immersed (see Graphic 1 and 2).

Questions 5 and 6 asked the users about their experience with the controllers. This time, each of the users find it easy to use the controllers in a different level, ranging from 2 to 5. Half of them admit feeling more immersed thanks to it, while one of them felt neutral about it and another one didn't feel more immersed. (See Graphic 3 and 4)

Questions 7 to 11 asked about the physical stimulus. Results show that 3 out of 4 felt the physical input, and half of them agreed it matched what they were actually seeing on VR. Besides, just one of them felt the input as something external that was not part of the experience, while another one felt it was part of the experience. The other two just felt indifferent about it. Adding to that, just one person confessed feeling more immersed because of the physical input (see Graphic 7, 8 and 9). Two people stated feeling distracted by the physical input and three considered it to be something they would actually find in a mountain. (See Graphic 10 and 11)

Regarding the questions about the sense of being immersed in the virtual environment, 3 out of 4 users felt neutral when asked if they forgot they were in a laboratory. The other one didn't feel as such. One of the volunteers felt as he was standing on the mountain and the others felt neutral or didn't feel like it. (See Graphics 5 and 6)

None of the volunteers felt like taking off the headset while on the VR experience and half of them felt separated from the real world. Just one person felt the sense of being in the VR world stronger than being in the real world, two were indifferent and one person disagreed (see Graphic 12 and 13). One volunteer felt events taking place around him and another one felt so involved in the environment that he forgot he was using controllers. (See Graphic 14 and 15)

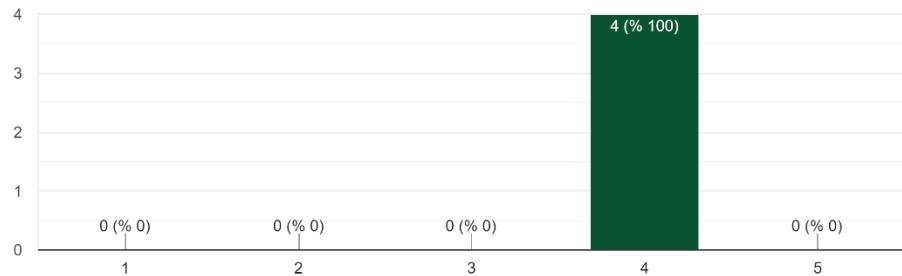
We asked if they would change in any way the physical input, one said that he would adapt the "intensity of the wind every once in a while". Another one suggested that the wind would be more effective if the room were warm, otherwise "if the room it has normal temperature it can be a little bit uncomfortable". The volunteers didn't feel any new physical stimulus apart from the intended ones.

Finally, 3 out of 4 participants felt disappointed that the experience was over and would like to experience it again. One participant felt indifferent about both questions. (See Graphic 16 and 17)

Graphics

To what extent did the virtual environment look like a mountain?

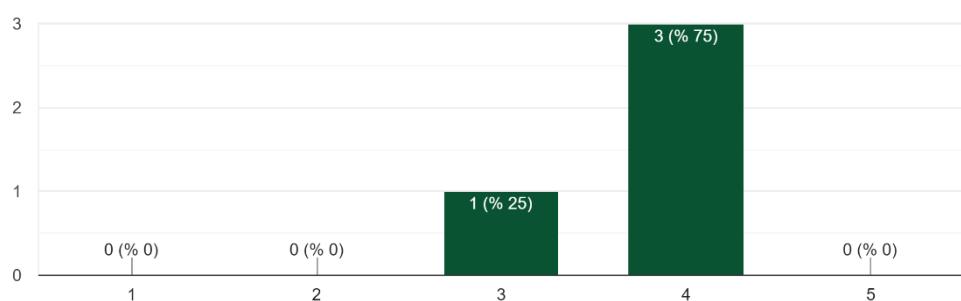
4 erantzun



Graphic 1

Did this make you feel more immersed in the environment?

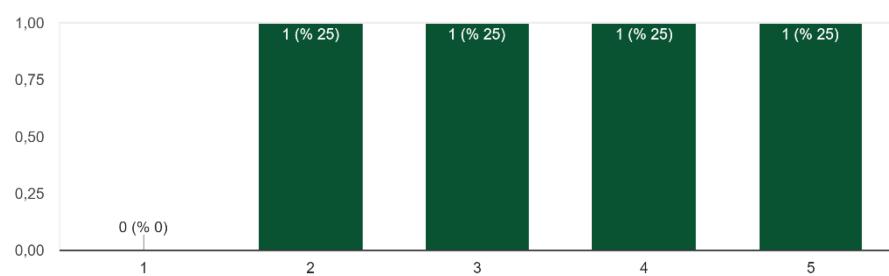
4 erantzun



Graphic 2

Did you find it easy to move around the place?

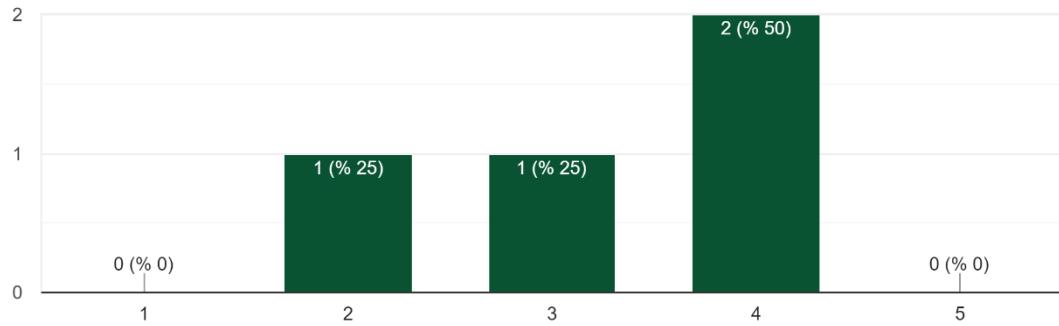
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Graphic 3

Did this help you be more immersed in the virtual environment?

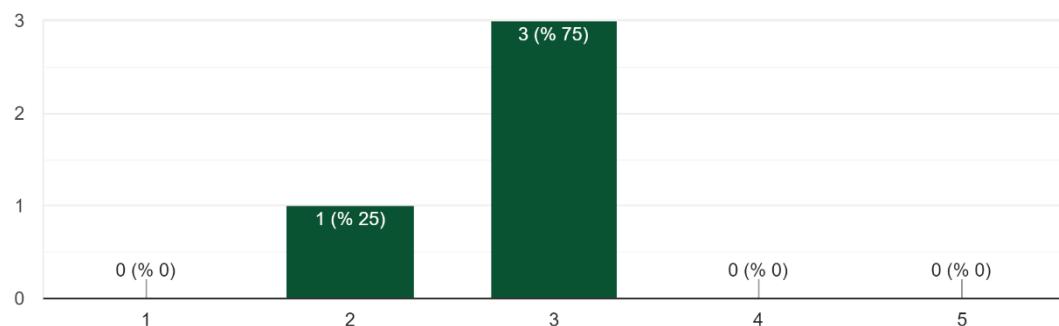
4 erantzun



Graphic 4

To what extent did you forget that you were in a laboratory?

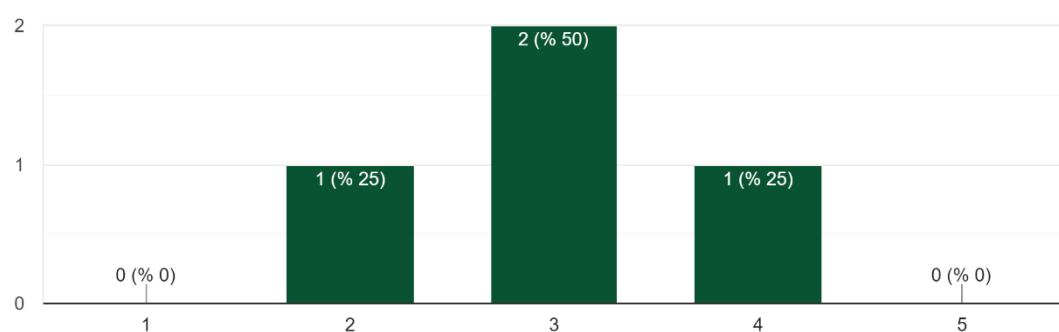
4 erantzun



Graphic 5

To what extent did you feel you were actually standing on a mountain?

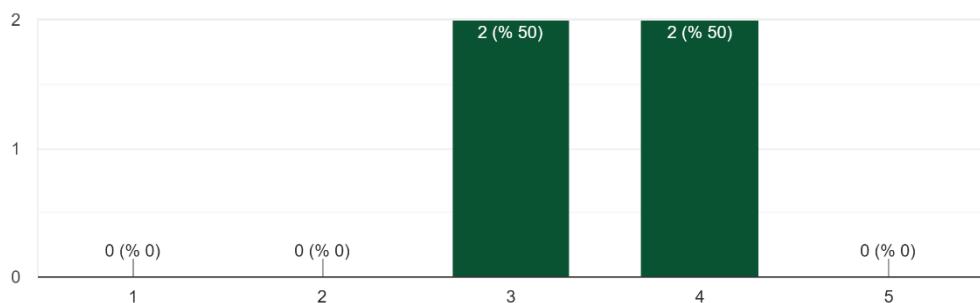
4 erantzun



Graphic 6

Did the physical stimulation match what you were seeing?

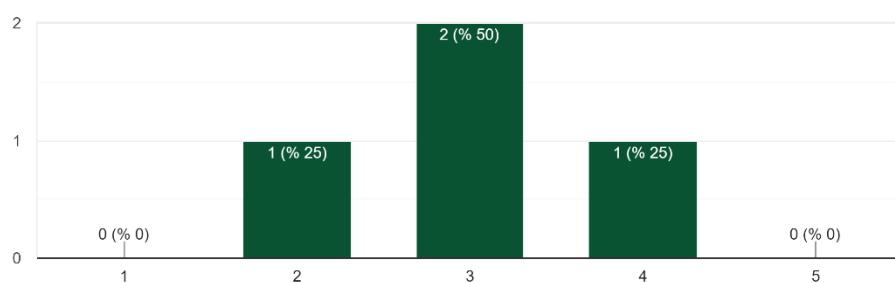
4 erantzun



Graphic 7

Did you feel the physical input as something external that was not part of the virtual experience?

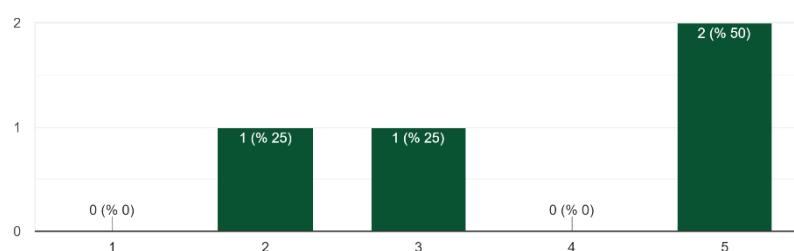
4 erantzun



Graphic 8

Did this input help you feel more immersed in the virtual environment?

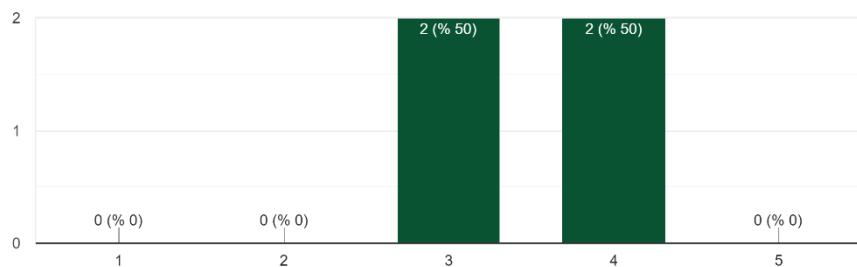
4 erantzun



Graphic 9

To what extent did it distract you from the virtual environment?

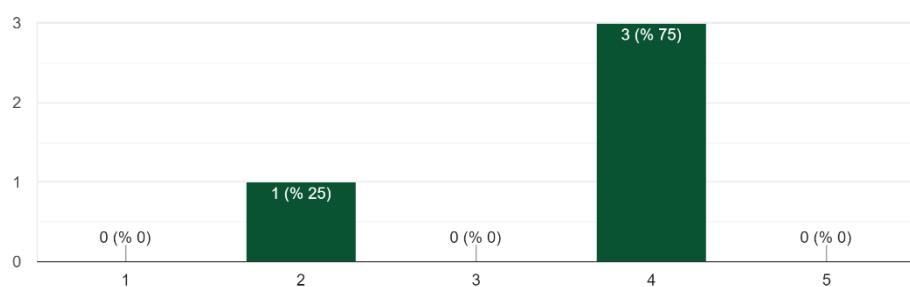
4 erantzun



Graphic 10

To what extent did you feel it as something you would experience in a real mountain?

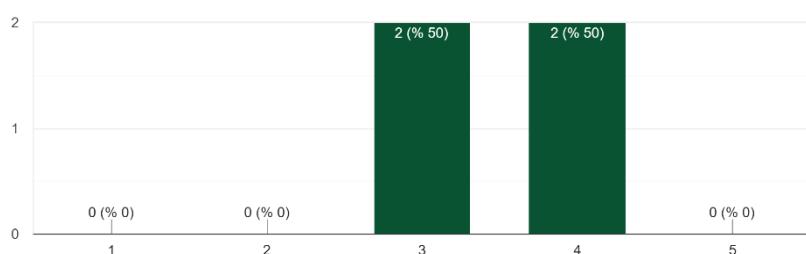
4 erantzun



Graphic 11

To what extent did you feel as though you were separated from your real-world environment?

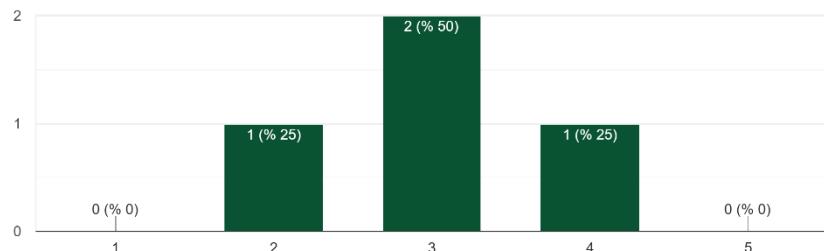
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Graphic 12

To what extent was your sense of being in the environment stronger than your sense of being in the real world?

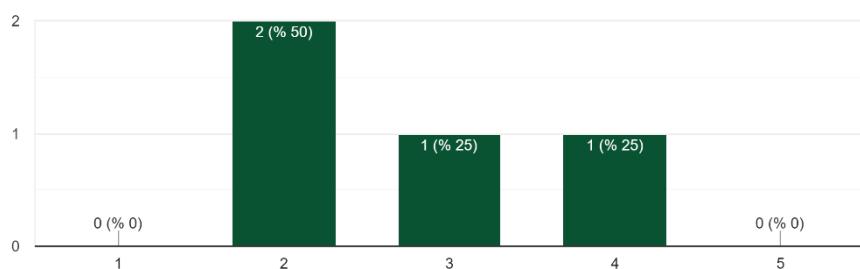
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Graphic 13

To what extent did you notice events taking place around you?

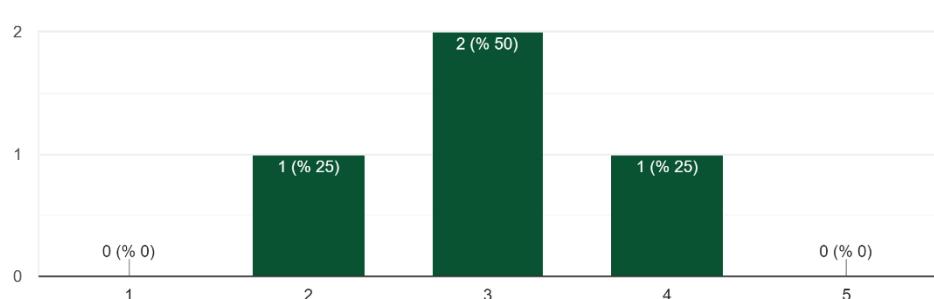
4 erantzun



Graphic 14

At any point did you find yourself become so involved that you were unaware you were even using controls?

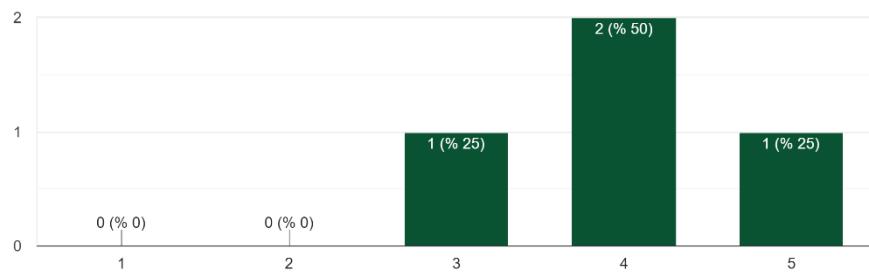
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Graphic 15

When interrupted, were you disappointed that the experience was over?

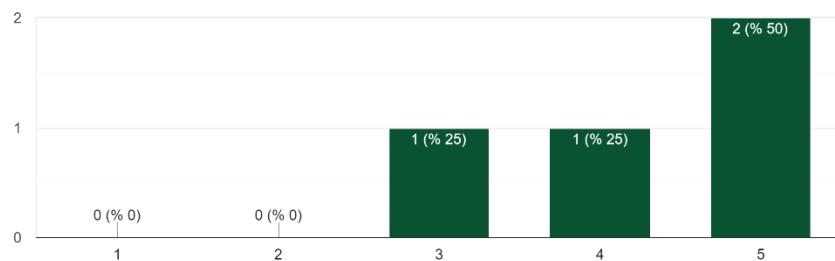
4 erantzun



Graphic 16

Would you like to have the experience again?

4 erantzun



Graphic 17

Experiment Feedback

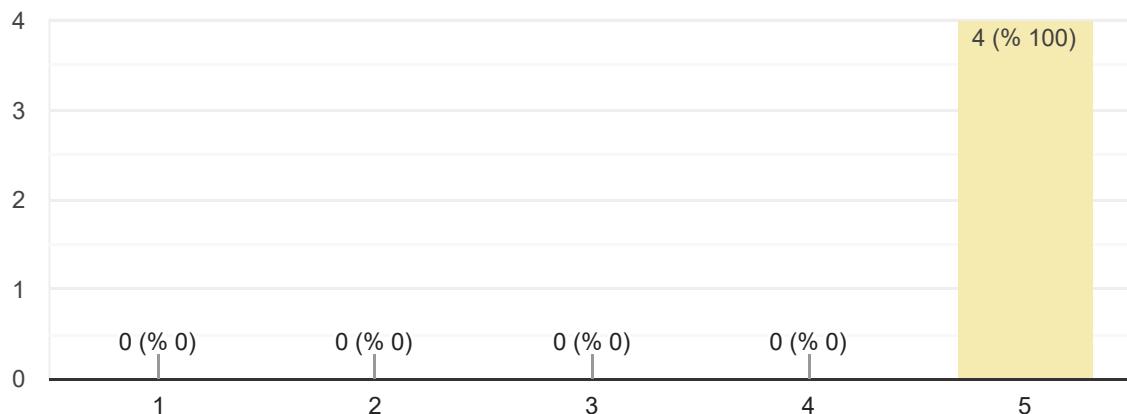
4 erantzun

[Argitaratu estatistikak](#)

Rate the overall communication of the experiment (WhatsApp, Email...)

 Kopiatu

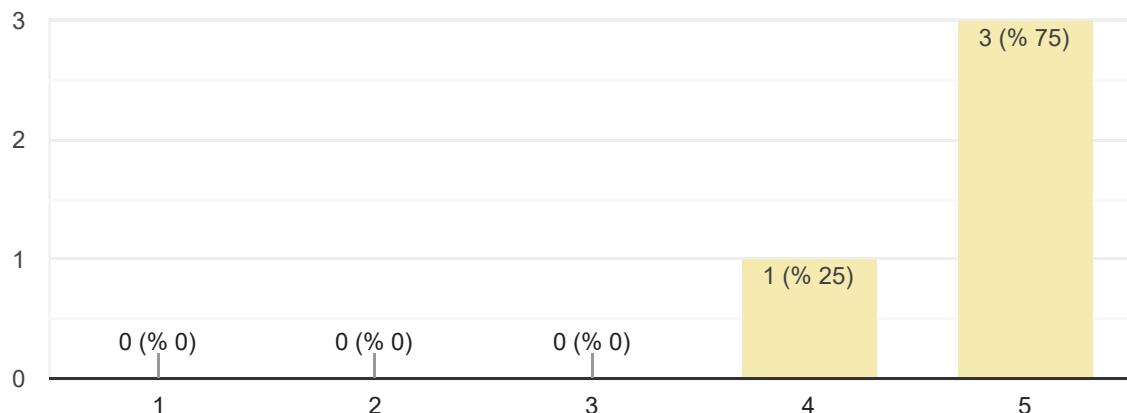
4 erantzun



Was the time-frame appropriate for you?

 Kopiatu

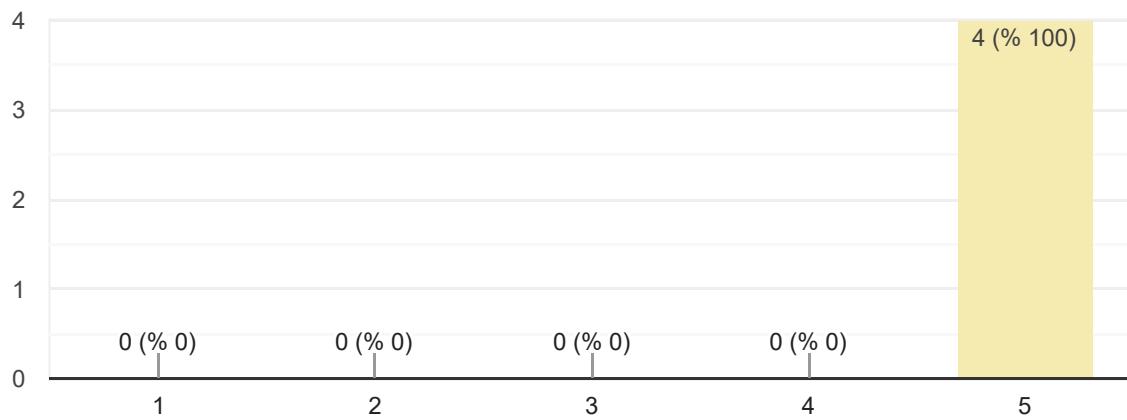
4 erantzun



Was the place of the experiment appropriate?



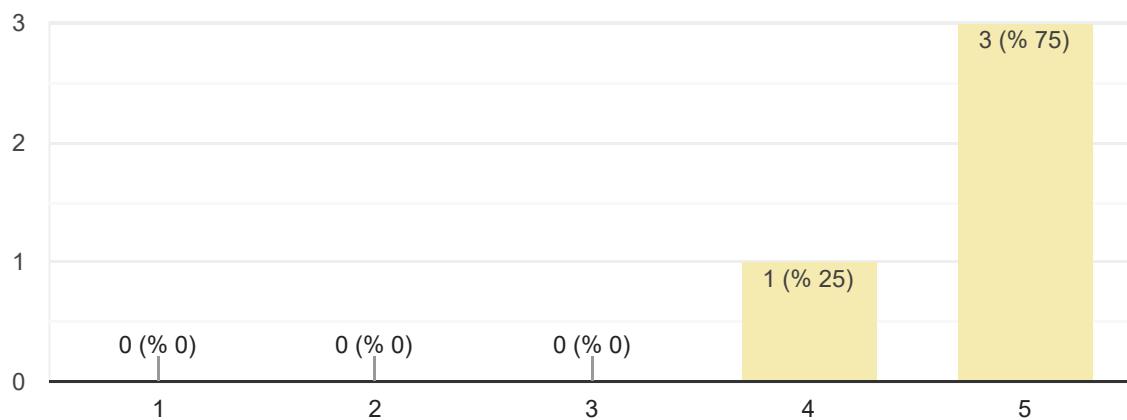
4 erantzun



Were the VR devices in good condition?



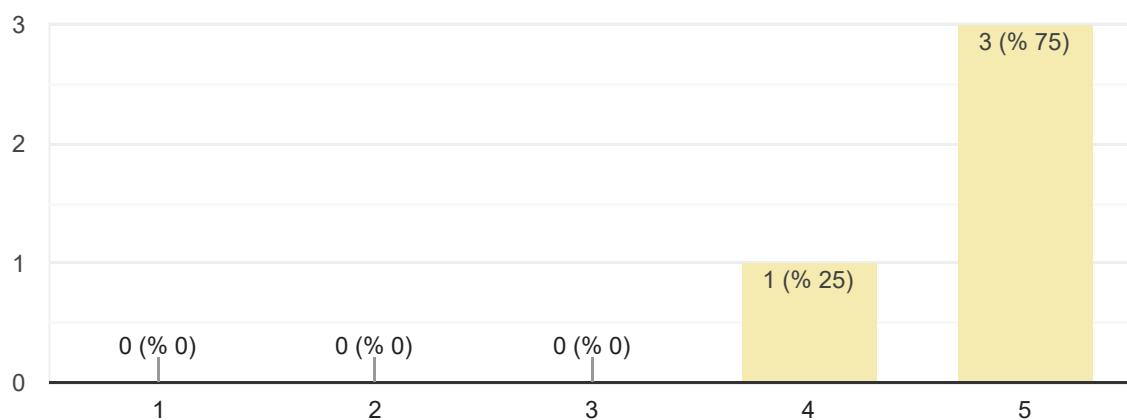
4 erantzun



Rate the performance of the team-members



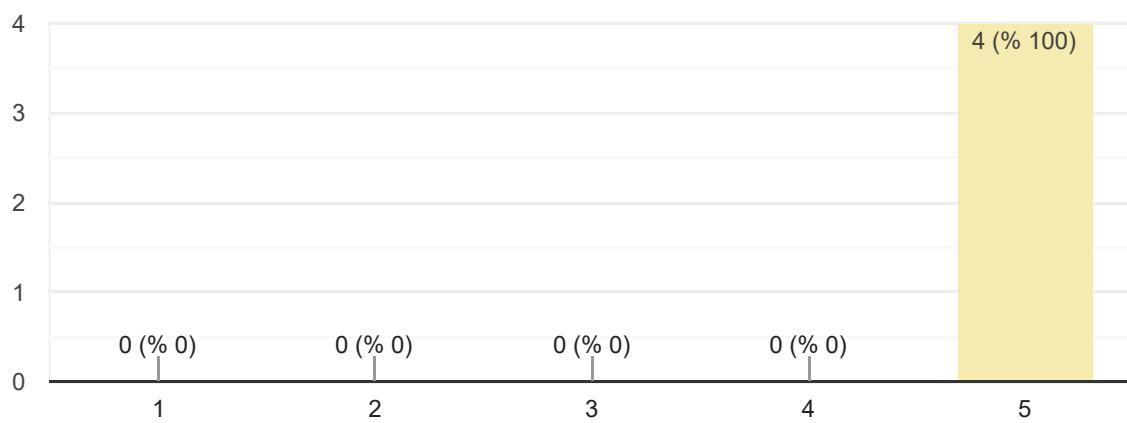
4 erantzun



Did you feel comfortable during the experience?



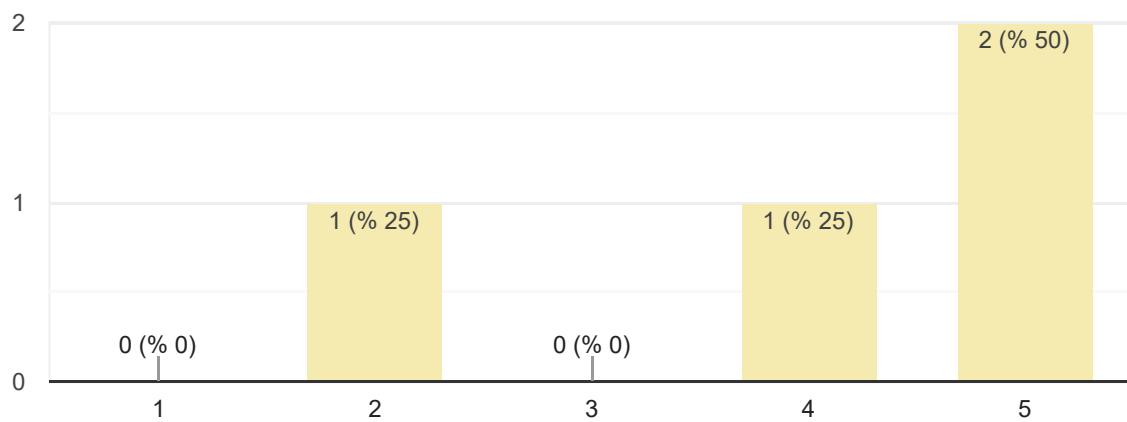
4 erantzun



Were the questions easy to understand?



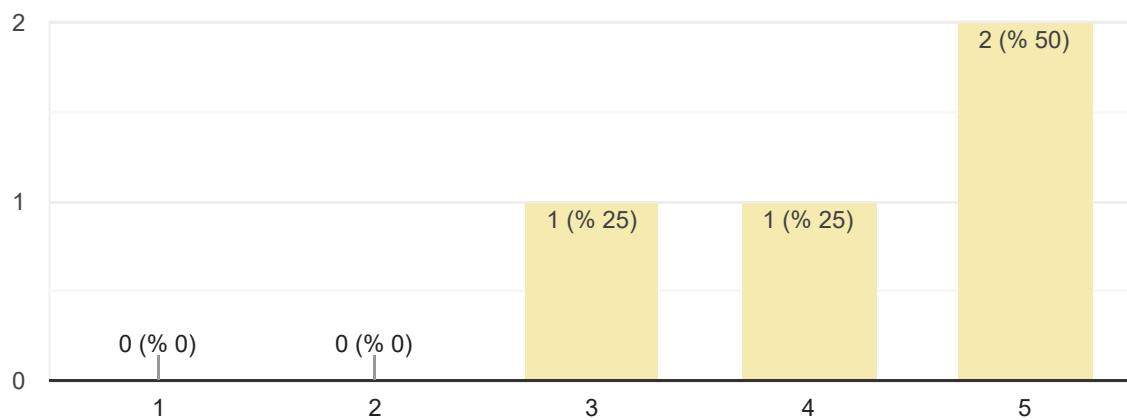
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Regarding the amount of questions

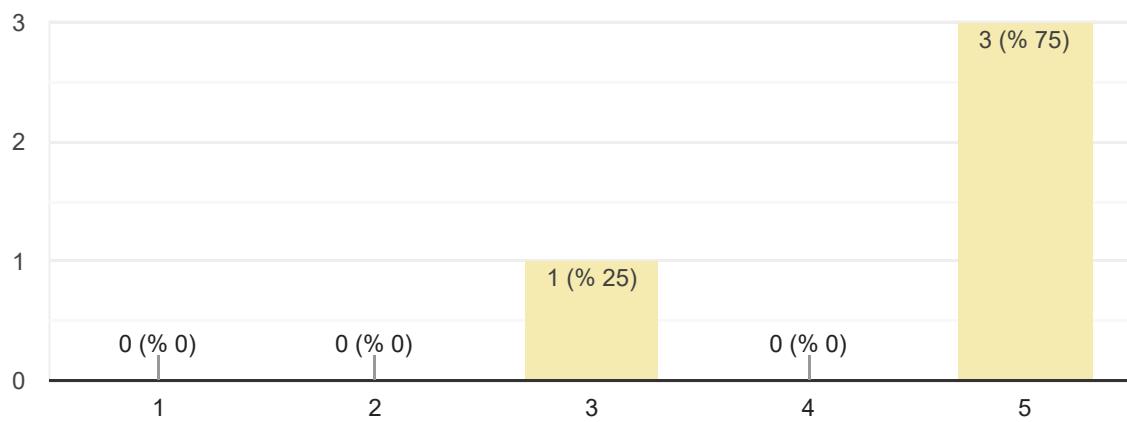


4 erantzun



Was the format of the questionnaire (online with Google Forms) easy to use?

4 erantzun



Feel free to leave us any feedback, suggestions or comments you may have.

4 erantzun

It was very helpful from you guys, thank you for the experience and patience!

good team that are doing really great job

When making the questions, all the questions should keep the same sense of rating.

jealous about your project

Eduki hau ez du Google-k sortu edo babestu. [Eman erabilera okerren berri](#) - [Zerbitzu-baldintzak](#) - [Pribatutasun-gidalerroak](#)

Google Inprimakiak



Appendix 4: Technical Project Report

Nature Realms: heightening immersion in XR Nature Environments

Technical project report



European Project Semester

Academic year: 2022-2023

Team: Hello Hyperreality (HYPER)

Team members: Víctor Fernandez Moya (ES), Philipp Parteder (AT),
Bavo Debraekeleer (BE), Leire Lisón Nicuesa (ES) and Gabriel Copier (FR)

Clients: Jeroen Cluckers and Lowie Spriet from the Immersive Lab

Project coaches: Hiram Bollaert and Erwin Listhaeghe

EPS coordination team: Geert Marrin and Bie Dirkx

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Introduction

This report gives an overview of the technical aspects of the project that don't fit the final project report itself. It describes the use of Artificial Intelligence in the ideation phase and all the used tools, technology and techniques for the creation of the virtual reality aspect of the project.

Technical Project Process

1 Artificial Intelligence Driven Design (AIDD) Process

Another topic our clients, the Immersive Lab at AP University, are researching is the use of generative artificial intelligence tools in creative processes, or [AI Driven Design \(AIDD\)](#).

How AIDD is used in this project is documented in this section.



Figure 1 Image generated by DALL-E 2

Promt: a header image for documentation about the use of generative ai driven design in a creative process

1.1 Generative AI Tools

There are a lot of different [generative AI](#) tools available online to use.

The most known of which use *text to image* models, eg. DALL-E 2, or *large language models (LLM)*, eg. ChatGPT, but you also have *text to audio*, *text to music*, *text to video*, *real to stylized video* and *image to 3D models*.

Most of these however are closed source and require a paid subscription to be able to use them. Although they often offer free credits that can be used for experimentation and finding the right tool for the job at hand. These often also return after a certain period of time.

Other models are open source and free to use on your own systems or through platforms like Google Colab to offload the processing power needed for the model to run. In the nature of open source projects, these also sprout all kinds of variations and models trained for specific purposes or styles.

Note: all details are as of writing in Q1 2023.

1.2 Tekst-to-Image

Text to image models generate an image from a given prompt.

A prompt can be a full sentence, random words or a mix of both separated by commas, depending on the specific model.

Often there are also more advanced options like:

- Negative prompt: things you don't want in the image.
- Weights: with which you can give heavier weight to words, meaning making some words more important than others.
- Seed: number to control or limit the randomness of the image generation. This is often a random number, but by setting it to a fixed number you can more easily monitor the influences of changing a prompt.

1.2.1 [DALL-E 2](#)

- **Model:** text to image and image expansion
- **License:** closed source
- **Usage:** [website](#) and API
- **Pricing website:** 4 images per credit, 50 free credits, 15 free every month, \$15 for 115.
- **Pricing API:** \$0.02 per 1024×1024 image, \$0.018 per 512×512 image, \$0.016 per 256×256 image. Enterprise team subscriptions possible.

DALL-E 2 is probably one of the easiest and best tools for non experts.

It's a closed source *text to image* model by OpenAI with which you can generate photorealistic and artistic images. It also has some extra feature like expanding existing images or photos beyond their original frame.

[A short explanation is available on their website](#).

It works through a [webpage](#) where you can write a prompt or upload an image, as well as through an API.

1.2.2 [Midjourney](#)

- **Model:** text to image and photo to image
- **License:** closed source
- **Usage:** Discord channel
- **Pricing:** Free trial of 25 min. GPU time, Basic at \$10/month for 200 min/month, Standard at \$30/month for 15h/month, Corporate at \$600/year for 120h/year.

Midjourney is a model created by a researchgroup which generates more artistic images, often concept art style looking. It's still in beta and works through a Discord channel which you can join by clicking the *Join the Beta* button on [their website](#).

The pricing is counted in GPU time the AI model spends generating your images. You get a free trial in the beginning of 25 minutes GPU time which regenerates every month.

To generate images join the Discord channel, go to a *newbies* thread, and write /imagine. A pop-up will show up for this command /imagine prompt:. Select it and write your prompt. This is a shared thread, so all images being generated by other users also show up. You can follow the generation of your image in the command you posted. When it's finished a new message is created with the result mentioning your username.

1.2.3 [Stable Diffusion](#)

- **Model:** text to image and photo to image
- **License:** open source
- **Usage:** website, local, Google Colab Notebook, etc.
- **Pricing:** Free (virtual machine costs may apply.)

[Stable Diffusion](#) is an open source projects. As most popular open source projects it has sprouted a lot of different versions trained for specific tasks and styles. Here are the easiest and most useful ways to use it:

- [Stable Diffusion Playground web interface](#) : this is an easy webinterface similair to DALL-E to demonstrate the model. Just write the prompt and press *Generate image*. There is also a [prompt database](#) available to get ideas of possible prompts.
- [Hugging Face Demo web interface](#) : Hugging Face is an open source AI organization. They also provide a free web interface to demo Stable Diffusion similar to the Stable Diffusion Playground.
- [Google Colab Notebooks](#) : if you just google it you can find a lot of different Google Colab Notebooks created by users to use. This is one example using a specific model, but a lot of other models are available to use as well. You can also couple your Google Drive to a Notebook to auto save the resulting images to it. This approach is for a bit more advanced users, but provides the possibility to change and add code in Python.

- [Dream Studio](#) : is another web interface that features faster generation and makes some parameters available as sliders that are available in code when you use a Notebook.
- [Running locally from GitHub repo](#) : another possibility is cloning the Stable Diffusion repository on GitHub and running it locally on your own system. How to do this is documented in the README of the repo.
- [Blender Plug-in](#) : there is also a plug-in available to use Stable Diffusion within Blender. It's still only 2D image generation, but can be used to for example generate textures and 2D animations. The generation is not run locally, but through an API for which you'll need a key.

1.2.4 [Photosonic](#)

- **Model:** text to image
- **License:** closed source
- **Usage:** website
- **Pricing:** Free Trial 2500 words/month, Long-form \$13-1749/month for 19-5750k words/month. 1 image generation gives you 2 images and costs 100 words.

Photosonic is a tool by Writesonic that offer a range of AI tools. It uses a web interface similar to DALL-E 2. It uses words as it's credits because it also has a chat AI called Chatsonic where this system is easier to understand.

1.3 Large Language Models

1.3.1 [ChatGPT](#)

- **License:** closed source
- **Usage:** [website](#)
- **Pricing:** Free Trial 2500 words/month, Long-form \$13-1749/month for 19-5750k words/month.

A chat AI by OpenAI.

1.3.2 [Chatsonic](#)

- **License:** closed source
- **Usage:** website, Chrome plug-in
- **Pricing:** Free Plan available when demand is low. Plus plan for \$20/month giving access even when demand is high, faster response speed and priority access to new features.

A chat AI by Writesonic.

2 Virtual Reality Development Process

To build the virtual reality aspect of the prototype experience, and collaborate iteratively, a wide variety of tools, technologies and techniques were utilized. This section gives an explanation of the whole process.

2.1 Overview

- VR headset: Meta Quest 2
- Software:
 - Game engine: Unity
 - Software editor: JetBrains Rider / Visual Studio Code
 - Story-, mood- and referenceboards: Miro
 - 3D modeling: Blender
 - 2D editor: Adobe Photoshop
 - Photogrammetry library importer: Quixel Bridge
 - 3D tree creation tool: SpeedTree Modeler
 - Audio editor: Audacity
 - 3D scanning app: Polycam
 - Meta Quest development tools:
 - Meta Quest Developer Hub (Windows)
 - Oculus App (Windows and Android)
 - OVRMetrics (debugging on headset)
- Assets:
 - Unity Asset Store
 - Quixel Megascans photogrammetry library
 - SpeedTree Models
 - Audio from Freesound
 - 3D assets from Sketchfab
 - HDRI maps for skyboxes from Poly Haven and HDRI Haven
 - Visual Tween path editor (Unity plugin)
 - Oculus Integration SDK and examples

2.2 The VR Headset: Meta Quest 2

The VR headset used for this project is the Meta Quest 2, previously named the Oculus Quest 2. It was chosen for its accessibility, previous experience by the team, and above all its mobility. Most headsets run on a desktop computer or gaming console which they are attached to by cable. They can deliver better performance and graphical quality compared to the mobile Android hardware of the Meta Quest 2, but the cable limits the user's mobility and can be a distraction that breaks immersion. This headset was provided by the clients of the Immersive Lab.

2.3 Unity Game Engine

The Unity game engine was chosen as the main development tool because of the experience of the team using it and the vast developer community around the engine.

2.3.1 Universal Render Pipeline (URP)

Within Unity, the Universal Render Pipeline was chosen for its great performance on mobile hardware and its flexibility in render settings and custom shader capabilities. For a couple of features in the environments build for the prototype experience of this project the Shader Graph was used. These features are highlighted in the Project Results chapter.

2.3.2 Oculus Integration SDK and Stage Tracking

Because the experience was developed solely for the Meta Quest 2 and to be able to use experimental features of the headset the Oculus Integration SDK was used within Unity. One of the things it provides which makes development easier is a tool that checks if all settings are set up correctly for any Quest headsets.

An experimental feature it provides that was used in this project is Stage Tracking. Standard tracking does not keep track of the user's position in the virtual world relative to your real-world surroundings. Only the headset's position relative to the boundary. For example, if you take the headset off, turn around and put it back the virtual world will be aligned the same in your view, meaning its alignment towards the boundary and the real world has changed. When using a physical setup that needs to match the virtual world this is not wanted. Stage tracking provides a better solution. It requires a Room Setup as well as a boundary. The Room Setup works by highlighting the walls around the playing area to make a closed space (they don't have to be the actual walls of the room). With this the headset can track the orientation of the room and keep the orientation relative to the virtual world. However, it wasn't designed to perfectly match the virtual world to the real world. Rather to bring elements of your room into an mixed reality experience. For example, depending on the direction you are facing when starting an application, the virtual world can be rotated by increments of 90°. To fix this a new boundary has to be drawn. Another example is that your starting position, or virtual world origin point, as set by calculating the centre point of the boundary rather than that of the room. This means the boundary has to drawn almost exactly the same way every time or the physical elements in the experience won't align correctly with their virtual representations. The tracking is also still in experimental face resulting in occasional slight shifts of the virtual world. For example, the floor level getting raised and lowered, mostly after coming out of standby mode when it needs to recover the tracking. But

this can also occur while drawing the boundary.

A another downside of using Stage Tracking is that it can't be used simultaneously with Hand Tracking. Hand tracking can help with immersion and be more intuitive, especially for people who don't like controllers, but it has its own technical problems and limitations.

2.4 Photogrammetry and 3D Scanning

The goal of the project is to give users the experience of actually being in nature. That is why the focus of the visuals is hyper-realism. The headset's mobile hardware has many limitations, but with photogrammetry and the right texture density, a lot can be achieved.

2.4.1 Photogrammetry and Quixel Megascans

Photogrammetry is the technique of scanning real-world objects to be used in digital visualization. It can be scans of whole environments and everything in it, separate objects and persons, or only a specific surface. The goal is to capture all the detail and random nuances the real world has to offer. Something digital tools try to replicate, but never quite succeed at. A great source of photogrammetry assets is the Quixel Megascans library. They have a vast amount of surfaces, 3D assets and 3D plants available. With their Quixel Bridge software and accompanying plugin for Unity it is very easy to get the assets in the engine. Special care does need to be taken with setting up the export settings. The correct map names and channels need to be set for the Materials and Terrain Surface to be used for texture exporting. For example, the Universal Render Pipeline (URP) Lit material uses a Base (Albedo) map, while the Terrain Surface uses a Diffuse map. Very similar, but not quite the same. The Unity documentation can be consulted for the correct setup.

For the 3D model export settings, it is best to check the individual triangle counts of every available LOD level on a per-asset basis to choose the right ones for the project's needs. It is recommended by Meta that the triangle count in your camera's view on the Meta Quest 2 should not exceed 500,000 to 1,000,000 triangles at any given time. The LOD system can greatly help with this, though every extra LOD will increase application size and load times, so they must be chosen with great consideration.

2.4.2 3D Scanning with Smartphone

Custom 3D scans were also used in the project. The physical setup was scanned and imported into Unity to be able to match the virtual world to the real world more closely. This was done with the Polycam app on an iPhone utilizing its LiDAR scanner for better results.

A fellow EPS student was also scanned this way and put in the experience as an easter egg for other students to find during the user tests. Sadly the texture quality is quite low due to technical limitations, but still, a fun addition for creating more enthusiasm and willingness among fellow EPS students to participate in user testing.

2.5 SpeedTree

SpeedTree is a long-time industry standard for creating convincing digital trees. This results in very easy integration in Unity. A SpeedTree model can have LOD's and Wind animation generated and set up in the SpeedTree Modeler. Next, it simply has to be exported as a SpeedTree file for Unity and when imported into Unity it automatically has the LOD system working and the wind animations work with Unity's wind system. The Trees aren't as realistic looking as photogrammetry assets, but they are convincing enough and very easy to use, especially for the wind animations. Quixel Megascans does have a similar system, though since they were bought by Unreal this only works with Unreal Engine. SpeedTree on the other hand got bought by Unity so in the future it might be improved to compete more closely with its Unreal counterpart.

2.6 Custom 3D with Blender

For very specific objects, or objects good 3D models couldn't be found for, custom models were developed. The software of choice is Blender, a free and open-source 3D modelling software package. More on this in the Project Results chapter.

2.7 Audio Design

The audio design is a very important aspect to make virtual environments convincing. Unity offers a 3D audio system that works very well out of the box.

The process of creating the audio design was to first decide what sounds fit the specific scene and list them up. Next sounds were gathered from Freesound, a free online sounds library, and edited down using Audacity to get the right part and/or length. Most of the sounds also need to be able to loop. This is because the user can stay in the same spot as long as they want while the audio needs to keep going without noticeable stops or cuts. It also greatly helps with reducing the application file size and scene load times. Unity also doesn't support every file type, so audio needs to be exported preferably in the .wav file type. Once imported into Unity the sounds can be placed in the scenes with 3D sound turned on for the best effect.

Project Results

3 Artificial Intelligence Driven Design (AIDD) Results

3.1 Using AI for Ideation

Generative AI tools can be very handy in the ideation phase of creative work.

It can be viewed as an extra thinker on the team coming up with ideas depending on the topic or description you give it.

It can also be an easy and fast tool for idea visualisation. The result it gives you can be very different from what you expected to get or what you had in your mind, but that is part of the creative spark it can provide.

Here it's mostly the text to image generation that can provide the most value.

To come up with innovative ideas the LLM chat AI's are less useful, because they mostly reproduce existing ideas.

3.2 Coming up with the experiments

The first thing that had to be decided on this project is what experiments would be conducted. For this we first did individual brainstorming to then bring those ideas together in a team brainstorm.

Here was an opportunity to use generative AI for both coming up with ideas as well as visualising ideas to be able to present them more clearly to the group.

3.2.1 Idea generation with Large Language Models

Because to use the text to image generators you should already have some idea of what you're looking for you can start with an LLM like ChatGPT or Chatsonic.

Below are some of the questions and results from Chatsonic.

Q: Give some research ideas to make a virtual reality experience in nature as immersive as possible.

A: To make a virtual reality experience in nature as immersive as possible, there are a few research ideas that could be explored. First, one could explore using artificial intelligence and machine learning techniques to develop algorithms that can accurately map and recreate the user's movements and environment within the virtual reality experience. Additionally, one could research methods of **enhancing the sensory experience of the virtual environment**, such as adding soundscapes, adjusting lighting, and developing more realistic textures and colors. Finally, one could explore the use of haptic technology to provide tactile feedback to the user and increase the realism of the experience. By researching and exploring these ideas, one could create a more immersive and realistic virtual reality experience in nature.

Q: Give some ideas around creating more immersion in a virtual reality nature environment by using physical objects.

A: To create more immersion in a virtual reality nature environment, one could utilize physical objects. For example, one could **use smells and fragrances to provide an olfactory experience** of the environment. Additionally, one could **incorporate wind, mist, and other air-based sensations** to further immerse the user in the experience. Furthermore, one could use tactile objects such as rocks, trees, and other objects to give the user a more realistic physical experience of the environment. Finally, one could use haptic technology to provide tactile feedback to the user, such as the feeling of grass or water when the user touches an object. By exploring and utilizing these ideas, one could create a more immersive and realistic virtual reality experience in nature.

Q: What are non obvious things that heighten the immersion in virtual reality.

A: To heighten the immersion in a virtual reality experience, one could incorporate several non-obvious elements. For example, one could use sound design to bring the environment to life, such as using ambient noises and soundscapes to create a realistic atmosphere. Additionally, one could use **3D audio** to create a more realistic sound experience, such as using positional audio to give the user the feeling of being close to an object or a creature. Furthermore, one could incorporate **subtle movement, such as swaying trees, water ripples, and other small movements**, to make the environment feel more alive. Finally, one could utilize visual effects such as depth of field and motion blur to create a more realistic experience. By exploring and utilizing these ideas, one could create a more immersive and realistic virtual reality experience.

Q: Give me a list of sensory contrast you find in nature.

A: Nature provides a plethora of sensory contrasts that can be found in any environment. From the way wind passes through the trees and **rustles the leaves, to the way fire crackles and pops, to the sound of thunder rolling through the sky**, each of these contrast provide an interesting and unique experience. Furthermore, the **contrast between hot and cold, soft and hard, light and dark, and wet and dry** can all be observed in nature. **The sight of a sunrise or sunset, the feeling of the sun's warmth on a cold day, and the taste of a fresh rain shower in the summer** are just some of the many sensory contrasts that nature has to offer.

Q: Give me some ideas an electronic sensor can bring to a virtual reality experience of nature.

A: Virtual reality offers users the ability to explore and experience settings that are not available in the physical world. With the implementation of electronic sensors, the virtual

reality experience of nature can be enhanced in many ways.

One way is to use sensors to detect the user's presence in the virtual environment and adjust the environment accordingly. For example, the user's location could be tracked in the virtual environment and trees and other elements of the landscape can be adjusted to create a more immersive experience. If the user is in a forest, for example, trees could be added to the surrounding area and other elements of the environment could be adjusted based on the user's location.

Another way is to use sensors to detect the user's movements and adjust the environment accordingly. For example, as the user moves, the trees and other elements of the landscape could move and change in the virtual environment. The user's movements could also create ripples in a virtual pond or lake, which could be used to create a more realistic and immersive experience.

Finally, sensors can be used to detect temperature, humidity, and other atmospheric conditions of the virtual environment and adjust accordingly. For example, if the user is in a virtual forest and the temperature of the environment changes, the trees and other elements of the landscape could be adjusted based on the new conditions. This could allow for a more realistic and immersive experience for the user.

Follow up Q: What about touch or pressure sensors?

A: Touch or pressure sensors can also be used to enhance the virtual reality experience of nature. These sensors can detect a user's movements and detect changes in the pressure exerted by the user's body. **This could be used to create a realistic experience of walking on grass, through a forest, or on a beach.** These sensors could also detect the user's hand movements, allowing for a more interactive and realistic experience when manipulating objects in the virtual environment. For example, if the user was picking flowers, the sensor could detect the user's hand position and the virtual flowers could be adjusted accordingly. Additionally, the sensors could detect the user's movements and move objects in the virtual environment to ensure a realistic and immersive experience.

Q: Give me some types of sensors to detect touch.

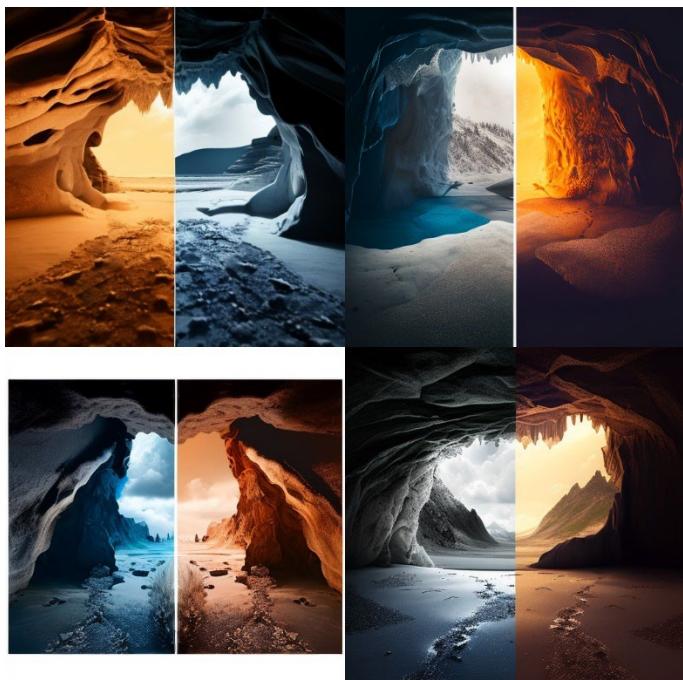
A: There are a variety of types of sensors that can be used to detect touch. One type of sensor that is commonly used is a **force-sensitive resistor (FSR)**. FSRs are resistors that increase their resistance when a force is applied to them. Additionally, **capacitive sensors** can also be used, which measure changes in capacitance when touched. Furthermore, **piezoelectric sensors** can be used to measure the pressure applied to them. Finally, **strain gauges** can also be used to measure the force applied to them. By utilizing these sensors, one can create a more immersive and interactive virtual reality experience with touch detection.

3.2.2 Idea visualisation with text-to-image AI tools

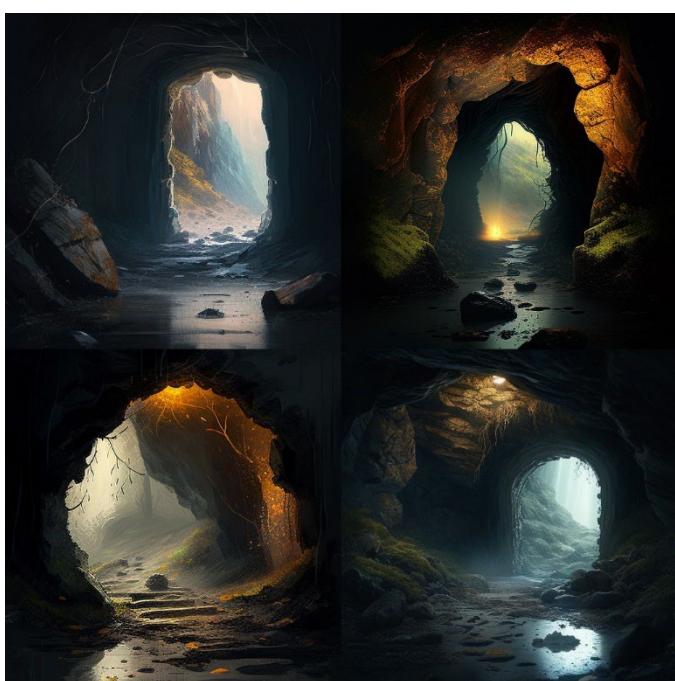
Once you have a clearer general direction to be able to write prompts for a text to image generator you can use visualisations of ideas to spark new ideas and/or present them to others. The following are examples of the resulting images that were used as inspiration.

3.2.2.1 Midjourney

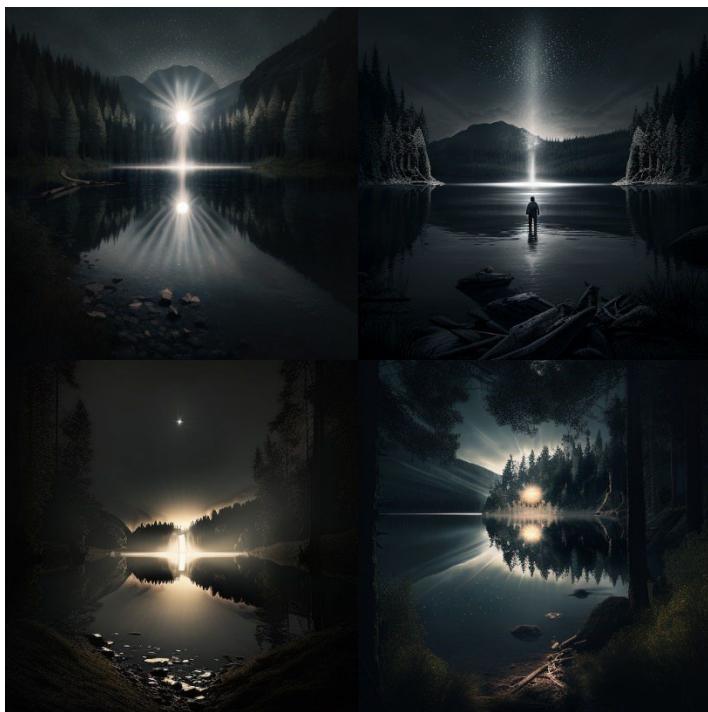
Contrasts in nature



Tight spaces

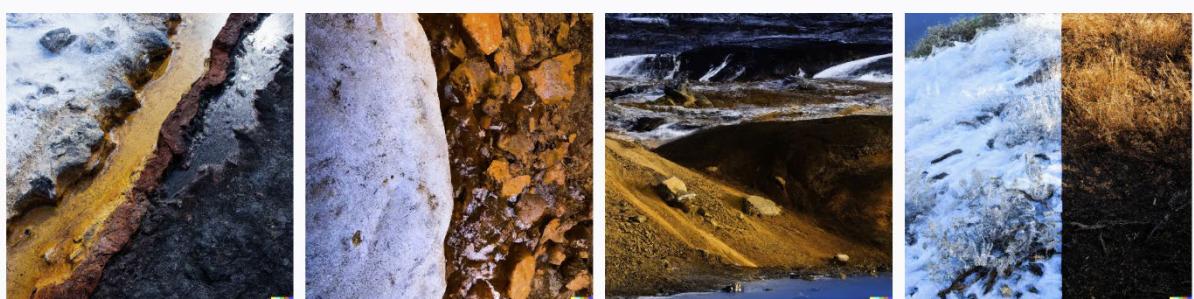


Light in the dark

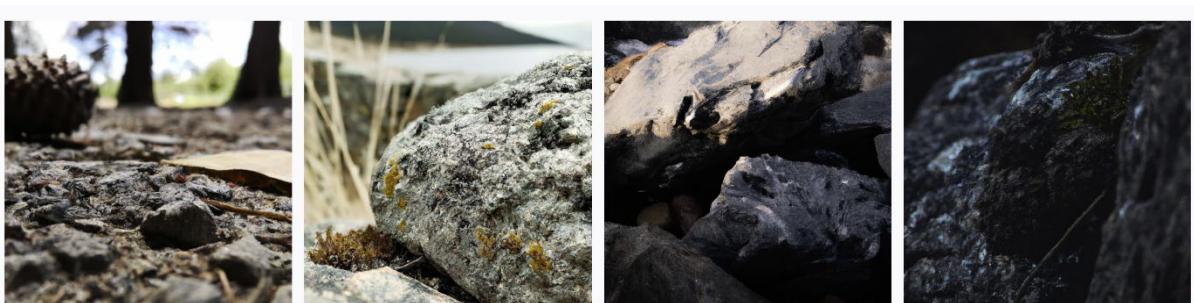


3.2.2.2 DALL-E 2

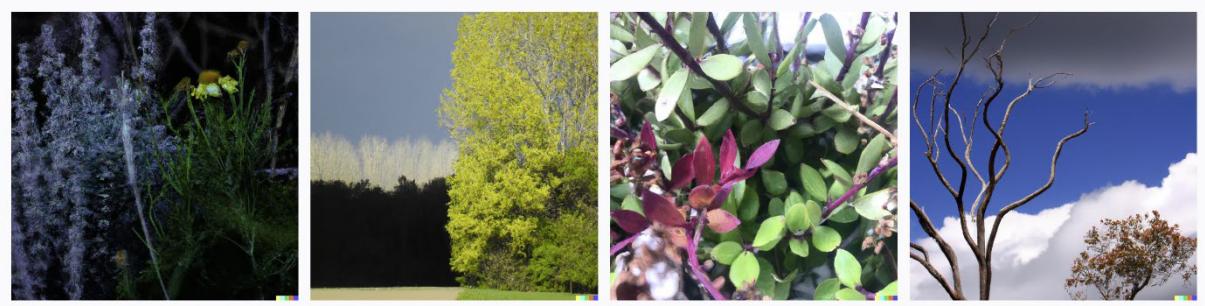
Prompt: contrast between hot and cold, soft and hard, light and dark, and wet and dry in nature



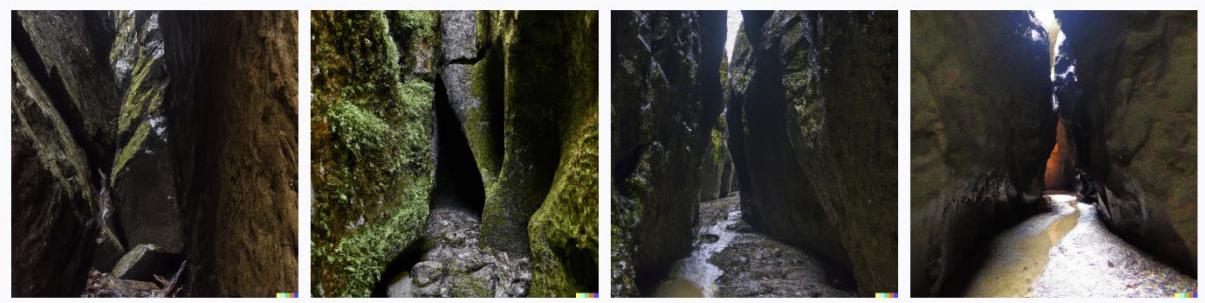
Prompt: contrast hard and soft in nature



Prompt: contrasts in nature



Prompt: damp cave narrow passage open air chasm canyon



Prompt: damp cave narrow passage



Prompt: damp cave



Prompt: narrow space in nature cold dry



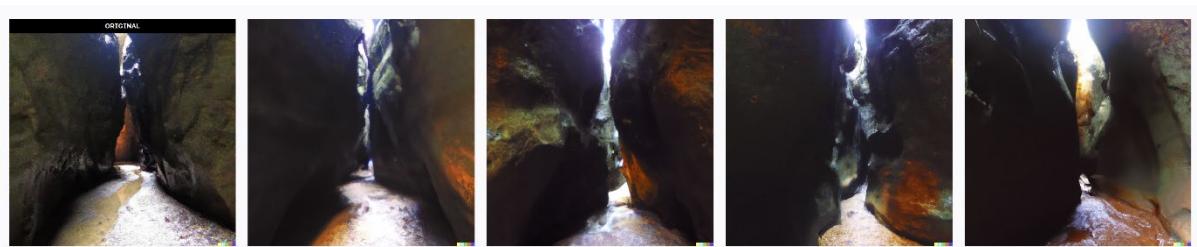
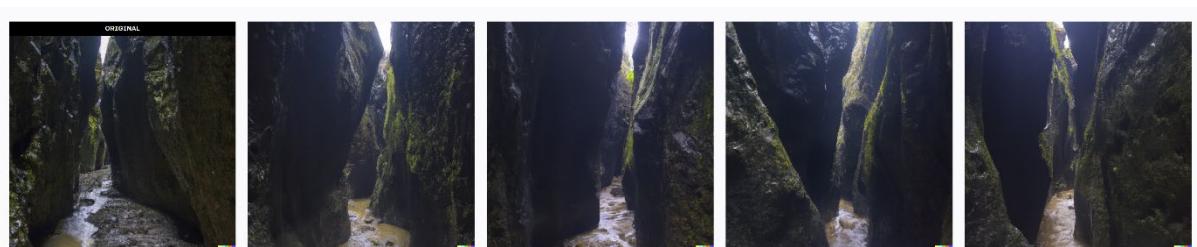
Prompt: narrow space in nature hot and dry



Prompt: narrow space in nature



Prompt: narrow space variations





Prompt: sensory contrasts in nature

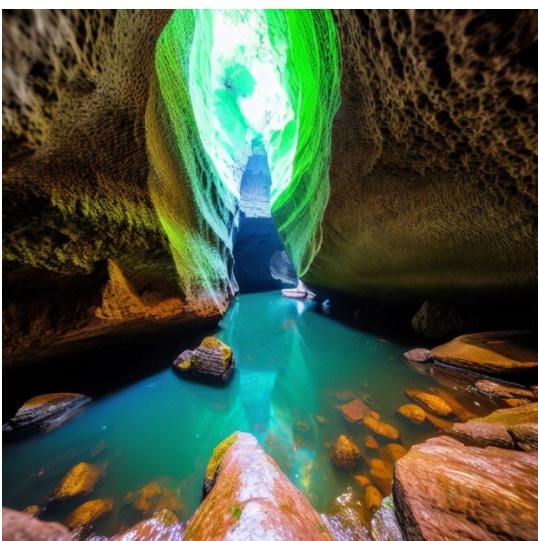


Prompt: the taste of a fresh rain shower in the summer



3.2.2.3 Stable Diffusion

Prompt: very narrow thight cave nature



Prompt: contrasts in nature



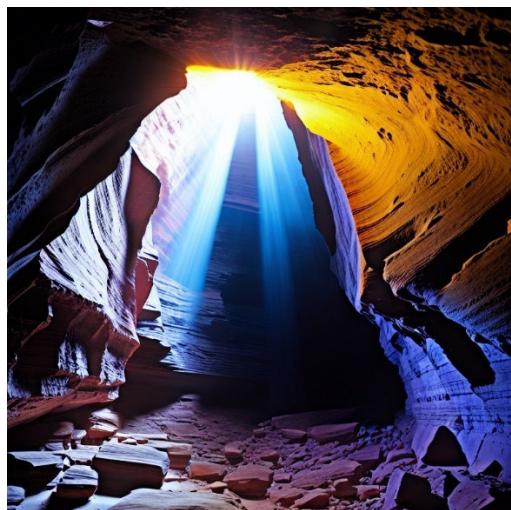
Prompt: sensory contrasts in nature



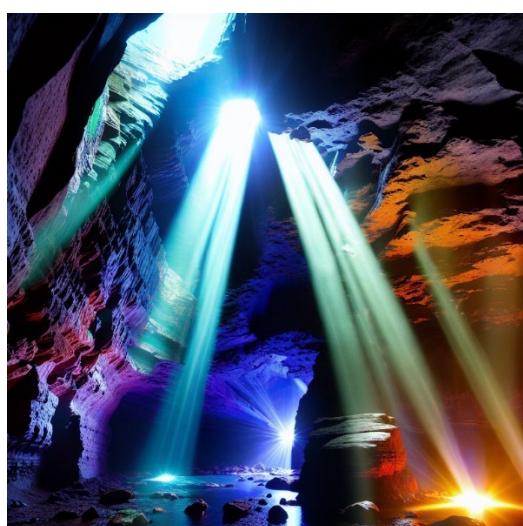
Prompt: hyper reality nature



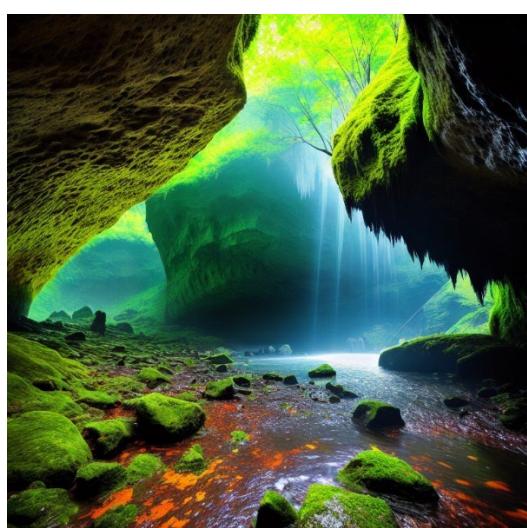
Prompt: dark cave shining light high contrast narrow walls closing in chasm canyon



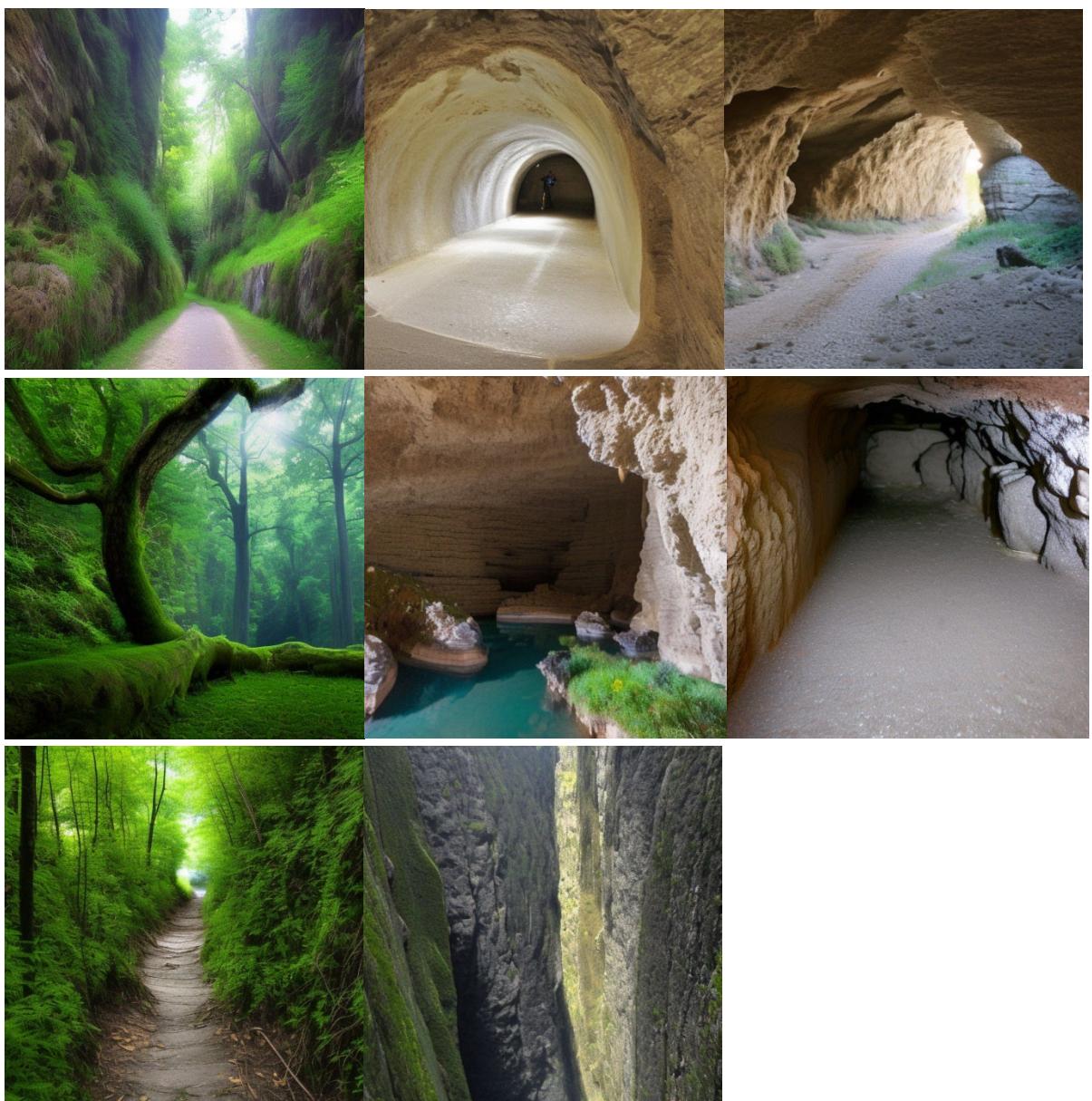
Prompt: wet dark cave shining light high contrast narrow walls closing in chasm canyon



Prompt: damp cave nature

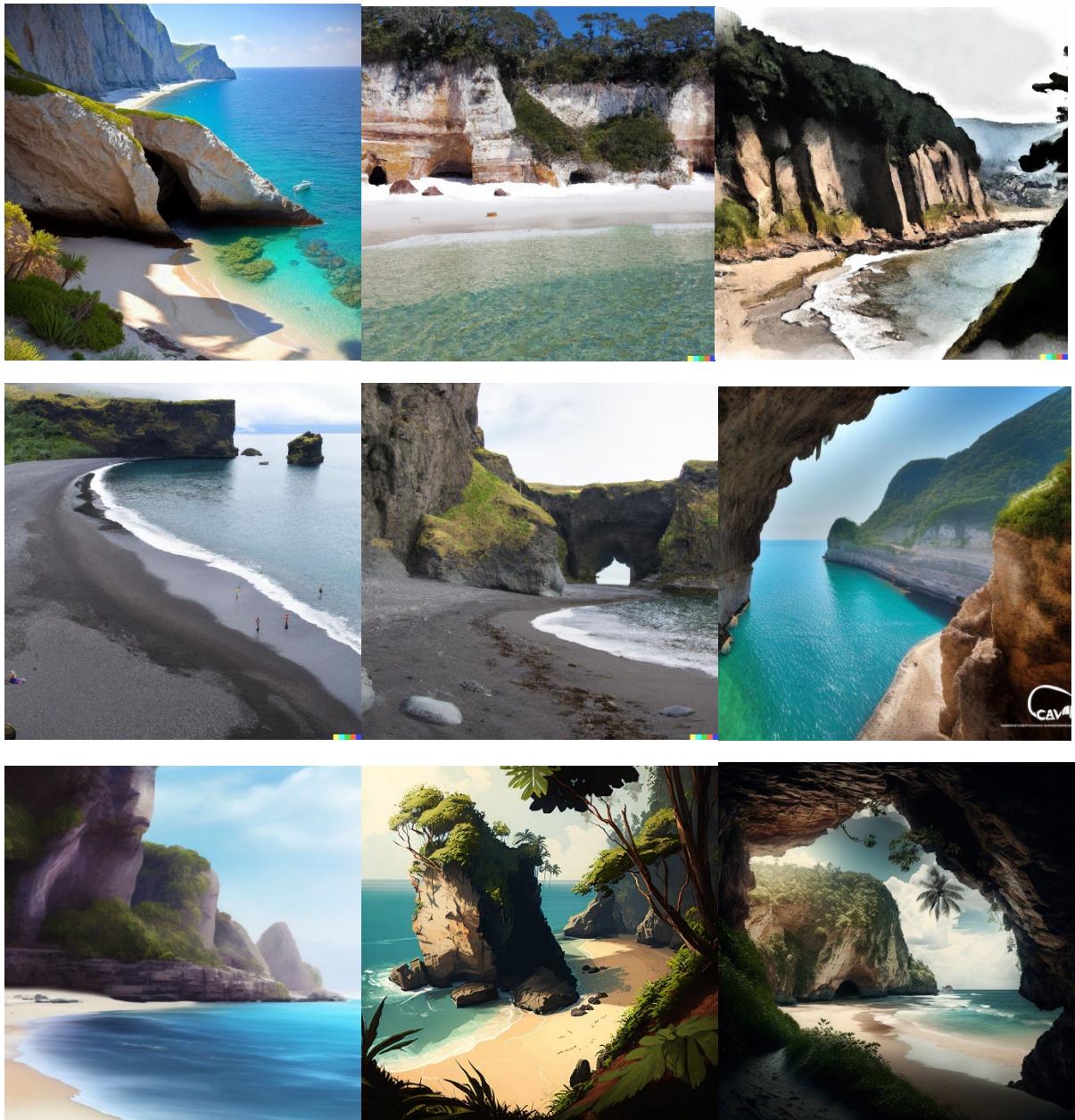


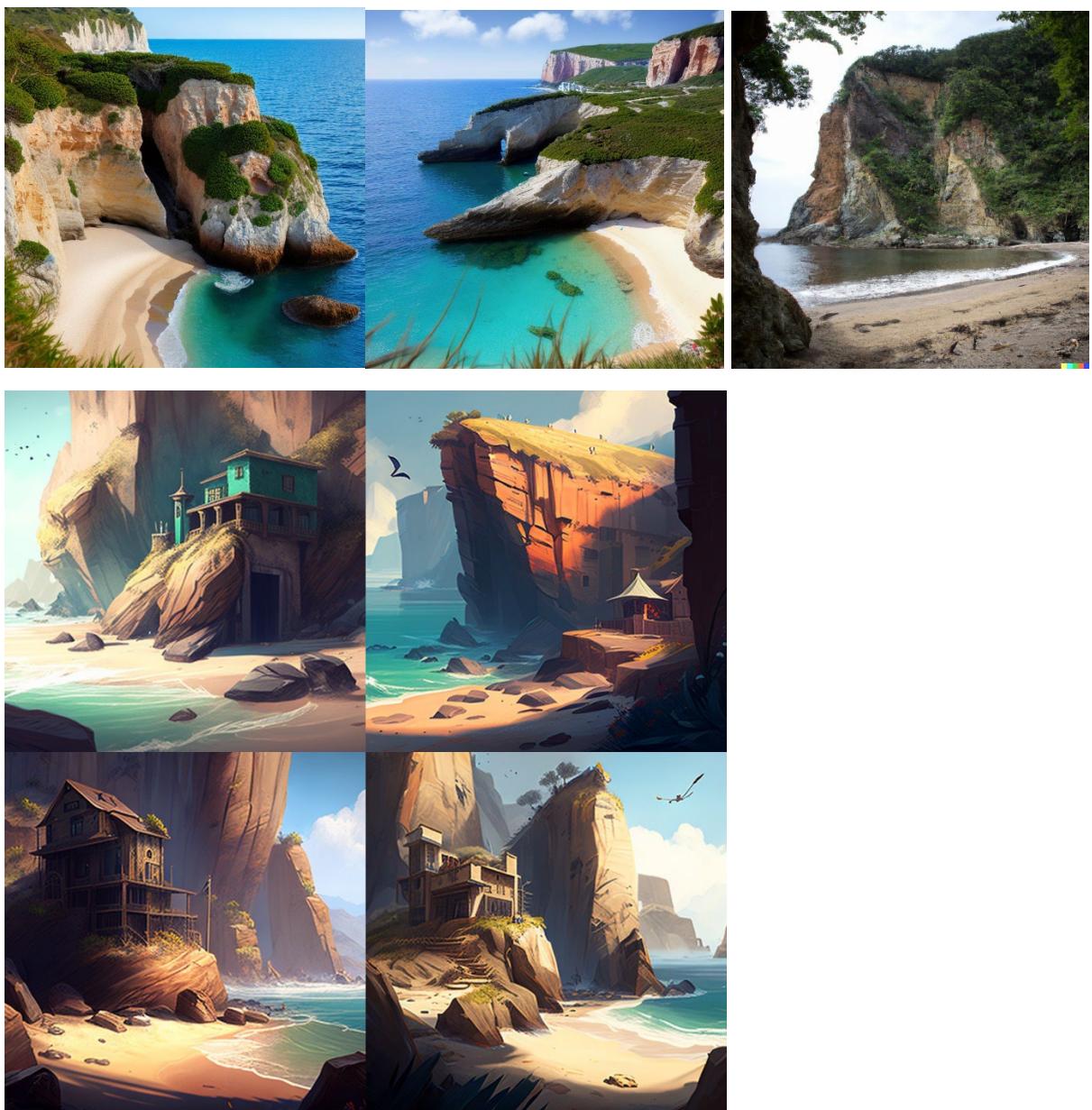
3.2.2.4 Photosonic



3.3 Visualising the Environments

3.3.1 Visualising the beach environment





4 Virtual Reality Development Results

To be able to do test the goals set for the project a custom virtual environment needed to be created. Out of the first user test we concluded that in order to be really immersed the user needed some sort of task or story that lasted long enough. If it is too short the user gets bored and the immersion breaks. It was already decided to build three different biomes to test different things. A Forest, Cave and Beach. So a story was constructed around these. As a starting scene an office environment was added, so the user could then, when ready, escape to nature. It follows a simple story structure where you journey through an environment that gets darker and darker and closes in around you to heighten the tension, to end with the relief of escaping the darkness and ending on the beach with a beautiful sunrise.

4.1 Playthrough Video

[Here](#) is a video of a complete playthrough of the experience as it was at the final user test.

4.2 Scene 1: Office

The office was added to give the user time to be set up with the headset and get used to the virtual reality. The user sits down at their desk and when ready they can press a button to escape to nature.

To build this scene assets from a low poly office asset pack were used together with custom 3D models made with Blender. Some Quixel Megascans materials were used to make surfaces look more convincing and real.



4.3 Scene 2: Forest

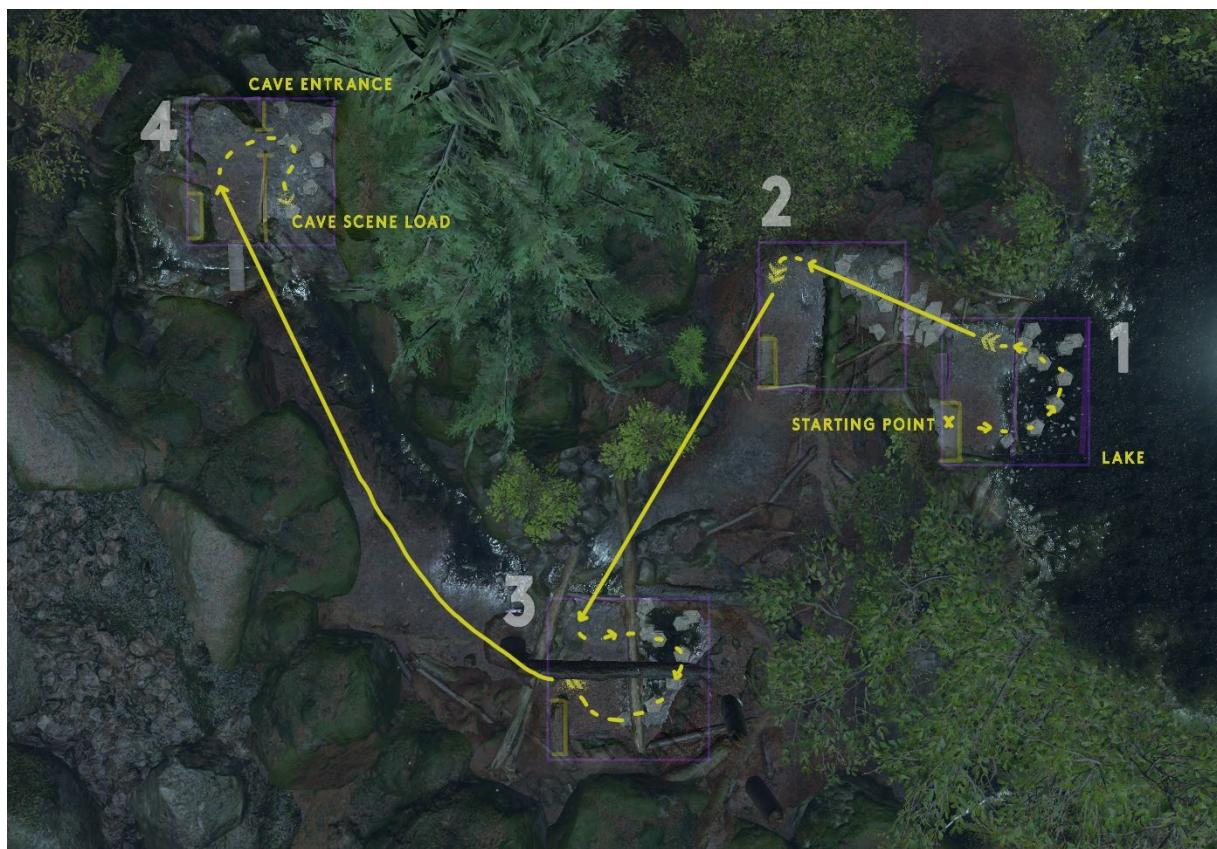
This scene consists of four different locations the user travels through. All four locations include the whole 4x4 meter physical setup.

To transition from the office to nature you start out sitting in front of a lake with a wide open view of where you can enjoy the northern lights. A phenomenon you normally have to travel

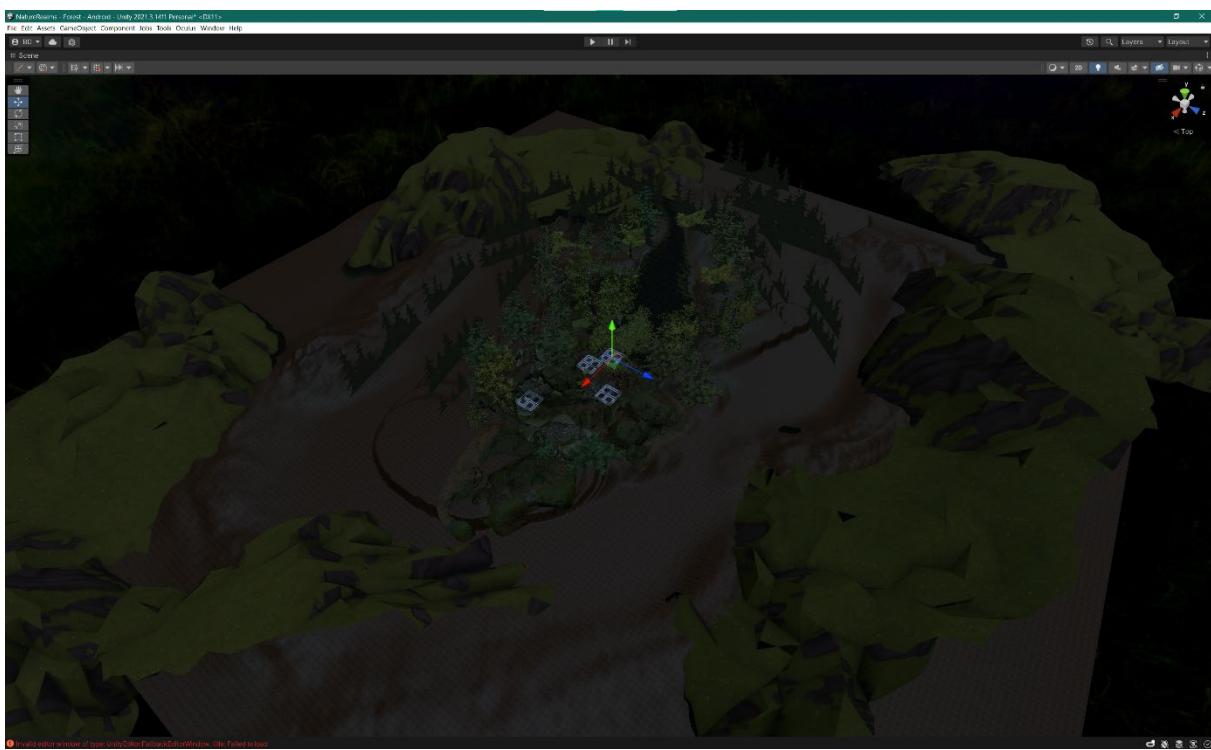
to Scandinavia for to be able to experience it. And even then you might be unlucky and don't get to see it. With a flashlight and umbrella in hand, represented by the Meta Quest 2's controllers, you travel through to forest to the Cave. Along the way there are fireflies that show the way. There are teleportation points on the ground indicated with an arrow and a beam of fireflies that show where the user will end up.

To build the scene mainly 3D assets from Quixel Megascans were used, together with tree models from SpeedTree with wind animations, and Unity's terrain tool with textures from the Quixel Megascans library. For the cave entrance, guidance arrows and aurora borealis effect, custom 3D models were made in Blender.

4.3.1 Overview







4.3.2 Location 1: Lake

4.3.2.1 Moodboard in Miro



4.3.2.2 Screenshots



4.3.3 Location 2: Uphill path

4.3.3.1 Moodboard in Miro



4.3.3.2 Screenshots



4.3.4 Location 3: Hill top

4.3.4.1 Moodboard in Miro

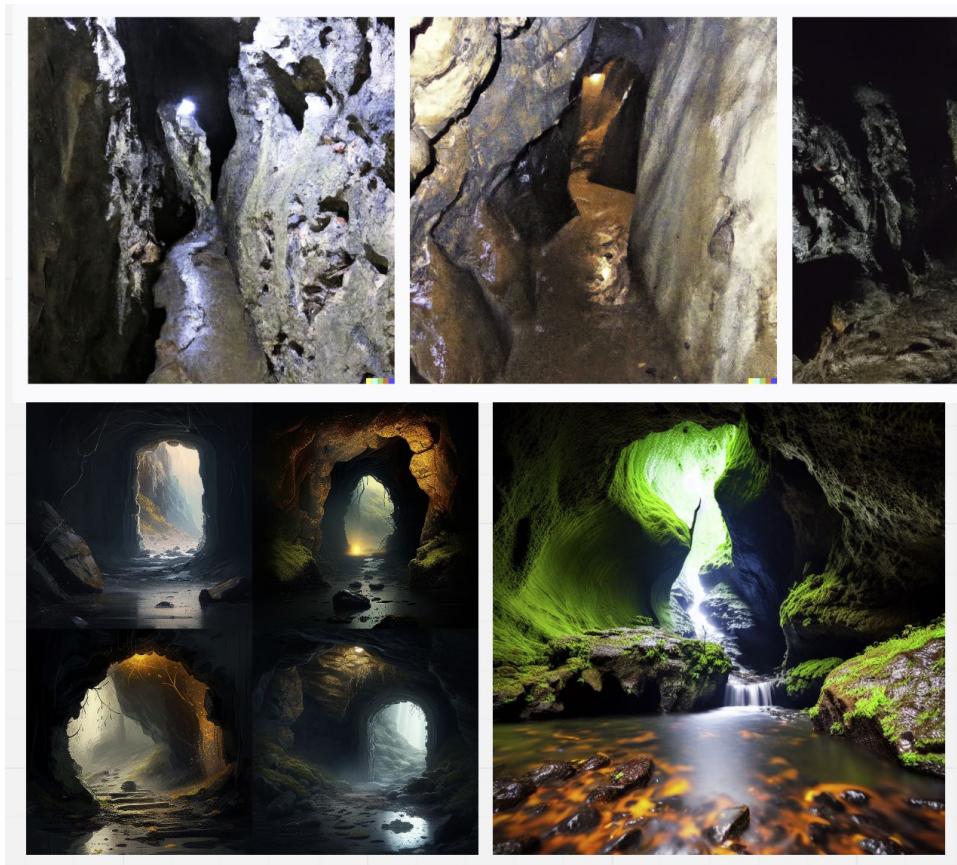


4.3.4.2 Screenshots



4.3.5 Location 4: Cave Entrance

4.3.5.1 Moodboard in Miro



4.3.5.2 Screenshots



4.3.6 Visual Effect: Aurora Borealis

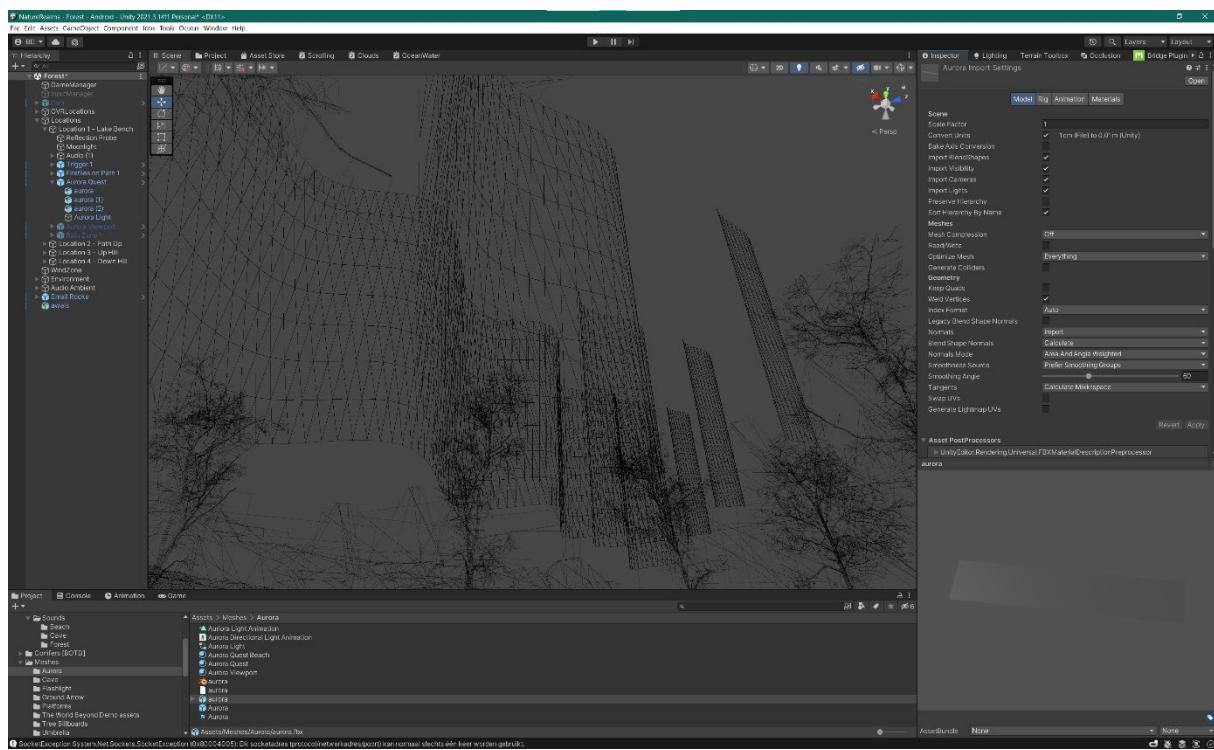
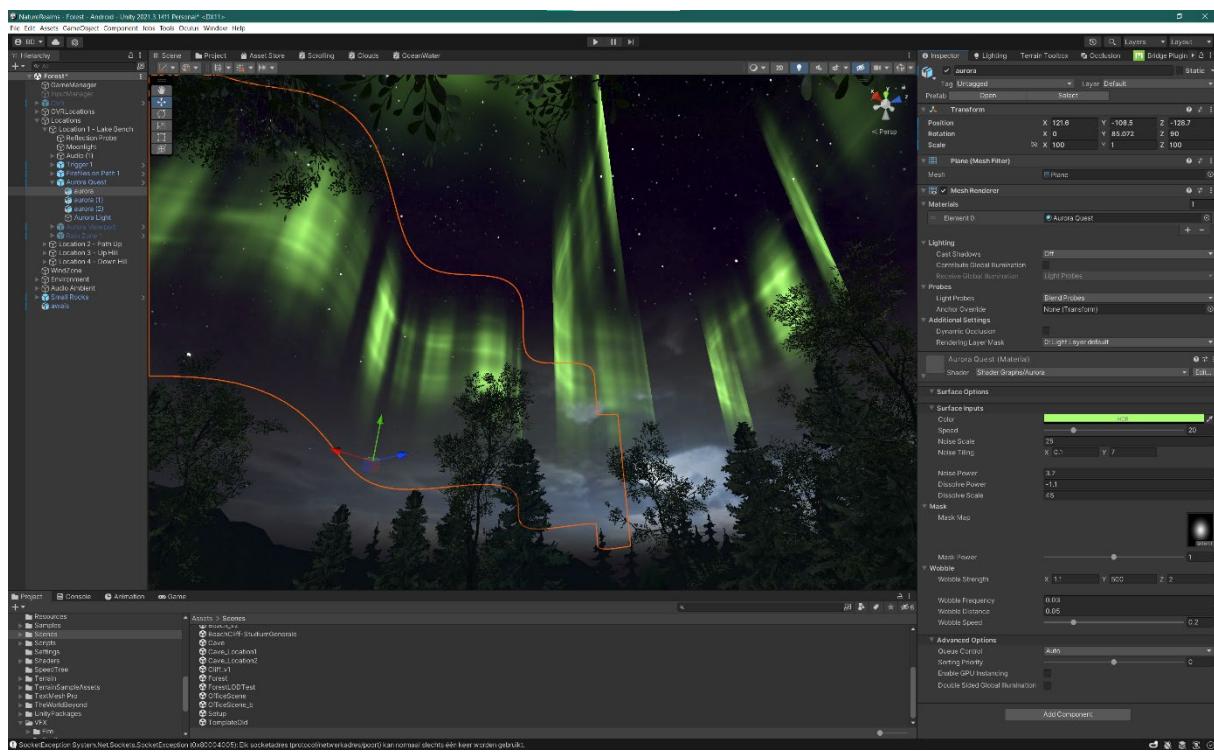
For the Aurora Borealis effect a custom 3D model was created as well as a custom shader with ShaderGraph and URP.

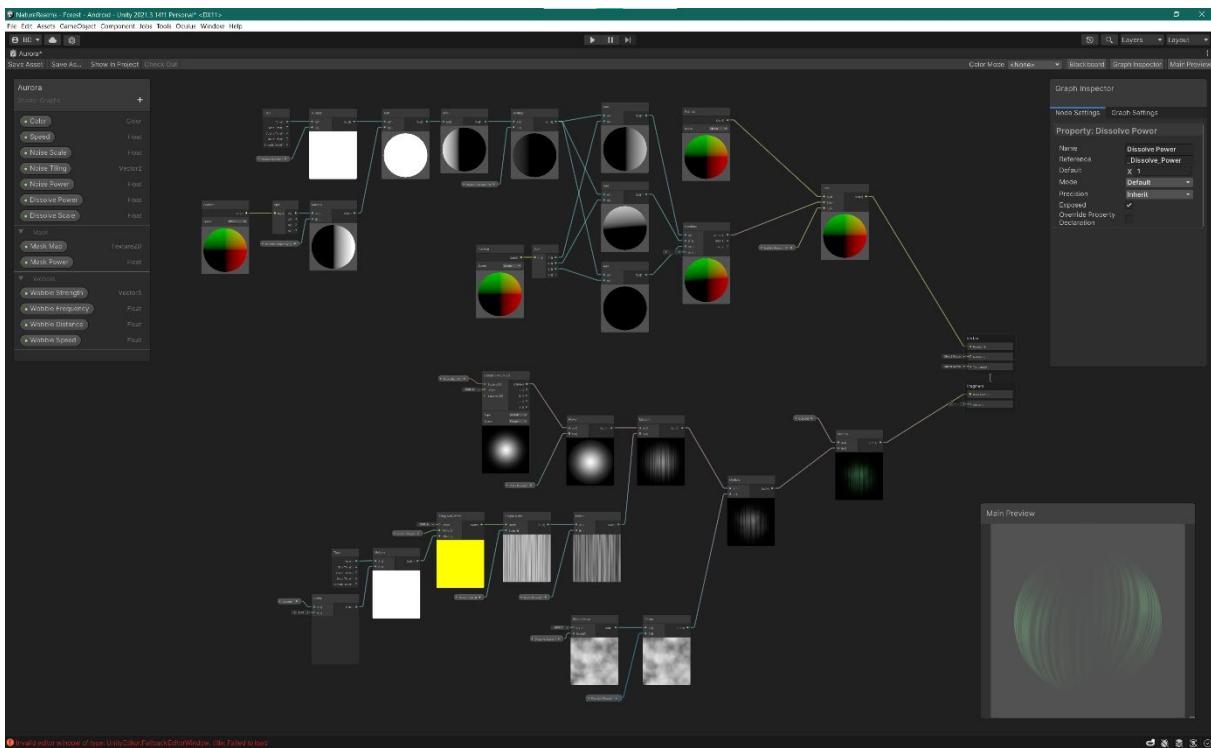
4.3.6.1 Referenceboard in Miro



4.3.6.2 Screenshots







4.3.7 Visual Effect: Fireflies

The guidance arrow and fireflies are a combination of a couple of things.

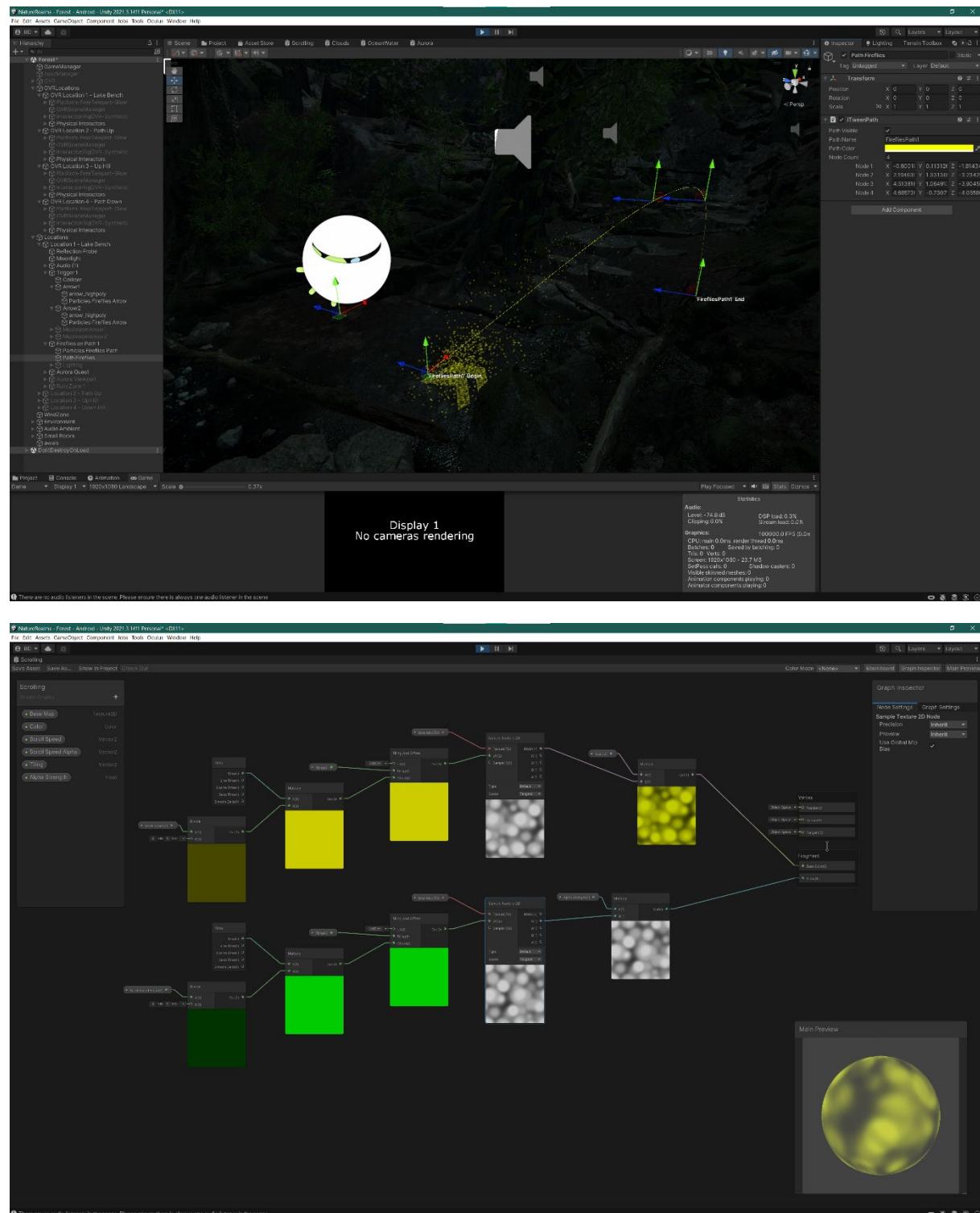
The guidance arrow is made of a custom 3D model with a custom shader build in ShaderGraph and a particles system.

To create the beam of fireflies to the next location the same particle system is used, although with slightly different settings, which are animated to follow a path set up with the Visual iTween path editor and an additional script.

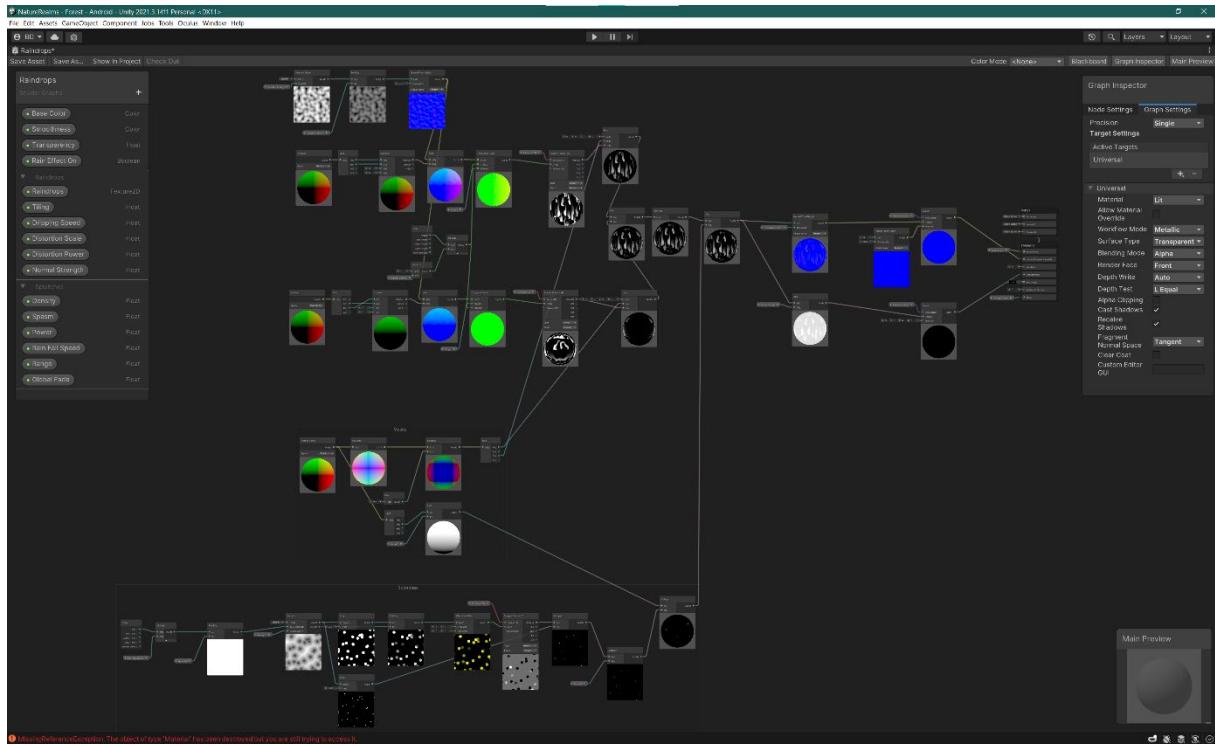
4.3.7.1 Referenceboard in Miro



4.3.7.2 Screenshots



4.3.8 Visual Effect: Umbrella Raindrops

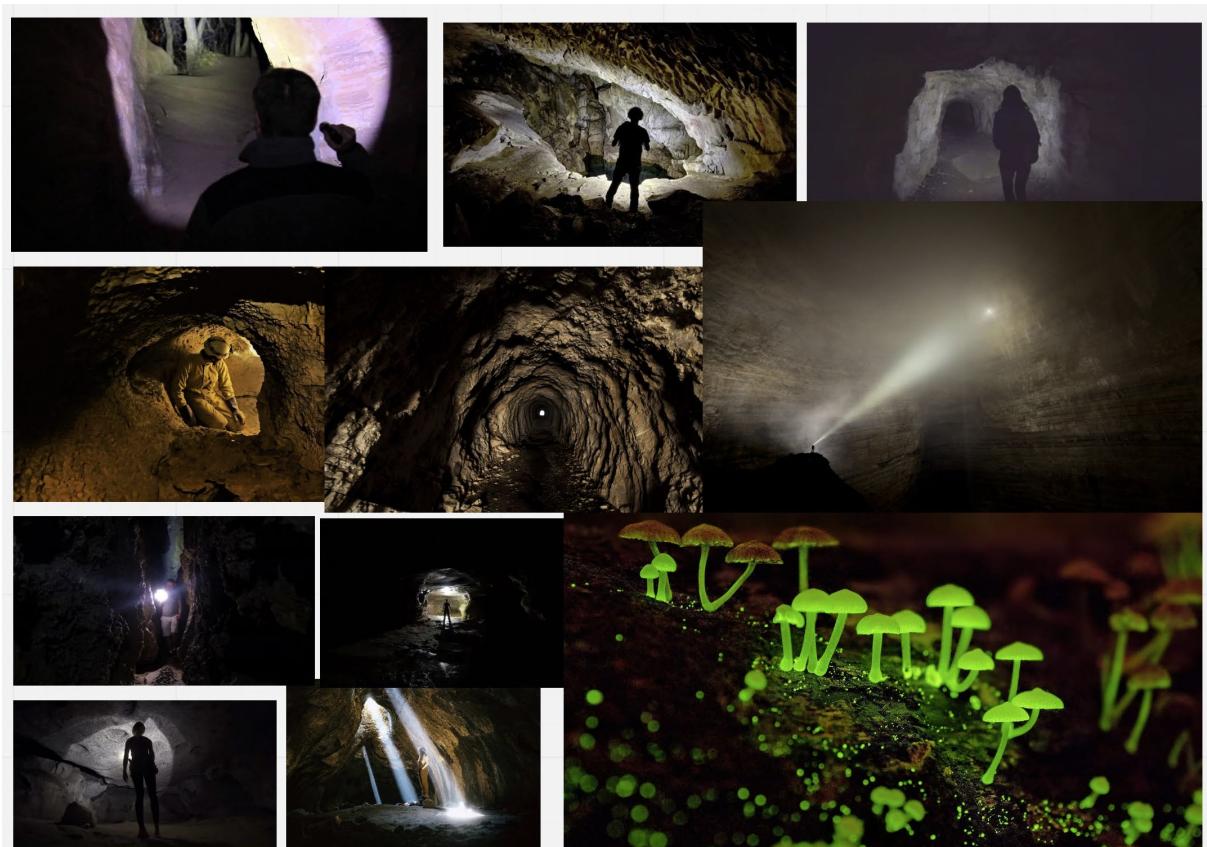


4.4 Scene 3: Cave

The cave consists of two locations. In the first the user experiences a wide open space, but with a very narrow passage next to an abyss. In the following the ceiling gets very low and the user has to crawl through towards the light. Along the way there are luminescent mushrooms to guide the way.

For the walls and structure of the cave a custom 3D model was build. The rest of the assets and materials are from the Quixel Megascans library. The bioluminescence for the mushrooms was easily achieved by slightly editing an existing texture and using it as an emission map.

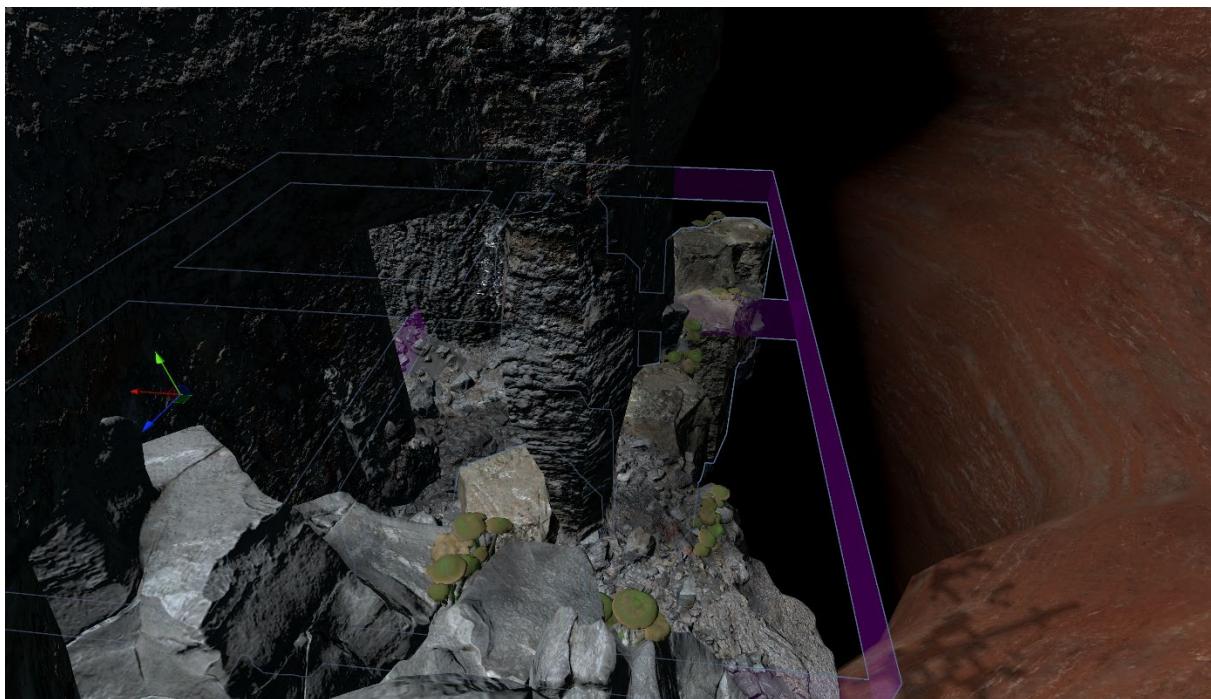
4.4.1 General Moodboard in Miro

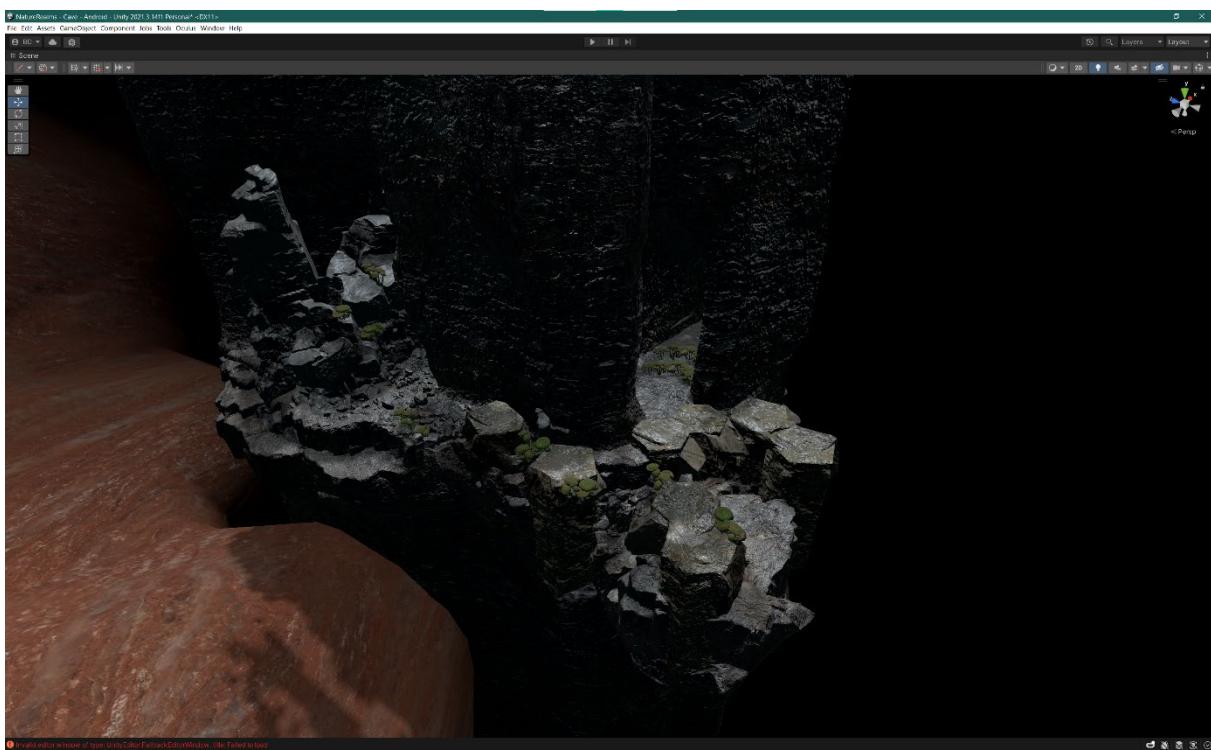


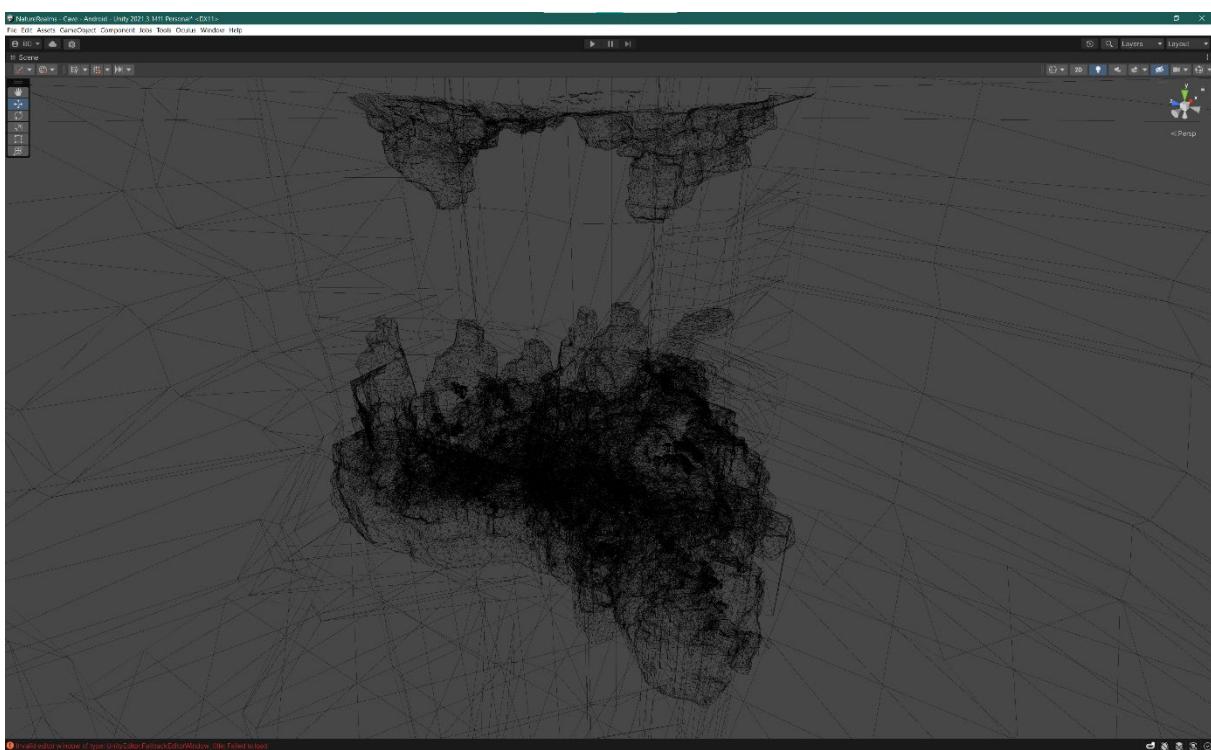
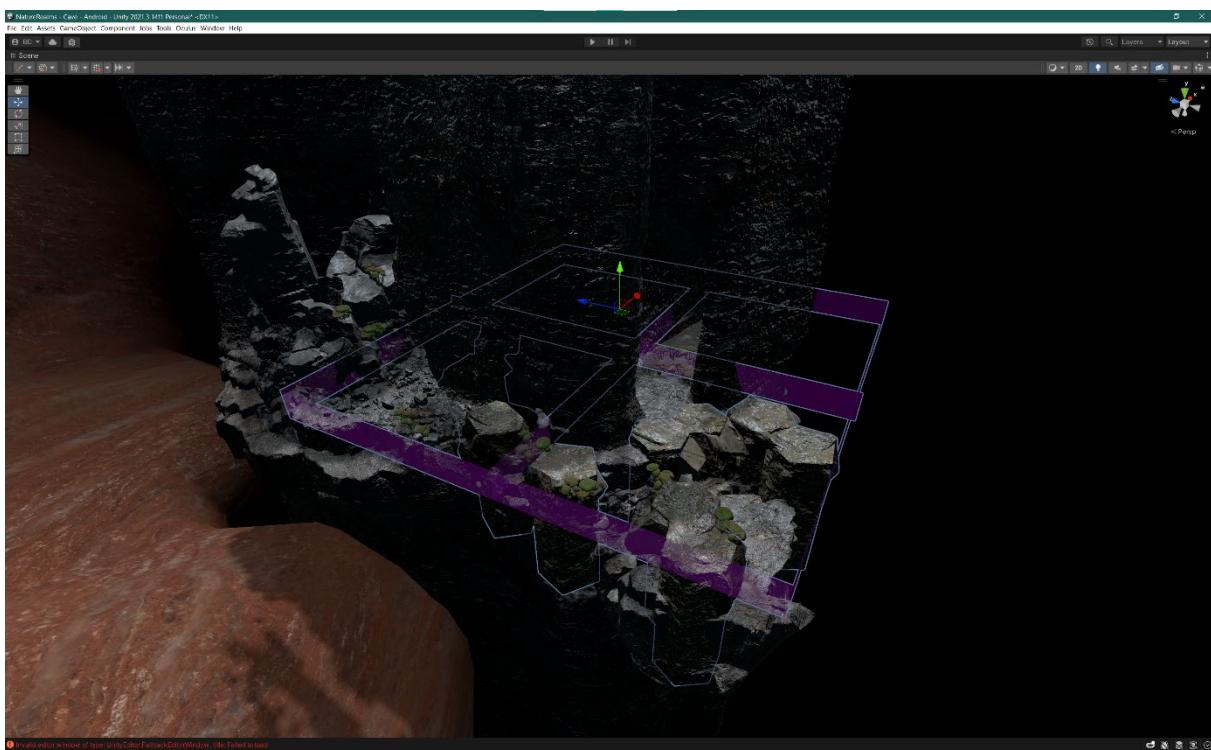
4.4.2 Location 1: The Abyss

The purple lines represent the physical platform size. The screenshots are significantly lit up.

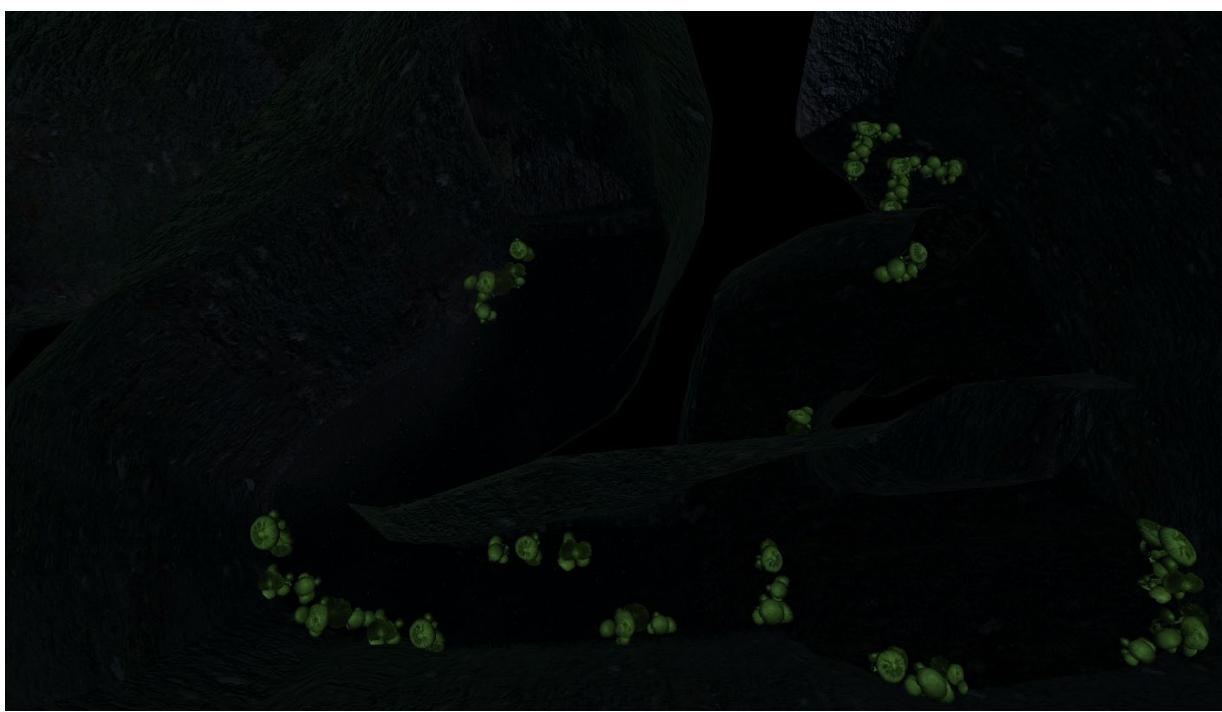
The actual lighting off the scene is the dark screenshot where you can only see the mushrooms in the darkness.

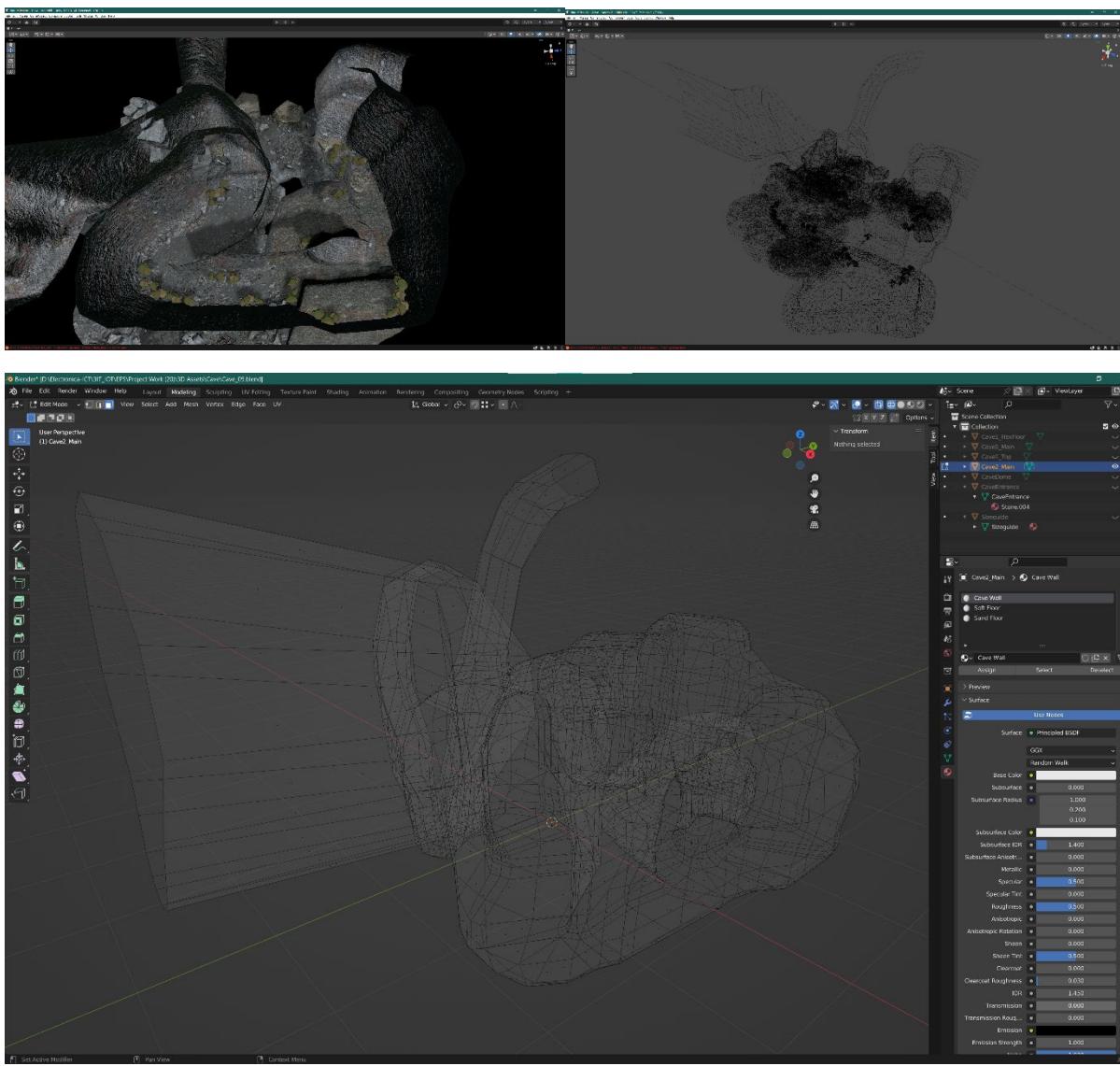




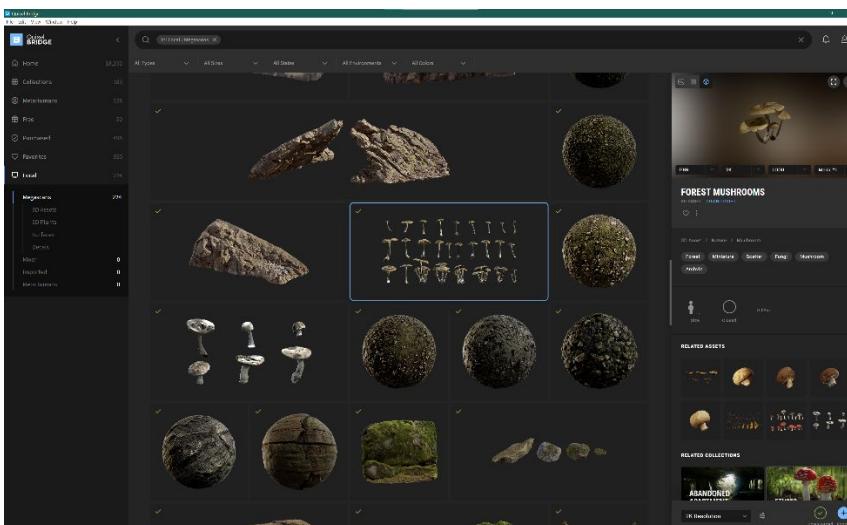
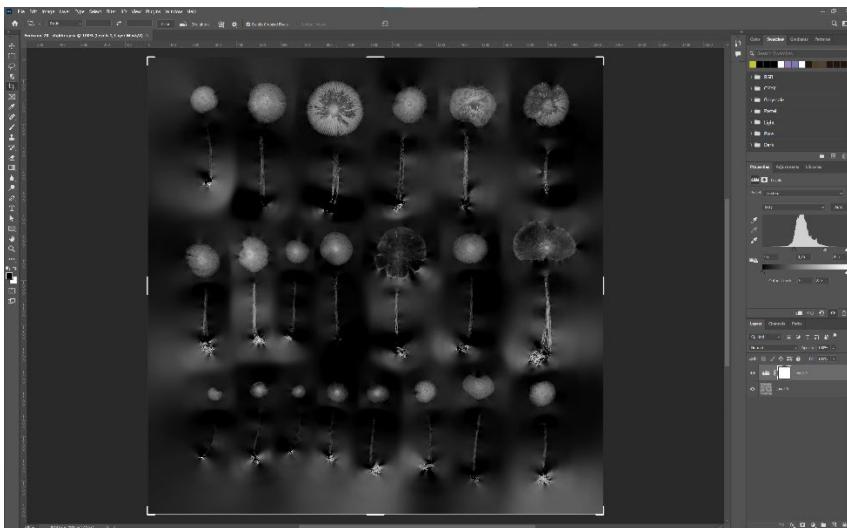
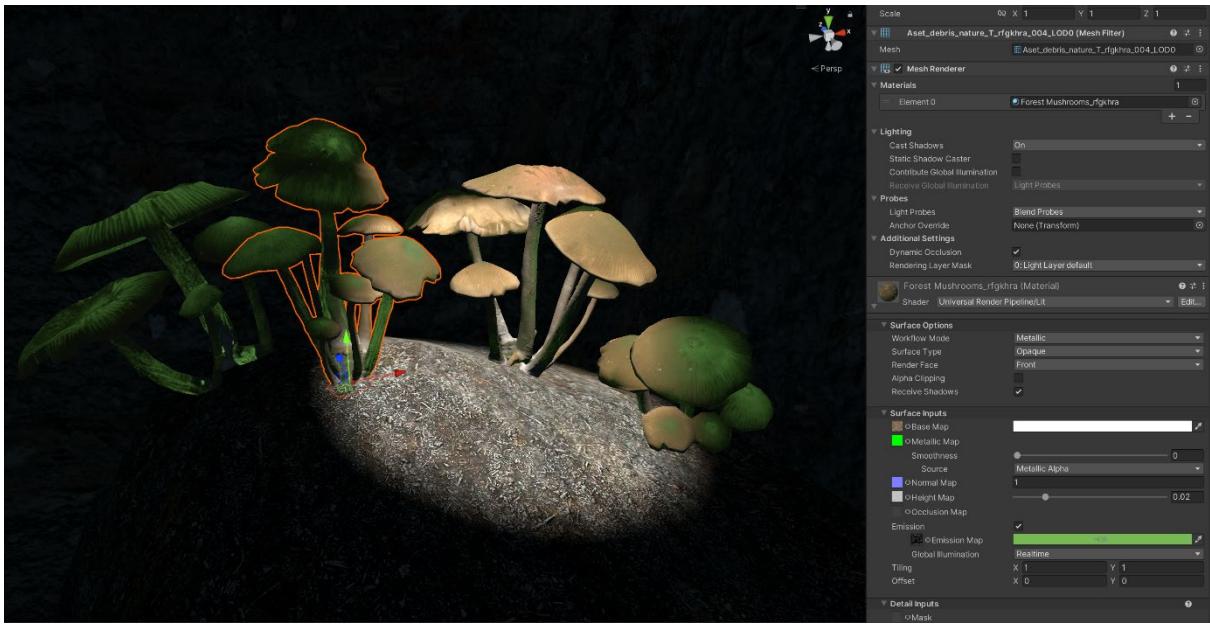


4.4.3 Location 2: The Tunnel





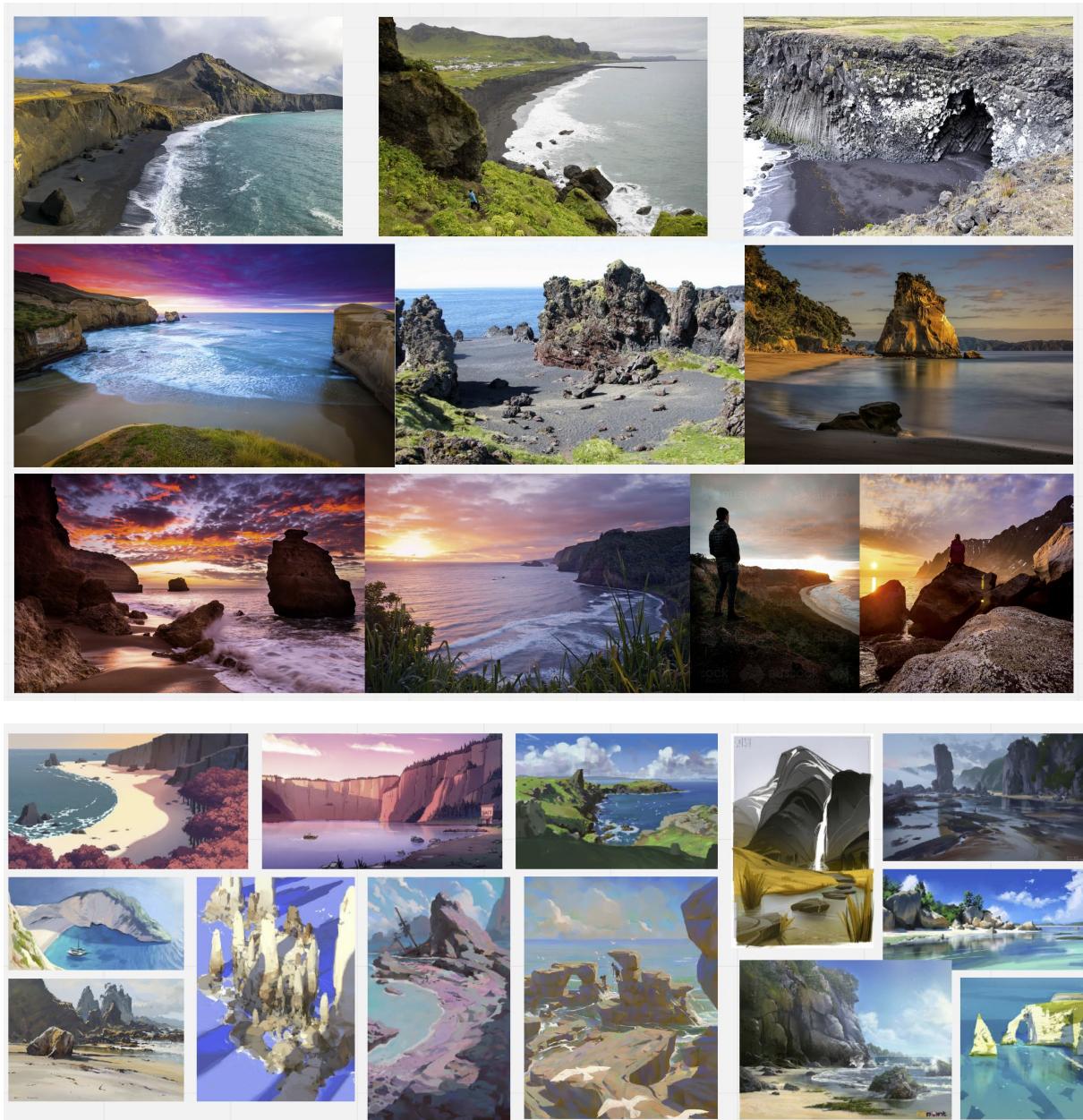
4.4.4 Visual Effect: Bioluminescent Mushrooms



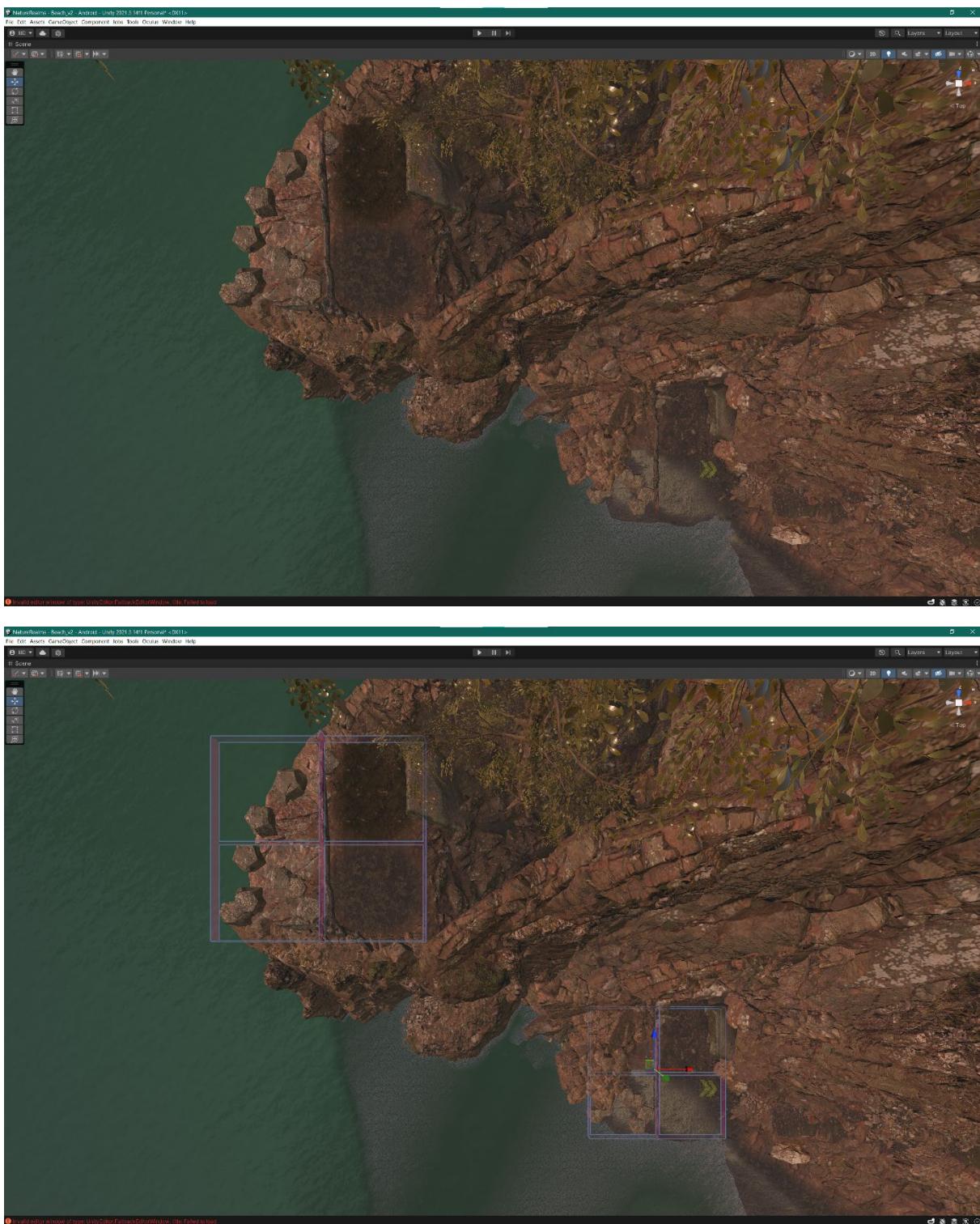
4.5 Scene 4: Beach

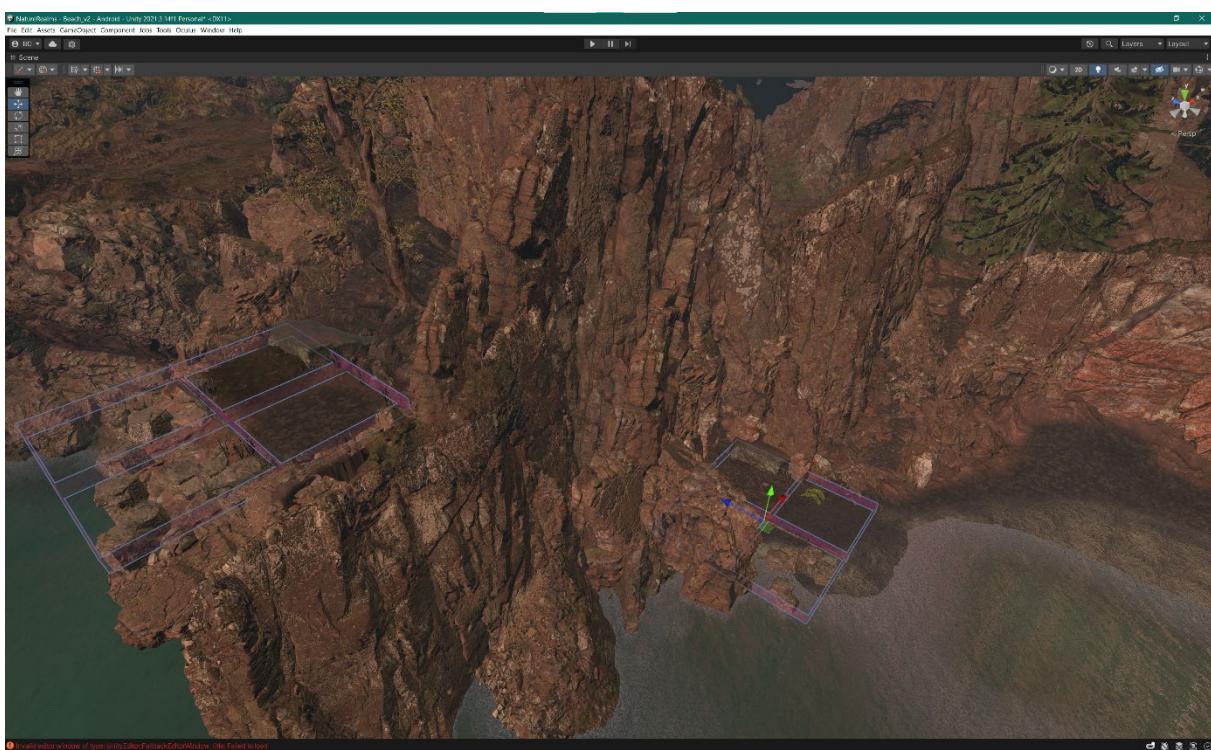
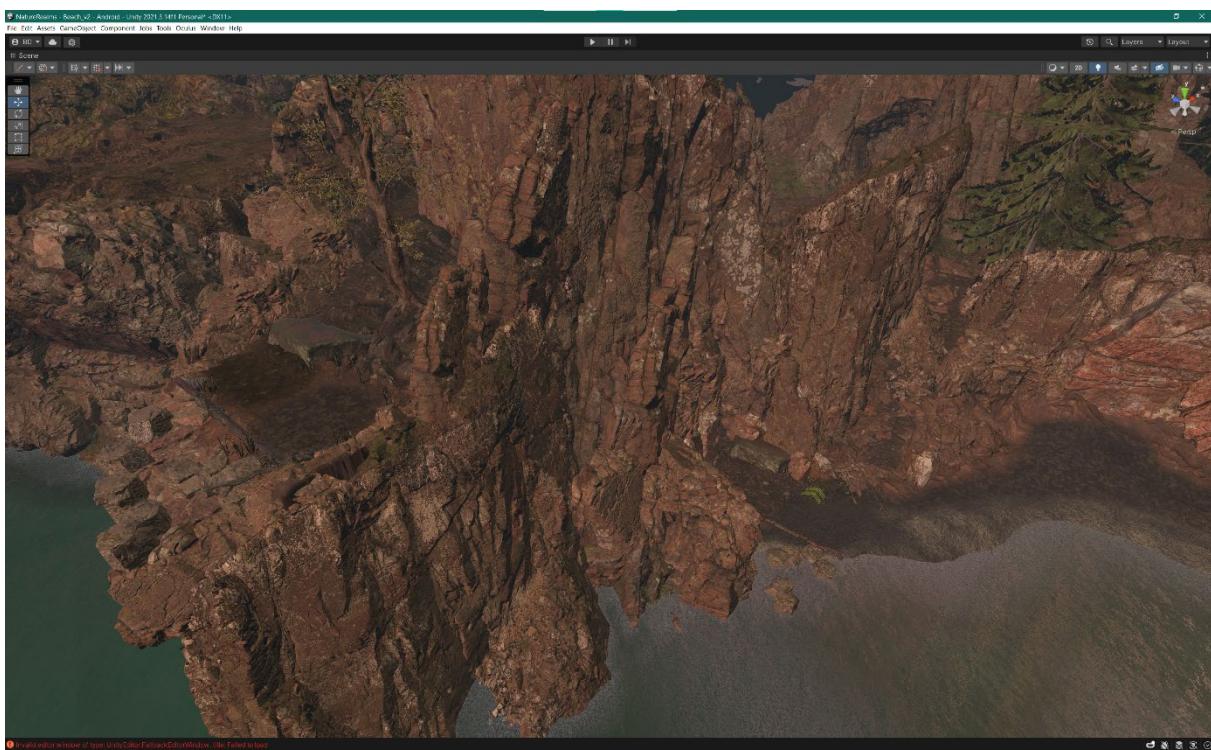
The Beach is meant to be a relief when you come out of the cave. It is a wide open view of a beautiful sunset. You can stay on the beach and enjoy the ocean waves or go to the top of a cliff to have an overview of your surroundings and enjoy the sunrise. Both standing up or sitting down.

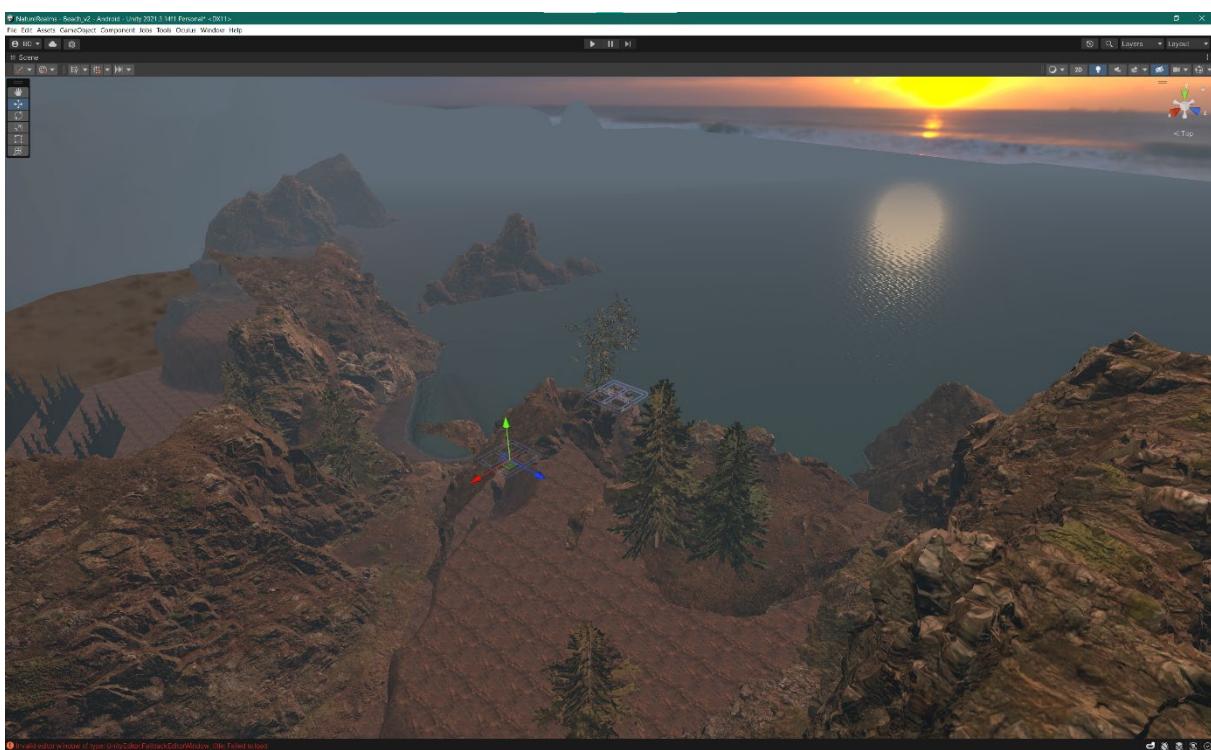
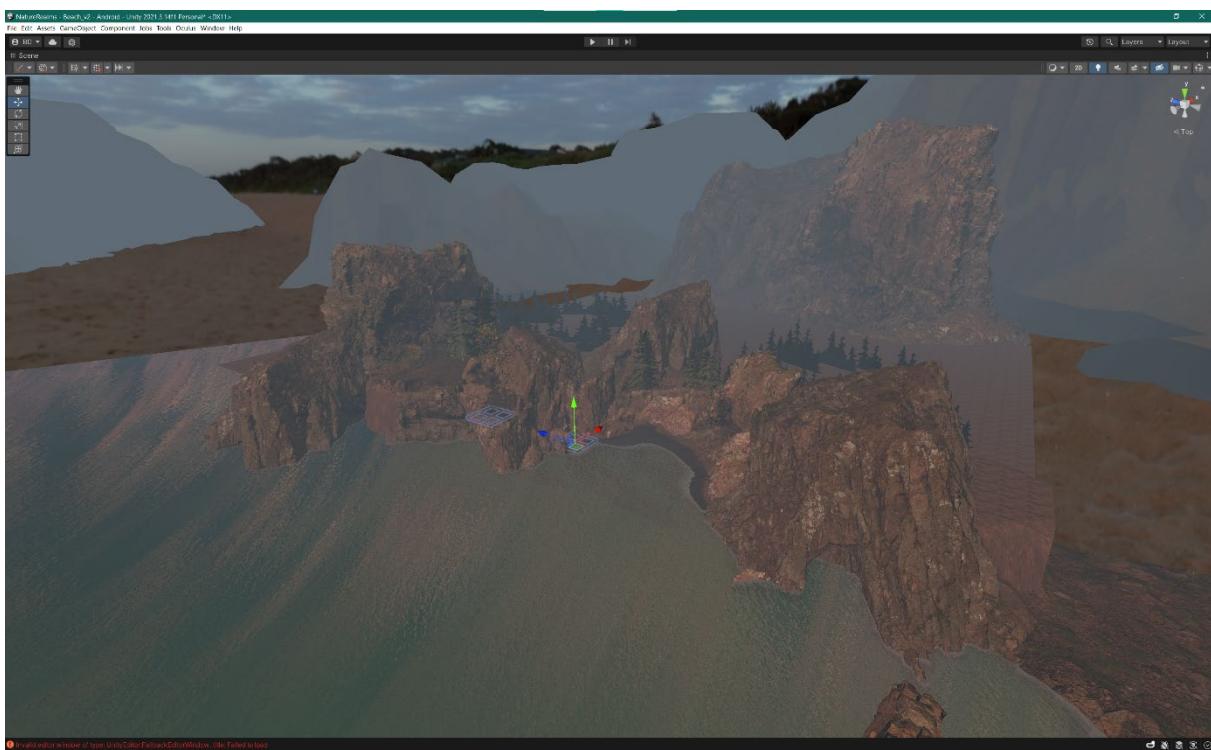
4.5.1 General Moodboard in Miro



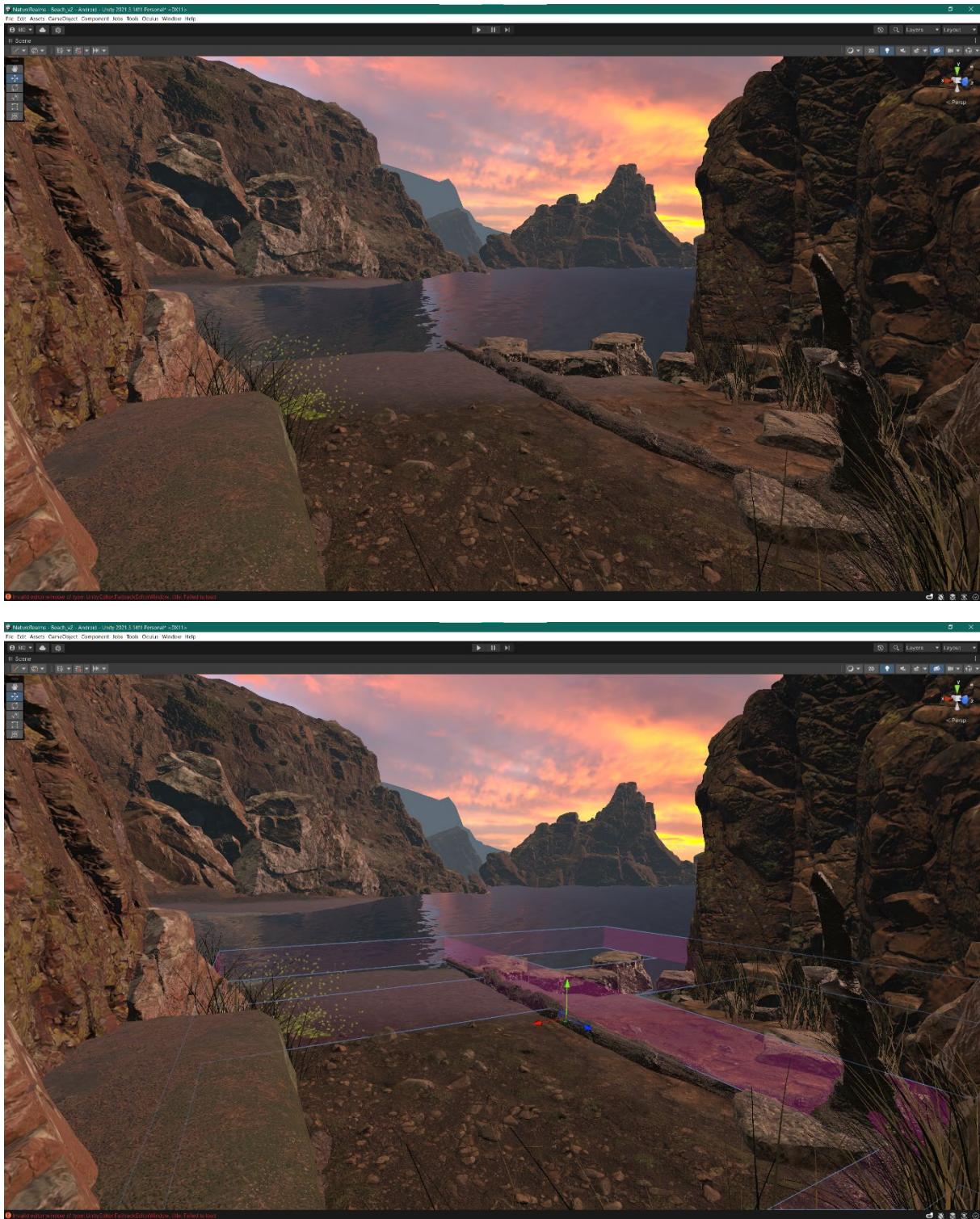
4.5.2 Overview

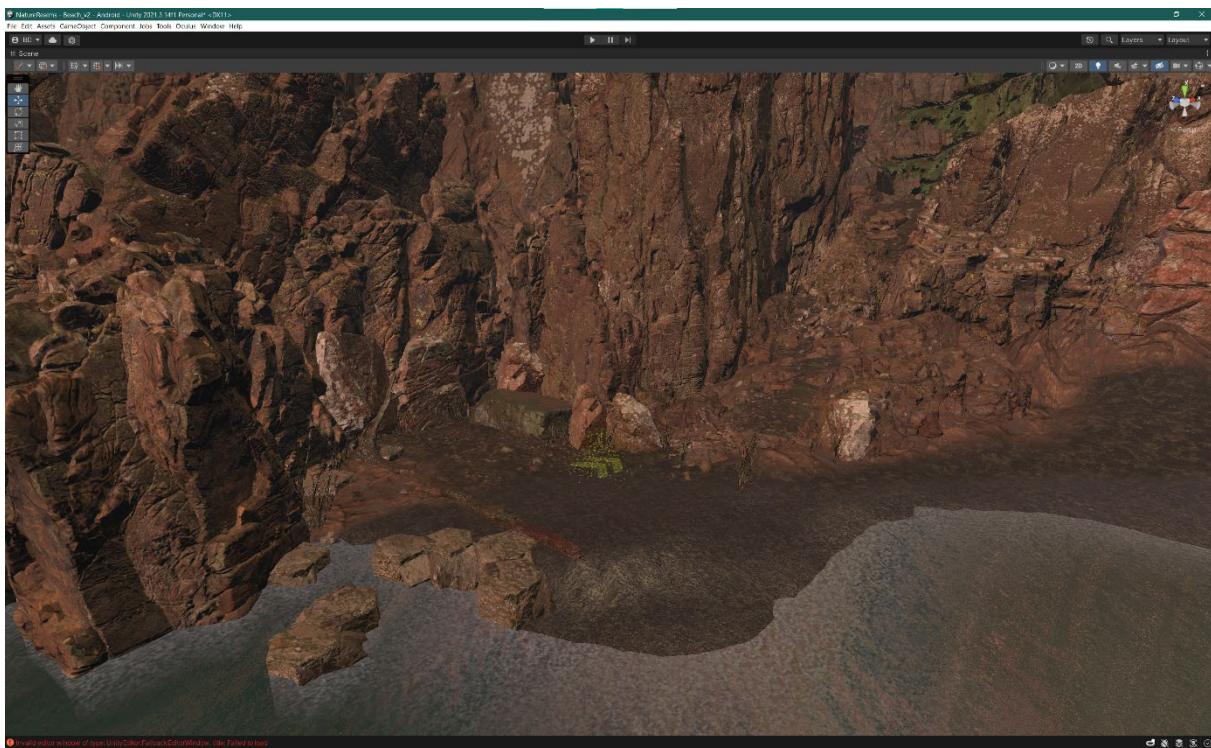




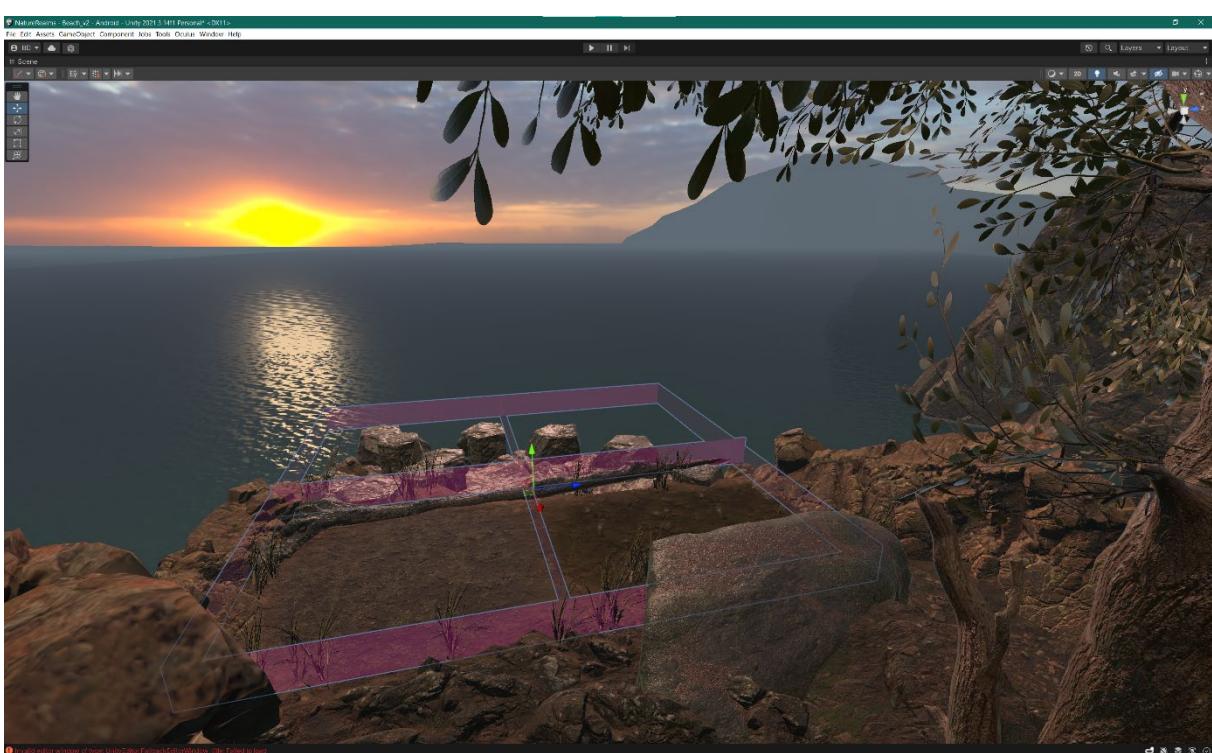
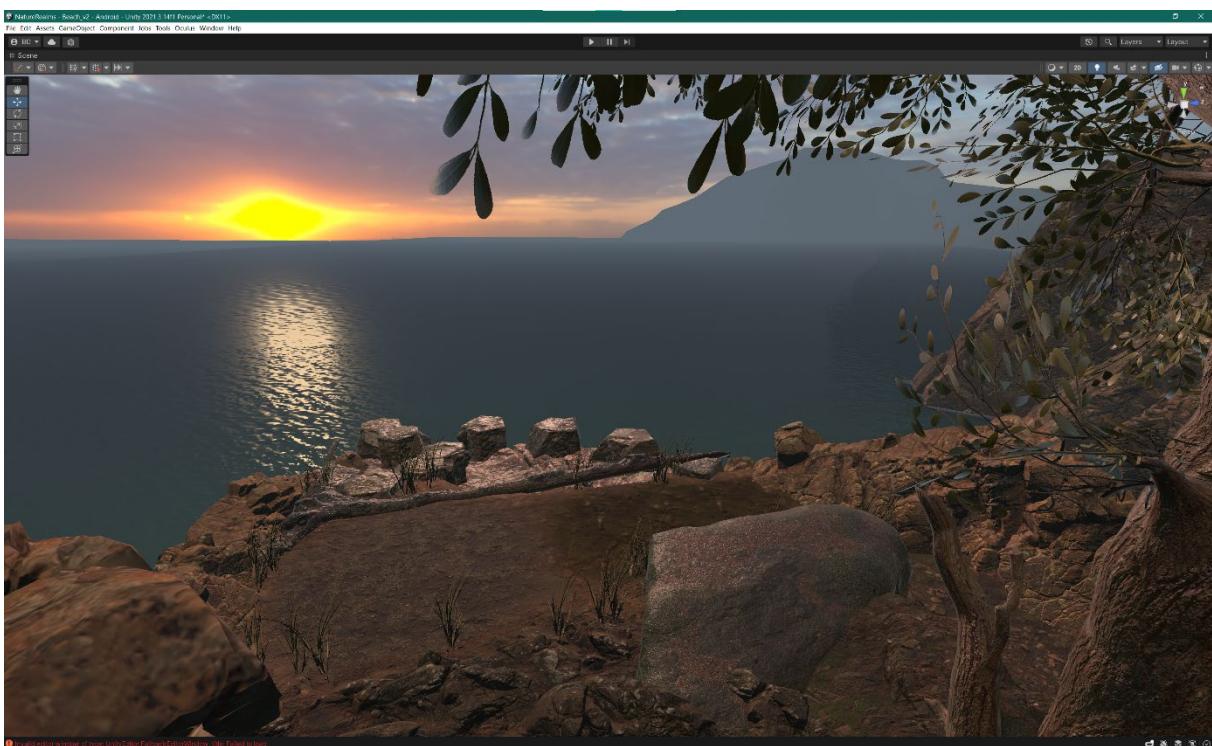


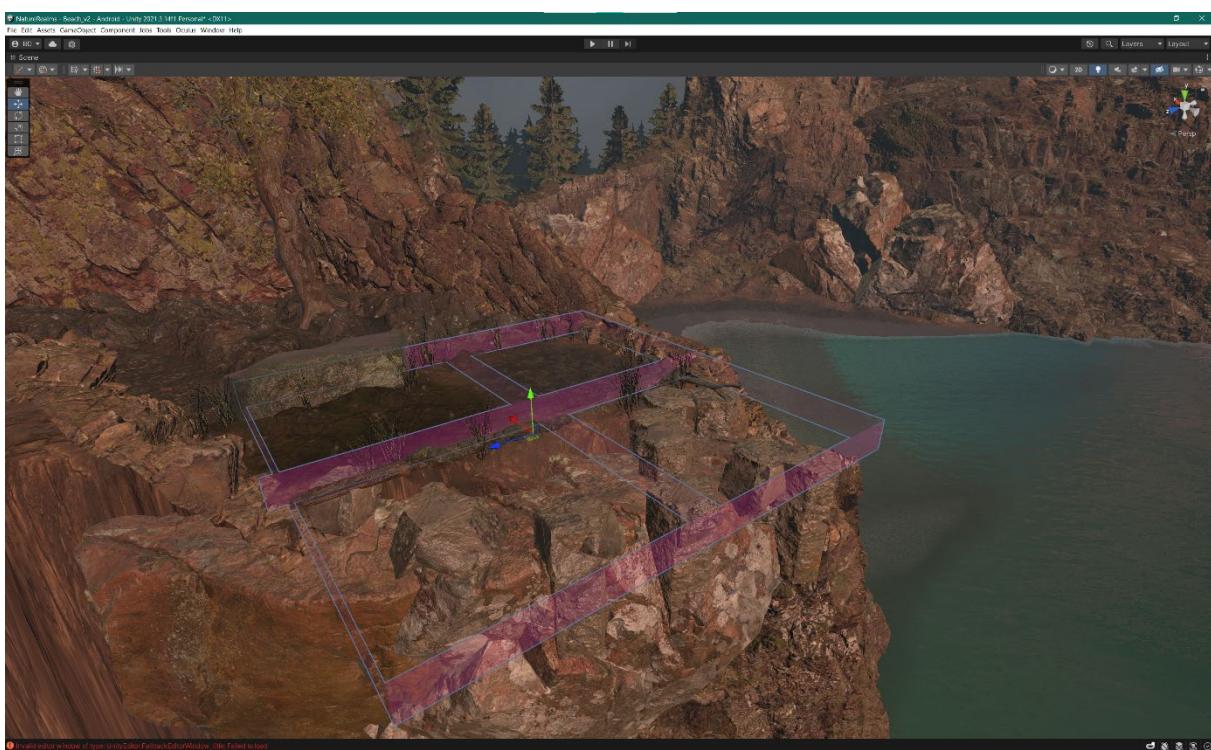
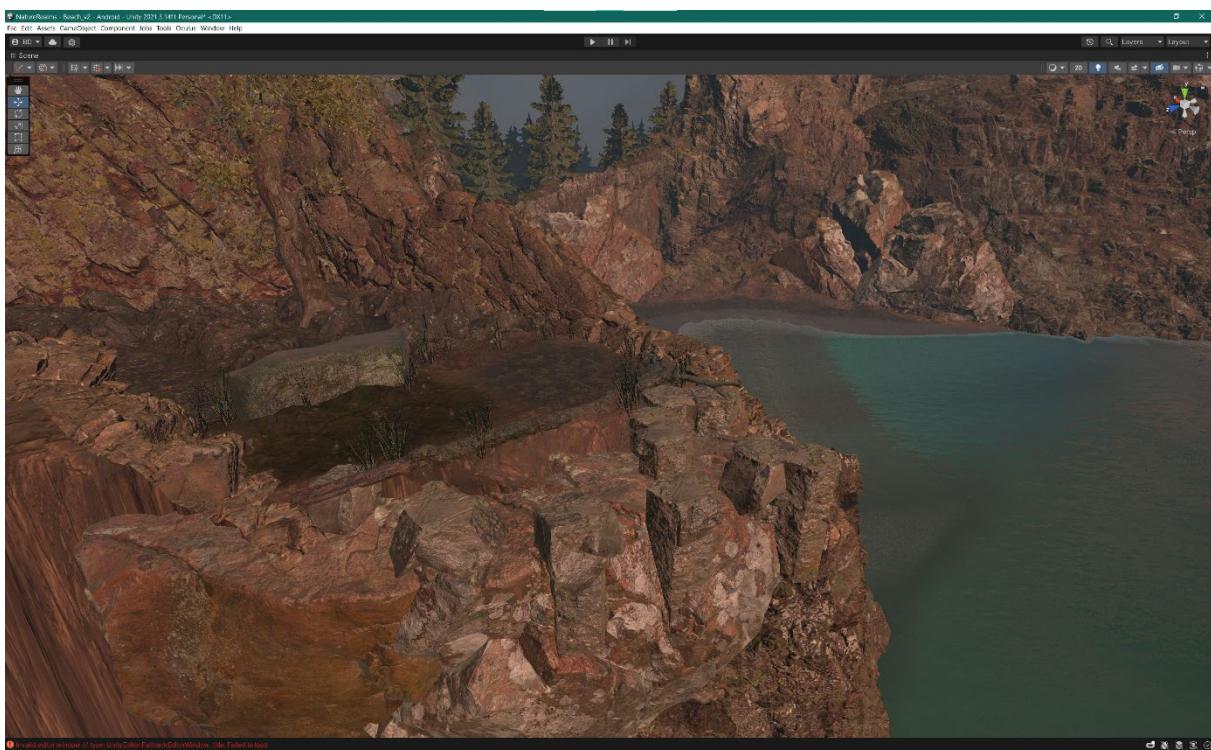
4.5.3 Location 1: The Beach





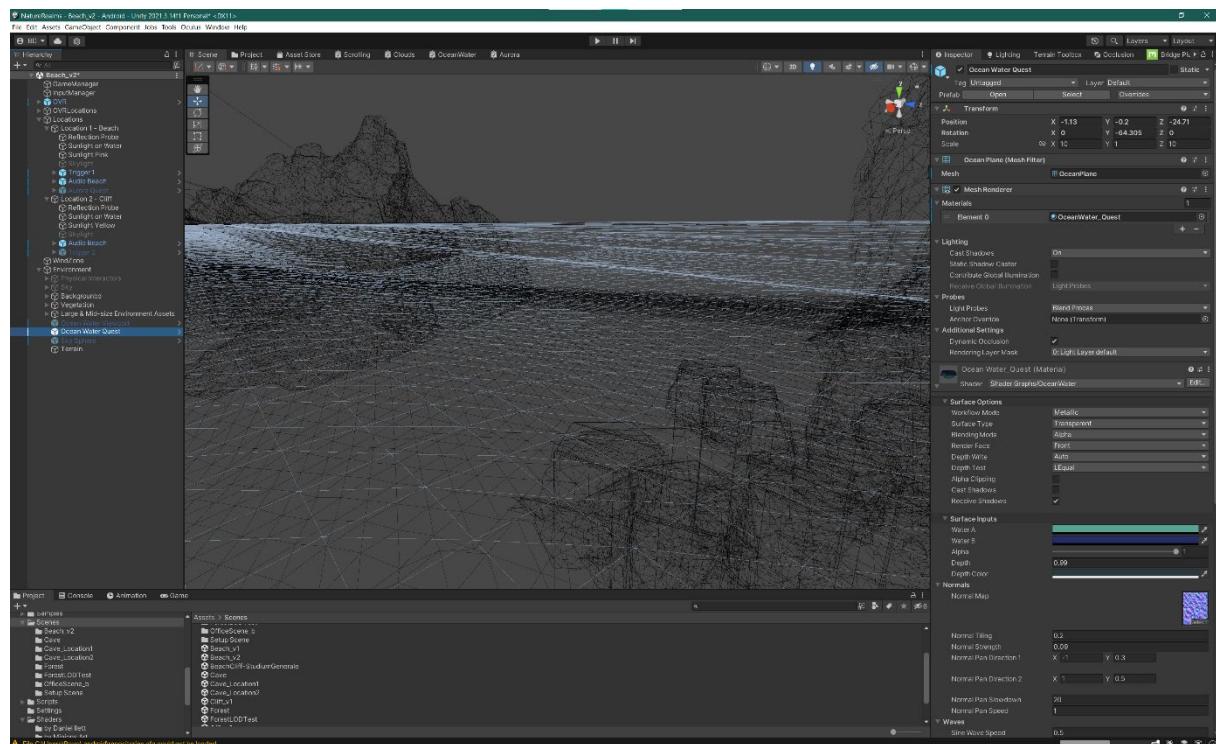
4.5.4 Location 2: The Cliff

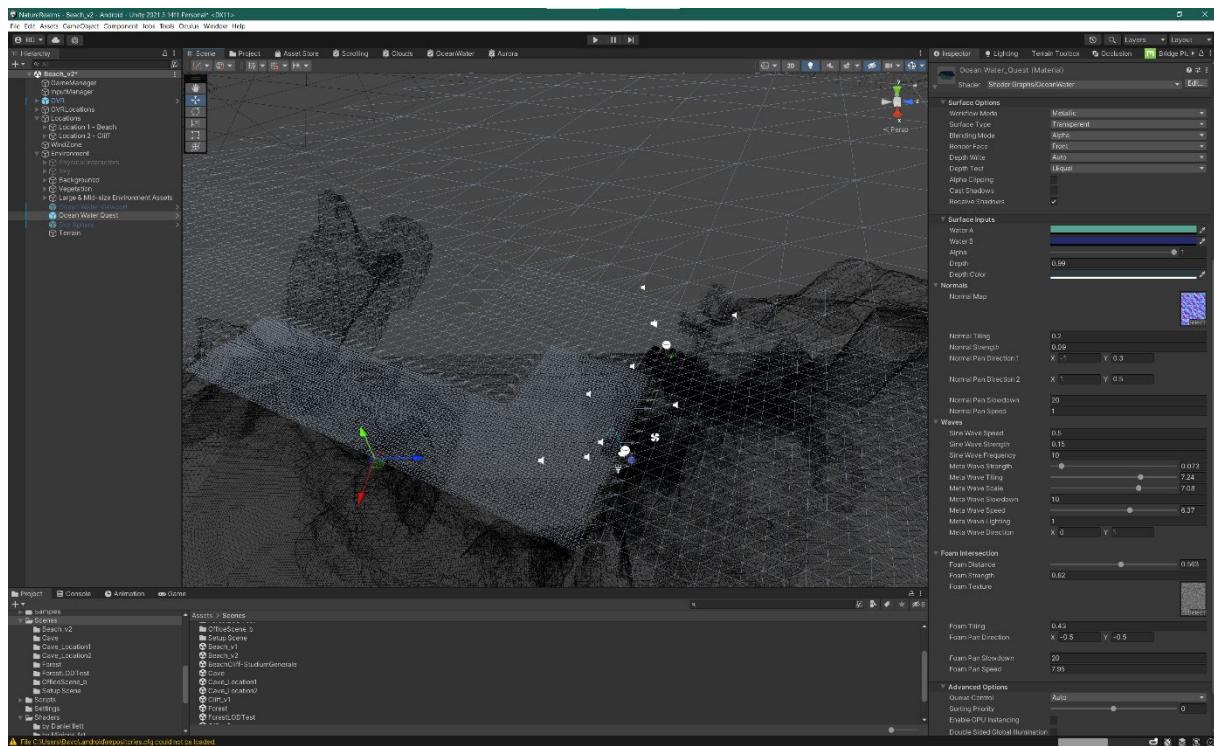
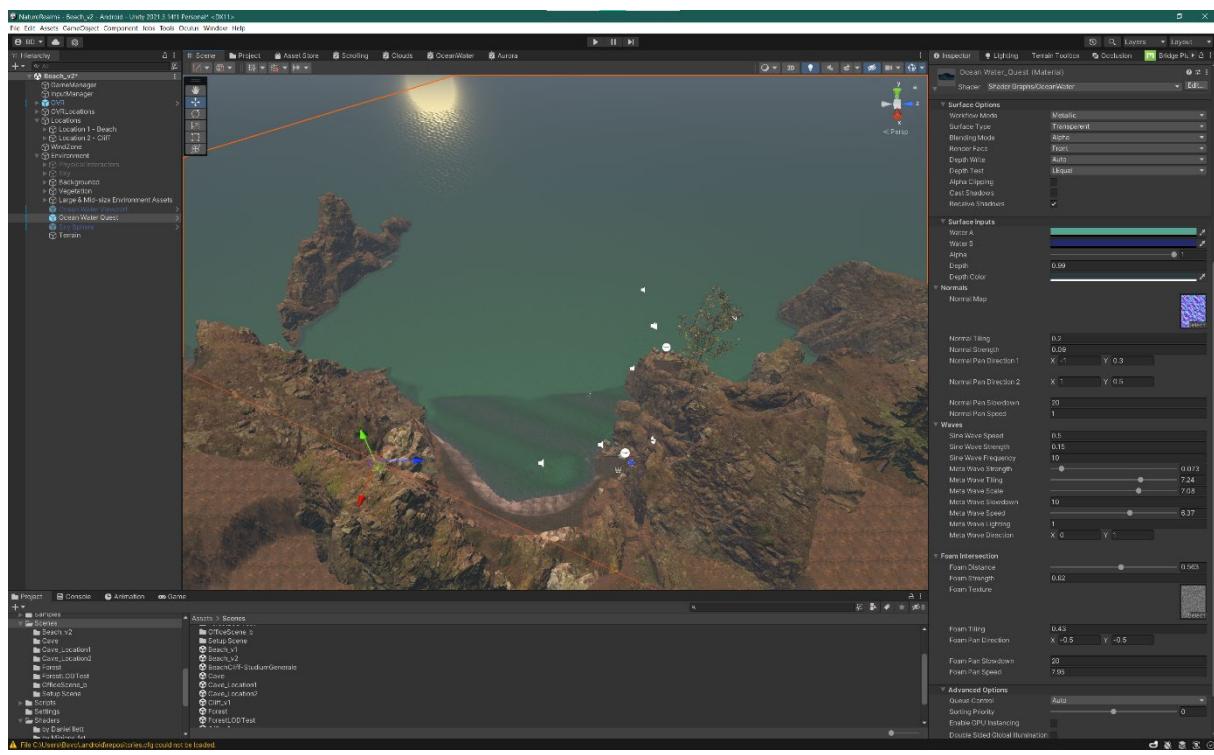


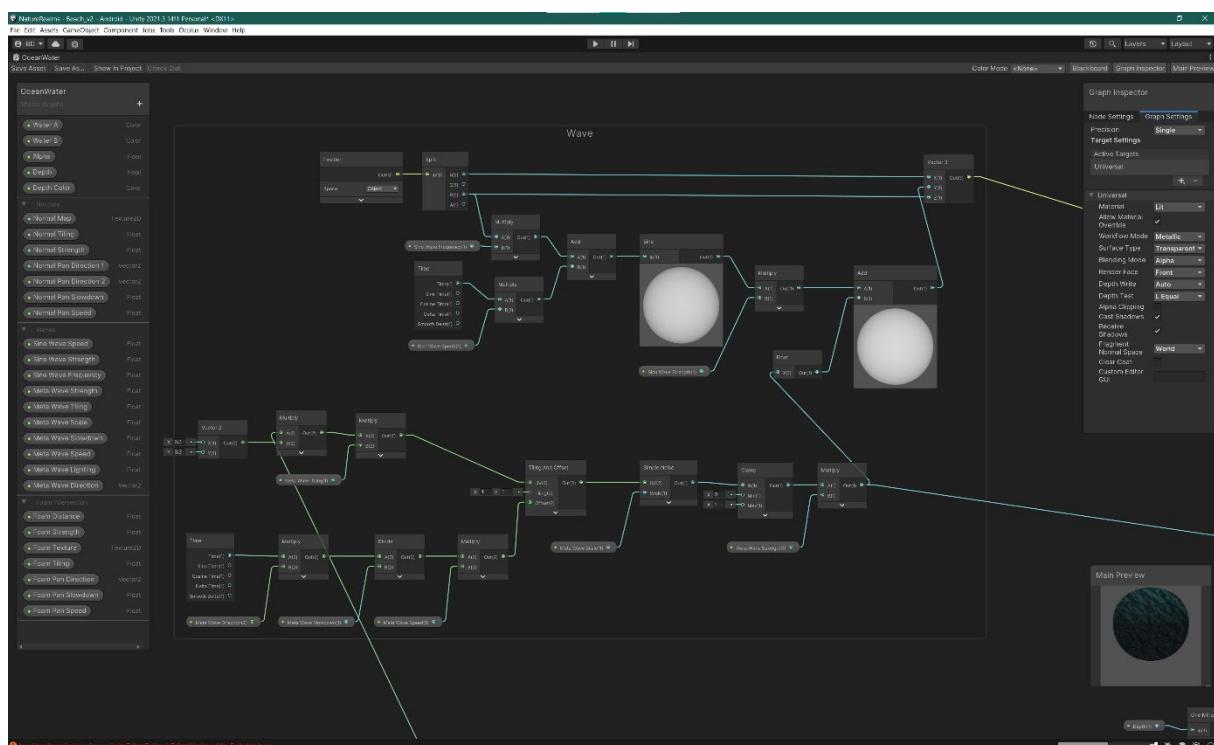
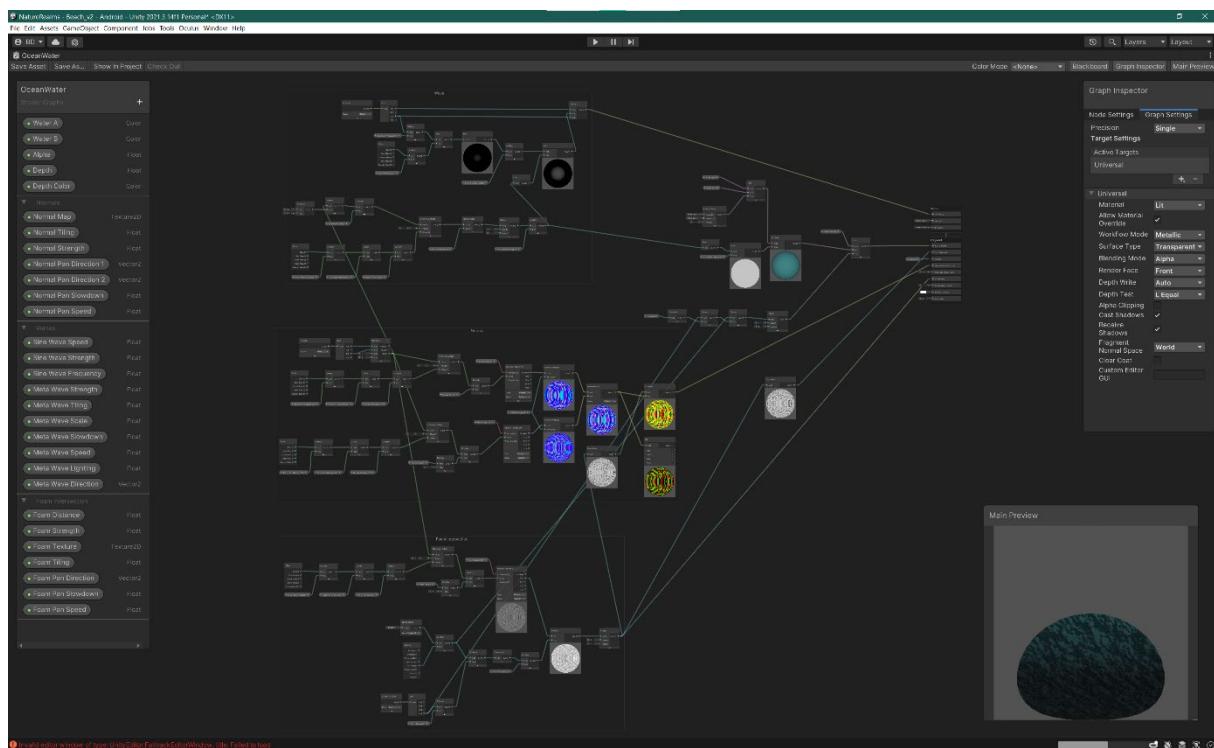


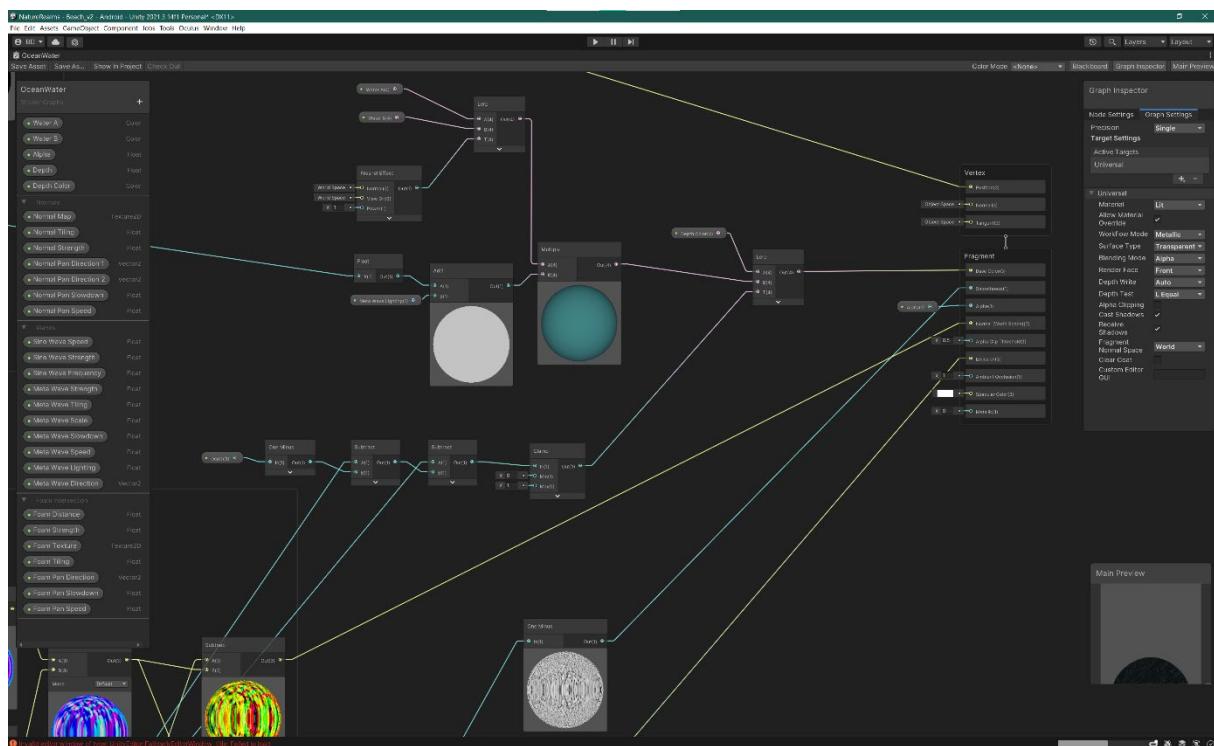
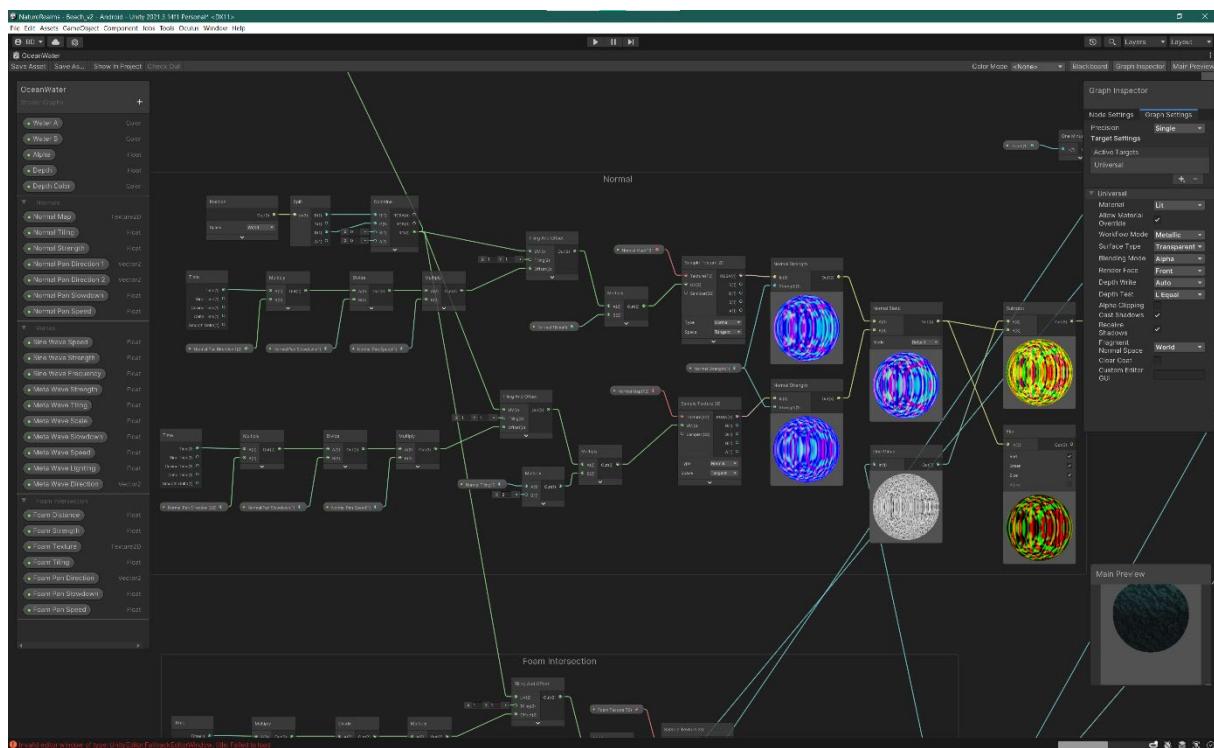
4.5.5 Visual Effect: Ocean Water

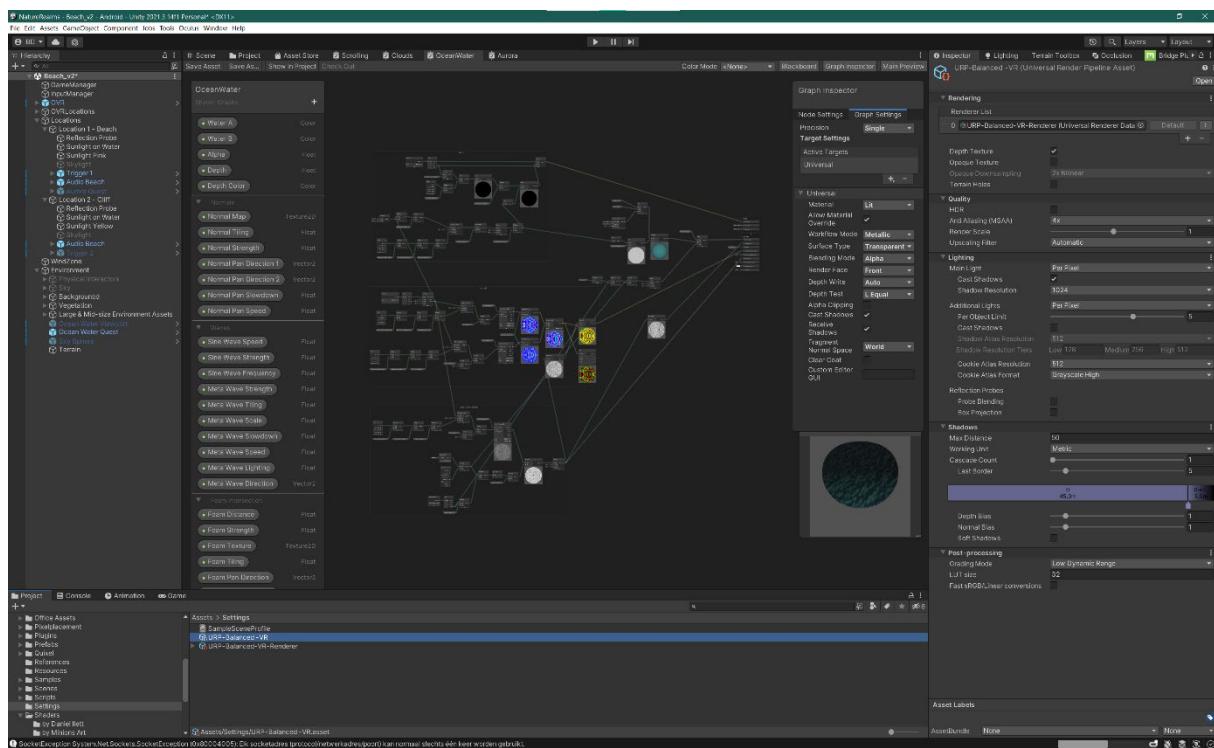
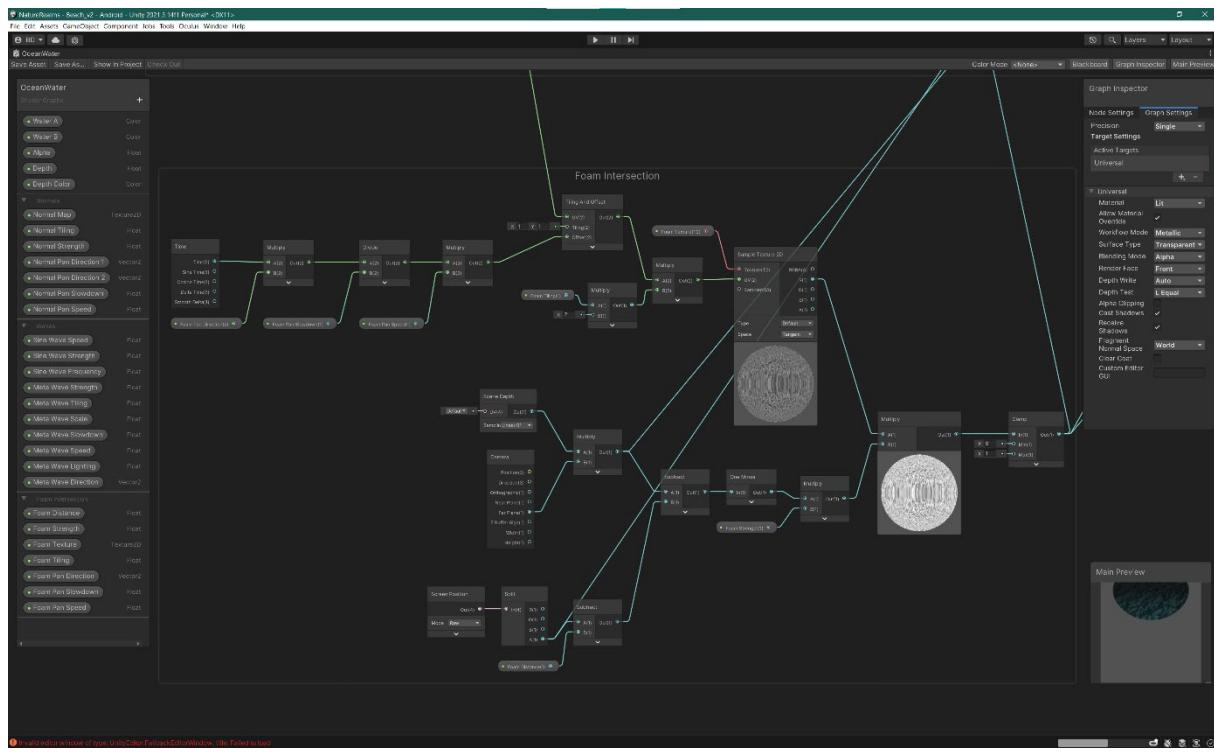
For the Ocean Water a custom 3D model was made to spread to spread the triangle count the where it is needed and a custom shader with ShaderGraph. To be able to use the Depth Texture needed for the shader this feature needs to be turned on in de render settings.







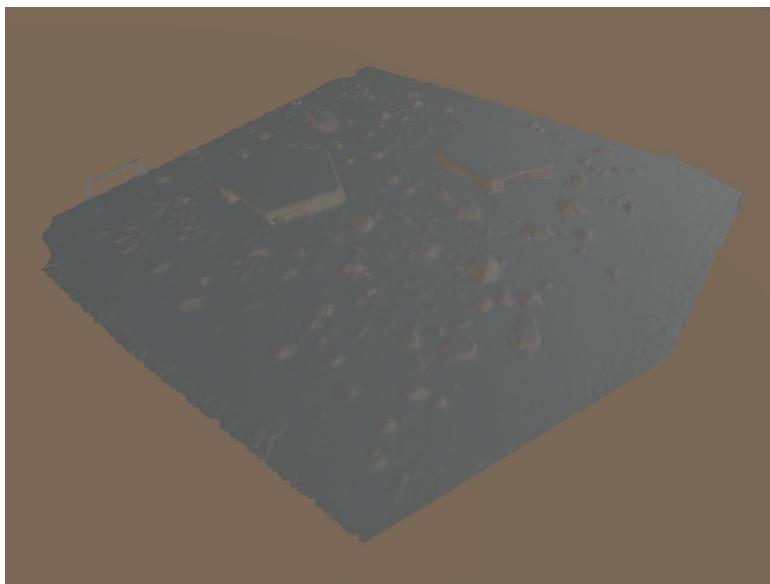




4.6 3D Scans

As explained in the process chapter two 3D scans were made for the project.

4.6.1 Physical Setup



4.6.2 Fellow Student



Appendix 5: Second User-Test Questionnaires

1st Questionnaire

Personal Information and Previous Experience with VR

Second User Testing of Nature Realms
by Team Hyper
3rd of May 2023. AP Immersive Lab

First of all, thank you very much for participating in our experiment. You are playing a fundamental role in our research process and we hope you enjoy this experience!

To get started, please fill out the following questionnaire.

We won't share your information with anyone outside the project-team and it will only be used for research-purposes.

If you would like more information regarding the collection and processing of data, you can have a look at the [Privacy Statement for Research at AP University](#).

Full Name

.....

Age

.....

Gender (if you don't feel comfortable disclosing your gender, skip this question)

.....

Country of origin

.....

Are you a student? Yes No

If yes, what is your field of study?

.....

If not, what is your profession? (If you are unemployed, please disclose it as well)

.....

Do you know what Virtual Reality (VR) is?

Yes No

Have you already had VR-Experiences before?

Yes No

If yes, please, tell us a little bit about your prior experience with VR.

Was it a game?

An immersive experience like a roller coaster?

a 360° video?

please specify the approximate duration, how many times you have experienced VR, etc ...

.....
.....
.....
.....

Choose the option that best describes your experience

- It was a positive experience
- It was a neutral experience
- It was a negative experience

Why? Explain your previous choice

.....
.....
.....

Do you have a VR headset at home? (Google Cardboard or similar devices also count)

Yes No

If yes, please specify the model:

.....

2nd Questionnaire

Virtual Experience

Second User Testing of Nature Realms
by Team Hyper
3rd of May 2023. AP Immersive Lab

Please, answer the following questions by selecting the relevant number in the scale.
These questions are asking you about how you felt during the virtual experience.

We won't share your information with anyone outside the project-team and it will only be used for research-purposes.

If you would like more information regarding the collection and processing of data, you can have a look at the [Privacy Statement for Research at AP University](#).

1. To what extent did the virtual environment look like a cliff?

Not at all 1 2 3 4 5 Very much so

2. Did this make you feel more immersed in the environment?

Yes

No

3. To what extent did you forget that you were in a laboratory?

I totally forgot about it 1 2 3 4 5 I was totally aware that I was in the laboratory

4. To what extent did you feel you were actually standing on a cliff?

I never felt like 1 2 3 4 5 I completely believed I was on a mountain

5. Did you find it easy to move around the place?

Not at all 1 2 3 4 5 Very much so

6. Did this help you be more immersed in the virtual environment?

Yes

No

7. Did the physical platform match what you were seeing?

Not at all 1 2 3 4 5 It was very accurate

8. Did this platform help you feel more immersed in the virtual environment?

Yes

No

9. To which extent did you feel the wind?

Not at all 1 2 3 4 5 Very much so

10. Did the wind help you feel more immersed in the virtual environment?

Yes

No

11. Did you ever feel like you could fall off the cliff?

Yes

No

12. Did you ever feel like taking the headset off to see what was happening in the real world?

Yes

No

13. To what extent did you feel as though you were separated from your real-world environment?

Not at all 1 2 3 4 5 Very much so

14. To what extent was your sense of being in the environment stronger than your sense of being in the real world?

Not at all 1 2 3 4 5 Very much so

15. When interrupted, were you disappointed that the experience was over?

Definitely not 1 2 3 4 5 Definitely yes

16. Would you like to have the experience again?

Yes

No

17. Would you change the platform or wind in any way (slope, intensity, direction...) to make it feel more like in the virtual environment?

Yes

No

18. Leave us your suggestions, please

.....
.....
.....
.....
.....
.....

19. Did you feel any other physical stimulus (any sound, smell, touch-sensation...), apart from the one(s) intentionally made by the laboratory staff? Describe it below

.....
.....
.....

.....
.....

20. Did this make you feel more immersed in the virtual environment?

Yes

No

3rd Questionnaire

Experiment Feedback

Second User Testing of Nature Realms by Team Hyper

3rd of May 2023. AP Immersive Lab

Thank you very much for being part of our first experiment!
We hope you enjoyed it and that you are eager to continue exploring VR together with us,
Team Hyper.
Please, fill in this last questionnaire, so that we can use your feedback to improve our
future experiments.

We won't share your information with anyone outside the project-team and it will only be used for research-purposes.

If you would like more information regarding the collection and processing of data, you can have a look at the [Privacy Statement for Research at AP University](#).

1. Rate the overall communication of the experiment (WhatsApp, Email...)

Very poor 1 2 3 4 5 Near perfect

2. Was the time-frame appropriate for you?

Not at all 1 2 3 4 5 Very much so

3. Were the VR devices in good condition?

Not at all 1 2 3 4 5 Very much so

4. Rate the performance of the team-members

Very rude and unorganised 1 2 3 4 5 Very polite and organised

5. Did you feel comfortable during the experience?

Not at all 1 2 3 4 5 Very much so

6. Were the questions easy to understand?

Not at all 1 2 3 4 5 Very much so

7. Regarding the amount of questions

There were very few, 1 2 3 4 5 There were too much,
more would have been needed less would have been needed

8. Was the format of the questionnaire (online with Google Forms) easy to use?

Not at all 1 2 3 4 5 Very much so

9. Feel free to leave us any feedback, suggestions or comments you may have.

.....

.....

.....

.....

.....

Appendix 6: Second User-Test Results

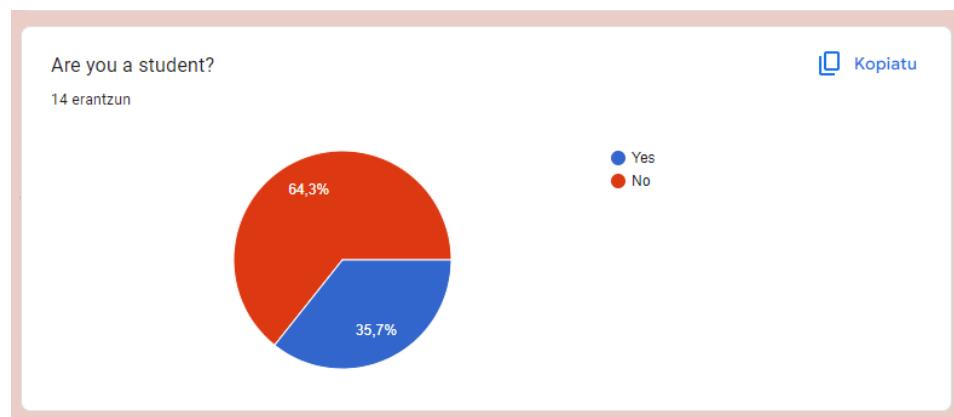
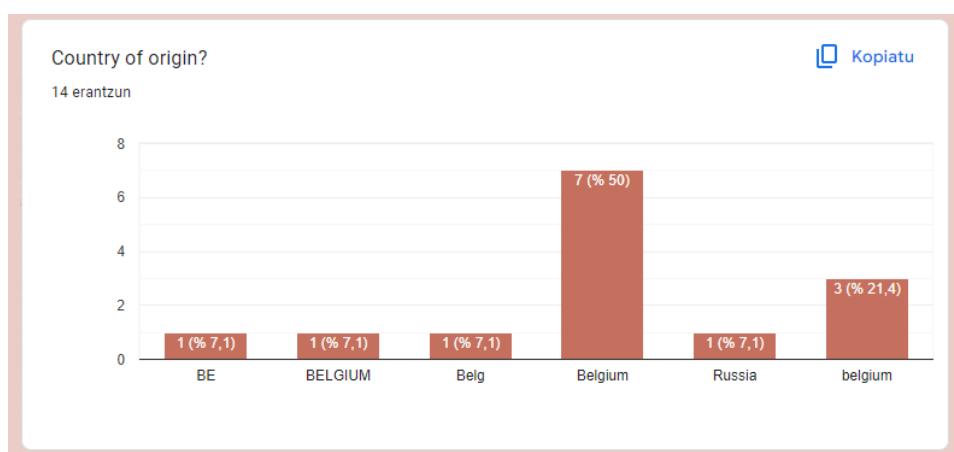
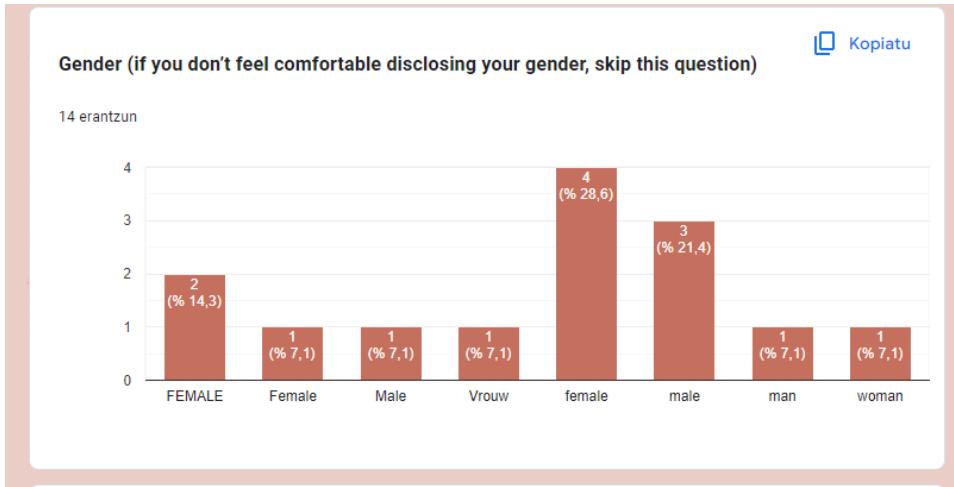
1st Questionnaire Results
Personal Information and Previous VR Experience
2nd User Test: 03/05/2023

The first questionnaire of the user-test gathered personal data about the volunteers. The results show that 14 filled in this questionnaire, both male (5) and female (9) between the ages of 21 and 75. 5 were students and the rest workers. The students belonged mainly to the fields of the social sciences and health, while the workers ranged from education to health sector, business and even a baker. All of the volunteers except 1, who was from Russia, came from Belgium.

Regarding their VR experience, all of them knew what Virtual Reality is, but two of them had never had previous experience with it. The ones that had previously tried VR, they had done it through art, gaming and multiple experiences (undersea, rollercoaster). 10 out of 14 evaluated this experience as positive, one as neutral and the other one as negative. When asked why it was positive, the volunteers stated that it was a “feeling of peace”, “different space and time”, a “realistic” view and “very immersive”. One person wrote that she/he got nauseous and another one cried. Besides, none of the users has a VR headset at home.

These are some graphics with the answers of the participants.





Studies
What is your field of study?
5 erantzun
Occupational therapy
SOCIAL WORK
Philosophy
Graphic Design
Ergotherapeut

Job

What is your profession? (If you are unemployed, please disclose it as well)

9 erantzun

University teacher

MEDICAL DOCTOR

Docent

business owner

Studentcounselor

innovation designer

orthodontist

Baker

Accounting manager

Previous VR Experience

Do you know what Virtual Reality (VR) is?

 Kopiatu

14 erantzun

● Yes
● No

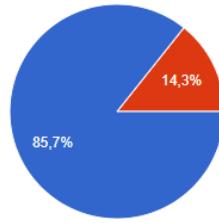


Have you already had VR-Experiences before?

 Kopiatu

14 erantzun

● Yes
● No



Personal experience

Please tell us a little bit about your prior experience with VR.

Was it a game?

An immersive experience like a roller coaster?

a 360° video?

please specify the approximate duration, how many times you have experienced VR, etc ...

12 erantzun

Immersive Van Gogh

It was a racing game

THE ART on the moon BY IAURIE aNDERSSON IN boZAR

Experience with both games and non-games: e.g. shooting zombies, jumping off a building, undersea experience

I have experienced VR at the museum. It was a 360 video of the ocean with fish and underwater fauna

Several immersive art experiences (Van Gogh, Klimt, Resetimmmezrsive, Breughel),..., game (light saber)

VR games (2 or 3x 1-2hrs) & rollercoaster in Phantasialand (DE) - 5min

It was not a game, it was on an exhibition by AP. I had experienced it 4 times.

I initiated a project for the flemish government with a VR-scenario on a ship, for the simulator of the Waterbouwkundig Labo in Borgerhout

art

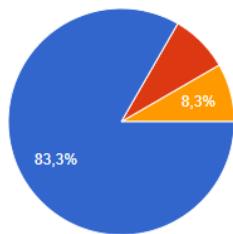
VR les anatomie

Participated in multiple VR gaming experiences

Choose the option that best describes your experience

 Kopiatu

12 erantzun



- It was a positive experience
- It was a neutral experience
- It was a negative experience

Why? Please explain your previous choice

12 erantzun

Nice envorrefment, feeling of peace

I got nocious

DIFFERENT SPACE AND TIME

It surprised me how much I gave in to the simulation, for instance, when I experienced vertigo when standing on a tall building, or when floating in outer space

It was quite exciting but a bit overwhelming and tiring

Very overwhelming. I cried ;-)

it's new, I'm very curious in nature

I was completely disorientated in a good manner of speaking

realistic height and depths. view on the river and seas.

very nice and it look real

Een realiteit beeld van een skelet, Handig om bij te leren.

Very immersive

 Kopiatu

Do you have a VR headset at home? (Google Cardboard or similar devices also count)

12 erantzun

 Yes
 No

100%

2nd Questionnaire Results

Virtual Experience

2nd User Test: 03/05/2023

The second questionnaire aimed at measuring the level of immersion of the user. The experience included a physical input that consisted of a wooden slope and a ventilator positioned accordingly so that, when the user got on the platform, it could feel the wind blowing from beneath, as if the user were standing in front of a cliff.

It is worth saying that this questionnaire was completed by 12 people.

Questions 1 and 2 evaluated the impact and quality of the visuals. All of them rated that the environment looked similar to a real cliff, and 10 out of 12 stated that this made them feel more immersed (see Graphic 1 and 2).

Questions 5 and 6 asked the users about their experience with the headset. This time, each of the users found it easy to use the device in a different level, ranging from 2 to 5. All of them admitted feeling more immersed thanks to the ease of use. (See Graphic 3 and 4)

Questions 7-10 and 17-20 asked about the physical stimulus. Results show that 8 out of 12 volunteers stated that the platform matched what they were actually seeing on VR. The rest of the participants were more doubtful about it. Adding to that, 10 people confessed feeling more immersed because of the platform. Regarding the wind, 8 people actually felt the wind, 6 of them quite a lot, while the rest didn't feel it as much. All of the volunteers admitted feeling more immersed because of it (see Graphic 5, 6, 7 and 8).

Regarding the questions about the sense of being immersed in the virtual environment, half of the users quite forgot that they were in a laboratory. The others, though, didn't. Also, half of the volunteers felt as they were standing on a real cliff and the others felt neutral or didn't feel like it. (See Graphics 9 and 10)

10 out 2 volunteers felt they could fall off the cliff and two of the volunteers felt like taking off the headset while on the VR experience. Half of the users felt the sense of being in the VR world stronger than being in the real world, four were indifferent and two people disagreed (see Graphic 11, 12 and 13).

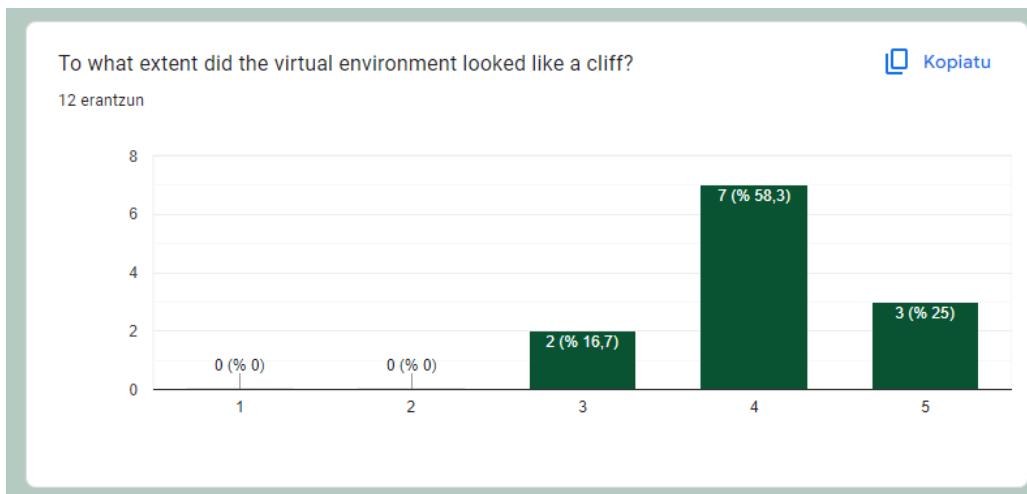
Finally, 7 out of 12 participants felt disappointed that the experience was over and all of them except one would like to experience it again. (See Graphic 14 and 15)

We asked if they would change in any way the physical input and three answered no. Nevertheless, some of the suggestions left by the other participants were the following ones (see Graphic 16 and 17):

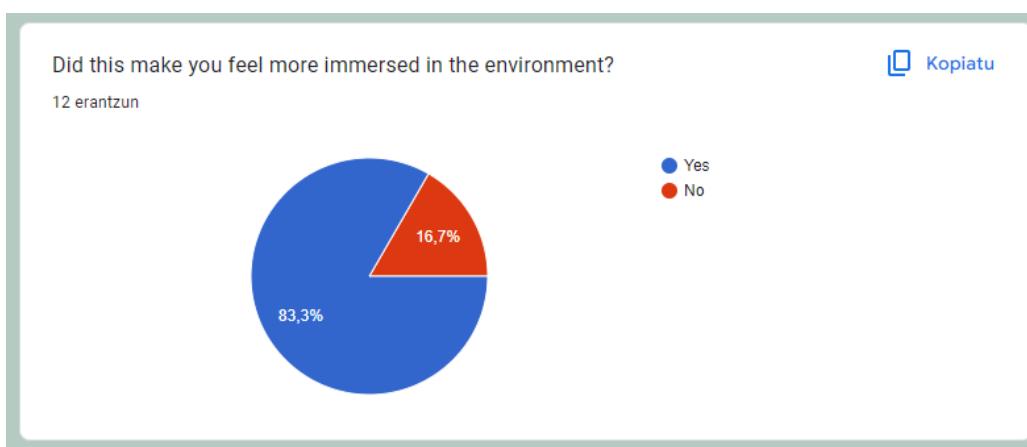
- Using smell.
- Appearance of animals by accident unexpected.
- A rocky and larger platform, with a bit more of slope.
- More intense breeze.
- Add background noise.
- Add a sit to relax.
- One said that she/he didn't feel that she/he was going up.

Finally, when asked about any extra physical input they might have felt, three of them highlighted the sound (see Graphic 18 and 19).

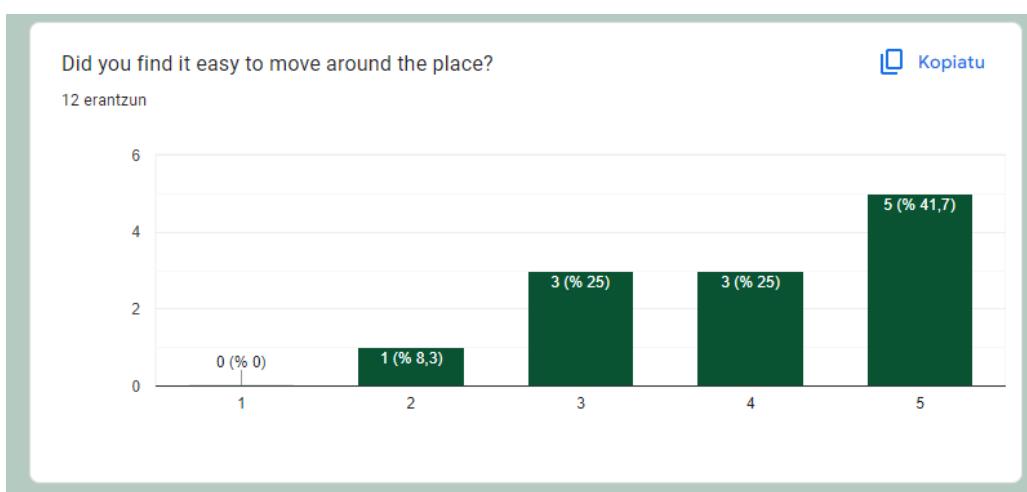
Graphics



Graphic 1



Graphic 2

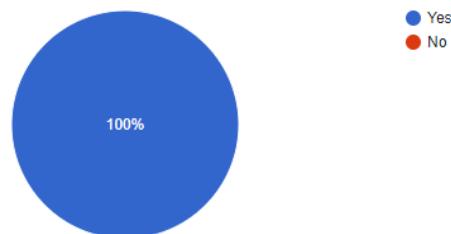


Graphic 3

Did this help you be more immersed in the virtual environment?

 Kopiatu

12 erantzun

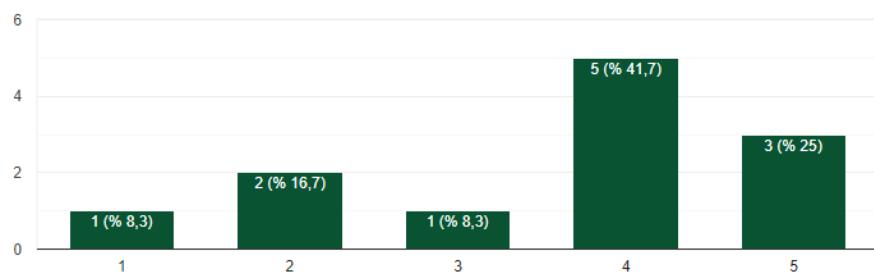


Graphic 4

Did the physical platform match what you were seeing?

 Kopiatu

12 erantzun

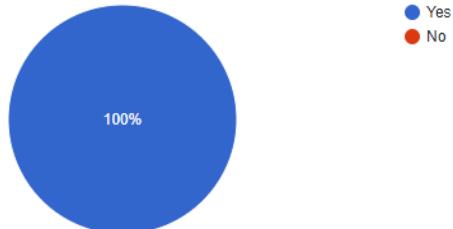


Graphic 5

Did this help you be more immersed in the virtual environment?

 Kopiatu

12 erantzun

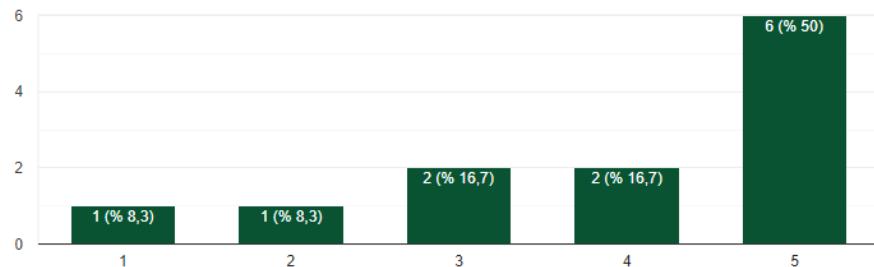


Graphic 6

To which extent did you feel the wind?

 Kopiatu

12 erantzun

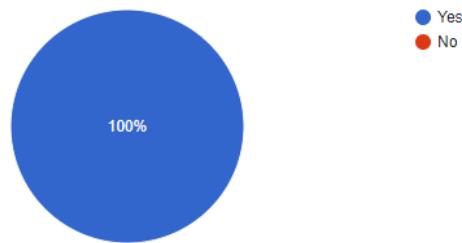


Graphic 7

Did the wind help you feel more immersed in the virtual environment?

 Kopiatu

12 erantzun

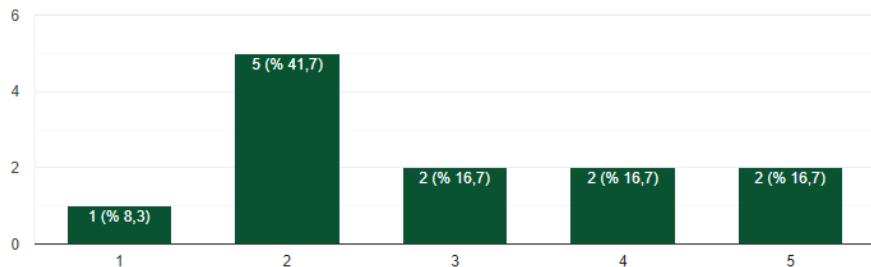


Graphic 8

To what extent did you forget that you were in a laboratory?

 Kopiatu

12 erantzun

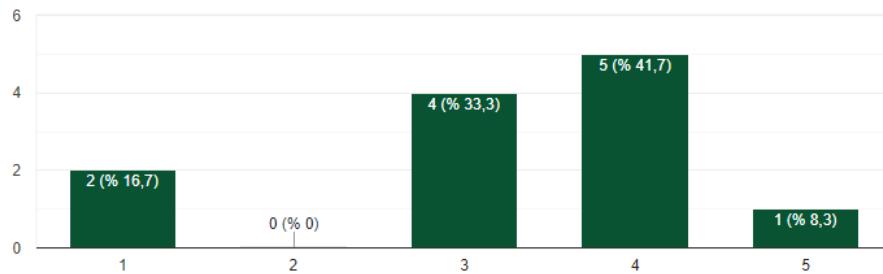


Graphic 9

To what extent did you feel you were actually standing on a cliff?

 Kopiatu

12 erantzun

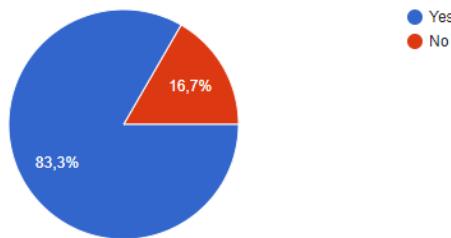


Graphic 10

Did you ever feel like you could fall off the cliff?

 Kopiatu

12 erantzun

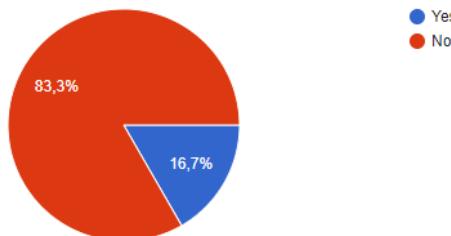


Graphic 11

Did you ever feel like taking the headset off to see what was happening in the real world?

 Kopiatu

12 erantzun

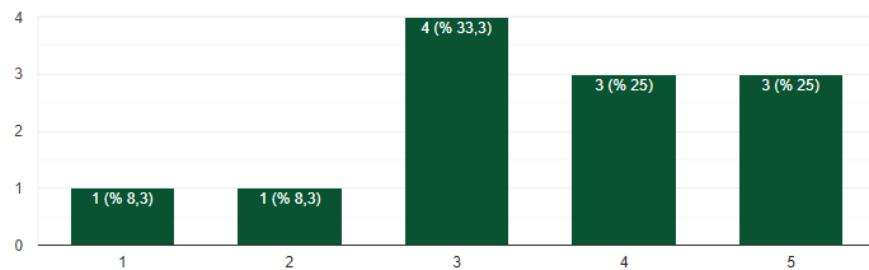


Graphic 12

To what extent was your sense of being in the environment stronger than your sense of being in the real world?

 Kopiatu

12 erantzun

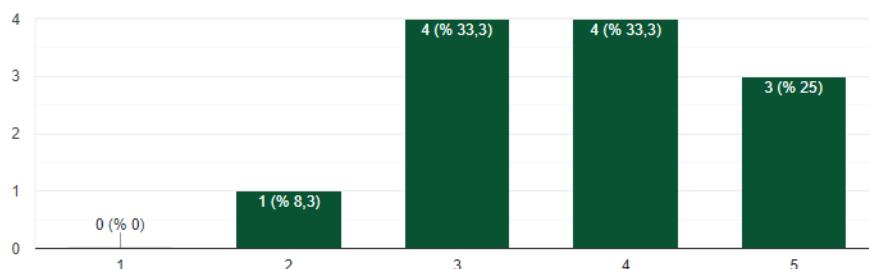


Graphic 13

When interrupted, were you disappointed that the experience was over?

 Kopiatu

12 erantzun

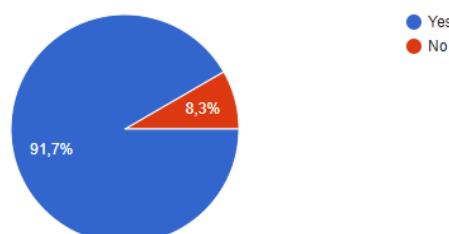


Graphic 14

Would you like to have the experience again?

 Kopiatu

12 erantzun

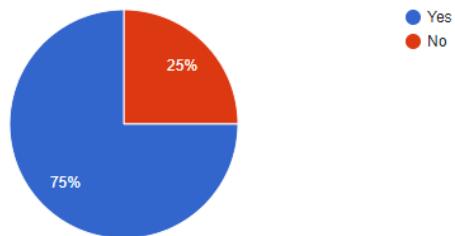


Graphic 15

Would you change the platform or wind in any way (slope, intensity, direction...) to make it feel more like in the virtual environment?

 Kopiatu

12 erantzun



Graphic 16

Leave us your suggestions, please

10 erantzun

Using smell

APPEARANCE OF ANIMALS BY ACCIDENT UNEXPECTED

It would help if the 'rocky', 'bumpy' nature of the virtual rock was reproduced in the physical platform

It might be helpful to make the platform a bit longer and the surface of the cliff more rocky or bumpy, to introduce some environmental texture.

breeze could have been more intense, maybe add the smell of the seashore and some background noise

I would increase the slope slightly and make the surface a bit rocky

I would like to sit down and relax for a while. Great experience, fine job

I did not feel or see that I was going up

with more fans, it would be more realistic

smell

Graphic 17

Did you feel any other physical stimulus (any sound, smell, touch-sensation...), apart from the ones intentionally made by the laboratory staff? Describe it below

10 erantzun

the sound of the waves

MOVING CLOUDS, TUNDERSTORM

a slight sense of vertigo, but the exciting kind that you also feel when standing on a real cliff

I only felt the wind

not aware, too focused on the moving around

the seagulls, the waves, the wind itself. no smell though.

bird sound, waves

sound, which was very real and important to the experience

no, although the smell of the sea was not far away

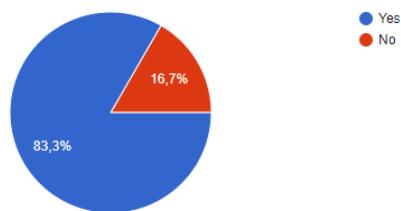
no

Graphic 18

Did this make you feel more immersed in the virtual environment?

 Kopiatu

12 erantzun



Graphic 19

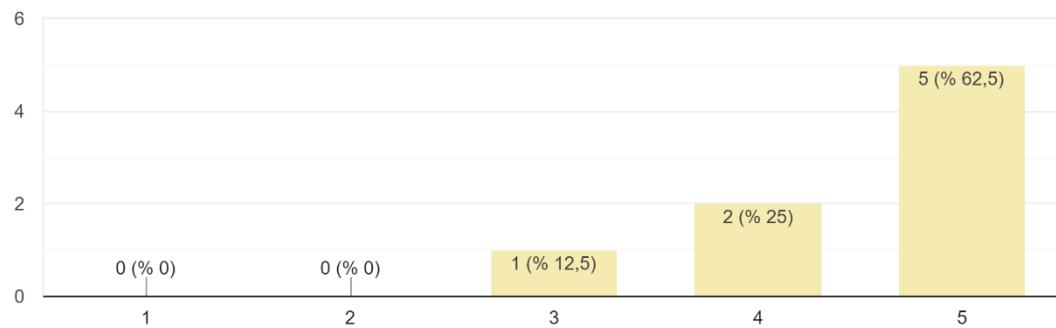
3rd Questionnaire Results

Experiment Feedback

2nd User Test: 03/05/2023

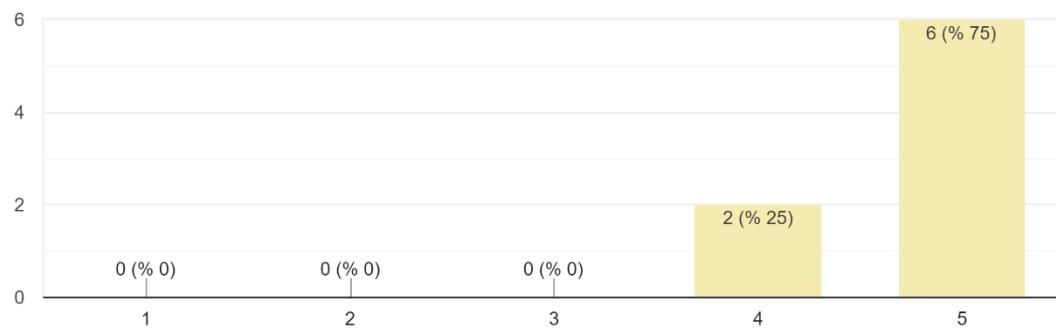
Was the place of the experiment appropriate?

8 erantzun



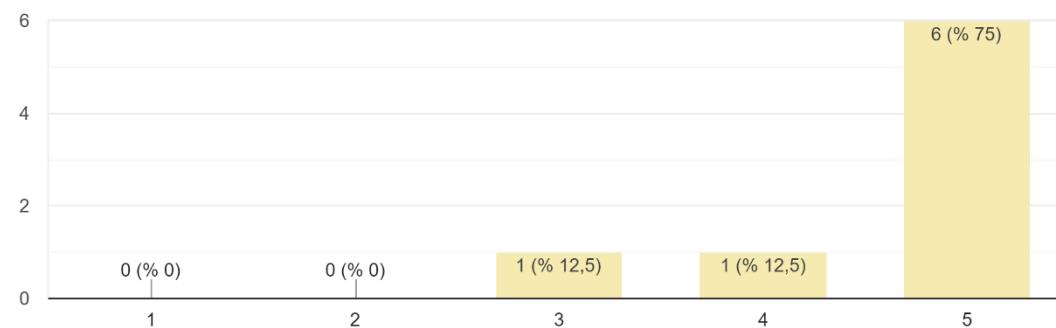
Were the VR devices in good condition?

8 erantzun



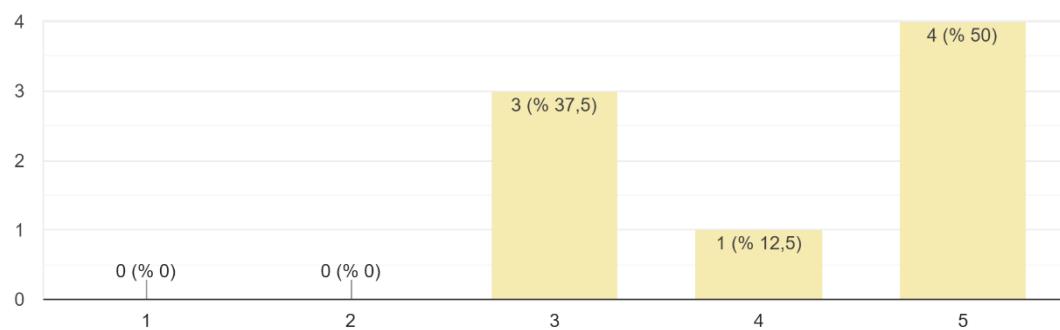
Was the physical platform secure and in good condition?

8 erantzun



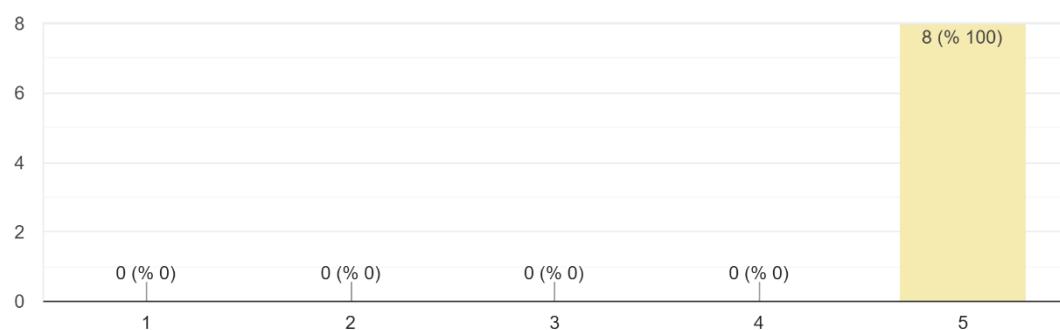
Rate the overall experience in the virtual environment

8 erantzun



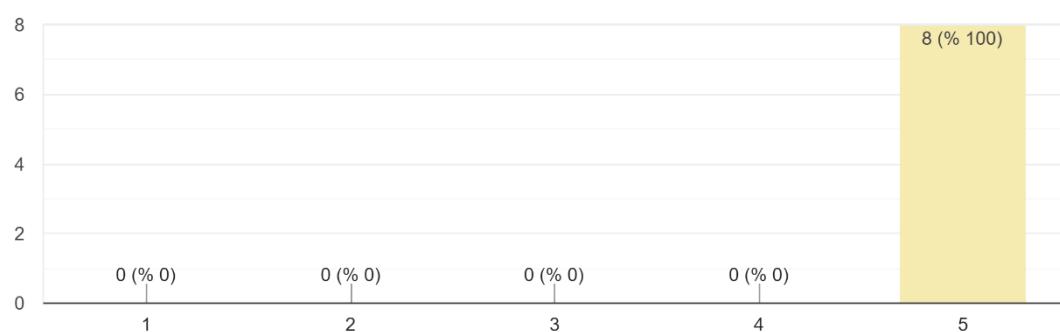
Rate the performance of the team-members

8 erantzun



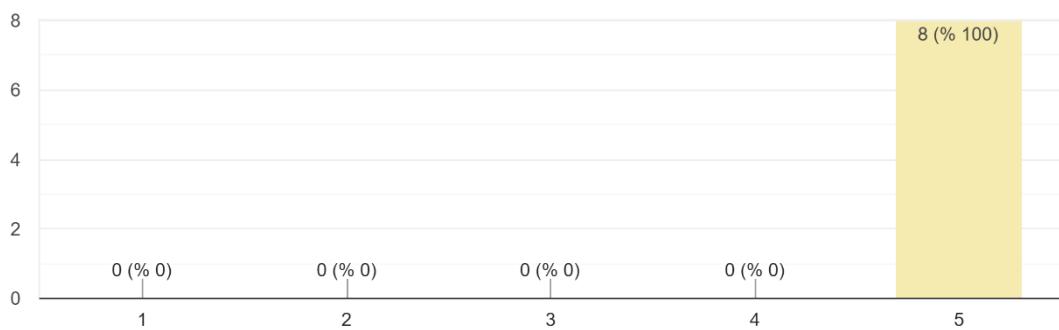
Did you feel comfortable during the experience?

8 erantzun



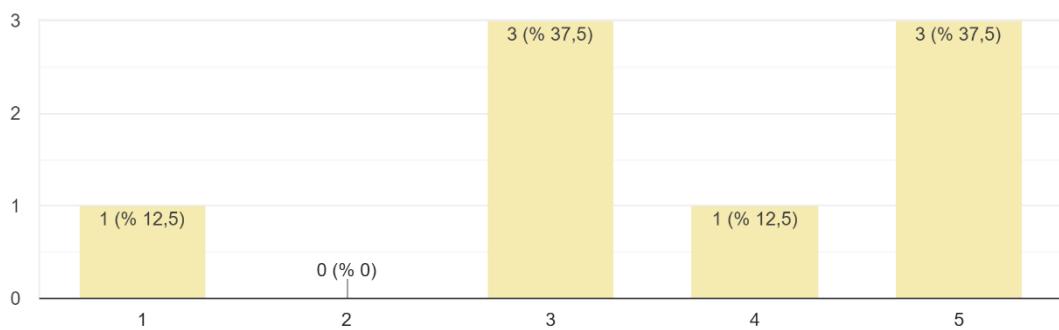
Were the questions easy to understand?

8 erantzun



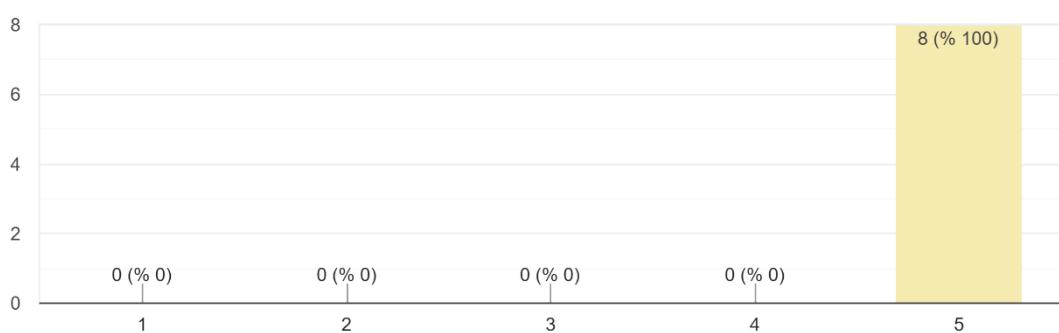
Regarding the amount of questions

8 erantzun



Was the format of the questionnaires (online with Google Forms) easy to use?

8 erantzun



Feel free to leave us any feedback, suggestions or comments you may have

8 erantzun

well done

Well done

;

ALL WAS FINE

Good luck, and perhaps treat yourself to a trip to a real cliff ;)

Thanks for the experience! Good luck with your research:)

put more computers in the room so multiple people can do the questionaire at the same time

a sipwell for waiting participants to have some water meanwhile.

Appendix 7: Physical Set-Up Materials

Physical Set-Up Materials



1



2



3



4



6



5



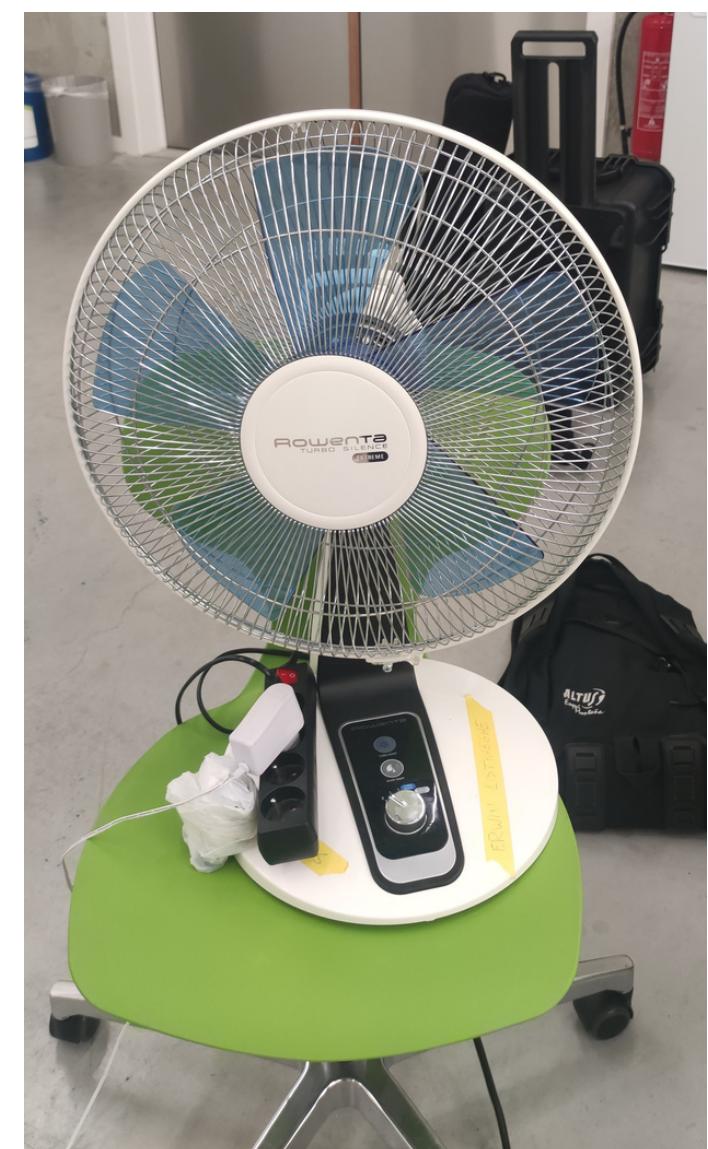
7



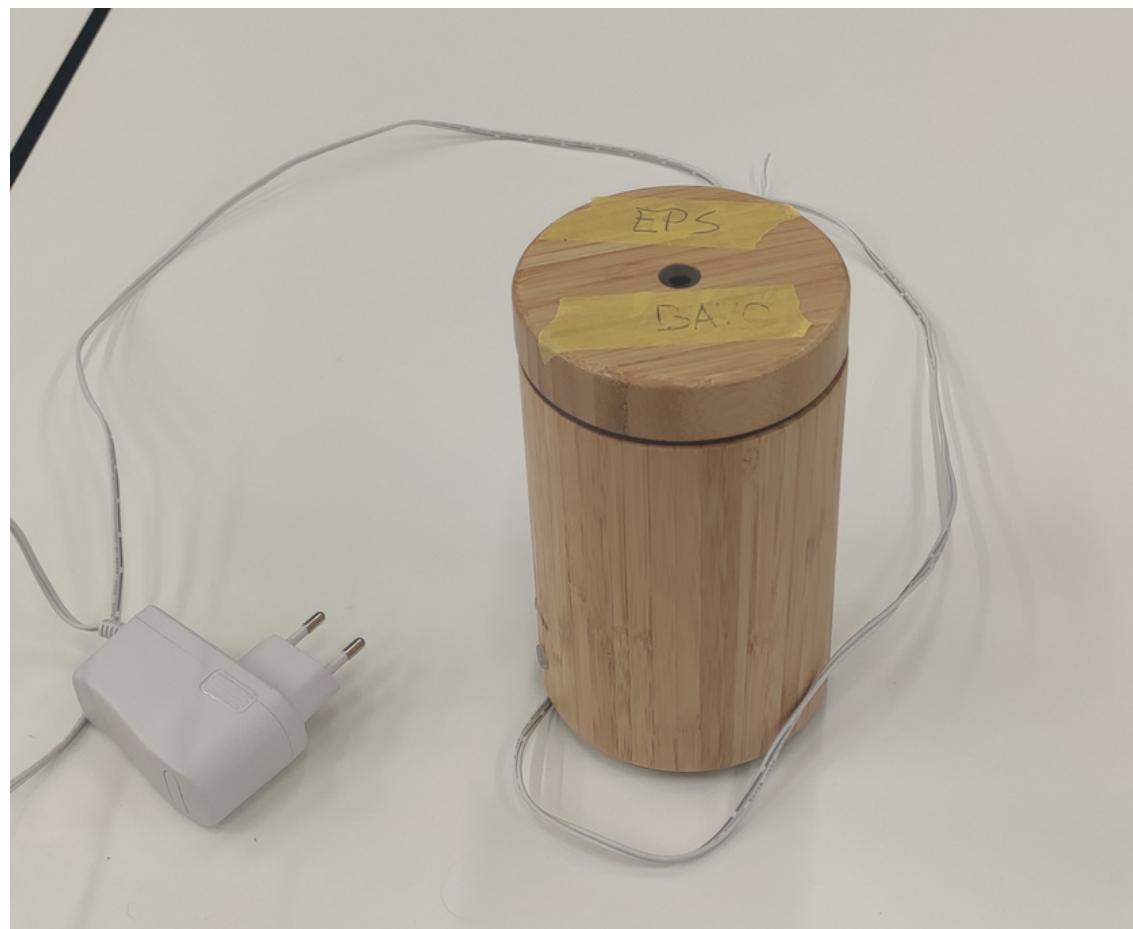
8



9



10



11



13



12

Appendix 8: Immersive Lab Quick Guide

THE IMMERSIVE LAB

A QUICK GUIDE



01

Go to floor -01 at
Campus
Spoor Noord

Continue until
the end of the
left corridor

02



03

Get to the door
of Campus
Ellermanstraat



Pass the gateway
with your AP card

04



05

We are in the
first room at
the right

WELCOME!

Appendix 9: Third User-Test Questionnaire

Questionnaire

Third User-Testing of Nature Realms
by Team Hyper
5th of June 2023. AP Immersive Lab

First of all, thank you very much for participating in our experience. You are playing a fundamental role in our research process and we hope you enjoy it!
Please fill out the following questionnaire.

We won't share your information with anyone outside the project-team and it will only be used for research-purposes.

If you would like more information regarding the collection and processing of data, you can have a look at the [Privacy Statement for Research at AP University.](#)

Personal Information

1. Age

.....

2. Gender (if you don't feel comfortable disclosing your gender, skip this question)

.....

3. Country of origin

.....

4. Are you a student? Yes No

If yes, what is your field of study?

.....

If not, what is your profession? (If you are unemployed, please disclose it as well)

.....

5. Do you know what Virtual Reality (VR) is?

Yes No

6. Have you already had VR-Experiences before?

Yes No

If yes, please, tell us a little bit about your prior experience with VR. Was it a game? An immersive experience like a roller coaster? A 360° video? Please, specify the approximate duration, how many times you have experienced VR, etc ...

.....
.....
.....
.....

Choose the option that best describes your previous answer

- It was a positive experience
 - It was a neutral experience
 - It was a negative experience

Why? Please, explain your previous choice

.....

Virtual Experience Test

In the following questions you will be asked about the virtual experience you tested today. Be as sincere as you can and let us know how you felt!

7. How realistic did the forest look like?

Not at all 1 2 3 4 5 Very much so

8. Did this make you feel more immersed in the environment?

Yes No

9. To what extent did you forget that you were in a laboratory?

I totally forgot about it 1 2 3 4 5 I was totally aware that I was in
the laboratory

10. To what extent did you feel you were actually standing in a forest?

11. Did you find it easy to move around the place?

Yes No

Explain your previous answer

.....
.....
.....

12. Did this help you be more immersed in the virtual environment?

Yes No

13. Did you understand where to go in the virtual environment?

I didn't know what to do 1 2 3 4 5 It was clear I had to step on the flat rocks

14. Did the physical set-up match what you were seeing?

Not at all 1 2 3 4 5 It was very accurate

15. Did you find disturbing that you couldn't see your feet or, in general, your body in the virtual environment?

Yes No

If you answered "Yes" in the previous question, explain briefly why and how this affected your immersive experience.

.....
.....
.....

16. Did this set-up help you feel more immersed in the virtual environment?

Yes No

17. Did you ever feel like you could fall into the lake?

Yes No

18. Did you ever think of stepping into the lake?

Yes No

19. To which extent did you feel the wind?

Not at all 1 2 3 4 5 Very much so

20. Did this wind help you feel more immersed in the virtual environment?

Yes No

21. Did you ever feel like taking the headset off to see what was happening in the real world?

Yes No

22. To what extent was your sense of being in the environment stronger than your sense of being in the real world?

Not at all 1 2 3 4 5 Very much so

23. When interrupted, were you disappointed that the experience was over?

Yes No

24. Would you like to have the experience again?

Yes No

25. Would you change the set-up in any way (amount of rocks/sand, size of rocks/tiles...) or add anything to make it feel more like in the virtual environment?

Yes No

Leave us your suggestions, please :)

Feedback

Thanks for being a fundamental part of our project!
Now it's time to rate our performance as a research team.

26. Rate the performance of the team-members

Very rude and unorganised 1 2 3 4 5 Very polite and organised

27. Was the place of the experiment appropriate?

Yes No

28. Did you feel the set-up was safe?

Not at all 1 2 3 4 5 Very much so

29. Were the questions easy to understand?

Not at all 1 2 3 4 5 Very much so

30. Regarding the amount of questions

31. Rate the overall experience

Very bad 1 2 3 4 5 Amazing

32. Feel free to leave us any feedback, suggestions or comments you may have :)

.....
.....
.....

Appendix 10: Third User-Test Results

Questionnaire Results
Personal Information and Previous VR Experience
3rd User Test: 05/06/2023

For this third user-test we have merged all the questions in one single questionnaire, in order to make it more comfortable for the volunteers to answer them. Nevertheless, we have followed the same structure as in the previous cases: personal information and previous VR experience, virtual experience and feedback. As such, for analysing the results, we will be following that same structure.

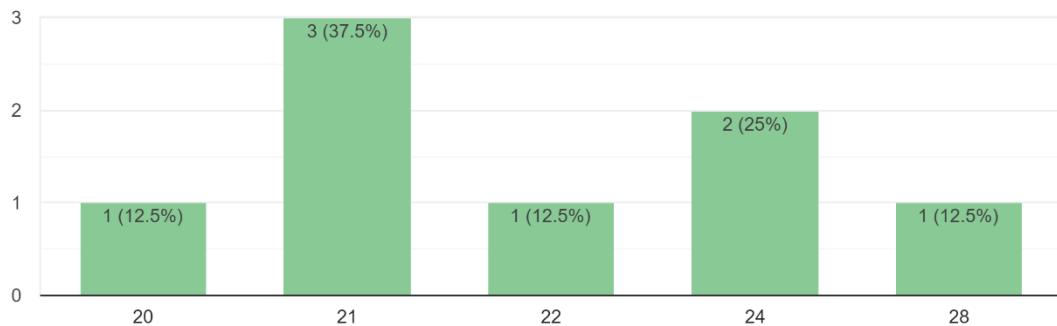
Personal Information and Previous VR Experience

The first section of the questionnaire gathered personal data about the participants. The results show that 8 people filled in this questionnaire, both male (3) and female (5) between the ages of 20 and 28. There were 4 nationalities present in this group of volunteers: Bulgaria, Germany, Turkey and Spain (one from the Basque Country and another one from Girona). All of them were students and belonged to the fields of social sciences, education, tourism, journalism and public relations (see Graphic 1, 2, 3, 4 and 5).

Regarding their VR experience, just one person didn't know what Virtual Reality is and three of them had never had previous experience with it. The ones that had previously tried VR, they had done it through our other experiments, other EPS demos, an immersive experience in an event and a game in a friend's headset. These experiences were for all of them positive. When asked to explain their answer, the volunteers stated that it was "something new" and that "the feeling is really nice". One of the participants even had a business idea to mix VR and tourism. Another user confessed that it was interesting to see how to develop a "VR cardboard game" and another one that "human curiosity is limitless" (see Graphic 6, 7, 8, 9 and 10).

These are the graphics with the answers of the participants.

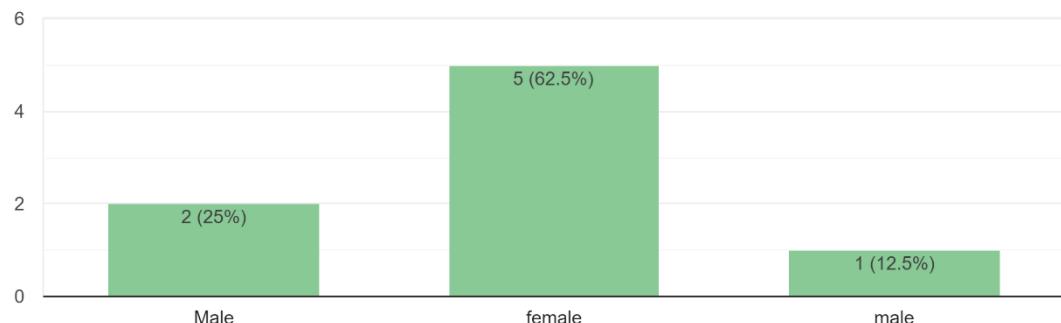
Age
8 responses



Graphic 1

Gender (if you don't feel comfortable disclosing your gender, skip this question)

8 responses



Graphic 2

Country of origin?

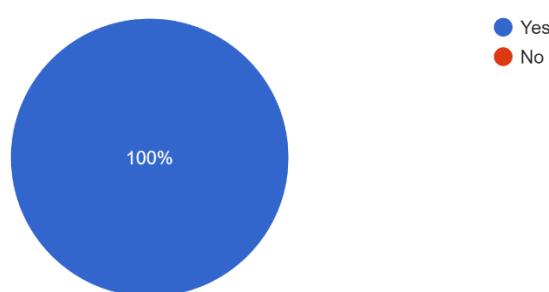
8 responses

Germany
bulgaria
Basque Country
Spain
germany
Girona, Espanya
Bulgaria
turkey

Graphic 3

Are you a student

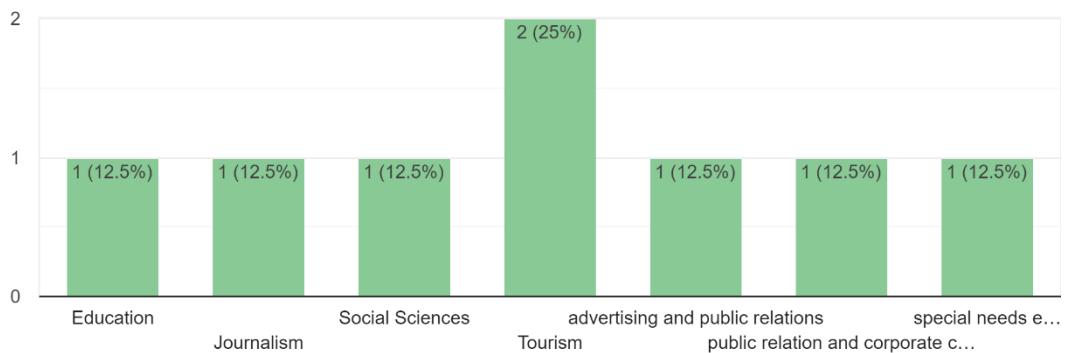
8 responses



Graphic 4

What is your field of study?

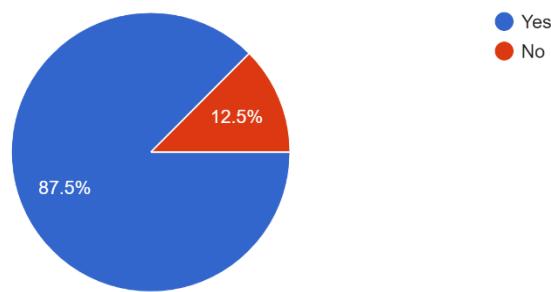
8 responses



Graphic 5

Do you know what Virtual Reality (VR) is?

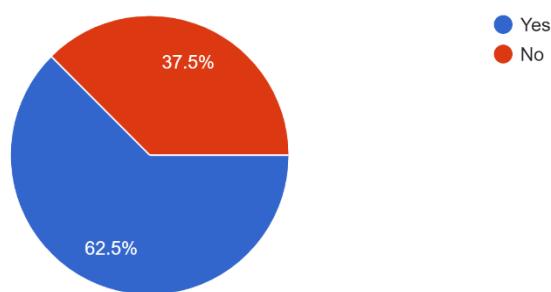
8 responses



Graphic 6

Have you already had VR-Experience before?

8 responses



Graphic 7

Personal Experience

Please tell us a little bit about your prior experience with VR. Was it a game? An immersive experience like a roller coaster? A 360° video? Please, specify the approximate duration, how many times you have experienced VR, etc ...

5 responses

I was in the first lab 3 month ago and I had experiences with Phillip he showed us with a VR some different levels

Game demo in AP Hogeschool, game development in cardboard for EPS. Approximation of 4 months

Games from the headset + previous experiments for EPS

It was an immersive experience as well in an event. It was like a kind of game in which I was a woodman and I had to cut some branches.

It was a game that you should smash the boxes with music, I tried 2 times with my friends vr set

Graphic 8

Choose the option that best describes your previous answer

5 responses



- It was a positive experience
- It was a neutral experience
- It was a negative experience

Graphic 9

Why? Please, explain your previous choice

5 responses

It's something new and the human curiosity is limitless

It was interesting to experience a different type of virtual experience and to see how a VR cardboard game is developed

The textures, the air and the sound felt that they matched and helped

Because I like this type of new technologies, in fact, once I had a business idea about VR mixed with tourism.

The feeling is really nice even you know where you are standing when you put the vr glasses it's so good

Graphic 10

Virtual Experience

The second section of the questionnaire aimed at measuring the level of immersion of the user. The experience included physical inputs that consisted of different surfaces (grass, sand and rocks) and ventilators.

Questions 7 and 8 evaluated the impact and quality of the visuals. All of the users rated that the environment looked similar to a real forest and that this made them feel more immersed (see Graphic 11 and 12).

Questions 11-13 asked the users about the usability of the headset. Just one person didn't find it easy and safe to move around the place (see Graphic 13). This user said that there were a bench and a rock that were in VR but not in the physical world, so this felt weird. The user would also have liked to touch the water. For the rest of the volunteers, the answers they provided can be seen in Graphic 14. All agreed that the ease of movement helped them be more immersed in the virtual environment (see Graphic 15). Only two volunteers didn't have it very clear where to go in the virtual environment (see Graphic 16).

Questions 14-16, 19 and 20 asked about the physical stimulus. Results show that all of the volunteers stated that the platform matched what they were actually seeing on VR and that this made them feel more immersed (see Graphic 17 and 18). Almost half of the volunteers found disturbing that they couldn't see their feet or body in VR. One user complained that this made him/her dizzy and that he/she couldn't see where he/she was going. Another one noticed that there were times when the feet and a rock didn't match their real location. The third volunteer confessed that if he/she had seen his/her feet, it would have been easier (see Graphic 19 and 20). Regarding the wind, three people actually felt the wind, while the rest didn't feel it as much. Except one, all of the volunteers admitted feeling more immersed because of it (see Graphic 21 and 22).

Regarding the questions about the sense of being immersed in the virtual environment, half of the users quite forgot that they were in a laboratory. Also, five volunteers felt as they were standing in a real forest and the others felt neutral about it (see Graphic 23 and 24). Half of the testers felt they could fall into the lake and three quarters of them thought of deliberately stepping into the lake (see Graphic 25 and 26).

Three of the volunteers felt like taking off the headset while on the VR experience. Half of the users felt the sense of being in the VR world stronger than being in the real world, three were indifferent and one person disagreed (see Graphic 27 and 28).

Finally, six participants felt disappointed that the experience was over and all of them except one would like to experience it again. (See Graphic 29 and 30).

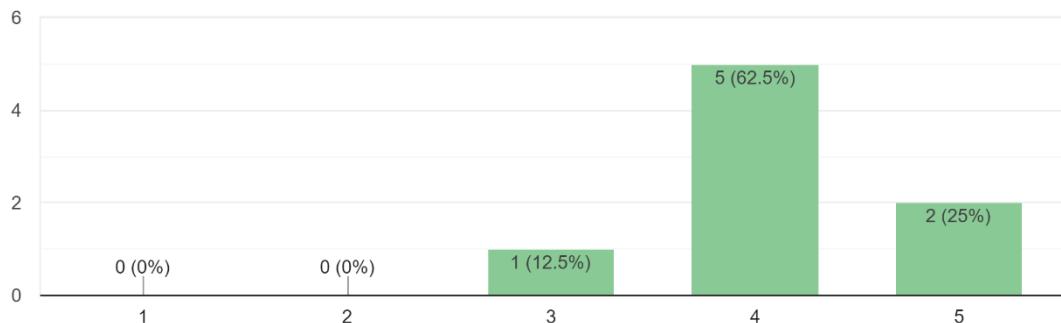
We asked if they would change in any way the physical input and two answered no. Nevertheless, some of the suggestions left by the other participants were the following ones (see Graphic 31 and 32):

- Spray water
- Scent of leaves
- Add water to touch (simulate lake)
- Remove the umbrella and add a walking stick instead
- Correctly place the flat rocks where people step on

These are the graphics with the answers of the participants.

How realistic did the forest look like?

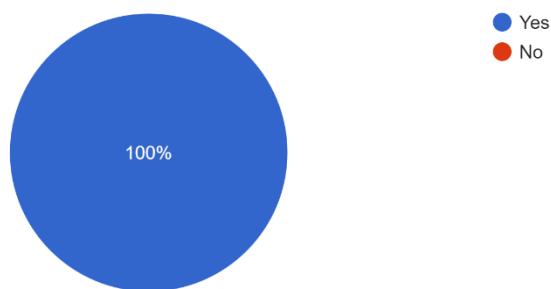
8 responses



Graphic 11

Did this make you feel more immersed in the environment?

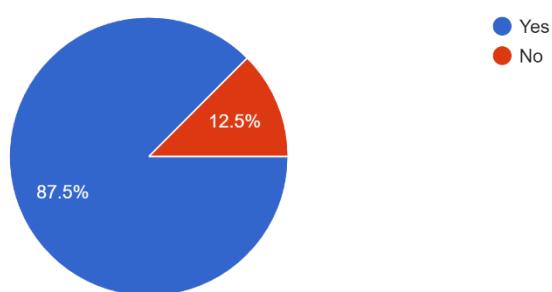
8 responses



Graphic 12

Did you find it easy and safe to move around the place?

8 responses



Graphic 13

Explain your previous answer

8 responses

with the stones and stuff like that was that kind of realistic

It was quite easy to move around, still, not knowing what happened in real life was a bit hard to move around

the idea of the torch was cool, and also the moving towards the little lights

I find it easy to move around the place and find the different obstacles, but at the same time I feel a bit scared about what I was going to find.

i trusted you, and because of the blue crosses I felt save, because I knew were I have to stop

There's a bench in the VR that there's not in the real life, and the same with a rock. But for the rest, its so good. I would like to could touch water.

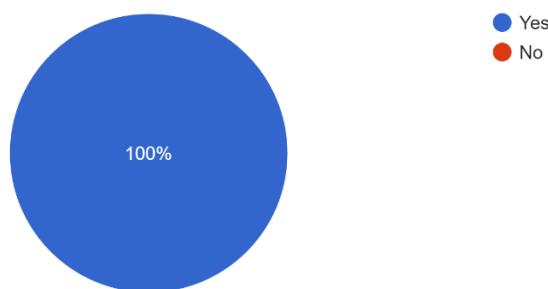
The lighter is amazing idea, really fun, the carpet makes you feel as if you are stepping on wet leaves for real

it looked so real tbh i was scared bc of the dark

Graphic 14

Did this help you be more immersed in the virtual environment?

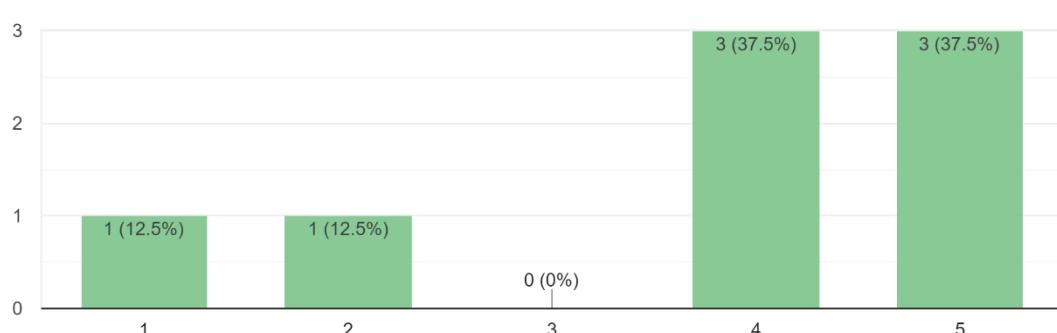
8 responses



Graphic 15

Did you understand where to go in the virtual environment?

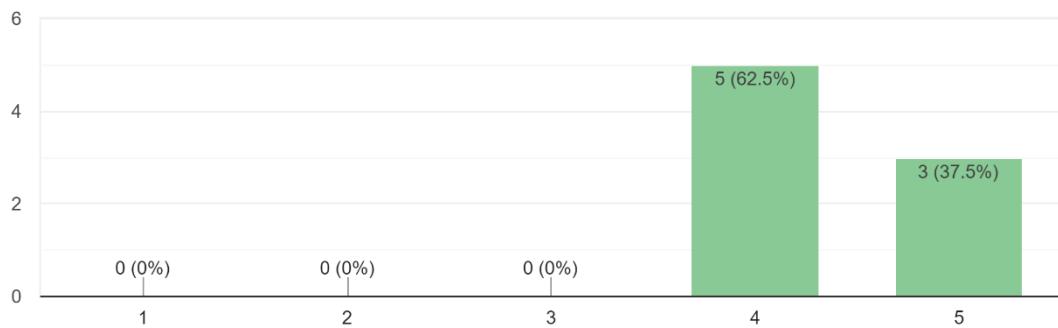
8 responses



Graphic 16

Did the physical set-up match what you were seeing?

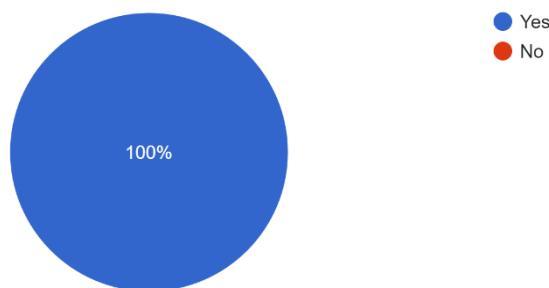
8 responses



Graphic 17

Did this set-up help you feel more immersed in the virtual environment?

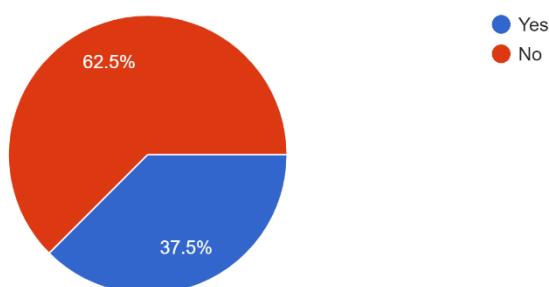
8 responses



Graphic 18

Did you find disturbing that you couldn't see your feet or, in general, your body in the virtual environment?

8 responses



Graphic 19

If you answered "Yes" in the previous question, explain briefly why and how this affected your immersive experience.

3 responses

It made me dizzy and you couldn't see where you were going.

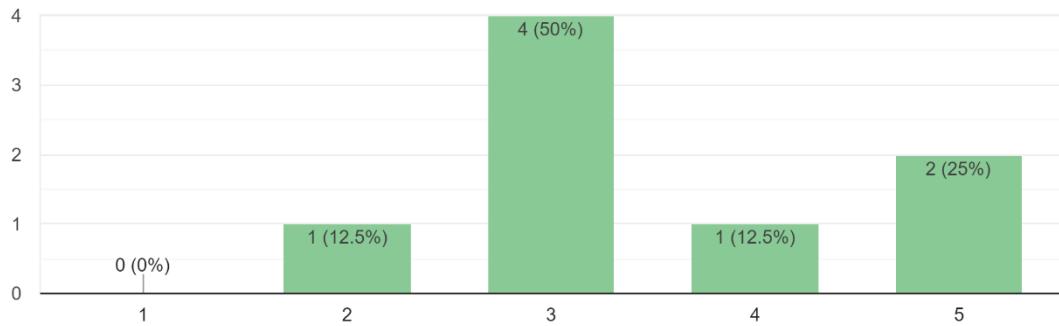
there were times that i felt that the feet did not match perfectly with the rocks but most of the experiment was very realistic

If I had seen my feet it would be easier.

Graphic 20

To which extent did you feel the wind?

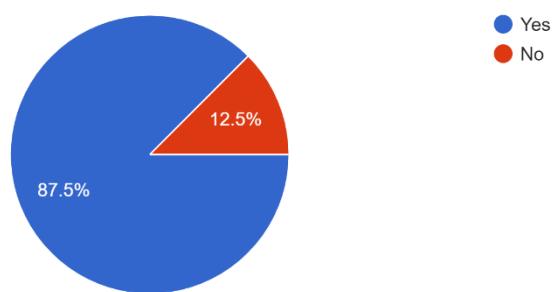
8 responses



Graphic 21

Did the wind help you feel more immersed in the virtual environment?

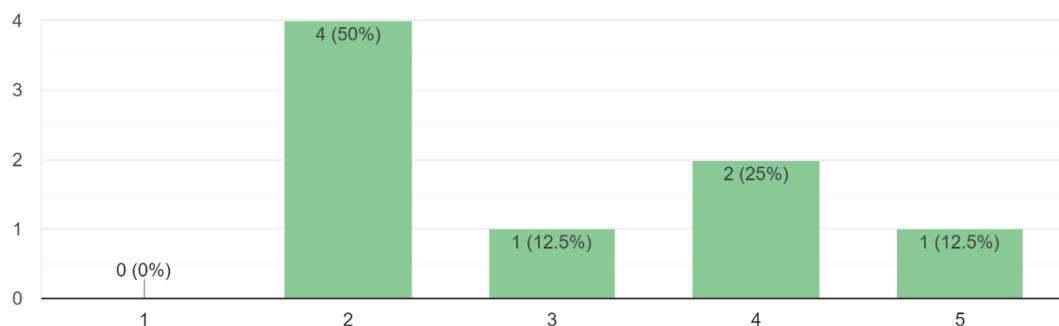
8 responses



Graphic 22

To what extent did you forget that you were in a laboratory?

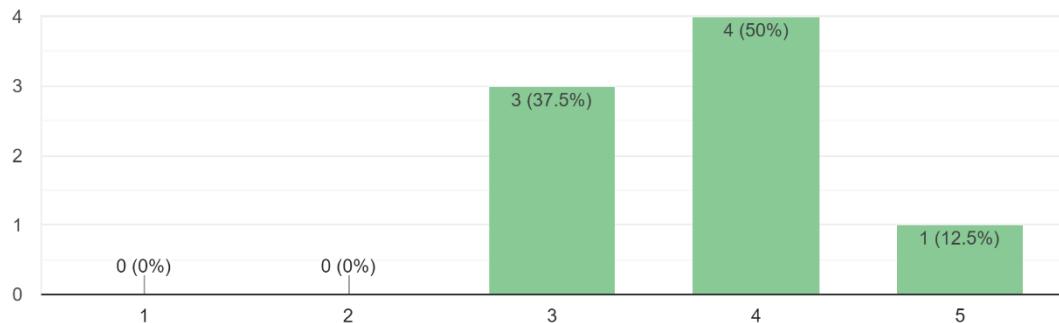
8 responses



Graphic 23

To what extent did you feel you were actually in a forest?

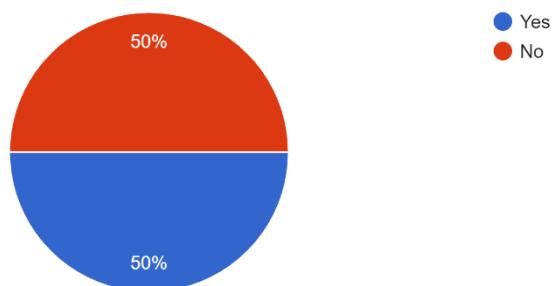
8 responses



Graphic 24

Did you ever feel like you could fall into the lake?

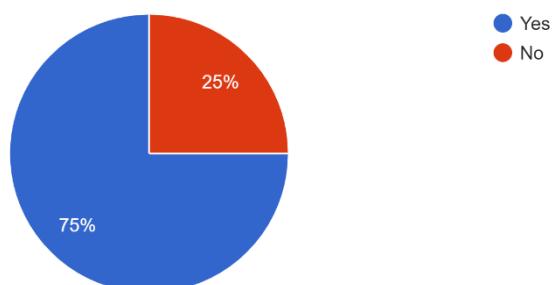
8 responses



Graphic 25

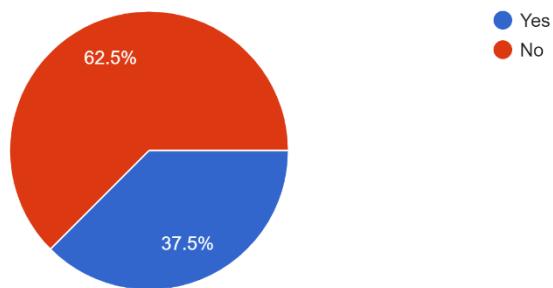
Did you ever think of stepping into the lake?

8 responses



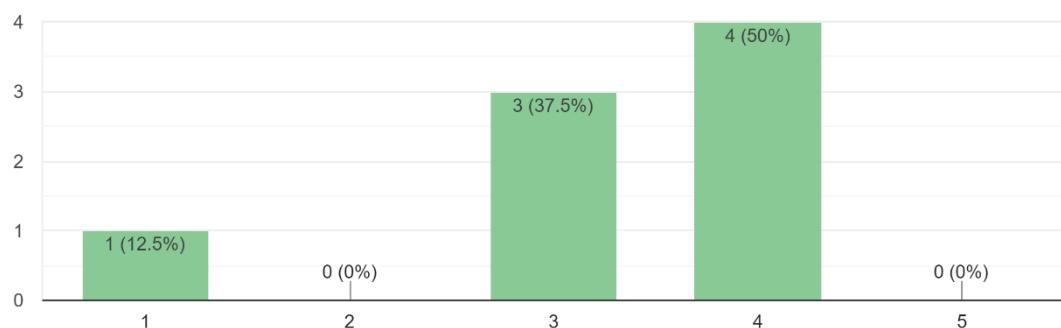
Graphic 26

Did you ever feel like taking the headset off to see what was happening in the real world?
8 responses



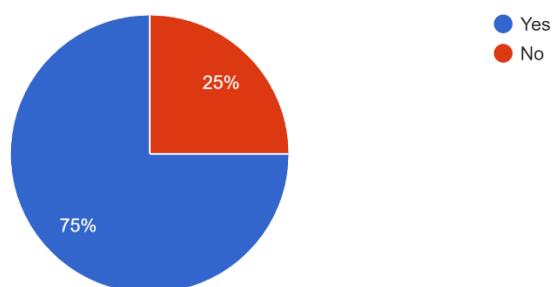
Graphic 27

To what extent was your sense of being in the environment stronger than your sense of being in the real world?
8 responses



Graphic 28

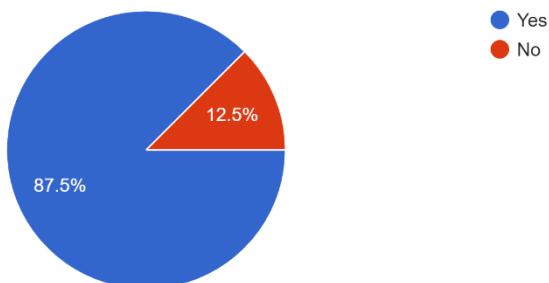
When interrupted, were you disappointed that the experience was over?
8 responses



Graphic 29

Would you like to have the experience again?

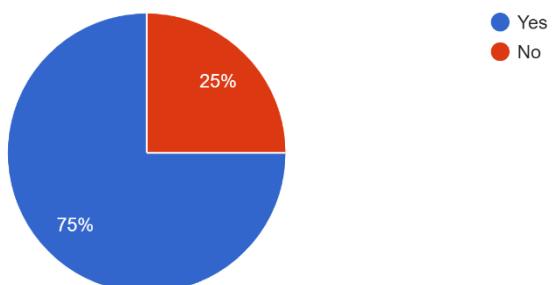
8 responses



Graphic 30

Would you change the set-up in any way (amount of rocks/sand, size of rocks/tiles...) or add anything to make it feel more like in the virtual environment?

8 responses



Graphic 31

Leave us your suggestions, please :)

7 responses

was nice expirience and my student collegues create something very well.....hand up

It would have been fun to spray some water! (just a bit) also add some scents of leaves

maybe add some drizzle (but of course it can cause problems the the headset)

For me the different floors were really nice, and made the experience much nicer :)

I would like to be able to touch some water and I would like a little bit of explanation at the beggining. I didn't i had to follow the insects.

I would remove the umbrella from the set and add a walking stick instead, in general it was amazing experience

i would change the umbrella with something more useful and the rocks we need to step is not in the correct placement sometimes but it was still really nice

Graphic 32

Feedback

In the third and last section of the questionnaire, the users gave feedback on the performance of the project-team.

According to the results, the team had a good performance (see Graphic 33). All agreed that the place of the experiment was appropriate, and that the set-up was quite safe (see Graphic 34 and 35).

Regarding the questions, most of the volunteers stated that they were easy to understand. Three people said that there were very few questions, other three felt neutral about it and two would have preferred less questions (see Graphic 36 and 37).

All of the volunteers evaluated the overall experience as positive (see Graphic 38).

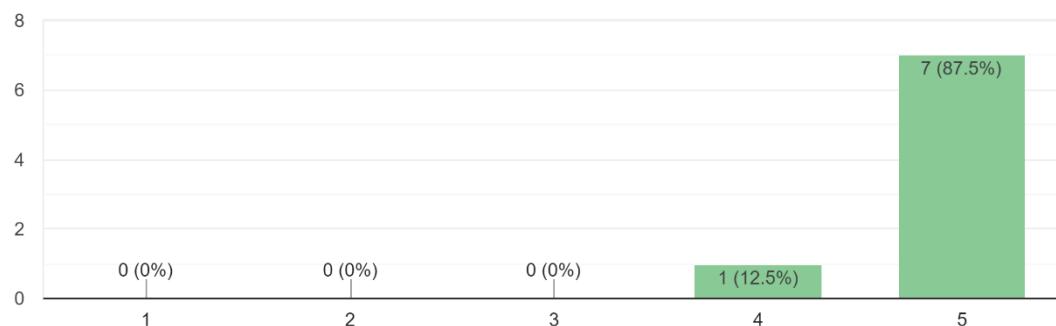
Some users wrote the following comments at the end of the questionnaire (see Graphic 39):

- “nice”
- “there were time that I couldn’t listen to the questions. But thanks for the experience, the formulaire is brief and I see that you have been working hard, good job”

These are the graphics with the answers of the participants.

Rate the performance of the team-members

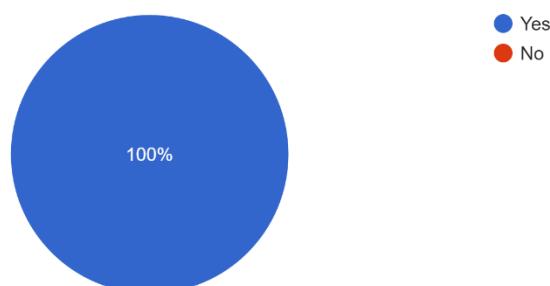
8 responses



Graphic 33

Was the place of the experiment appropriate?

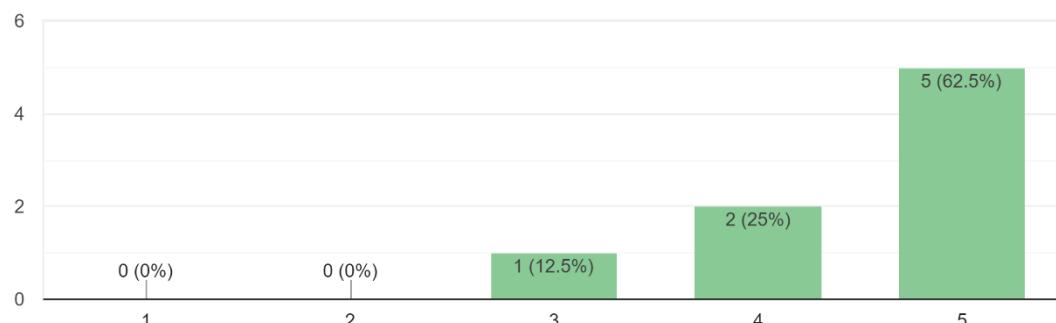
8 responses



Graphic 34

Did you feel the set-up was safe?

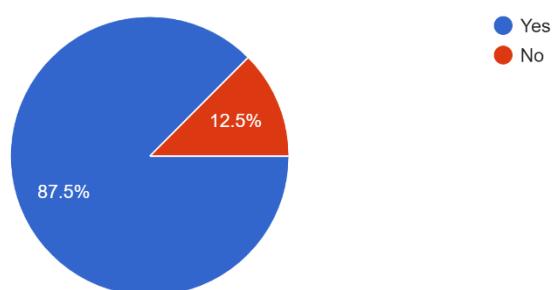
8 responses



Graphic 35

Were the questions easy to understand?

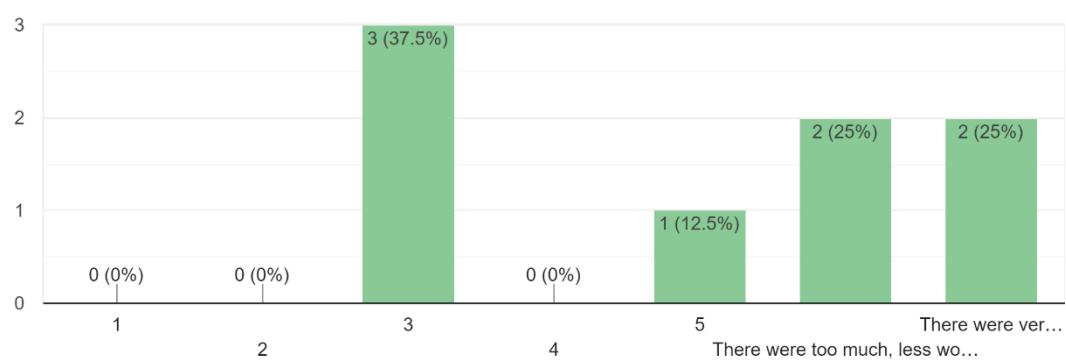
8 responses



Graphic 36

Regarding the amount of questions

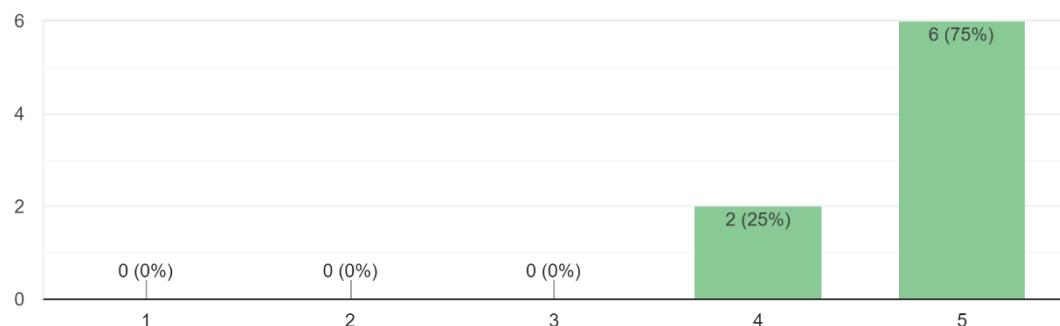
8 responses



Graphic 37

Rate the overall experience

8 responses



Graphic 38

Feel free to leave us any feedback, suggestions or comments you may have :)

2 responses

nice

there were times that i couldn't listen to the questions

but thanks for the experience, the formulaire is brief and i see that you have been working hard, good job

Graphic 39

Appendix 11: VR User-Test Sign Up

VR User-Test Sign Up

Fourth User-Testing of Nature Realms
by Team Hyper
13th of June 2023. AP Immersive Lab

TEAM HYPER PRESENTS... THE FINAL VR EXPERIENCE!

Come and join our very last user-test!

We have finished building our nature VR experience and we are excited to invite you to try it yourself :)

1. Name

.....

2. Email

.....

3. Choose a time-slot

- 12:15-12:30
- 12:30-12:45
- 12:45-13:00
- 13:00-13:15
- 13:15-13:30
- 13:30-13:45
- 13:45-14:00
- 14:00-14:15
- 14:15-14:30
- 14:45-15:00
- 15:00-15:15
- 15:15-15:30
- 15:30-15:45
- 15:45-16:00

Appendix 12: Fourth User-Test Questionnaire

Questionnaire

Fourth User-Testing of Nature Realms
by Team Hyper
13th of June 2023. AP Immersive Lab

First of all, thank you very much for participating in our experience. You are playing a fundamental role in our research process and we hope you enjoy it!
Please fill out the following questionnaire.

We won't share your information with anyone outside the project-team and it will only be used for research-purposes.

If you would like more information regarding the collection and processing of data, you can have a look at the [Privacy Statement for Research at AP University](#).

Image Permission

During the experience we will take pictures and record videos of users testing our project, so that we can use them for promotional purposes.

1. Do you give us permission for filming and taking pictures of you?

Yes No

Personal Information

These questions are aimed at gathering some data about the profile of our users.

2. Age

.....

3. Gender (if you don't feel comfortable disclosing your gender, skip this question)

.....

4. Country of origin

.....

5. Are you a student? Yes No

If yes, what is your field of study?

.....

If not, what is your profession? (If you are unemployed, please disclose it as well)

.....

6. Do you know what Virtual Reality (VR) is?

Yes No

7. Have you already had VR-Experiences before?

Yes No

If yes, please, tell us a little bit about your prior experience with VR. Was it a game? An immersive experience like a roller coaster? A 360° video? Please, specify the approximate duration, how many times you have experienced VR, etc ...

.....
.....
.....
.....
.....

Choose the option that best describes your previous answer

- It was a positive experience
- It was a neutral experience
- It was a negative experience

Why? Please, explain your previous choice

.....
.....
.....

Personal Experience

8. Describe briefly in your own words what you have just experienced in the Immersive Lab

.....
.....
.....

Virtual Experience Test

In the following questions you will be asked about the virtual experience you tested today. Be as sincere as you can and let us know how you felt!

9. How realistic did the forest look like?

Not at all 1 2 3 4 5 Very much so

10. Did this make you feel more immersed in the environment?

Yes No

11. Did you feel, at any point, that you were in the rain?

Yes No

12. Did you find it easy to move around the place?

Yes No

Explain your previous answer

.....
.....
.....

13. Did this help you be more immersed in the virtual environment?

Yes No

14. Was it clear for you how to navigate the environment? (Follow the lights, teleportation...)

I didn't understand how to advance in the environment	1 2 3 4 5	It was clear I had to follow the lights and that I would change scenes through teletransportation
---	-----------------------	---

15. Did you find disturbing that you couldn't see your feet or, in general, your body in the virtual environment?

Yes No

If you answered "Yes" in the previous question, explain briefly why and how this affected your immersive experience.

.....
.....
.....

16. How did you feel about the umbrella and flashlight? Was it comfortable to carry them?

Explain in your own words the experience

.....
.....
.....

17. Did you feel comfortable with the height of the ground? That is, in the VR experience, did you feel you were shorter or taller than you really are?

- I felt shorter
- The height was fine
- I felt taller

18. What physical inputs did you notice?

.....
.....
.....

19. Did the physical set-up match what you were seeing?

Not at all 1 2 3 4 5 It was very accurate

20. Did this set-up help you feel more immersed in the virtual environment?

Yes No

21. To which extent did you feel the wind?

Not at all 1 2 3 4 5 Very much so

22. Did the wind help you feel more immersed in the virtual environment?

Yes No

23. Did the physical bench match the one you were seeing in VR? (surface, height...)

Yes No

24. To what extent did you forget that you were in a laboratory?

I totally forgot about it 1 2 3 4 5 I was totally aware that I was in
a laboratory

25. To what extent did you feel you were actually in a forest?

I never felt like I was in a forest 1 2 3 4 5 I completely believed I was in a forest

26. Did you ever feel like you could fall into the lake?

Yes No

27. Did you ever think of stepping into the lake?

Yes No

28. Did you feel claustrophobic or fear of heights in the cave? (You can choose more than one)

- Claustrophobic
 - Fear of heights
 - None

29. Did you crawl through the end of the cave?

Yes No

If you answered “Yes” to the previous question, explain briefly how did it feel.

.....
.....

30. Did you ever feel like taking the headset off to see what was happening in the real world?

Yes No

31. To what extent was your sense of being in the environment stronger than your sense of being in the real world?

Not at all 1 2 3 4 5 Very much so

32. When interrupted, were you disappointed that the experience was over?

Yes No

33. Would you like to have the experience again?

Yes No

34. Would you change the set-up in any way (amount of rocks/sand, size of rocks/tiles...) or add anything to make it feel more like in the virtual environment?

Yes No

Leave us your suggestions, please :)

.....
.....
.....
.....
.....

Appendix 13: Fourth User-Test Results

Questionnaire Results
Personal Information and Previous VR Experience
3rd User Test: 05/06/2023

For this fourth user-test we have merged all the questions in one single questionnaire, in order to make it more comfortable for the volunteers to answer them. Besides, we have deleted the “Feedback” section, as we already received direct feedback from each user after the tests and the questionnaire results didn’t add up much information. We have also added a question for asking permission for taking pictures during the experience. In the report we have followed the same structure as in the previous cases: personal information, previous VR experience and virtual experience. As such, for analysing the results, we will be following that same structure.

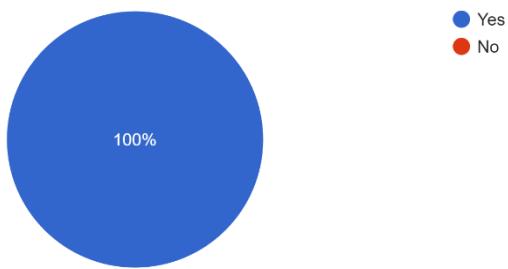
Only 3 people signed up for the user-test, but in the end 10 people took part and filled out the questionnaire.

Image Permission

All the users agreed to being filmed during the experience (see Graphic 1).

Do you give us permission for filming and taking pictures of you?

10 erantzun



Graphic 1

Personal Information and Previous VR Experience

The first section of the questionnaire gathered personal data about the participants. The results show that 5 male and 4 female users, between the ages of 20 and 51 took part in our fourth user test. One person answered to the question about gender with the word “Gender”, so it is not clear the gender of the 10th user (see Graphic 2 and 3). Regarding the nationalities, there were Basque (1), Belgian (2), Bulgarian (1), German (4) and Spanish (2) (see Graphic 4).

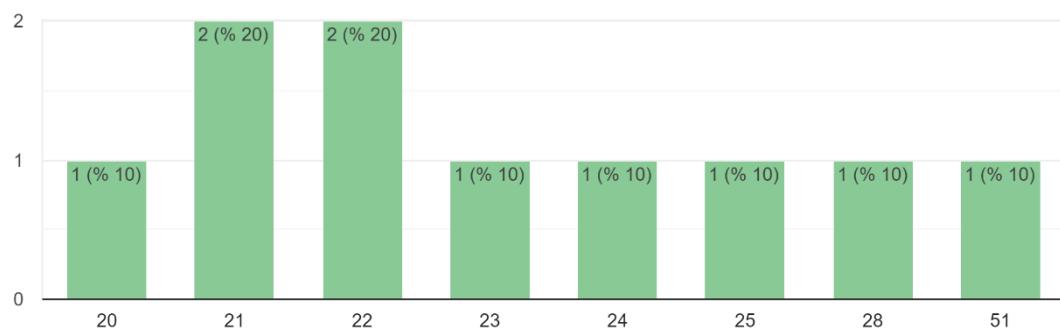
All users except one were students from various study backgrounds: occupational therapy, tourism, education, humanities, mechanical engineer, communication, and public relations and corporate communication. The other user was a lecturer (see Graphic 5, 6 and 7).

All of the users knew what VR was and all except two had had previous experience with it. The experiences they had were diverse: in Anatomy class, our previous EPS experiments, gaming and attractions (roller-coaster, jumping off a building). For all of the students except one, who felt neutral about it, considered the experience as positive (see Graphic 8, 9, 10 and 11).

Regarding the last question about the previous VR experience, it must be said that the order of the questions was not correct, and that people answered this question with regards to the current VR user-test, and not their previous experience. Therefore, we are not considering these answers for the results.

These are the graphics for this section of the questionnaire:

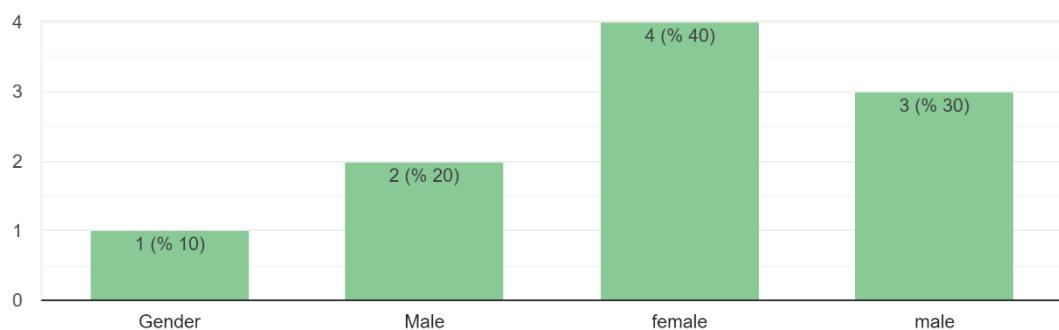
Age
10 erantzun



Graphic 2

Gender (if you don't feel comfortable disclosing your gender, skip this question)

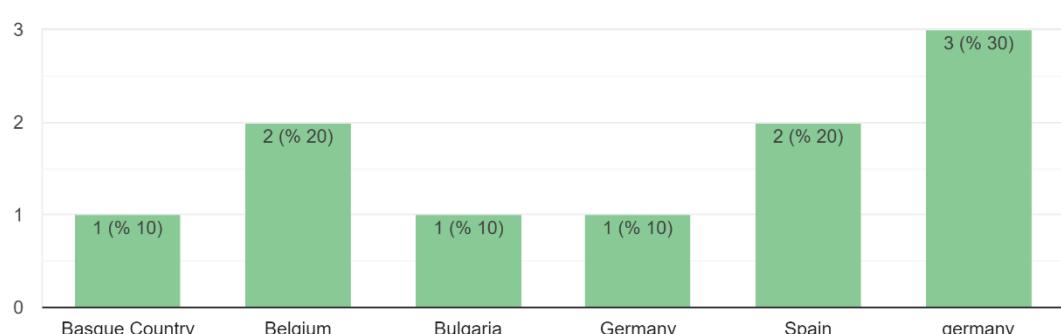
10 erantzun



Graphic 3

Country of origin?

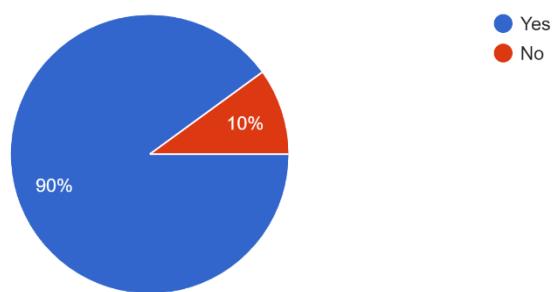
10 erantzun



Graphic 4

Are you a student

10 erantzun



Graphic 5

Studies

What is your field of study?

9 erantzun

occupational therapy

Tourism

Education

Humanities

Mechanical Engineer

Communication

PR and Corporate Communication

primary school teaching

special needs

Graphic 6

Job

What is your profession? (If you are unemployed, please, disclose it as well)

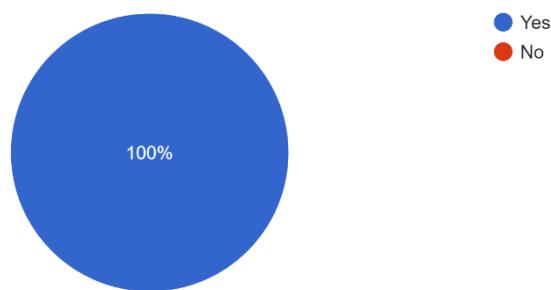
Erantzun bat

Lecturer

Graphic 7

Do you know what Virtual Reality (VR) is?

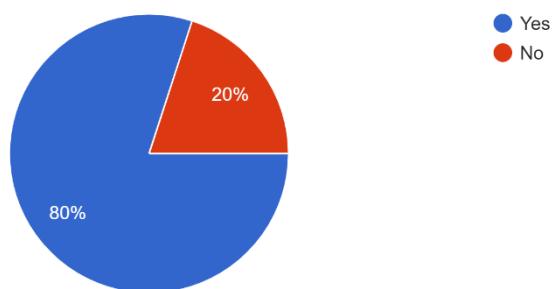
10 erantzun



Graphic 8

Have you already had VR-Experience before?

10 erantzun



Graphic 9

Please tell us a little bit about your prior experience with VR. Was it a game? An immersive experience like a roller coaster? A 360° video? Please, specify the approximate duration, how many times you have experienced VR, etc ...

10 erantzun

I used VR before, in class to study anatomy. We used it to let the body turn and have a good image of the bones and muscles etc.

EPS

My previous experience was with you, when I tried your previous immersive experience.

All the EPS experiments + VR games from Meta VRs

I've developed a VR videogame, so I am a little bit used to VR. I've also played some games like Beat Saber or Shooters and done some experiences like roll-costers or jumping from buildings (1 hour experience).

Very little experience. Playing games, messing around in a room build in unity

Just normal exp. with friend, but always amazing

XXX

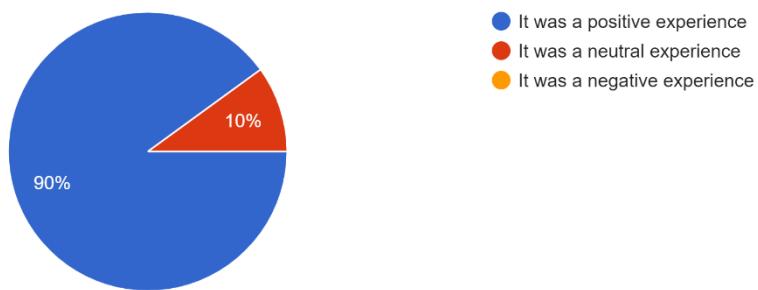
i onlz had the experience last week with you

none

Graphic 10

Choose the option that best describes your previous answer

10 erantzun



Graphic 11

Personal Experience

When asked to briefly describe the fourth user-test in their own words, they highlight the change of scenery, how dark and cold the cave feels and the relief when reaching the sunset. See Graphic 12 for the whole descriptions.

Personal Experience

Describe briefly in your own words what you have just experienced in the Immersive Lab

8 erantzun

It feels like you're really in a forest. It's cool to feel anxious in the cave and experience even the cold when you go down the cave. You have to follow the path that's made for you, so you know which way you have to go. To feel the underground change, is a big part of the experience, because it feels like the real world.

Very nice experience, interesting and very immersive

I was in a different spaces, first in a forest with a lake that was very dark, then I was in a cave, small cave also in the dark. In that place I feel like I could fall in the hall, but at the end I finished in a beautiful hall with amazing views to the sunset in the sea. From my experience, I am very surprised, it feels real, I was scared about falling, so congrats because you achieve that I forgot where I really was.

An evening out in the nature exploring

An immersive experience where the aim is to make the user feel totally immersed in the scene that he or she is looking at through the headsets.

An immersive vr journey through forests and caves.

i was so suprised that students from Europe create such a nice lab and getting better and better

a excited and funny experience!!

Graphic 12

Virtual Experience Test

In this section of the questionnaire the users are asked about the quality of the VR experience.

First of all, in terms of visuals, they all agree that they were realistic and immersive and half of the volunteers felt that they were in the rain (see Graphic 13, 14 and 15).

80% of the users found it easy and safe to move around, because the physical experience matched what they were seeing in VR. Also, there were some people who didn't feel that comfortable because of the scenes themselves; the cave was a bit scary. They also point out that the lights and mushrooms were helpful. All of this, though, made the users feel more immersed in the virtual environment (see Graphic 16, 17 and 18).

All the users stated that it was clear how to navigate the environment and just three confessed that they found disturbing that they couldn't see their body in the VR environment. They would have felt safer if they could have seen their feet, especially in the cave (see Graphic 19, 20 and 21).

As for the umbrella and flashlight, generally, they felt the flashlight was more useful than the umbrella, since some users didn't really feel the rain or thought the umbrella was not necessary. Also, one user missed the possibility of turning the flashlight off and another wanted to hold the rock but couldn't because of the controllers (see Graphic 22).

For the 80% of the users the height of the ground was fine, and the others felt shorter (see Graphic 23).

When asked about which physical inputs did the users notice, and this is what they answered: wind, different grounds (leaves, carpet, sand, rocks), walls, smell, obstacles on the ground, height and tree branches (see Graphic 24).

All the volunteers agreed that the physical set-up matched what they were seeing and that this made them feel more immersed (see Graphic 25 and 26).

The wind was felt by most of the users and this made them also feel more immersed. The bench all matched the one that they were seeing in VR (see Graphic 27, 28 and 29).

When asked about the level of immersion, five didn't forget that they were in a laboratory, but four did and one felt neutral about it. Nevertheless, nine volunteers felt they were actually in a forest (see Graphic 30 and 31).

More than half of the users felt they could fall into the lake and they also thought of actually stepping into the lake (see Graphic 32 and 33).

Seven people felt fear of height in the cave, one claustrophobic and three didn't feel nothing at all. Also, half of the users admitted crawling through the end of the cave. The ones who did it stated that it felt "nice", "funny", "realistic" and "crazy" (see Graphic 34, 35 and 36).

Just one person felt like taking the headset off to see what was happening in the real world and most of the users felt a stronger sense of being in the environment than in the real world (see Graphic 37 and 38).

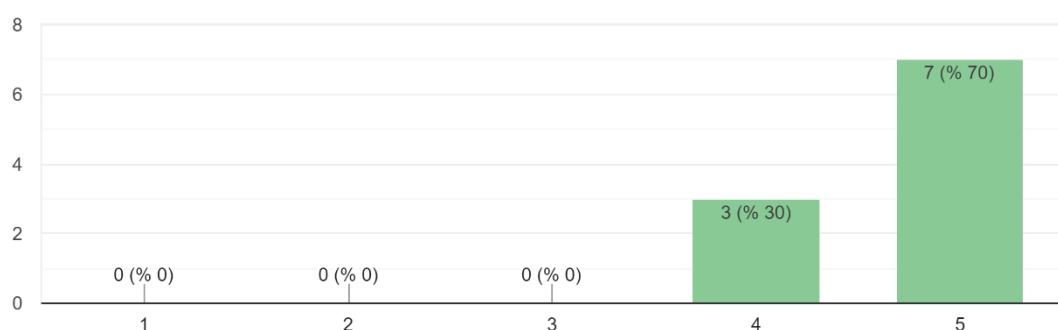
Just one person was not disappointed that the experience was over, but all of them would like to have the experience again (see Graphic 39 and 40).

More than half of the users wouldn't change anything from the experience, but these are some suggestions that they gave us (see Graphic 41 and 42):

- Add water
- Add smells
- Add branches hitting the head
- Add the big tree trunk to climb over
- Add wall-obstacle

How realistic did the forest look like?

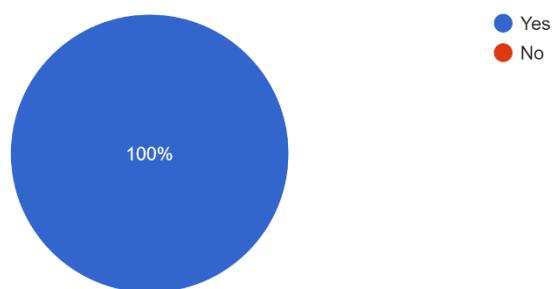
10 erantzun



Graphic 13

Did this make you feel more immersed in the environment?

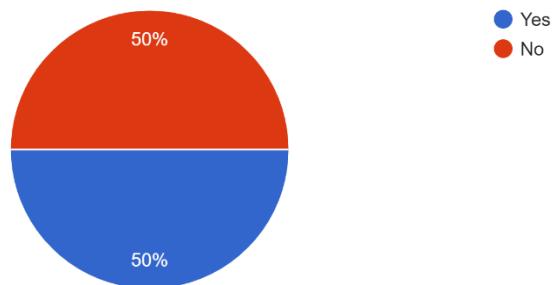
10 erantzun



Graphic 14

Did you feel, at any point, that you were in the rain?

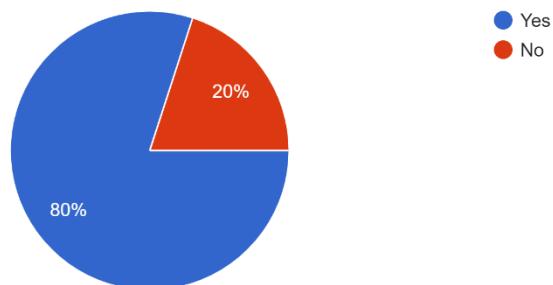
10 erantzun



Graphic 15

Did you find it easy and safe to move around the place?

10 erantzun



Graphic 16

Explain your previous answer

10 erantzun

What you saw in the game, is also what you felt in your environment, so I really felt it safe to move around in the forest, as well in the cave.

Where the high area was, it would've been nice to have some physical aid because I really felt that I could fall

The immersive experience scared me, so I don't feel very safe moving around the different areas.

Adding the lights + the mushrooms was a good one

It had no difficult obstacles and it was easy to walk around.

It was exciting and intuitive. The only scary part was the cave with the abyss.

It was so realistic

it was super nice and exciting and it felt so real!! Also the different weather conditions felt very real. With the rain of course I couldnt feel the drops but since i have an umbrella in my hand its realistic that i dont

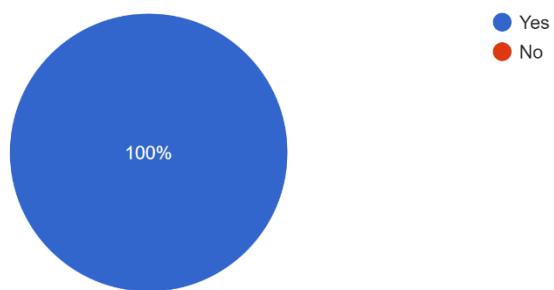
is was not easy because it was not a comfortable situation but in real live i felt safe

The VR was realistic enough to feed the eye-foot coordination

Graphic 17

Did this help you be more immersed in the virtual environment?

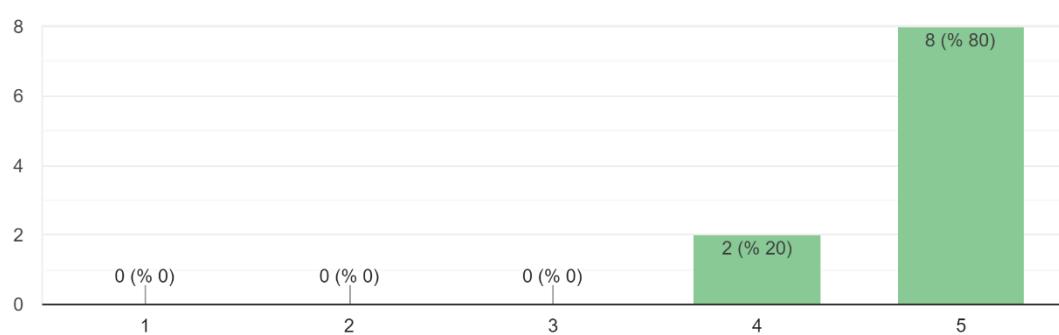
10 erantzun



Graphic 18

Was it clear for you how to navigate the environment? (Follow the lights, teleportation...)

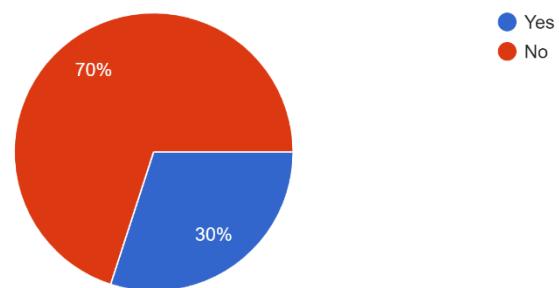
10 erantzun



Graphic 19

Did you find disturbing that you couldn't see your feet or, in general, your body in the virtual environment?

10 erantzun



Graphic 20

If you answered "Yes" in the previous question, explain briefly why and how this affected your immersive experience.

3 erantzun

I would prefer to know where is my feet, to feel more safe, and to be more aware about my movements.

maybe you felt that the steps did not match perfectly

In general it was not something that I missed but when I was in the cave I was so focused looking at the floor that then I realised that I had no legs.

Graphic 21

How did you feel about the umbrella and flashlight? Was it comfortable to carry them? Explain in your own words the experience

10 erantzun

Yes, for me it was no problem to hold the controllers, it felt more realistic to have a flashlight to use in the cave. The umbrella was useful for the rain, so it didn't feel disturbing.

Yes, it was comfortable

Yes, I think they were comfortable, and it is really cool to see in the game the umbrella and the flashlight.

the umbrella is quite passive but is cool to play with it + the flashlight

Yes, it was cool to have them. But I missed the possibility to turn off the flashlight.

The umbrella was (sorry for the hard words) kind of useless because I never really felt like it was raining. The lamp however was very immersing and intuitive. It feels like a real lamp

was very helpful

was fine. I think the umbrella was less necessary but the flashlight was super cool and authentic, especially in the darker environments

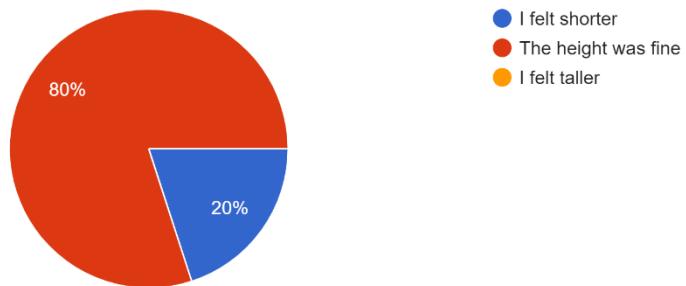
yes but sometimes I wanted to hold the rock to feel more safe but that wasn't possible

I hate umbrellas and never use them but I get why you implemented it. The flashlight was great.

Graphic 22

Did you feel comfortable with the height of the ground? That is, in the VR experience, did you feel you were shorter or taller than you really are?

10 erantzun



Graphic 23

Physical Stimulus

What physical inputs did you notice?

10 erantzun

The wind was blowing, the underground was changing from leafs and sand, to rocks and back again to sand.

Wind, stones, platforms, carpet, sand, etc

rocks, sand, wind and walls

wind, rough terrain and different textures

The "wind", the smell, the obstacles on the ground...

Wind, smell, sand and rocks on the floor, height and cliffs, tree branches on the floor

sometime when the environment changed i scared a bit

i sometimes hesitated do do a step or walk further because it felt so real and sometimes scary (in a good way), i felt very calm in the relaxing environments like the rainy forest and the sunset cliffs

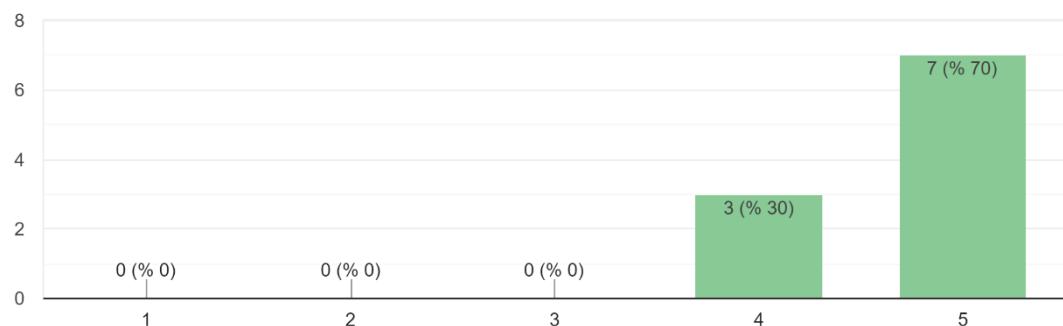
the rocks, the underground changed, the wind

Different undergrounds and levels

Graphic 24

Did the physical set-up match what you were seeing?

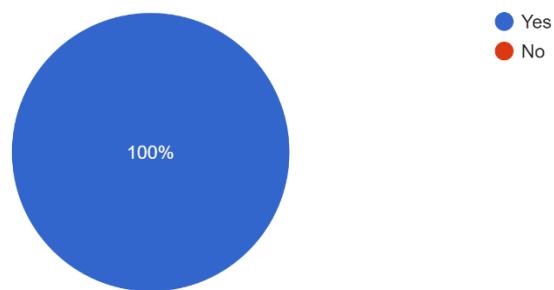
10 erantzun



Graphic 25

Did this set-up help you feel more immersed in the virtual environment?

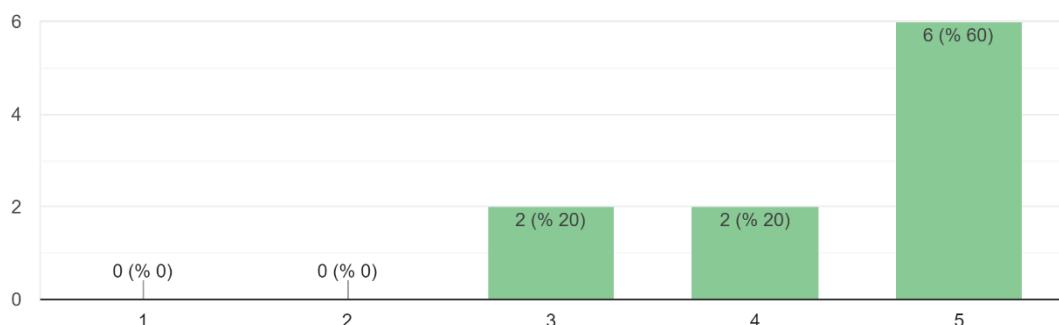
10 erantzun



Graphic 26

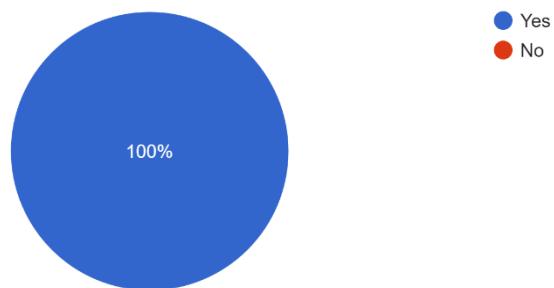
To which extent did you feel the wind?

10 erantzun



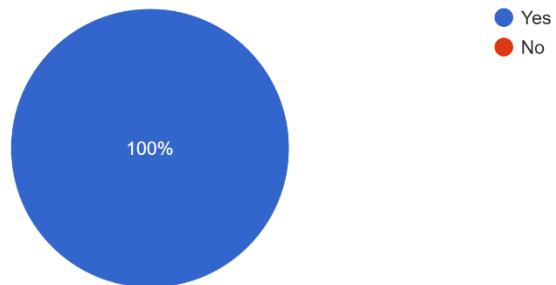
Graphic 27

Did the wind help you feel more immersed in the virtual environment?
10 erantzun



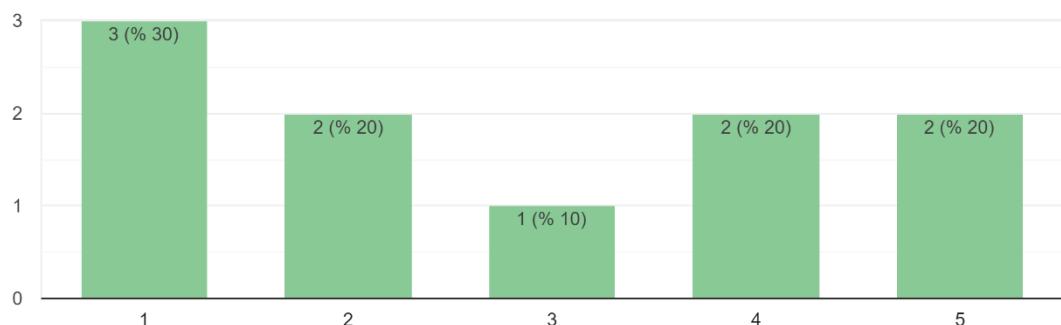
Graphic 28

Did the physical bench match the one you were seeing in VR? (surface, height...)
10 erantzun



Graphic 29

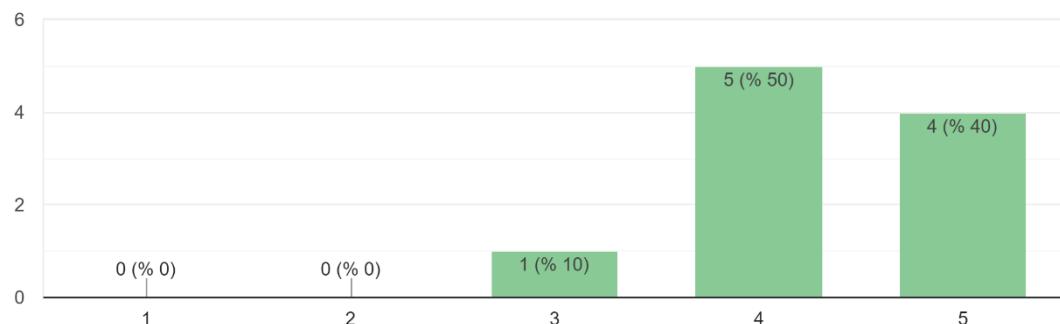
To what extent did you forget that you were in a laboratory?
10 erantzun



Graphic 30

To what extent did you feel you were actually in a forest?

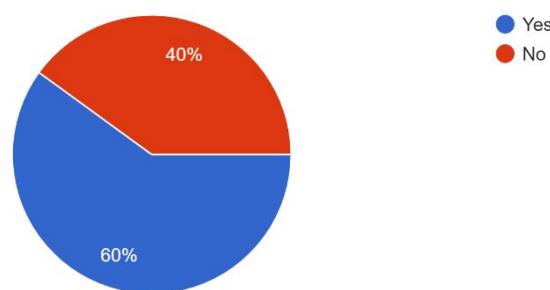
10 erantzun



Graphic 31

Did you ever feel like you could fall into the lake?

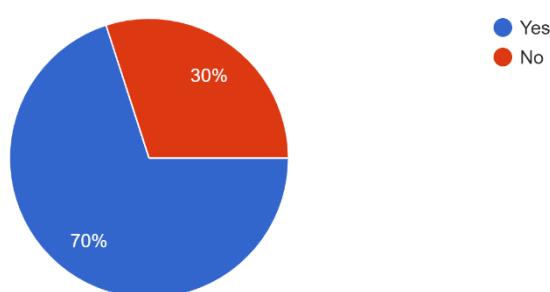
10 erantzun



Graphic 32

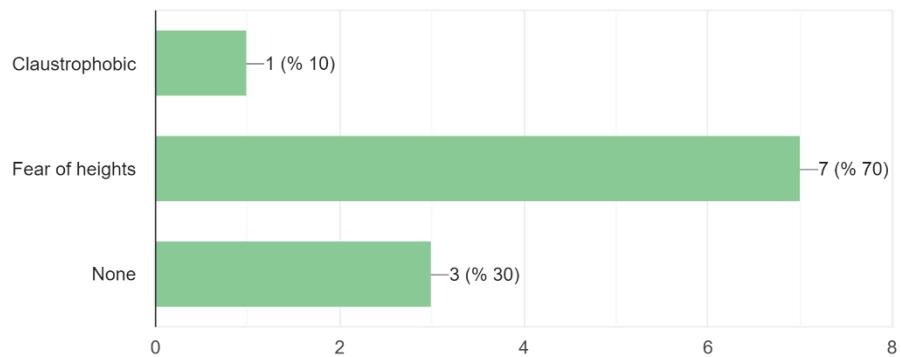
Did you ever think of stepping into the lake?

10 erantzun



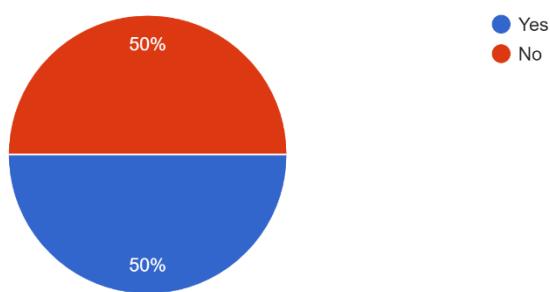
Graphic 33

Did you feel claustrophobic or fear of heights in the cave? (You can choose more than one)
10 erantzun



Graphic 34

Did you crawl through the end of the cave?
10 erantzun



Graphic 35

If you answered "Yes" to the previous question, explain briefly how did it feel.

5 erantzun

It felt nice

It was funny to do it. I knew that I didn't have to do it but I really wanted to do it.

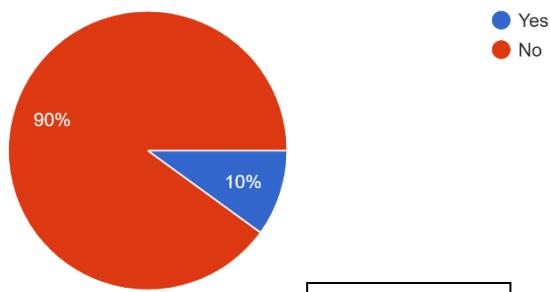
feels so realistic

so the fear of heights was actually not so scary more of a cool feeling that i could step out of my confort zone becuase i would never do this in real life! so cool! Crawling through the cave made it so real!!!

crazy, i really felt that i have to do it, that was fun

Graphic 36

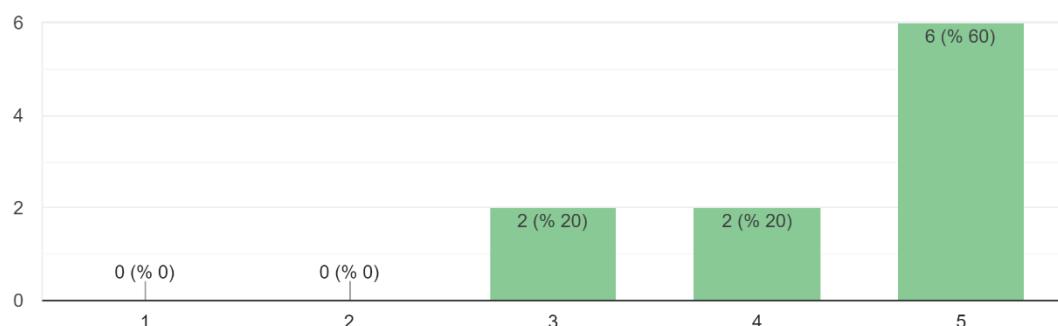
Did you ever feel like taking the headset off to see what was happening in the real world?
10 erantzun



Graphic 37

To what extent was your sense of being in the environment stronger than your sense of being in the real world?

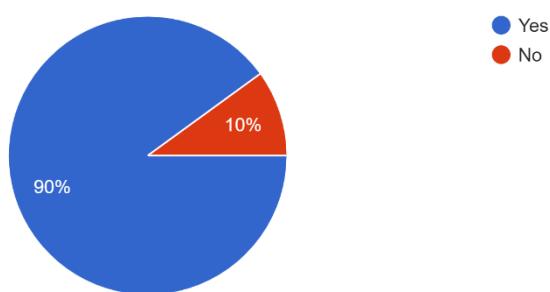
10 erantzun



Graphic 38

When interrupted, were you disappointed that the experience was over?

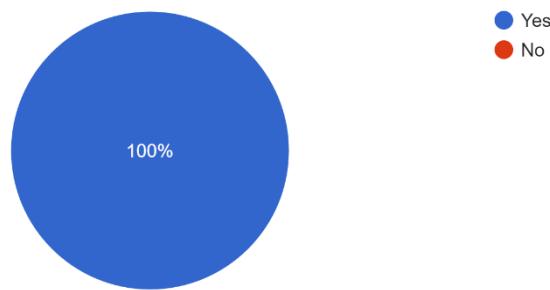
10 erantzun



Graphic 39

Would you like to have the experience again?

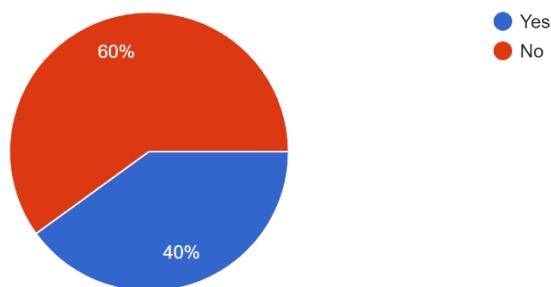
10 erantzun



Graphic 40

Would you change the set-up in any way (amount of rocks/sand, size of rocks/tiles...) or add anything to make it feel more like in the virtual environment?

10 erantzun



Graphic 41

Leave us your suggestions, please :)

8 erantzun

I'd add some water sprays and smells but in general it's an amazing experience

maybe some branches hitting on the head

It was very fun. The cave was the best part because it was very scary. Maybe the forest was the one that felt less immersive because I missed some physical objects like the wide tree but it still was a very funny experience.

Even though you had one and it didn't work out, some kind of wall-obstacle would maybe have been nice

amazing

the only thing I remember was that I was kind of walking through the tree stump in one situation because I knew that there is not a real tree. Maybe it would be fun to add some object/obstacle to climb over something. Otherwise just AMAZING

thank you!!!

Great job and great experience. Thanks for letting me try it out! Well done!

Graphic 42