

Tidal

How can lighting and sound be used to create
sensory immersion in an underwater game
environment?

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1. Introduction

Tidal is a first-person exploration game set underwater with a focus on sensory immersion through lighting and sound. Using Unreal Engine 5, the project strips away survival mechanics and complex systems, isolating lighting and sound as the central focus and allowing both to be examined closely. The underwater setting was chosen because both lighting and sound behave distinctly underwater, light refracts and reflects differently, while sound travels and resonates in unique ways. From light rays, caustics and bioluminescence, the water creates a sense of atmosphere and depth that would be harder to achieve in a land-based environment. Additionally, sound takes on a different quality underwater, where distant ambience, creature calls and silence can make a space feel vast or packed with life. Together, these qualities make the underwater world an ideal canvas for exploring how light and sound shape player experience.

In games such as ABZÛ and Subnautica, lighting and sound are utilised as powerful tools for creating immersion. Both games demonstrate how these features can shape the emotional tone of an underwater space, guiding the player and anchoring them in the environment. However, in each case, these aesthetic tools exist alongside complex survival systems, narrative structures, and threat mechanics. This makes it difficult to isolate what is actually driving the player's immersion, as the effect of lighting and sound becomes diluted by the broader experience. As a result of this context, Tidal addresses the research question of how lighting and sound can be used to create sensory immersion in underwater environments.

Lighting serves as the primary focus in this project, with research by Niedenthal (2008) suggesting that simulated illumination in games can provide more to a player than just visual aesthetic, where it can instead be used to guide players attention and influence the path they take. This idea is used within Tidal, where certain sections use lighting as a guidance tool amongst being an aesthetic feature. Sound plays a crucial role alongside this, with research by Guillen et al. (2021) indicating how its role is in sync with the visual experience, used as a tool to anchor the player within the space. Sound actively enhances the sensory immersion rather than simply playing a supporting role, as a result of these two features being included, these become the core of what Tidal sets out to investigate.

The artefact takes the player through a series of connected environments, beginning inside an underwater cave and opening out into a larger open-water space. Each area uses lighting and sound differently, aiming to create a distinct atmosphere in each section without relying on mechanics or narrative. To evaluate how well the artefact achieves this, users will play Tidal and then complete a short questionnaire about their experience. Questions focus on how immersive the environment felt and on the role lighting and sound played in that experience. This approach allows the project to be assessed directly against its original aim while also giving players space to describe their experience in their own terms.

The report begins by reviewing relevant literature and similar artefacts that informed the project's approach to lighting, sound, and immersion. It then outlines the design requirements established from that research, before explaining the development

process and the decisions made during the creation of Tidal. The final sections present and evaluate the feedback gathered from user testing, then reflect on the project.

2. Background / lit review

2.1 Immersion

Immersion in games is often defined as deep sensory and/or emotional involvement. Jennett et al. (2008) describe immersion as players becoming absorbed in the virtual environment, where sensory immersion and emotional involvement are crucial. Keeping this in mind is important as the project is not focused on challenges, survival or complex systems, but instead on ensuring the player feels the environment as they move through the space. Immersion in Tidal utilises atmosphere, water, movement, lighting, and sound to create a sense of being drawn into the underwater environment, making immersion the main measure of the project's success. If players later describe the experience as calming, atmospheric, or engaging, this suggests that the sensory-driven world-building is affecting them. Since Jennett et al.'s definition primarily focuses on sensory and emotional involvement, the idea of immersion becomes an appropriate way for the success of Tidal to be measured, where the project is specifically focusing on lighting and sound anchoring players into an underwater space.

2.2 Lighting as an aesthetic and guidance tool

In underwater settings, lighting plays a crucial role as water alters lighting behaviour. Features such as light rays, shadows, caustics, and darkness all work together to influence the player's perception of depth and distance. From this, lighting can be used to create visually intriguing environments whilst simultaneously providing players with a sense of direction. This is relevant to Tidal, as the project treats lighting as having a purpose beyond simply being an aesthetic tool, where it focuses on lighting as a potential guidance tool.

Lighting in games can serve a purpose beyond simple visibility. As Niedenthal (2008) illustrates, simulated light can enhance overall aesthetic quality, influencing how players experience an environment and how they pathfind through it. This idea is one of the features utilised in Tidal, where lighting is used throughout, from strategic downward lighting to bioluminescent glows, to direct and focus attention.

Games such as ABZÛ utilise these features effectively, as lighting is used to prioritise aesthetics, appeal and directional cues over natural realism. Factors such as colour, brightness, contrast, and shadows are individual components of lighting that can be crafted to create an experience that feels intentional rather than simply a directional indicator. This method of direction is used throughout every section to evoke a sense of immersion through aesthetics and directional use.

2.3 Sound as immersion and atmosphere

Sound plays a significant role in creating immersion in games. Hedges, Sazdov, and Johnston (2024) suggest that audio is essential in shaping immersive experiences. Spatial audio, music, and sound in gaming environments generally enhance immersion. These findings support the approach taken in Tidal, where audio is used both for

background ambience and for sound effects that shape the underwater environment. In this context, sound shapes how an environment feels; this aligns with Guillen et al. (2021), who discuss sound as closely aligned with a player's visual experience, serving as an anchor that brings the player into the virtual space. Within Tidal, this relationship between sound and visuals is essential to the experience, as audio constantly reinforces lighting and environmental changes, enhancing the atmosphere throughout the underwater areas.

Aquatic environments, by nature, can create a sense of distance, tension, and tranquillity, where ambient noise can be utilised effectively to enhance the vastness of the experience. Reducing sound can also be effective, as quieter sections can create a sense of discomfort or isolation. Such methods highlight how sound can be used in a versatile way to create a strong influence on the environment's atmosphere. In Tidal, sound is used differently to support these ideas, with different areas of the game feeling quieter and more enclosed, whilst open sections feel wider, more alive, and filled with more ambient water sounds. This links back to the project's main goal: players' responses to these sounds can indicate whether the audio has increased their overall sensory immersion in the project.

2.4 Case studies

2.4.1 ABZÛ

One of the main points of reference for Tidal was the game ABZÛ (Giant Squid, 2016). The inspiration for this was how ABZÛ presents underwater exploration to players. ABZÛ offers an extremely peaceful, visually appealing, and atmospheric experience, where all the lighting points discussed in the lighting as a tool for aesthetics and guidance section have been employed. The world itself feels calm and often ethereal, where lighting can often be seen as a directional tool guiding the player through the space without direct instructions to do so. This directly influenced how lighting is used in Tidal, particularly at the first cave entrance, where downward light is used, and in the last open-water section. The first jump-down section uses lighting to create an initial point of interest, encouraging the player to work with the landscape and descend. Whereas the open water sections use brighter, wider lighting to make the space feel larger than it is.

Additionally, the sound design in ABZÛ directly supports the sound choices utilised in Tidal, where ambient, ethereal music plays throughout the playthrough alongside sound effects. ABZÛ demonstrates that underwater immersion can be effective without relying on danger or survival, which inherently influenced some design choices in Tidal. Although these features influenced Tidal, ABZÛ incorporates longer progression and more interactive features. This implies that although lighting and sound are important, they are not the sole immersion contributing elements. During the game, the players' experience is affected by third-person swimming, visuals, interactions, and pacing, which makes it difficult for Tidal to gauge the effects of lighting and sound on immersion.

2.4.2 Subnautica

Subnautica (Unknown Worlds, 2018) was the second game that, throughout development, heavily influenced Tidal's design choices. Unlike ABZÛ, Subnautica uses sound more effectively to create a deeper sense of unease and tension. The underwater environment in Subnautica utilises darkness, distance, creature sounds, and reduced visibility to evoke strong feelings of uncertainty and horror, depending on the area. Furthermore, intimidation plays a large role throughout the game, as the player cannot always see what is around them. This way of creating immersion comes from a place of tension rather than a calm atmosphere, which can evoke different feelings in players.

Additionally, Subnautica's use of creature noises influenced the use of whale noises in the opening cutscene. Although Tidal does not aim to create danger or vast uncertainty, there are many instances of creatures throughout the experience, including octopuses, whales, turtles, and various fish, each placed specifically to make the game feel more alive. In later sections, the use of quieter, more eerie cave sounds is influenced by Subnautica's design choices, where audio can make the cave sections feel enclosed and tense without the necessity of a threat actually existing. This helps Tidal create a softer, yet vague, form of tension that fosters deep immersion, where the player is not in danger but can feel the space changing around them.

Lighting in Subnautica can also be used in this comparison: darker areas inherently make players feel vulnerable, while artificial light is often used for navigation and safety. Tidal takes strong influence from this by using focused lighting within darker sections to provide slight directional guidance without telling the player where to go. Unlike Subnautica, where light is tied more closely to survival or danger, Tidal uses the idea in a softer, more intricate way by helping the player move through the darkness while keeping the focus on the atmosphere. This allows Tidal to draw on Subnautica's lighting approach without adopting its survival mechanics, crafting, or threats toward the player. As a result, lighting remains the central point of the experience without needing survival pressure to affect the immersion.

3. Requirements

The requirements for Tidal were created based on the background research and the relevant case studies of Subnautica and ABZÛ. The main goal of the artefact was to create a visually impressive yet sensory-immersive game where lighting and sound received the most attention, rather than complex mechanics. As a result, Tidal reflects the design choices required to create an underwater experience designed to hold user attention.

3.1 Functional Requirements:

- First-person with visible hands.
- The player is able to move using WASD, with CTRL and Space for vertical movement.
- Starting cutscene with above water section on opening.
- Guided through cave and open-water sections by lighting.
- Ocean includes flora and fauna throughout.

- The player does not require complex mechanics to experience the game.

3.2 FR Explanations

First-person gameplay was chosen for Tidal because the project is focused on keeping the player feeling present in the environment. Given this, having the player's hands visible also helps the player feel a sense of body within the space, avoiding the feel of controlling a camera. The movement controls for Tidal are simple. WASD, CTRL, and Space allow the player to move through the environment easily, mimicking swimming. This is important as controls and complexity should not distract the user from the main focus of lighting, sound and overall atmosphere.

The opening cutscene and above-water sections were added to provide a more expansive and clear opening. Doing so helps create a clear transition between the above- and below-water sections, designed to make the moment of entering the water feel very deliberate. Additionally, this gives the player a clear, effective starting point before they begin exploring, rather than immediately placing them underwater.

Lighting guidance, creatures, plants, and a strategic lack of complex mechanics were all chosen to drive immersion. The player is given vague instructions during the cutscene, along with the use of lighting features to guide them through the cave and open-water sections, rather than heavy UI elements or waypoints. Flora and fauna are used throughout the ocean to reduce feelings of emptiness and keep the space more alive, without having every creature or plant play a unique role through interaction systems. Avoiding survival, combat and resource collection was important in the game, as it was essential that it not detract from the experience.

3.3 Non-Functional Requirements

- The game should ideally run without noticeable stuttering.
- Environment should be contained yet large.
- Player receives basic directional instructions at the start without a complex tutorial.
- Avoiding unnecessary HUD or complex UI elements.

3.4 N-FR Explanations

The non-functional requirements here refer to how the artefact should run and feel during play. Each of these is important, as Tidal relies on atmosphere; poor performance, confusing controls, or unnecessary UI could distract from the overall experience. The game should run without stuttering. If there is any lag or freezing, it would quickly reduce immersion. Basic instructions are provided too so that users are able to understand vaguely where to go but leaving most exploring to the player. The environment is also required to be contained yet large, evoking a full-of-life feeling everywhere, unless strategically reasoned to be absent in an area. Avoiding unnecessary HUD and UI elements helps the user pay more attention to the surroundings and check more areas. These points link back to the desk research conducted for this project, as Jennett et al (2008) frames immersion around players becoming absorbed in an environment. Therefore, having many stutters, confusing controls or overuse of UI could weaken the experience. Avoiding a frequent use of HUD links back to Niedenthal's (2008) ideas surrounding attention, as Tidal aims to use the

environment with a starting and ending indicator to guide the player rather than frequent UI popups.

4. Design and Development

The design and development of Tidal investigates an underwater experience built around lighting, sound, and atmosphere. Although the project previously planned to utilise Unity's High-Definition Render Pipeline, during development the project changed to using Unreal Engine 5 as it was able to provide more suitable tools for underwater, lighting and environmental design. This, however, did not alter the aim of the project with light and sound being central, but it did affect the way the artefact was created technically. Tidal's development includes a series of large or small underwater connected spaces with fauna and flora, the following sections detail the main design and development choices used to create the artefact along with any decisions made throughout.

4.1 Unreal's Water System

During Tidal's development, the main development focus was ensuring that the water system was correct. Although the extended abstract originally focused on Unity's HDRP, development later moved to Unreal Engine 5, which provided better tools for creating water and environments. This was essential, as water is not a background feature; it enhances and brings the project together, serving as the main way atmosphere is created. If fog visuals and water feel did not work well, then the lighting and sound would be weakened.

The Ocean built into Unreal Engine was tested first, and many issues arose with the water zone and scaling. The water zone refers to the higher-quality rendered water area that is specific but cannot be scaled. This meant that only a small portion of the water would be high-quality, while the surrounding Ocean would look poor. From this, I then compared the built-in water to an underwater blueprint setup. Whilst the built-in water had stronger wave controls, the blueprint provided much better underwater visuals throughout the entire water, where features could be tuned specifically. Since Tidal focuses on sensory immersion, it felt more apt to use the underwater blueprint, as a realistic wave simulation is not as necessary when underwater. The image below shows

the realistic water vs the low-quality version, where more computation is needed for the higher quality.

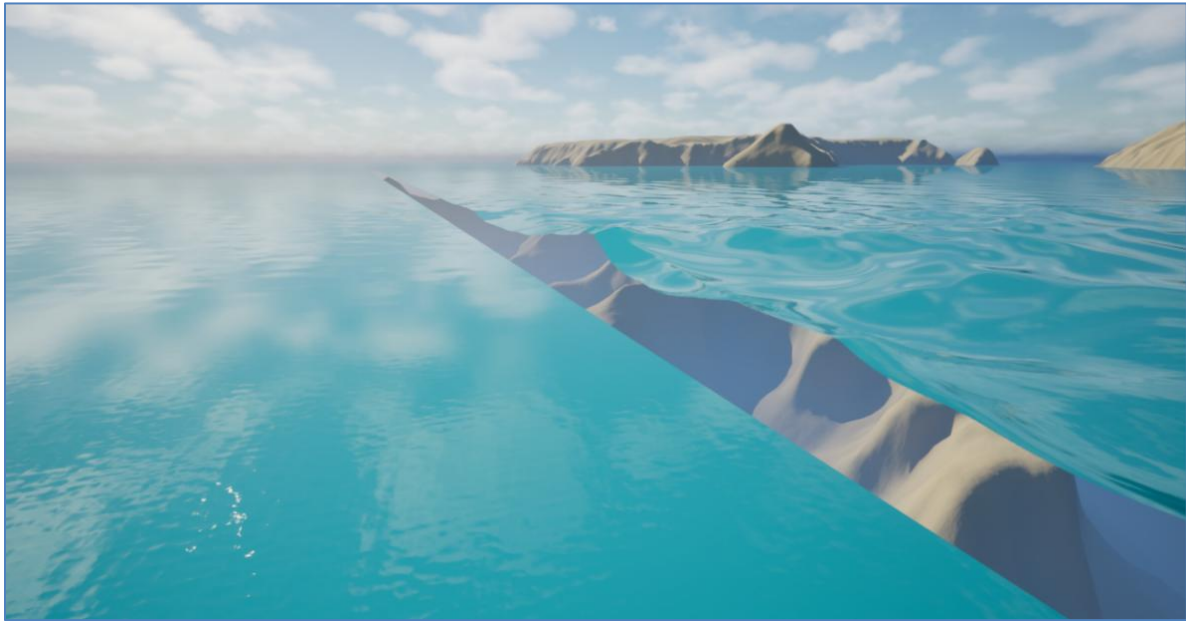


Figure 1 - Unreal Engine water zoning issue, Shows the difference between the higher quality render water and low-quality surrounding ocean

4.2 Player-Movement and Underwater Control

Player movement was one of the first features I focused on, as the experience relies heavily on a player being able to move freely through the environment. Since a first-person perspective was chosen, the Unreal Engine's prefab player was used, allowing the player to feel present in the experience rather than like a floating camera. The movement system uses two methods: WASD for directional movement and Space to go up, with CTRL to move down. This keeps the movement simple and free with adjustable speeds to mimic swimming, doing so links back to the project's functional requirements, where movement is needed to stay simple to allow users to focus on the atmosphere.

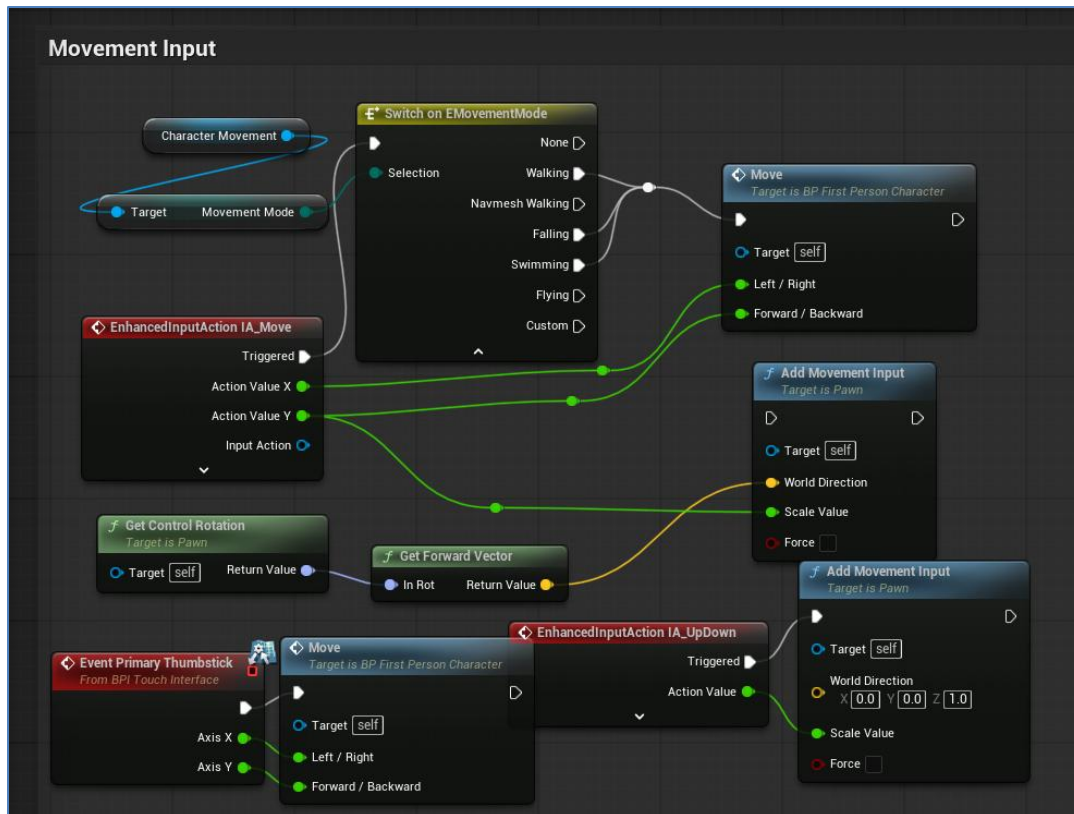


Figure 2- Movement Input Blueprint: directional and vertical movement

The movement system underwent a few iterations during development due to bugs that emerged. With earlier versions, the movement feels too fast, and the side movement does not work properly. This later changed to the current omnidirectional movement system, where the player can use the WASD keys to move relative to the camera, along with the Space and CTRL keys to go up and down slowly. The player movement in this situation needed to feel close to natural, so players would not spend extended time thinking about it.

4.3 Underwater Cave and Post-Process Logic

The underwater state was an important factor throughout the project, as Tidal needed a clear, easy separation between the above- and underwater sections. Since the experience begins above water, the transition to water needs to be visually appealing, effective, and intuitive. This was done using the swimming detection blueprint logic,

which swaps the character's movement between walking and swimming based on whether they are in water.

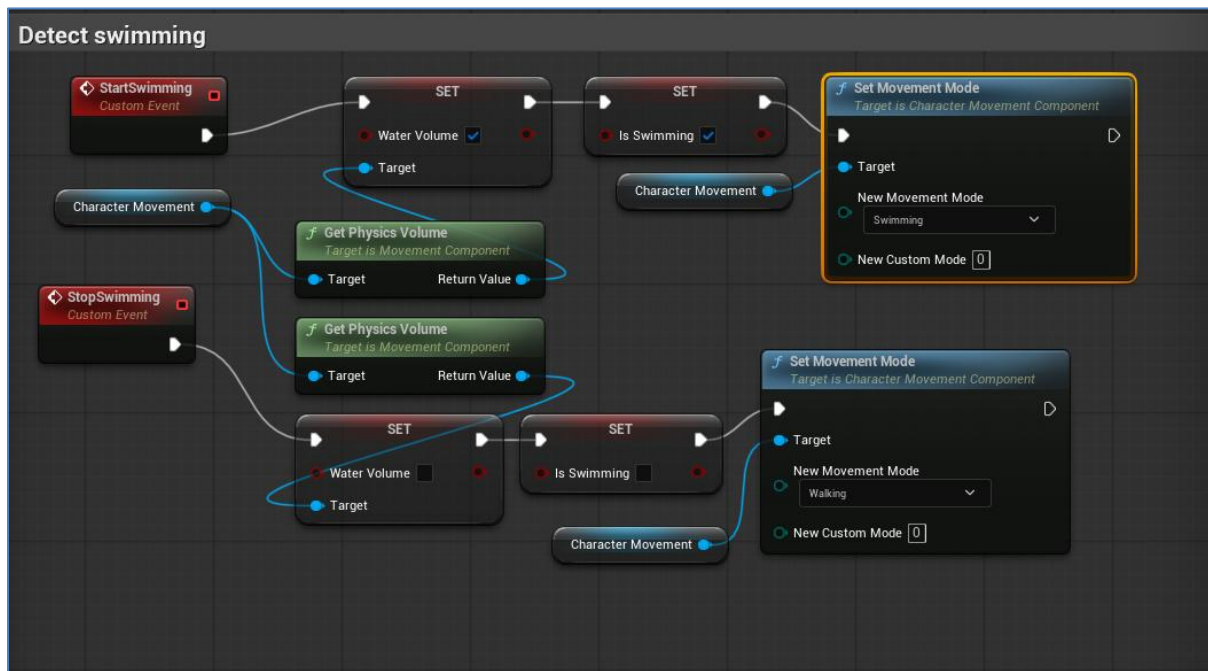


Figure 3- BP logic used to detect swimming and swap between walking and swimming movement modes

While less apparent, since the player is only above water once during the game, the transition and feel of the swap needed to be seamless and visually satisfying to the user. Early development included tests in water-cave spaces with air pockets, along with using post-processing volumes in different areas. Since moving away, the testing for this logic provided a good use even without an air pocket system, as it helped define how the game should handle water states and visuals. The post-processing effect became important later and is covered in the section on implementing visual immersion. The cave sections also benefited from this use of volumes, with certain caves featuring varying fog and/or darker lighting, making the caves feel more enclosed and atmospheric. As a result, underwater states and post-process logic provided meaningful support for the project's visual and aesthetic goals.

4.4 Implementing Visual Immersion

Visual immersion is the most important part of Tidal, as the project focuses heavily on lighting and its effects on the player's experience. Rather than using light solely to make the scene visible, every light was implemented with the atmosphere and aesthetics in mind. This links back to the background research, as lighting is used for aesthetics and to influence how the player navigates through the Space.

The first cave section uses overhead light rays to create a clear focus point as the player enters the water. The light coming from above instinctively makes the player look down, giving an immediate sense of depth and scale. This was imperative because it was the

first underwater moment in the artefact, and an atmosphere needed to be established quickly.



Figure 4- First underwater cave section using overhead lighting from the moon

The second cave section uses greater levels of ambient lighting and post-process colouring, where the green cave utilises a stronger colour post process to provide a contrast to the first cave area. This was important as the use of post process, and lighting changes all affect the water making it feel like a different section, with a darker murkier water. The section feels less natural, and in a way more mysterious where the cave does not feel too visually repetitive.



Figure 5- Green cave lighting used to create an enclosed, mysterious and murky atmosphere

The large tree section within Tidal was created to serve as a visual landmark for players in the experience and was influenced by Subnautica's world tree (Unknown Worlds, 2018). Since the project does not use overly complicated objectives or a constant HUD, larger environmental features can help players find memorable points along the route.

Lighting around the area helps make the tree feel like a centrepiece without needing instructions to say so.



Figure 6- Large tree section used as visual landmark

After passing through the large tree section, whilst following a turtle with a small light on its back, you are met with a darker cave section. This cave uses lighting more directly as a guidance tool, as most of the caves are unseeable aside from light rays coming down from the open water section. This design choice naturally encourages players to move towards the light, creating a clear contrast between the enclosed cave and the wider open section. Since Tidal does not use HUD elements and objective markers, it is imperative that the players understand where to go, and the lighting in Figure 7 illustrates this contrast.



Figure 7- Dark Cave Exit

After leaving the darker cave section in figure 7, the player reaches a contained but more expansive section as shown in figure 8. This section utilises brighter lighting,

clearer water and visible water to create a strong sense of scale and contrast between the ocean and dark section. This contrast was put in place to create an appreciation for the ending section, where the player is given a chance to explore the open space rather than being guided through the caves. During this section, the player is able to see fish, turtles, and sting rays throughout the experience, in addition to the caustics and wider lighting to help make the space feel more alive without the necessity for complex mechanisms to experience the artefact.



Figure 8- "Open" Section

4.5 Soundscapes and Spatial Triggers

Sound in Tidal was implemented specifically to support the atmospheric quality of the underwater scenery rather than just acting as background audio. Since sensory immersion is the focus, the soundscape needed to change as the player's location in the scene shifted. The opening section of the cutscene uses creature sounds to create a sense of scale and distance before going underwater, whilst the initial music and water sounds anchor the player in the physical body. This choice links back to the research focus where sound is intended to act in a way to show environmental and atmospheric change rather than acting as a means for objective.

Player triggers were utilised throughout the experience to adjust sound in different areas. This allowed audio to be specific to one area, so that players could, for example, move between the green cave and the first opening section, and the music would swap correctly with a clean fade. During the development phase, the sound transitions were both too abrupt and did not work when moving from one area to another. However,

once fixed, it provided seamless audio transitions and was tailored for each section, in parallel with the lighting used to create a sense of immersion.

A key design decision made in Tidal was to have sound that is responsive to how the player moves through the environment. For example, I wanted for the darker cave to feel more isolated and enclosed, whilst larger spaces used stronger audio to make the space feel artificially larger. This meant that sound was also working along side lighting and fauna design choices, where the regions that feel large and open have more plants and animals, whilst the enclosed spaces have less. Although this method of supporting immersion through specific audio, the final evaluation suggests that the sound did not provide as great an impact as expected.

Sound was kept intentionally as an environmental purpose rather than aiding or creating more ease for mechanics. Instead of using the sound as a means for directly telling the player where to go, it was used to make sections of the game feel different based on where the player was. This meant that audio worked to provide atmosphere rather than instruction, matching the aim of keeping the experience immersive without large use of UI elements.

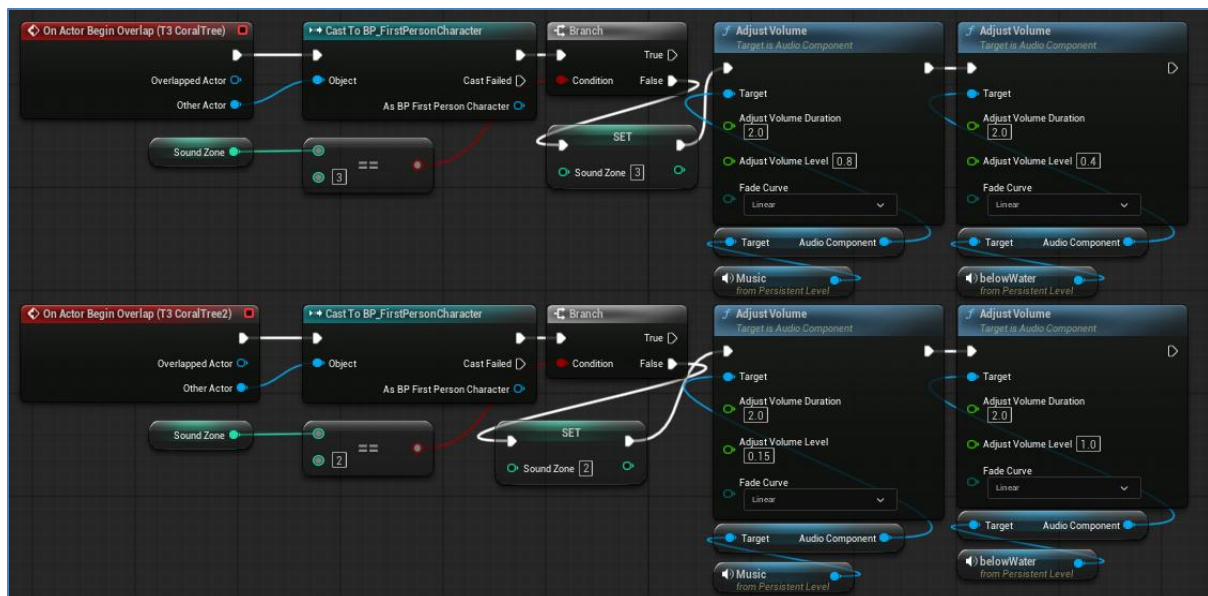


Figure 9- Sound Transition Example

4.6 Guided Exploration and Fauna Movement

Fauna was added to Tidal to help the terrain come to life without the project needing complex interactions. Since survival mechanics and combat are not part of the game, creatures serve a supporting role in aesthetics rather than as a threat. Fish, octopuses, turtles, and stingrays all help the environment feel less empty, while providing passive creatures that do not instil fear in a player by accident. In the experience, the turtle became the main guide, used to subtly lead a player through the darker cave section from the large tree area. A small light was placed on the turtle's back to act as a visual cue, without the need for a waypoint or a HUD pop-up to indicate it. The movement follows a start point on a trigger, where the turtle circles above the dark cave until the player comes within range. The turtle then breaks the circle and guides the player through the dark cave to open water. During development, this system was adjusted

frequently, so that the loop and exit appeared more seamless. However, due to Unreal Engine's spline implementation, the turtle transition is not fully seamless. Additionally, a simpler version of the spline movement logic has been applied to other creatures in the environment, such as the rays, octopuses, and whales in the cutscene.

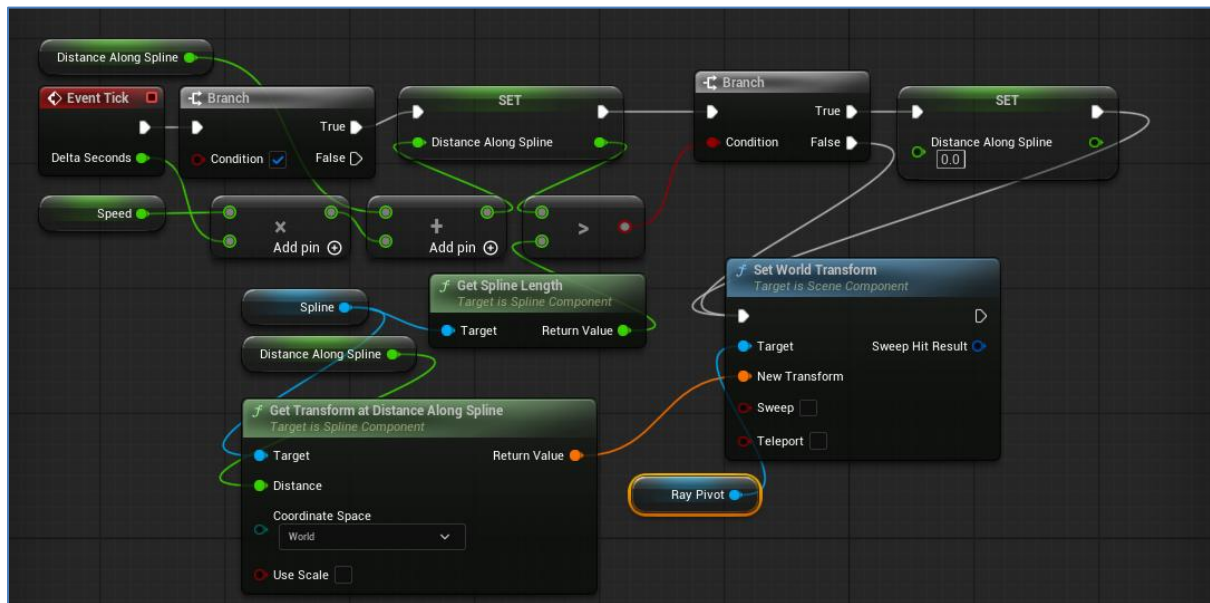


Figure 10 - Spline based movement logic for fauna in Tidal

4.7 Cutscene, Ending and UI Creation

The UI was kept minimal, as Tidal, in general, focuses on atmosphere rather than interface interaction. The menu displays a title, a start game button with a hover effect for the mouse cursor, and the controls for the experience. Having controls helps overall usability and lets users figure out what they need to do quickly. The font and background were chosen specifically to match the underwater aesthetic, with the water moving slightly and soft music and water sounds playing.



Figure 11 - Main Menu And control screen

The main opening cutscene of Tidal was created to give players an intriguing experience before going underwater. Originally, the player was placed underwater; during

development, this was later switched to a cutscene that ended with the player on land. The sequence starts with a fast-moving camera and lightning sounds in the sky, then moves down to show the whales, cuts the storm audio, then comes back up and fades the storm audio back in. The whales here utilise the same spline movement from the turtles and octopus to move through the scene in a controlled way, whilst being positioned correctly for the camera. The text used in the cutscene was also added to provide the player with a light sense of direction without giving off a strong narrative. The line "in the depths, a forgotten wreck remains" offers the player a vague incentive to move forward but provides little explanation. This fits the project well, as the aim is not to take attention away from the lighting, sound, and atmosphere, where the text helps set a tone before going down beneath the water.



Figure 12 - Opening Cutscene Whales



Figure 13 - Opening Cutscene text, Light narrative

Figures 14 and 15 illustrate a lighting transition that was used towards the ending section of Tidal. This blue to green lighting change was done in a way to make the final section feel more deliberate, as for a period in development finding the ship did not feel significant. The first image shows before whilst the second shows after. This helped create a tonal shift, where moving into the space felt more controlled. Figure 16 shows

the blueprint logic that was used to trigger this transition, which was called on a trigger collider and uses an alpha colour fade to create a slow transition over 5 seconds.



Figure 14 - Light Before Transition



Figure 15 - Light After Transition

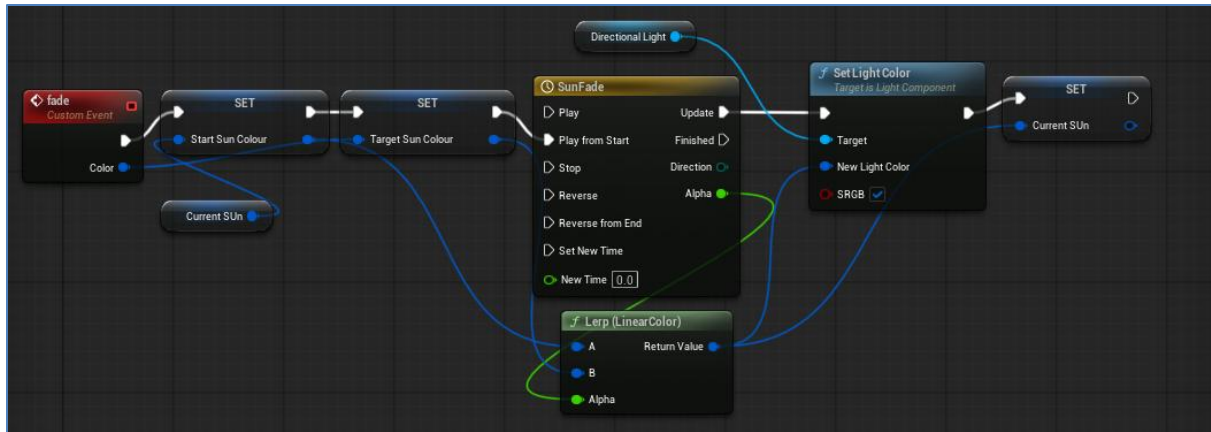


Figure 16 - Light Transition Blueprint

The ending text was added to provide the artefact with a more complete conclusion, rather than having no text and controls fading away without context. Once the player comes within a certain range of the ending trigger, the controls are removed so the player focuses on the ending sequence, with audio fading and the screen fading to black. This matches the rest of Tidal, as the tone remains simple and peaceful, and the experience concludes well. Using the fade to black removes the need for a traditional completion screen and offers a different take on the ending, whilst still making the artefact feel complete.

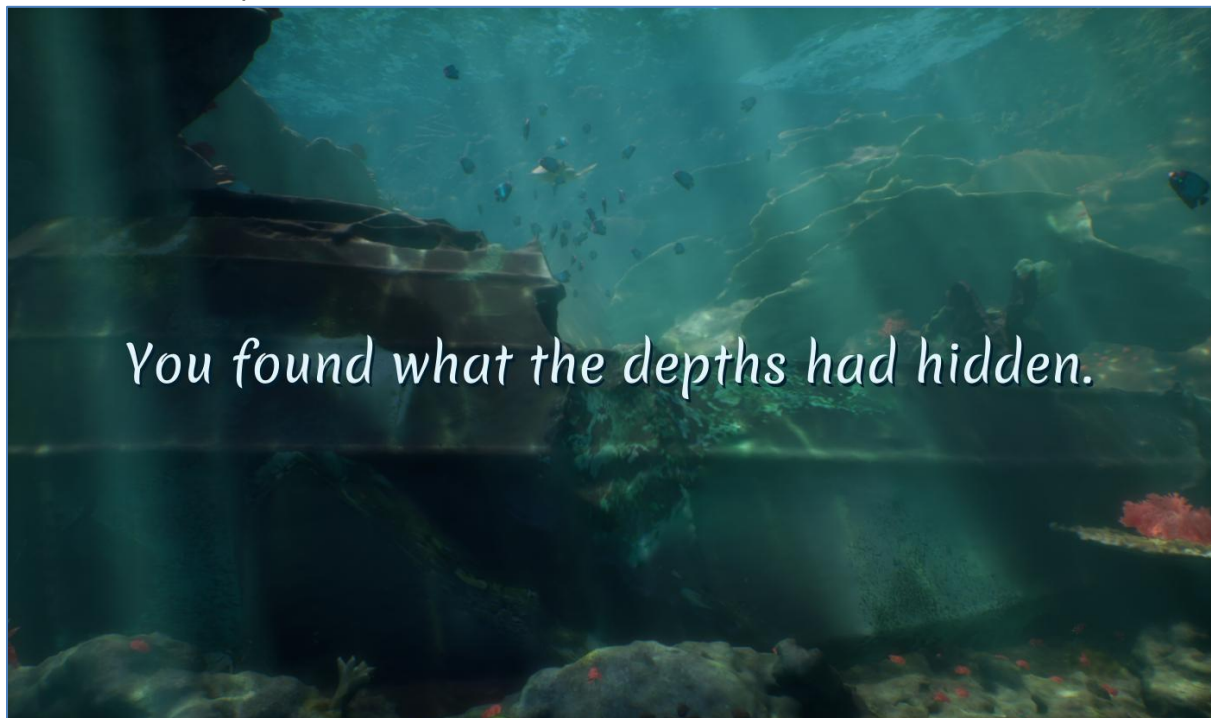


Figure 17 - Ending Text

4.8 Development Issues

During development, many issues emerged that affected the final artefact, mostly due to the nature of the Unreal Engine's built-in water system. The project itself relies heavily on water, movement, lighting, and sound working together, so, naturally, these features caused many development issues, such as the water zone problem, swimming

movement changes, audio transition fixes, and spline-based movement. However, fixing these issues brought the experience closer to the functional and non-functional requirements of a full-of-life design without a vast open world.

The largest issue was the water system and getting the initial visuals correct. This is because Unreal Engine shows visible quality differences by region, where the underwater environment looked completely different depending on where you were. This led to using an underwater blueprint setup, with lighting and other details that were more visually appealing. Movement also required many changes, as early development felt too fast, and the direction would not work as intended. This was later improved to the current omnidirectional system, making the player feel slightly more natural.

Audio and fauna movement caused many issues, where multiple iterations of the spline movement were done to improve it, mainly stemming from the follow turtle, which switches splines twice to direct the player on where to go. The loop transition for the turtle was causing teleporting issues and glitching the animation. Although teleporting remains, for the most part, minimised due to how splines work, there is still some slight teleporting. As for audio, the issues mainly arose from transitions where audio would instantly change from one volume to another, making the environment swaps feel too abrupt. Additionally, the environmental triggers all used a 1-time swap mechanic, so if the player moved backwards, the audio would not return to its original state for that section.

5. Evaluation

This section evaluates how successfully Tidal has met the aim of creating sensory immersion through lighting and sound. The project itself focuses on the experience as opposed to task completion, aside from “finding” the wrecked ship, however as a result of this use of vague task completion user feedback was essential. User feedback was essential to help gain a better understanding of if lighting, sound and underwater atmosphere were all understood by participants. This evaluation was based on a questionnaire completed by participants after a playthrough of Tidal.

5.1 Testing Methods and Ethics

The method of testing falls under an anonymous questionnaire which had a total of 13 participants. This was chosen because the project is focused on experience and has the opportunity to be heavily influenced by personal feelings as people experience or feel immersed in different ways. However, even with such subjectiveness, questions were made to attempt to remove that and gain a better insight into the effects of lighting and sound.

Ethical considerations were followed during testing, participants were provided with an information sheet explaining the project's purpose in addition to what they will be asked to do, and how data will be used. Participation was voluntary, where participants were anonymous and allowed to withdraw their data with an email provided. This was important as the evaluation involved many user responses, so the process needs to be clear and appropriate for the nature of what is being asked. No special category data was collected, and a copy of the information sheet, ethics checklist and questionnaire

consent form are in the appendix. All participants confirmed that they were over the required age, had read the sheet, consented to take part, acknowledged the use of Gemini AI for response summarisation, and being able to withdraw their data. Gemini AI was used to assist with summarising the anonymous questionnaire responses, with no identifiable data provided and all final checks done by the researcher.

5.2 Questionnaire

The questionnaire was designed to avoid overly leading questions whilst still keeping the focus on participants answering regarding the lighting, sound and immersion. Questions were split into general immersion questions and Tidal-specific ones. Focusing on attention, focus, time, separation from the real world, and whether the experience felt as if the participant was experiencing it rather than simply doing it.

Some questions were inspired by the Immersive Experience Questionnaire by Jennett et al. (2008) and by questions from the Film IEQ by Rigby et al. (2019), which is cited in Hedges et al.'s (2024) review of audio and immersive experience. Although the full questionnaire was not used due to Tidal being a shorter game, not all questions applied; a more focused set was used specifically on lighting, sound, and underwater atmosphere. As a result, the questionnaire findings were not analysed using the full IEQ scoring procedure; instead, the IEQ was used as guidance for measuring relevant aspects of immersion.

Additional questions were made specifically for the project, which gave participants a chance to share their experience in slightly more detail through a short text response. This helped frame the questionnaire more relevantly to the research question, as the aim was not to measure how everything influenced immersion, but only lighting and sound. This allowed participants to share what could have been improved. One limitation I noticed about the questionnaire is that due to the nature of the project, questions focus on lighting, sound and overall immersion. This becomes an issue as there is more to the project that could have caused immersion, including fish and plants. Although in the written responses, some participants mention more environmental details, for example, one participant stated “the imagery and underwater creatures and plants”. In reference to the question regarding “What aspects of the experience contributed most to your sense of immersion?”. This suggests that immersion was not only created by the lighting and sound, but also through the scene design as a whole. As a result of this, if continued, future questionnaires would include more specific questions on if fauna and flora helped to improve the environment as a whole. The full questionnaire is available in the appendix.

5.3 Results and Themes

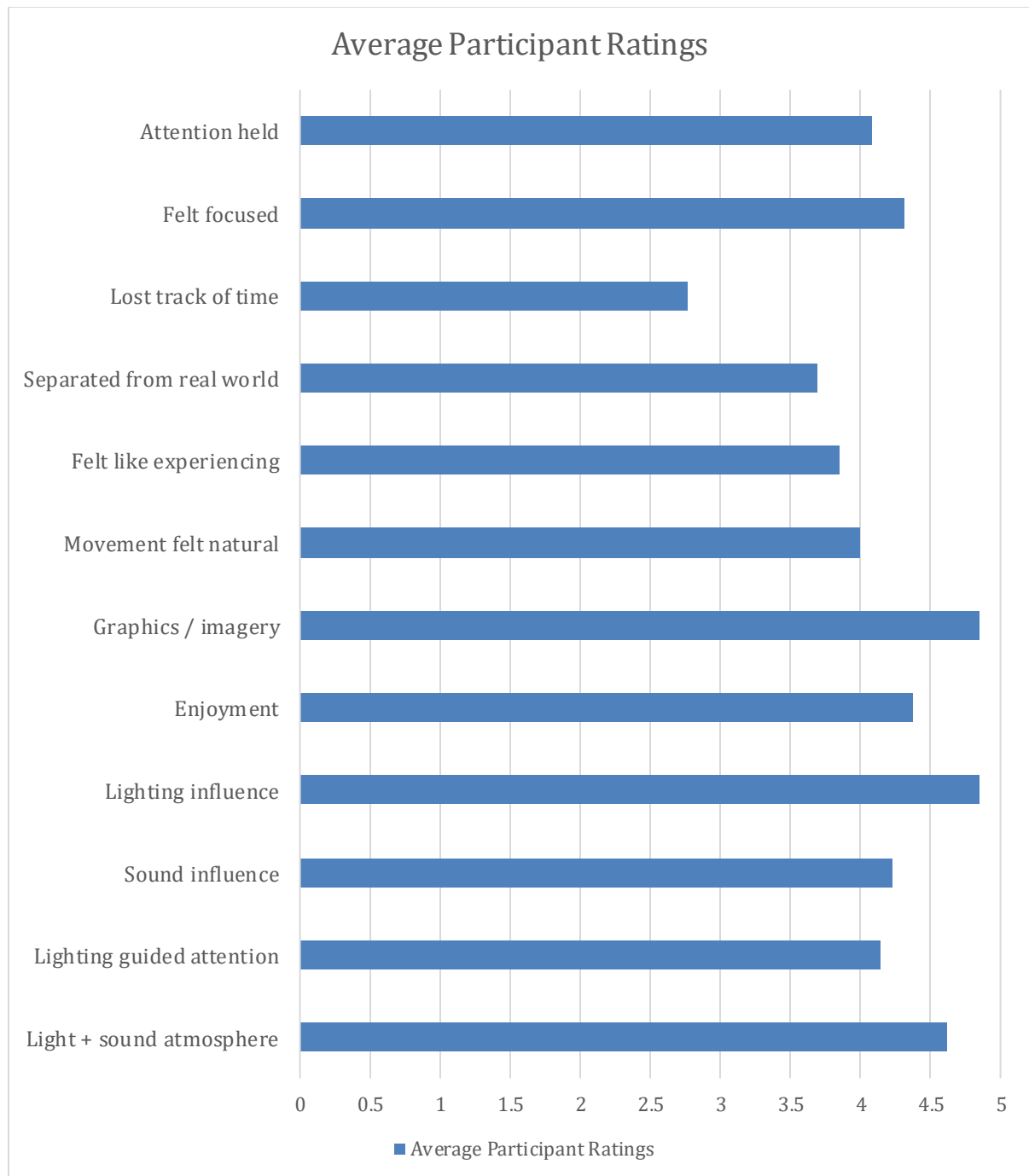


Figure 18 - Questionnaire Result Bar chart

Figure 18 illustrates how the stronger questionnaire results were linked to lighting and visuals. Graphics and lighting received an average score of 4.85 out of 5; this suggests that the visual side of Tidal was one of the more successful parts of the artefact. The overall combination of lighting and sound scored 4.62, indicating that participants generally understood that the atmosphere was created to enhance sensory features. Sound averaged 4.23, which, whilst still positive, is lower than expected. This suggests that sound supported the experience well but was not as dominant as the visual design of the project. Some of the results were not as strong; losing track of time received an

average score of 2.77, suggesting that the game was atmospheric and engaging; however, the experience was not sufficiently long or developed to create a strong sense of time loss. Separation from the real world also scored lower on average at 3.69. This shows that Tidal worked well as a sensory prototype, but deeper, more connected immersion would require more than what has been presented.

The written responses support this, as participants mention lighting, visuals, underwater scenery, colours, fish and environmental detail as the main factors that contributed to immersion. Two written responses regarding immersion include: “Definitely the visuals and lighting”, and “The imagery and the underwater creatures and plants”. These responses both support the idea that immersion was not created as a result of just lighting and sound, but through the way lighting and sound interacts and works together. This links back well to the design choices made, where lighting was used to guide attention and create atmosphere, whilst fauna and flora helped this, guiding player attention and reinforcing atmosphere. Some participants also mentioned VR as being an effective way to improve the experience. This is very useful as an initial scope for the project, which included ideas for VR but was removed due to technical and time constraints. This suggests that if the underwater setting already works well in one setting, it makes sense to create another setting. Other responses included clearer boundaries, better sound quality, breathing audio, and more creatures. These responses make it clear that Tidal would likely need to be longer and feel more responsive in some situations; however, overall, the results suggest that lighting was the strongest contributor to immersion, while sound supported the experience but needs development. Additionally, a few participants mentioned noticeable stuttering, which is an important response as smooth performance was one of the non-functional requirements of the project. The cause for stuttering in this case could have been due to many factors, but the likely issues is shadow maps, lighting or high polygon count. Whilst this did not stop the artefact from being experienced, it suggests that optimisation would need to have taken place more than existing implementations made, as more frame drops could take away the player from the sensory anchor of the experience.

5.4 Conclusion

Overall, the evaluation suggests that Tidal has successfully created sensory immersion through lighting and sound, with lighting as the stronger element. Participants responded well to visuals and lighting, indicating that the visual design was effective in shaping the atmosphere and guiding attention. Sound-supported immersion was well received, but the results and written responses suggest there is room for improvement, from more layers to clearer sound effects/detail. This means that Tidal has achieved sensory immersion, enabling participants to notice lighting and sound more directly by removing complex mechanics. The evaluation supports the original aim of the project whilst also showing that deeper immersion would likely require a longer experience, greater reactivity, and better audio.

6. Reflection

Tidal mostly met the aim for the project of investigating how lighting and sound can create sensory immersion in underwater environments. The artefact avoids traditional game systems, and more presents the game as an experience, where survival mechanics, combat, resource collection and complex objectives are taken away. However, the intention of this removal stems from helping players to focus on the features of the game that are being tested. From this, Tidal works well as a sensory experience as the final artefact allows the environments lighting, sound and atmosphere to become apparent for players. The strongest part of the project in my opinion was the visual design and lighting which through user testing, supports this opinion. Based on questionnaire results where lighting and graphics received the highest responses, it suggests that the visuals were a success. However, the questionnaire did not ask participants about specific areas of the experience, but written responses stated colours, lighting and underwater scenery all contributed to the sense of immersion. Knowing this, the lighting choices for the different cave sections from the green-post process area to the large tree all suggest that the intended atmosphere was achieved.

One of the areas that did not reach the same level was sound. Throughout the development of the project, this was expected. In an isolated situation the sound works well however based on user testing, it is clear that sound is playing more of a vague role in immersion, rather than a driving factor. Although sound definitely contributes to the experience with the music, water ambience, cave audio and whale sounds, the testing shows that the impact of sound on immersion was less pronounced than anticipated. If more time was available, sound would be the first area I would improve, more detailed creature sounds, consideration of breathing audio from user testing, and more layered ambience. Since participants noted stuttering during the experience, one of the next steps would be optimisation to help make the game more accessible to players.

Overall, one of the main reflections I have is how the project became more successful once the scope of the project was greatly reduced. Earlier in development, a large open environment, complex fauna, interaction, movement changes and VR were all considered earlier in development. Although these ideas are interesting and some coming up in user testing, including these for the current artefact would have moved the project away from the main aim. Keeping the experience as more of a route rather than an open world allowed for lighting, sound, flora and fauna to be placed with more deliberate meaning than just filling a space. A significant decision was the switch from Unity to Unreal Engine 5, this was done as Unreal provided a better stand point for both underwater environments and visuals in general. However, this created many technical issues with water, movement and understanding blueprint logic. Moving to Unreal was the right decision, as it also meant I could spend time learning the blueprint system and fixing bugs that would not have been as apparent in Unity, which has helped to build my understanding of every detail of the project, allowing it to expand further.

From both testing and my own initial ideas, the most important next step for Tidal would be to look into Virtual Reality. Having an embodied presence within the nature of underwater settings, a first-person view, and slow movement could work very well. However, the drawbacks of VR become apparent when considering it, as the reason the

choice was not made to have VR support was due to performance, time and requiring a better movement understanding. If Tidal is to be further developed I would focus on looking at all of the user testing as a whole, but mainly looking into improved sound design, clearer player boundaries, more responsive creatures, and making the experience longer. Overall, Tidal has reached the aims of the project by demonstrating that sound and lighting can be strong contributing factors for sensory immersion. However, it also showed that immersion does not come from just one feature, although lighting scored higher than sound as a contributing factor. Even though the projects focuses were lighting and sound, it would be inaccurate to suggest that the experience would be as immersive if not for the plants, animals, and environment as a whole. All aspects of the game work together to create immersion, however the two driving factors, supported by testing, are lighting and sound. Having participants respond as well as they did to an experience that includes no survival and no complex systems demonstrates that an underwater space can feel immersive when focus is put into specific areas.

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Appendix A. Ethics Checklist

RESEARCH ETHICS CHECKLIST FOR TAUGHT STUDENTS

FOR PROJECTS USING DEPARTMENT LEVEL ETHICS PRE-APPROVAL

This checklist is to be used for *research by ACT staff and research students* where the work can be considered low-risk from an ethical perspective. This checklist is to be used **ONLY** for *research work by the ACT students who wish to use the Department Level Ethics Pre-Approval* to accommodate the ethical risks of their proposed research work.

Students must ensure that their proposed research work can be accommodated by the restrictions in this Checklist. If not, you will be unable to conduct the work without further Ethical scrutiny by the ACT Ethics Committee as the work is considered to have higher ethical risks. To apply for additional Ethics approval, you must submit the Research Ethics Clearance Form for review by the ACT Ethics Committee. However, please note that some modules DO NOT permit students to submit individual Ethics applications.

All students who use the Department Level Ethics Pre-Approval for their work must complete this checklist and include the following as Appendices to their assessment reports:

- This completed Checklist;
- Example Participant Information Sheets and Participant Informed Consent Forms, if appropriate;

Please note that if this Ethics Checklist is associated with an assessment that has an **anonymous submission** (i.e. if you are using your Exam Number, Y123456 for submission) you **MUST** redact your name and any other information that would identify you as an individual from the appendices before submission.

Please note that your assessment markers will compare the submitted assessment work to this Ethics Checklist, Information Sheets and Consent Forms to ensure compliance.

You are also required to conduct this research work in compliance with the General Data Protection Regulation (GDPR). Information on how to ensure compliance is available on the ACT Ethics VLE site.

Before completing this Research Ethics Checklist for Taught Students, please consult the ACT Ethics VLE Site for guidance and further information.

SECTION 1: STUDENT AND PROJECT DETAILS

Box 1A: Student Details

ALL students must complete this box.	
Student Name OR Exam Number for Anonymous Submission	Y3935239
Degree Title	BSc Interactive Media
Stage (e.g. 2 nd year Undergraduate)	3 rd year Undergraduate
Role in Project (e.g. Team Leader)	Project Lead

Box 1B: Project Details

All students must complete this box.	
Module Title and Module Code	TFT00090H-S1-2-A
Project Supervisor Name and Email Address	Sanjit Samaddar sanjit.samaddar@york.ac.uk

SECTION 2: RESEARCH ETHICS CONCERNS

Box 2A: Checklist of Research Ethics Questions

ALL applicants must complete this box		YES	NO
1	Will the project involve conducting work that would typically require NHS Ethics approval? That is, will you be working with any of the following as participants, if recruited specifically due to their involvement with the NHS: - Patients and Users of the NHS, - Relatives or carers of patients and users of the NHS, - NHS staff? OR will you be using or accessing NHS premises or facilities as part of the work?		x
2	Will the project involve conducting work that would typically require His Majesty's Prison & Probation Service Ethics approval? That is, will you be conducting research with staff and/or offenders in prison establishments, National Probation Service (NPS)/Community Rehabilitation Companies (CRC) regions or within His Majesty's Prison and Probation Service (HMPPS) Headquarters? OR will you be conducting research on HMPPS premises?		x
3	Will you be working with vulnerable participants (e.g. those under 18, people with learning disabilities, people with mental impairment due to health or lifestyle, people who are terminally ill or recently bereaved etc.)? Note that if you are unsure whether someone you would like to work with could be considered vulnerable under the circumstances, you are required to discuss your concerns with your supervisor and/or Ethics Chair. It is generally expected that any student working with vulnerable groups would submit a Full Research Ethics Clearance form.		x
4	Will you be identifying any of the participants in your outputs?		x
5	Will you be discussing sensitive or potentially upsetting or distressing topics with participants?		x
6	Is it reasonably foreseeable that the work could involve causing physical or emotional distress to participants or researchers?		x

ALL applicants must complete this box		YES	NO
7	Is it reasonably foreseeable that the participants could disclose or discuss participation in illegal activities (e.g. drug use)?		x
8	Is it reasonably foreseeable that the participants could disclose confidential or sensitive information (e.g. financial data, sensitive organisational data)?		x
9	Will you be deliberately misleading the participants in any way?		x
10	Will you be filming or making recordings of people without their knowledge and consent (e.g. covert filming of people in non-public places)?		x
11	Will you be researching or discussing issues relating to terrorism or political extremism as part of your work?		x
12	Will you be collecting online data that has been generated by human participants (e.g. social media data) from closed, restricted forums (i.e. from closed communities or those that require approved membership to view, e.g. restricted Facebook groups)?		x
13	Will you be identifying anyone from online data that has been generated by human participants (e.g. social media data) from either open or closed forums (i.e. by including information that could make the individual identifiable, such as direct quotes or usernames)?		x
14	Could the work involve potentially damaging property and/or the natural environment?		x
15	Will the work involve animals?		x
16	Is it reasonably foreseeable that the work could result in any anticipated university/institutional risk (e.g. adverse publicity or financial loss)?		x
17	Will you be compensating participants with financial inducements OTHER THAN reasonable incentives (e.g. chocolate, cake) for the inconvenience?		x
18	Will you be paying participant expenses?		x
19	Will you be conducting any of the work for this project OUTSIDE of the UK?		x

If you have answered “YES” to ANY of the questions in Box 2A: Checklist of Ethical Research Ethics Questions:

The Department Level Ethics Pre-Approval together with this Research Ethics Checklist for Taught Students MAY be insufficient to accommodate the ethical risks of your proposed work.

Some lower-risk ethical issues can be accommodated without further scrutiny by the ACT Ethics Committee provided that you agree to follow a process that is considered appropriate. These situations and processes are described on the ACT Ethics VLE site.

IF there is a suitable procedure to manage this ethics issue, please complete Box 2B to provide further details of how you intend to manage the ethical issues associated with your proposed work in consultation with either the module convenor or your assessment supervisor.

Box 2B: Further Details

Complete this box if you answered “Yes” to any question in Box 2A AND there is an identified procedure to manage the ethical risks in this situation.

Provide details of the nature of the ethical risks that you identified by answering YES to questions in Box 2A and describe the process that you will follow to minimise the risks.

Please note that if you answered YES to Question 17 and/or 18:

Will you be paying your participants? If research participants are to receive any payments, reimbursement of expenses, or any other incentives or benefits for taking part in your research, please give details, indicating what and how much they will receive and the basis on which this was decided.

Payment must follow the [University’s policy](#). Please note that the policy includes maximum limits and researchers should note that they may pay less than these, as appropriate.

Alternatively, the associated risks of your proposed work may be sufficiently low risk that an appropriate approach can be agreed with the ACT Ethics chair without requiring submission of the ACT Research Ethics Clearance form. Your supervisor/module convenor may contact the ACT Ethics on your behalf to identify an agreed process on a case-by-case basis. If your supervisor has discussed your proposed work with the ACT Ethics Chair via email, please complete Box 2C: Case-By-Case Agreed Process.

Box 2C: Case-By-Case Agreed Process

Students must complete this box IF they have answered “YES” to any questions in Box 2A AND there is no identified procedure to manage the ethical risks of the proposed work. Note, that most students will need to submit a ACT Research Ethics Clearance form and this case-by-case process approach is ONLY suitable for work that can be considered low risk.		YES	NO
1	Has your project supervisor or module convenor discussed the proposed work and associated ethical risks with the ACT Ethics Chair via email?		x
2	Was your project supervisor or module convenor able to agree a process to manage the low risks associated with your proposed work?		x
IF YES to BOTH questions please provide further details of the anticipated risks of the proposed work and the process that was agreed with the ACT Ethics chair. Please include dates of the email correspondence AND the name and email address of supervisor/module convenor involved.			

If the associated risks of your proposed work cannot be accommodated through an identified procedure or through a case-by-case agreed process then, provided the module convenor permits it, you will need to submit an application to the ACT Ethics Committee for review using the Research Ethics Clearance Form. But, please note that some modules do NOT permit students to submit individual applications to the Ethics Committee.

SECTION 3: RESPONSIBLE USE OF AI

The [Responsible AI Use in Research Policy and Best Practice Document for Researchers](#) provides Policy and Guidance on the responsible use of AI in research. This document is about the use of AI tools to support research and does not apply to developing or building AI models as part of the research. For more information, see the [University’s Code of Practice on Research Integrity](#). Please also review the FAQ page of the [ACT Ethics community site](#) regarding the responsible use of AI in research.

Box 3A: Use of AI

All students must complete this box	Yes	No
-------------------------------------	-----	----

1.	Have/will you use/d generative AI in any part of your research? (Design, data collection, analysis, writing, recruitment, etc.)	x	
If yes, please outline the use below, including which generative AI product you have/will use. If no, go to 4A. <i>Please note, Gemini is the University's preferred GenAI tool because: Any data inputted is fully protected. Your chats are never used for training or human review by Google. You must make sure you are logged into your University Google account to ensure this. Google Workspace is the University's primary collaboration and communication platform. So it makes sense to use a GenAI tool that is part of the same ecosystem. It offers a simple path to upgrade to full GenAI capabilities within Google as and when required.</i>			
Gemini Ai will only be used in the analysis and consolidation of anonymous questionnaire responses to provide an initial summary of results. Preliminary themes will be identified by AI but cross-coded and verified by the researcher.			

Box 3B: Informing stakeholders of the use of AI

All students must complete this box		Yes	No
1	Have you clearly explained to participants or data subjects how AI will be used in the research, in the information sheet?	x	
2	Have you ensured that any personal or sensitive data is anonymised or securely protected before use in AI systems?	x	

Box 3C: Adherence to University Code of Practice on Research Integrity, in relation to the use of AI

All applicants must complete this box		Yes	No
1	I confirm that I have read Responsible AI Use in Research Policy and Best Practice Document for Researchers .	x	
2	I confirm that I will ensure any use of AI is transparent at all stages of the research process to all those involved or impacted by the research and that I will use the prompt record to record my AI use where it relates to the research process as outlined in the document. (Please cc act-ethics@york.ac.uk when submitting a prompt to record proforma)	x	

3	I confirm that I will follow the University's information classification scheme by either: - Using tools that never send data outside of University of York systems OR - Using only tools that have been approved by the University of York for the type of data I am storing or processing. <i>IT provides a list of preferred AI tools. For tools outside this list, consult with IT or your ethics committees, as needed, whether it is appropriate to use them for the tasks you need.</i>	x	
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Box 3D: Further Details

Please provide further information in this box if you answered “No” to any question in Box 5B, or 5C with reference to the [Responsible AI Use in Research Policy and Best Practice Document for Researchers](#).

Please complete Section 6: Data Protection

SECTION 4: DATA PROTECTION

In order to comply with the General Data Protection Regulation (GDPR) you **MUST** adhere to the data usage and storage principles described in Box 3A: Checklist of Data Protection Questions.

Box 4A: Checklist of Data Protection Questions

ALL students must complete this box		YES	NO
1	Will you guarantee that you will inform all people whose personal and/or special category data that you are using: • What data you will be collecting and why; • How you will be storing the data; • The legal basis under which you are storing the data; • When/if/how the data will be destroyed? Please note that using a GDPR Compliant Project Information Sheet will ensure you meet these requirements.	x	
2	Will you guarantee that IF you use a portable device to collect electronic data you will transfer that data to your University Google Drive account or University Filestore as soon as possible after the interview AND delete it from your personal device?	x	
3	Will you guarantee that the data will ONLY be accessible to the project team AND that IF the project team extends beyond the University of York that you have consulted the University's IP and Legal team to ensure appropriate data protection safeguards are in place?	x	
4	Will you guarantee that you will ONLY use Google Forms OR Qualtrics to host online surveys that collect personal and/or special category data?	x	
5	Will you guarantee that you are collecting the MINIMUM amount of data necessary for the intended project?	x	
6	Will you guarantee that IF you are storing or accessing data from OUTSIDE the European Economic Area (EEA) you will access the data through your University of York Google Account connected to the University of York Virtual Private Network (VPN)?	x	
7	Will you guarantee to destroy all physical AND electronic data EITHER after your module marks have been ratified by the Board of Examiners OR 10 years after last requested access?	x	

ALL students must complete this box		YES	NO
8	IF storing electronic data for 10 years after last requested access, will you guarantee to EITHER use a University Google Drive account OR an approved data repository service to store the data?	x	
9	Have you screened your project against the Data Protection Impact Assessment (DPIA) screening questions AND if required conducted a DPIA and submitted a copy to the Data Protection Officer for review?	x	
10	If capturing audio, will you use an encrypted device for recording (e.g. an Apple iOS device or encrypted voice recorder)?	x	
11	Where data is held on an encrypted portable device (e.g. laptop, tablet) will you back it up to a University approved service as soon as possible and perform periodic checks to ensure data is being backed up appropriately?	x	
12	Will you ensure confidential information is encrypted before it is transmitted/shared digitally?	x	
13	Please detail what other protections will be used for digital data (e.g. access/edit permissions, procedural safeguards re downloads/making copies, remote access via VDS/VPN, 2 factor authentication)?		
	Give answer here: Data protections listed above along with additional password protection.		
14	Confirm you have reviewed the user commitments under the Policy for the safe use of University information on devices . Detail anything in the user commitments that will pose a challenge in carrying out your proposed research.	x	
	Give answer to the second element of question 14 here: N/A		
15	Will you ensure that personal data or confidential data held on paper are stored in a lockable filing cabinet or container, and/or a locked room in secure premises?	x	
16	How will devices be physically protected (e.g. in transit, when not in use or left unattended)?		

ALL students must complete this box		YES	NO
	Give answer here: Devices will be stored in a safe carrier in a locked room when not in use.		
17	Will you ensure the device(s), accounts, or storage area(s) used to store data are not accessible to any unauthorised parties?	x	

Box 4B: Checklist of Data Retention Questions

ALL students must complete this box			
1	How long will you keep personal data after the project, in what form and for what reason? https://www.york.ac.uk/library/info-for/researchers/data/sharing/		
	Give answer here: Until marks for the module are ratified in July 2026		
2	When will the research data be destroyed, by whom, and how?		
	Give answer here: By the main investigator (me), around the ratification at July 2026, (BoE ratification panel)		
3	Will any personal or special category data (i.e. data that is not truly and irrevocably anonymised) be deposited in an archive or external repository? Move on to Question 5 if you have answered 'no'	Yes	No
			N/A
4	Where personal data are to be transferred to an archive or repository, please confirm that your Information Sheet will: (i) cover the archiving and reuse of any personal data and participant agreement to this, (ii) explain to participants the benefits of any data sharing, (iii) indicate where possible whether research data will be deposited in a named, recognised repository (e.g. Archaeology Data Service, UK Data Service, York's institutional repository, etc.)		N/A

ALL students must complete this box			
5	Where you have special category personal data or criminal data, will it be destroyed in line with an agreed retention policy (set by the University, the data provider, or approved by this ethics committee)? You may enter 'N/A' if you are not collecting this type of data		N/A

Before submission of your assessment work, you must complete Section 5: Student Agreement. This completed Checklist must be included as an Appendix to your assessment report, together with examples of your Project Information Sheets and Informed Consent Forms.

SECTION 5: STUDENT AGREEMENT

Box 5A: Student agreement

ALL students must complete this box.		YES	NO
1	I confirm that the work conducted for the above project has met all the statements as expressed in this Research Ethics Checklist.	x	
2	I confirm that the work conducted for the above project was guided by the University's ethical rules and regulations.	x	
3	I have included example Project Information Sheets and Informed Consent Forms as Appendices to my report, if applicable.	x	
4	I confirm that I have adhered to the ACT requirements for storing personal and special category data compliant with the General Data Protection Regulation (GDPR). Note that GDPR compliance guidance can be found on the ACT Ethics VLE site.	x	
5	I confirm that, if applicable, all payments made to personnel in relation to this project have complied with financial regulations.		
Student Name (or Exam Number for Anonymous Submission)		Ivo Nugent	
Date		28/04/2026	

Box 5B: Supervisor Agreement

		YES	NO
1	I have reviewed this Research Ethics Checklist.	X	
2	I have reviewed the Project Information Sheets and Informed Consent Forms, as applicable.	X	
Supervisor name		Sanjit Samaddar	
Signed		SSamaddar	
Date		29/04/2026	

Appendix B. Information Sheet



School of Arts and Creative Technologies

Participant Information Sheet: Anonymous Research

Project background

The University of York would like to invite you to take part in the following project:
Interactive Media Individual Project

Before agreeing to take part, please read this information sheet carefully and let us know if anything is unclear or you would like further information.

What is the purpose of the project?

This project is being undertaken by Ivo Nugent, pxq501@york.ac.uk

The work is being conducted according to restrictions that have been subject to approval by the ACT Ethics committee. The Chair of the ACT Ethics committee can be contacted on ACT-ethics@york.ac.uk.

For this research project, we are interested in the effects of lighting and sound on immersion. Your participation in this project will involve a play through of the game Tidal, and then answering a short 5 minute long questionnaire

Please note that to comply with the approved Ethics requirements of this work, we do not intend to discuss sensitive topics with you that could be potentially upsetting or distressing. If you have any concerns about the topics that may be covered in the research study, please raise these concerns with the researcher.

Your participation in this project is voluntary. If you wish, we will provide you with access to the report that we submit after our marks have been confirmed. If you would like to receive access to these, you can indicate as such on the consent form.

Why have I been invited to take part?

You have been invited to take part because we are aiming to recruit a diverse group participants, and we hope you might be interested in this work.

Do I have to take part?

No, participation is optional. If you do decide to take part, you will be given a copy of this information sheet for your records and will be asked to complete a participant consent form. If you change your mind at any point during the research activity, you will be able to withdraw your participation without having to provide a reason. To withdraw your participation you need to email Ivo Nugent at pxq501@york.ac.uk and your data will be deleted as soon as possible.

Will I be identified in any outputs?

No. Your participation in this research activity will be treated anonymously and you will not be identified in any outputs.

Privacy Notice

This section explains how personal data will be used by Interactive Media Individual Project at the University of York.

For this project, the University of York is the [Data Controller](#). We are registered with the Information Commissioner's Office. [Our registration number](#) is Z4855807.

What is our legal basis for processing your data?

Privacy law (the UK General Data Protection Regulation (GDPR) and Data Protection Act 2018) requires us to have a legal reason to process your personal data. Our reason is we need it to perform a public task.¹

This is because the University has a public function, defined in [our charter and statutes](#), which includes carrying out research projects.² We need to use personal data in order to carry out this research project.

Information about your health, ethnicity, sexual identity and other sensitive information is called ["special category" data](#). We have to have an additional legal reason to use this data, because it is sensitive. Our reason is that it is needed for research purposes.³ All research projects at the University follow our [research ethics policies](#).

How do we use your data?

Data collected through the questionnaire in this project will be used to evaluate participants experiences for Tidal, with focus specifically on how lighting and sound contribute to immersion. Participants will play the game and then answer a short anonymous questionnaire. Responses will be reviewed and analysed by the researcher to determine common themes and patterns in the feedback provided. Data will be used for academic purposes within the project, where the final report will outline results.

Will AI be used to analyse my data?

Gemini Ai will be used to provide assistance in the analysis and consolidation of the questionnaire responses, with guidance on summarising themes in participant feedback. No identifiable data will be entered into the system. Gemini Ai chats through the university account are not used for training the model. All Ai outputs will be checked and interpreted by Ivo Nugent where final analysis will be done without Ai use.

Who do we share your data with?

The data from the questionnaire will only be accessed by Ivo Nugent, and if necessary, IMIP project supervisor. No personal data will be shared outside of the University of York. For research purposes any themes within the data will be used in the final report, with outputs being anonymous with no identifying information.

¹This refers to [UK GDPR Article 6 \(1\) \(e\)](#): processing is necessary for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller

² [Our charter and statutes](#) states: 4.f. To provide instruction in such branches of learning as the University may think fit and to make provision for research and for the advancement and dissemination of knowledge in such manner as the University may determine.

³This refers to [UK GDPR Article 9 \(2\) \(i\)](#): processing is necessary for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes in accordance with Article 89(1) based on Union or Member State law which shall be proportionate to the aim pursued, respect the essence of the right to data protection and provide for suitable and specific measures to safeguard the fundamental rights and the interests of the data subject.

As well as this, we use computer software or systems to hold and manage data. Other companies only provide the software, system or storage. They are not allowed to use your data for their own reasons.

We have agreements in place when we share data. These agreements meet legal requirements to ensure your data is protected.

How do we keep your data secure?

The University is serious about keeping your data secure and protecting your rights to privacy. We don't ask you for data we don't need, and only give access to people who need to know. We think about security when planning projects, to make sure they work well. Our IT security team checks regularly to make sure we're taking the right steps. For more details see [our security webpages](#).

How do we transfer your data safely internationally?

If your data is stored or processed outside the UK, we follow legal requirements to make sure that the same level of privacy rules still apply.

How long will we keep your data?

The University has rules in place for [how long research data can be kept](#) when the research project is finished. Your information will be kept for 3 months until after mark ratification, and after this time an anonymised version will be kept. As this will be fully anonymous, it will not be possible to identify you in any way from this data.

What rights do you have in relation to your data?

[You have rights over your data](#). This sheet explains how you can stop participating in the study, and what will happen to your data if you do. This information is in the section 'Do I have to take part?'.

If you want to get a copy of your data, or talk to us about any other rights, please contact us using the details below.

Questions or concerns

If you have any questions or concerns about how your data is being processed, please contact Ivo Nugent, pxq501@york.ac.uk. Or Sanjit Samaddar, sanjit.samaddar@york.ac.uk

If you have further questions, the University's Data Protection Officer can be contacted at dataprotection@york.ac.uk or by writing to: **Data Protection Officer, University of York, Heslington, York, YO10 5DD.**

Right to complain

If you are unhappy with how the University has handled your personal data, please contact our Data Protection Officer using the details above, so that we can try to put things right.

If you are unhappy with our response, you have a right to [complain to the Information Commissioner's Office](#). You can also contact the Information Commissioner's Office by post to **Information Commissioner's Office, Wycliffe House, Water Lane, Wilmslow, Cheshire, SK9 5AF** or by phone on **0303 123 1113**.

Appendix C. Consent Form / Questionnaire

Consent

Consent questions shown to participants:

I confirm that I am 18 years old or older.

Yes / No

I have read the information sheet about this project.

Yes / No

I consent to take part in this research project.

Yes / No

I understand that my participation is anonymous.

Yes / No

I understand that I can withdraw my data by contacting the researcher.

Yes / No

I understand that Gemini AI may be used in a limited supporting role to help summarise anonymous questionnaire responses.

Yes / No

Participants are only allowed to continue with the questionnaire if yes has been answered to all questions.

Appendix D. Questionnaire

Section 1 of 6

Tidal Questionnaire

The game can be downloaded from the link below, instructions on how to run can be found in the folder.

Game Download Link:

[Tidal Download](#)

The questionnaire is based on your experience once having played the game.

Tidal is designed for higher end machines.

7 mins

This online survey is part of a student project for the Interactive Media Individual Project module at the University of York, UK. The survey aims to gather feedback on how lighting and sound contribute to sensory immersion in an underwater exploration game artefact. The results of this survey will help me evaluate the success of the artefact and understand how these aesthetic features influence the player's experience. The estimated completion time for the survey is approximately 5 minutes.

The survey is conducted by Ivo Nugent pxq501@york.ac.uk

Please read the Participant [Information Sheet](#) before continuing. This explains the purpose of the study, how your anonymous data will be used, your right to withdraw, and how AI may be used in a limited supporting role to help summarise anonymous questionnaire responses.

By continuing with this questionnaire, you confirm that you have read the Participant Information Sheet and consent to participate in this study.

I confirm that I am 18 years old or older.

*

I have read the information sheet about this project

*

I consent to take part in this research project.

*

I understand that my participation is anonymous.

*

I understand that I can withdraw my data by contacting the researcher.

*

I understand that Gemini AI may be used in a limited supporting role to help summarise anonymous questionnaire responses.

*

After section 1

Section 2 of 6

Video Game Context

Have you played underwater games before?

On average, how many hours per week do you play video games?

After section 2

Section 3 of 6

Immersion and Experience

To what extent did the experience hold your attention?

Not at all

- 1
- 2
- 3
- 4
- 5

Very much so

To what extent did you feel focused on the experience whilst playing?

Not at all

- 1
- 2
- 3
- 4
- 5

Very much so

To what extent did you lose track of time whilst playing?

Not at all

- 1
- 2
- 3
- 4
- 5

Very much so

To what extent you feel separated from the real-world environment whilst playing?

Not at all

- 1
- 2
- 3
- 4
- 5

Very much so

To what extent did the experience feel like something you were experiencing, rather than something you were just doing?

Not at all

- 1
- 2
- 3
- 4
- 5

Very much so

To what extent did you feel as though you were moving through the environment according to your own will?

Not at all

- 1
- 2
- 3
- 4
- 5

Very much so

To what extent did you enjoy the graphics and imagery?

Not at all

- 1
- 2
- 3
- 4
- 5

Very much so

How much would you say you enjoyed playing the game?

Not at all

- 1
- 2
- 3
- 4
- 5

Very much so

After section 3

Section 4 of 6

Lighting and Sound

To what extent did the lighting influence your experience of the environment?

Not at all

- 1
- 2
- 3
- 4
- 5

Very much so

To what extent did the sound design influence your experience of the environment?

Not at all

- 1
- 2
- 3
- 4
- 5

Very much so

To what extent did the lighting affect where you directed your attention in the environment?

Not at all

- 1
- 2
- 3
- 4
- 5

Very much so

To what extent did the combination of lighting and sound influence the atmosphere of the experience?

	Not at all
1	
2	
3	
4	
5	
	Very much so

What aspects of the experience contributed most to your sense of immersion?

How, if at all, did the lighting and sound affect your experience?

What could be improved to make the experience more immersive?

After section 4

Section 5 of 6

Thank you for participating in the questionnaire

If you have any questions please contact Ivo Nugent, pxq501@york.ac.uk

After section 5

Section 6 of 6

You are not permitted to partake in the Research Study

Appendix E. Questionnaire Results

The Section below uses Gemini AI for average results and text about summarised themes.

The questionnaire received 13 anonymous responses. All participants confirmed that they were 18 or over, had read the information sheet, consented to take part, understood that participation was anonymous, understood that they could withdraw their data, and acknowledged that Gemini AI may be used in a limited supporting role to help summarise anonymous questionnaire responses.

Participant context:

- 5 participants had played underwater games before.
- 8 participants had not played underwater games before.
- 1 participant played 0–5 hours of video games per week.
- 6 participants played 11–20 hours of video games per week.
- 6 participants played 20+ hours of video games per week.

Question | Average result out of 5

To what extent did the experience hold your attention? | 4.08

To what extent did you feel focused on the experience whilst playing? | 4.31

To what extent did you lose track of time whilst playing? | 2.77

To what extent you feel separated from the real-world environment whilst playing? | 3.69

To what extent did the experience feel like something you were experiencing, rather than something you were just doing? | 3.85

To what extent did you feel as though you were moving through the environment according to your own will? | 4.00

To what extent did you enjoy the graphics and imagery? | 4.85

How much would you say you enjoyed playing the game? | 4.38

To what extent did the lighting influence your experience of the environment? | 4.85

To what extent did the sound design influence your experience of the environment? | 4.23

To what extent did the lighting affect where you directed your attention in the environment? | 4.15

To what extent did the combination of lighting and sound influence the atmosphere of the experience? | 4.62

Summary of written response themes (Gemini AI):

Participants most linked immersion to lighting, visuals, colours, underwater scenery, fish, creatures, plants, music and environmental detail. Several responses specifically mentioned that lighting helped guide attention or made the underwater space feel more realistic. Sound was also mentioned positively, especially water ambience, music and cave sound effects, although some participants suggested that sound could be developed further through more layers, breathing audio or additional sound effects.

Suggested improvements included clearer boundaries, more interactive fish or creatures, longer playtime, VR support, breathing audio, more sound effects and optimisation. A small number of participants mentioned noticeable stuttering, which links to the non-functional requirement that the game should run without noticeable stuttering.

Selected anonymised response examples:

- “Definitely the visuals and lighting.”
- “The imagery and the underwater creatures and plants.”
- “The lighting made it feel more tranquil and guided me towards where I needed to go but the sound repeated too soon.”

- “The sound was good but didn't stand out as much as the visuals and lighting. Maybe add a few more layers of sound.”
- “This would be a great game for VR.”
- “Optimising it better, the little stuttering took me out of the immersion a few times.”

Appendix F. Asset List

Asset Name	Source	Purpose	License	Price if Applicable
Underwater Blueprint V1	https://lynkoli.ghet.gumroad.com/l/raiev?layout=profile	used for, Rocks, Particles, Fish rotation niagra particle, post process customisation, editable fog effects, water particles.	Free	
Underwater Soundscapes	https://fab.com/s/88d2df9ae01c	Used for general underwater sounds, background water audio, whale cutscene noises.	Fab Standard License	£4.45
Merinda Variable Font	https://fonts.google.com/specimen/Merinda?preview.script=Latn	Foont used in all menu and UI screens	Free	
Good Sky	https://fab.com/s/d8fd5e8581ca	used for lightning in cutscene and moon/clouds in initial play	Free	
Dry Thunder	https://pixabay.com/sound-effects/nature-dry-thunder-364468/	Thunder audio sound in cutscene	Free Pixabay Content License	
Horror-underwater sound effect	https://pixabay.com/sound-effects/horror-under-water-sound-effect-for-movies-and-videos-343060/	Dark cave water sound	Free Pixabay Content License	

Underwater Waves	https://pixabay.com/sound-effects/film-special-effects-underwater-waves-5983/	initial water entry splash sound	Free Pixabay Content License	
Ambience sleep music	https://pixabay.com/music/ambient-sleep-music-vol16-195422/	Music throughout the entire gameplay	Free Pixabay Content License	
Soul Cave	https://fab.com/s/632573897d7a	used for rocks in the first cave downward section	Fab Standard License	
Underwater Life	https://fab.com/s/f6bdaa405277	Octopus and sting ray	Fab Standard License	£4.45
Underwater Blueprint V3	https://www.artstation.com/marketplace/p/D7MOD/underwater-bpv3?utm_source=artstation&utm_medium=referral&utm_campaign=homepage&utm_term=marketplace	Various coral, rocks, materials, caustics materials, sand texture, school of fish niagara systems	Artstation Standard License	£6.56