# *Saudade*

# Exploring Immersive Boundaries through Horror Environments and Heuristic-Based AI in VR

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# Acknowledgements

# Contents

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## Richard Corrente

## Abstract

*Saudade* is a virtual reality (VR) psychological horror game designed to elevate player immersion by integrating adaptive artificial intelligence (AI) and meticulously crafted atmospheric design. The in-game experience investigates the boundaries of the horror genre by exploring the psychological tension between the player and an adaptive antagonist. Set in the abandoned and foreboding Saudade Memory Rehabilitation Center, the player must navigate a series of tasks to escape a facility steeped in mystery. As they progress, they uncover the unsettling truth about the facility and the protagonist's connection to it. The narrative unfolds through environmental storytelling and player-driven exploration, immersing the player in an eerie world that feels both alien and disturbingly familiar.

Central to *Saudade* is its adaptive antagonist—a figure of horror that dynamically responds and adapts to the player's actions. This AI-driven entity observes the player's behavior, identifies behavior patterns, and develops new strategies to hinder their progress of escape. For instance, if the player frequently uses certain evasive methods or hides in specific locations, the antagonist adapts by altering its patrol routes or how it attacks the player. This constant adaptation heightens the psychological tension of the player experience, as the player cannot rely on predictable adversarial behavior. The relationship between the player and the entity creates an unpredictable and escalating sense of dread. By emphasizing psychological tension over traditional jump scares and exploring the complementary immersive potential of VR and horror, *Saudade* aims to revolutionize the way players engage with and experience horror. The project serves as a case study in exploring elements of immersion in game design.

# 1  Introduction

Within digital media, particularly video games, the horror genre tends to elicit higher levels of engagement between the user and the content. Nothing establishes a greater display of user experience than witnessing someone jump out of their chair, throw off their headset, and scream as if they felt the danger in real life—a startle response, or in other words, a 'jump scare.' The body reflexively acts to protect itself from the sudden appearance of apparently dangerous stimuli. The eyes go wide and repeatedly blink, and the arms and hands attempt to deflect harm from the body's vital parts. However, jump scares are a relatively straightforward method of accomplishing horror, often regarded as cheap, reducing the artistic buildup of momentum and tension. Traditional horror games rely heavily on jump scares; however, atmosphere, suspense, and adaptive threats can achieve a more profound sense of fear.

The goal of this project is to utilize a virtual reality (VR) experience as a method of exploring an artistic approach to immersion in the context of horror. Instead of focusing on instilling terror via jump scares or absurdly loud noises, the development of *Saudade* focuses on the relationship between the player and a dynamic and adaptive 'figure of horror.'

To define a 'figure of horror' in the video game context: an entity designed to antagonize, harass, or scare the player in an attempt to prevent the player from accomplishing the in-game objectives.

Featuring jump scares in the VR medium may result in a disruptive, potentially harmful, playing experience. Jump scares, by nature and purpose, can lead to sensory overload. As previously described, a jump scare tends to lead to the player physically removing themself from the video game. When this occurs, the sense of immersion is entirely lost, as the player is no longer present in the playing experience. Throwing off the headset or jumping away from the TV/monitor are accessible ways for someone who wishes to disengage following a jump scare, but such methods of disengagement are not as easily possible in virtual reality. The horror genre inherently creates intense sensory experiences across all media platforms, but VR technology exponentially amplifies these effects through its unprecedented level of immersion. Compared to watching a horror film on the screen, the level of abstraction separating the player from the elements of fear is significantly minimal. The minimal abstraction between the player and the virtual environment makes the experience viscerally immediate and intense. Therefore, deliberately incorporating elements that exploit primal fear responses not only potentially induces negative psychological effects, but also counterproductive to maintaining sustained player engagement [1]. It is necessary to explore a more nuanced approach to horror design that prioritizes player safety while maintaining atmospheric tension.

# 2 Background

While the player attempts to escape the Saudade Memory Rehabilitation Center, the antagonist tries to 'hunt' the player before the player fulfills a series of tasks that would grant their survival. The player will have a range of methods to evade or avoid the antagonist (can never kill/eliminate it). However, suppose the player tends to rely on a particular method or two (e.g., hiding in a locker). In that case, the antagonist will develop counter-strategies (e.g., searching lockers) to challenge such repetitive behavior. The result is a highly interactive, replayable, and engaging experience.

The player wakes up in a mysterious facility containing eerily familiar artifacts of nostalgia. An inexplicable and pervasive sense of unease disturbs the player, motivating them to desire to leave the building as soon as possible. To escape, the player must complete a series of tasks while discovering the unsettling history of the seemingly abandoned facility. The player finds that they are not alone—some entity seeks to prevent their escape. Whenever the entity subdues the player, they suddenly reappear in the room where they wake again.

## 2.1 'Figure of Horror' Concept

The figure of horror, or antagonist, is the "Fragment." An entity born from the concept of absence—it is an incomplete presence, only visible through the player's handheld mirror. The Fragment's appearance in the mirror is unsettling: limbs in unusual positions, smeared characteristics (ex: facial features), and seemingly hollow. Initially, it appears humanoid, albeit distorted. As the player uncovers more memories, it becomes increasingly monstrous, a grotesque representation of the protagonist's regrets and fears. If the player excessively uses the mirror, their grasp on reality gradually distorts. The Fragment's existence evokes the sense that some things are always present, even when unseen—as if it is ever-present in the back of your mind.

Its presence is primarily auditory, with whispers and echoes of unfinished apologies and bitter memories.

## 2.2 Relationship between Protagonist and Antagonist

The Fragment is representative of the protagonist's avoidance of the past. Regardless of the protagonist's attempts to escape the facility, he is inevitably drawn deeper and deeper into the facility and must confront the recesses of his mind. The Fragment is the embodiment of *Saudade*—you can feel it, sense it, but never fully reclaim what was lost.

Facing these lost memories might allow The Fragment to fully manifest, at which point the game prompts the player with a difficult choice:

1. **[Forget]** Erase the painful memories, including The Fragment itself, and live in peaceful ignorance. As The Fragment vanishes, so do the memories that allowed the protagonist to become what he is now. While forgetting brings peace, it can leave one with a haunting void of emptiness.

2. **[Move Forward]** Accept the memories (the truth) and coexist with The Fragment. The protagonist accepts the sadness and longing as part of himself. He realizes that while the feeling of *Saudade* can never subside, it's something we carry with us, as we will remain forever incomplete but full of meaning.

## 2.3    Environmental Setting

### 2.3.1    Definition of the In-Game Environment

The playable experience is set in *Saudade*, an abandoned memory rehabilitation center. Saudade Memory Rehabilitation Center (SMRC) was conceived as a pioneering institution for the exploration and understanding of human memory. Built upon the cutting edge of neuropsychology, computational neuroscience, and biotechnical engineering, SMRC's primary objective was to provide and research therapeutic interventions for individuals suffering from memory-related disorders. These included post-traumatic stress disorder (PTSD), Alzheimer's disease, and other conditions involving cognitive impairment or maladaptive memory retention.

SMRC served as both a clinical rehabilitation center and an advanced research hub, housing a range of proprietary technologies designed to decode, reconfigure, and restore neural pathways associated with memory.

The Saudade Memory Rehabilitation Center is strategically located in a remote area to ensure patient privacy and limit external stimuli that could interfere with memory rehabilitation.

The interventions conducted at SMRC raised profound ethical questions. The ability to modify memories posed numerous risks, such as identity loss, propagation of false memories, or facilitating cognitive dependence on technological interfaces. Critics and media outlets warned of the potential for misuse in non-therapeutic contexts, such as surveillance, coercion, or manipulation. The facility's unexpected cessation of operations remains a mystery. Initial reports suggest an anomalous event within the Memory Weave Core, a critical proprietary technology, that disrupted its operations. The evacuation was abrupt, and the lack of documentation left many questions unanswered. The psychological and neurological state of former patients remains a subject of concern.

**Key Environmental Areas**

- **Cognitive Stimulation Suites**: Designed to immerse patients in controlled sensory environments that replicate past experiences or stimulate the formation of new

memory pathways.

- **Dormitory Complexes**: Quarters equipped to monitor patients during sleep cycles, utilizing advanced polysomnography to analyze physiological processes during sleep.

- **Memory Integration Chambers (MICs)**: Small, individualized units used for deep neural interfacing, combining neurochemical stimulants with machine-learning algorithms to access and modify memory engrams.

- **The Memory Weave Core (MWC)**: The central hub of the facility, where neural data from patients is processed, analyzed, and manipulated. The Memory Weave Core is the flagship research device of SMRC.
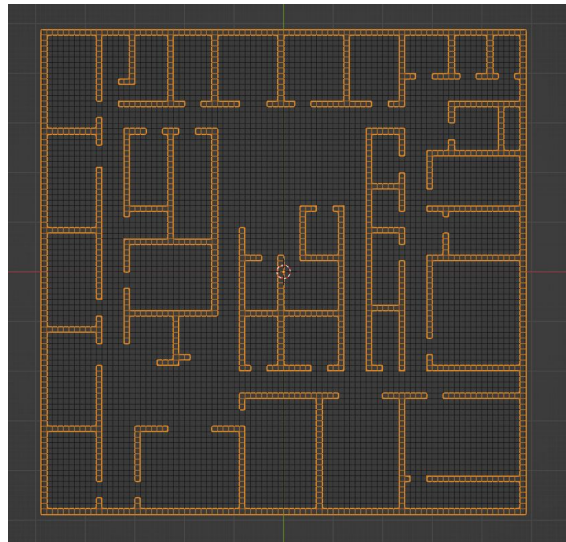


Figure 2.1: Layout of Saudade Memory Rehabilitation Center

# 3 Methodology

## 3.1 Technologies Used

I am using the Unity3D [2] engine to develop *Saudade*. Unity3D conveniently provides access to the OpenXR API, which provides support for various XR devices. For this year, the game is played using the Meta Quest 2. Unity3D using C# as its primary scripting language. The VR-functionality relies on the imported XR Interaction Toolkit package, which provides the following features as stated in the Unity3D documentation [3]:

- Cross-platform XR controller input: Meta Quest (Oculus), OpenXR, Windows Mixed Reality, and more.

- Basic object hover, select and grab

- Haptic feedback through XR controllers

- Visual feedback (tint/line rendering) to indicate possible and active interactions

- Basic canvas UI interaction with XR controllers

- Utility for interacting with XR Origin, a VR camera rig for handling stationary and room-scale VR experiences

For prototype purposes, the current models are made using the given Unity primitive objects, except for the map. The map layout was made in Blender. The final implementation of the game will consist of models custom-made by me using Blender [4].

## 3.2 Elements of Immersion & Engagement

Immersion is "the sensation of being surrounded by a completely other reality that takes over all of our attention, our whole perceptual apparatus"[5]. In the context of video games, immersion and engagement are closely related but distinct concepts that describe the player's physical, psychological, and emotional involvement with the game experience.

Immersion represents the degree to which a player feels absorbed in the game world, the 'other reality,' losing awareness of the real world around them. The concept can be broken down into four different dimensions:

1. **Sensory Immersion**: Achieved through graphics, sound design, and other sensory stimuli that make the game world feel real or tangible.

2. **Cognitive Immersion**: Involves the mental challenge and focus required by the game. Players can become absorbed in problem-solving, strategizing, or mastering in-game mechanics.

3. **Emotional Immersion**: When players form emotional connections with the characters, plot, or events present in the game.

4. **Spatial Immersion**: Relates to the player's perception of the game environment and level design as a coherent and explorable space, often enhanced by technologies like VR.

Engagement describes the level of interest, motivation, and attention a player invests in a game. It is arguably broader than immersion and encompasses the following aspects:

1. **Behavioral Engagement**: The actions players take, such as completing quests, solving puzzles, or advancing through levels.

2. **Emotional Engagement**: The feelings and emotions elicited by the game, such as excitement, frustration, joy, or fear.

3. **Social Engagement**: Interaction with other players or non-playable characters (NPCs), which can include cooperative or competitive multiplayer experiences.

4. **Cognitive Engagement**: The mental effort and curiosity exerted to understand and interact with the game, including its story and characters (if present).

The key difference between immersion and engagement lies within what each concept focuses on. Engagement focuses more on the player's active participation and involvement with the game mechanics and narrative. It is concerned with how well the game design motivates the player to continue playing and interacting. Immersion is fundamentally about the player's perceived presence in the game world, referring to how the player can lose themself in this fictional reality. For instance, a mobile puzzle game may require intensive mental decision-making, thus a moderate-high level of behavioral and cognitive engagement. The player remains engaged as the levels progress in difficulty and demands for strategy. However, the player may not feel extensively transported into this puzzle game world. It may lack a detailed narrative or features beyond solving puzzles on the screen. The game world might not feel 'real' or immersive, but the player feels behaviorally, emotionally, and cognitively engaged.

To create a compelling user experience, the two concepts must work together whether in a gaming or film context. A highly immersive game can lead to deeper engagement as players become more invested in the game world and its challenges. Conversely, engaging gameplay mechanics and narratives can enhance the player's sense of immersion by drawing them further into the game's reality. Immersion and engagement are fundamental aspects of the video game experience, contributing to the medium's unique ability to captivate players as they interact visually and physically.

### 3.2.1  Environmental Gameplay

The player suddenly wakes up in bed in Room 3, a small dormitory equipped with a lone, pale, and flickering light. The playable protagonist realizes the beds, meant for three other patients, are unusually unoccupied. The protagonist undergoes an immediate sense of disorientation, roughly recalling vague fragments: silhouettes of faces and hushed conversations between SMRC employees. Stepping out into the hallway, the absence of other humans becomes undeniable. The usual shuffle of patients, the chatter of nurses, and the mechanical sounds of trolleys and medical equipment are absent. Instead, the building feels alive in a more alien way—a subtle creak in the walls, a distant hum, and a faint whisper-like hiss from an unknown source. The feeling of isolation sets in, but something deeper, an inexplicable wrongness, lingers in the atmosphere. A strong impulse tells the player to escape the facility before it is too late.

As the player explores the Saudade Memory Rehabilitation Center, they encounter the following (to be implemented):

- **Shifting Pathways**: Hallways that once seemed linear twist and turn unexpectedly. A familiar route to the bathroom might now lead to a dead end with a maintenance closet. Paths may loop or disappear entirely, giving the impression of a labyrinth that reshapes itself. Doorways appear where none existed before.

- **Past and Present Merge**: As the player collects VHS tapes, the environment begins to mirror the associated memories. A sterile research lab may now contain a child's toy or an old photograph.

- **Unfamiliar Transformations**: Rooms once visited feel subtly altered upon return—furniture slightly rearranged, lighting dimmer, or walls now lined with unfamiliar objects. These transformations deepen the sense of unreality, making the player question whether the facility itself is alive or if the protagonist's mind is fracturing.

### 3.2.2  Sound Design

As the player seeks to obtain the next VHS tape, they constantly wonder where The Fragment might be. They fear the possibility of encountering The Fragment as they merely turn the corner. Every noise made—every accidental drop of an object—may summon the attention of *something*. This is a visual representation of tension, "a feeling of worry and stress that makes it impossible to relax" [6]. Tension thrives on the anticipation of the unknown. In the horror genre, sound design is critical in achieving sensory immersion. When combined with sound design, tension leverages sound to immerse players in an oppressive atmosphere. The fear of encountering The Fragment in a mysterious, everchanging environment becomes omnipresent, fueled by sound cues that do not just signal danger but provoke dread. The player may second-guess every sound, gradually grinding away at their sense of reality.

Silence is as critical as sound in the construction of tension. In *Saudade*, silence is never inevitable, instead faint environmental noises (ambience) populate the space. Ranging from the distant buzz of a failing lightbulb to the mechanical hums of the facility, these ambient sounds fill the void, creating a heightened sensitivity in the player. Moments of true silence, however, are reserved for the most intense buildup of tension, where any noise, such as opening a locker, feels deafening.

"Tension, stress, and suspense: these are the bread and butter of a scary game" [7]. During high moments of tension, the player should be at the edge of their seat, or in the case of VR, perhaps on their tip-toes. Sound is ultimately the driving force in the artistic buildup of tension.

### Ambient Layers

The ambient soundscape in Saudade Memory Rehabilitation Center is alive with subtle, oppressive elements:

- Low-frequency drones that sit just below conscious awareness, creating unease.

- Mechanical hums from the facility's infrastructure.

- Distant echoes of whispers of indeterminate origin beyond the player's reach.

These elements create a background texture that feels omnipresent and invasive, amplifying the sense of constant tension.

### Dynamic Sounds Based on Player Actions

- Action-Reaction Feedback: Accidental sounds—dropping an object—are exaggerated to underscore their potential consequences in alerting The Fragment to the player's presence. Deliberate, unavoidable sounds, such as opening a locker to hide in, can unintentionally alert The Fragment to the player's location as it seeks to investigate the cause of the sound.

The tension builds as the player realizes their actions might have tangible repercussions. Despite The Fragment not immediately appearing, it does get drawn closer if within some range (varies based on the interacted object). This feature is to be implemented.

### Antagonist's Auditory Signature

Without looking in the handheld mirror, the player can determine The Fragment is nearby based on its characteristic series of unsettling, discordant sounds signaling its presence:

- Glitched frequencies resembling screaming.

- Whispers, cries, and echoes of laughter that sound strangely familiar.

- A void-like ambient hum.

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The Fragment's auditory cues remain inconsistent, reinforcing its unknowability and making players constantly second-guess their safety. In some instances, the threat of The Fragment is made very clear.
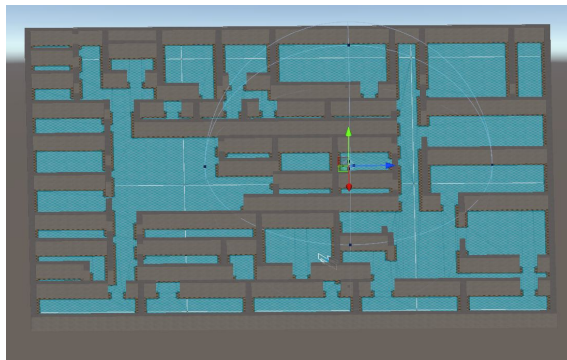


Figure 3.1: Range of The Fragment's 'Walking Sound' cue

When the player is within the range of the highlighted sphere, they can hear the audio associated with the 'walking state' of The Fragment [AI behavior explained in Section 3.3.2].

## 3.3 Core Gameplay Loop

To complete the game, the player must avoid The Fragment and escape Saudade Memory Rehabilitation Center. The player can only visibly see The Fragment by looking into a handheld mirror. Before escaping the facility, the player must collect and watch 6 VHS tapes. Each tape depicts the interactions between a father (the recorder), his wife, and his toddler daughter. Upon watching/collecting all 6 tapes, the exit is made available to the player. Going through the exit ends the game, signaling its completion.

### 3.3.1 Gameplay Progression

The collection of each tape indicates a one-step progression in the game state. With each progression, the behavior and appearance of The Fragment change, along with the layout of Saudade Memory Rehabilitation Center. The difficulty of the gameplay experience generally increases with each tape collected: 0/6 is the easiest state, and 6/6 is the hardest state. The content depicted within each tape escalates as the game state approaches 6/6.

Note that VHS tapes { TAPE 2, TAPE 3, TAPE 4 } are an unordered set. This means the player can stumble upon either of them regardless of sequential order. For example, a gameplay session might conclude with the collection TAPE 1, TAPE 3, TAPE 4, TAPE 2, TAPE 5, and finally, TAPE 6. This correctly implies that the player can view the recorded content within { TAPE 2, TAPE 3, TAPE 4 } out of chronological order depicted by the timestamps in each recording.

- **PRE VHS TAPE 1**: Before collecting VHS Tape 1, The Fragment is not yet active—providing a grace period for the player to explore the environment and user
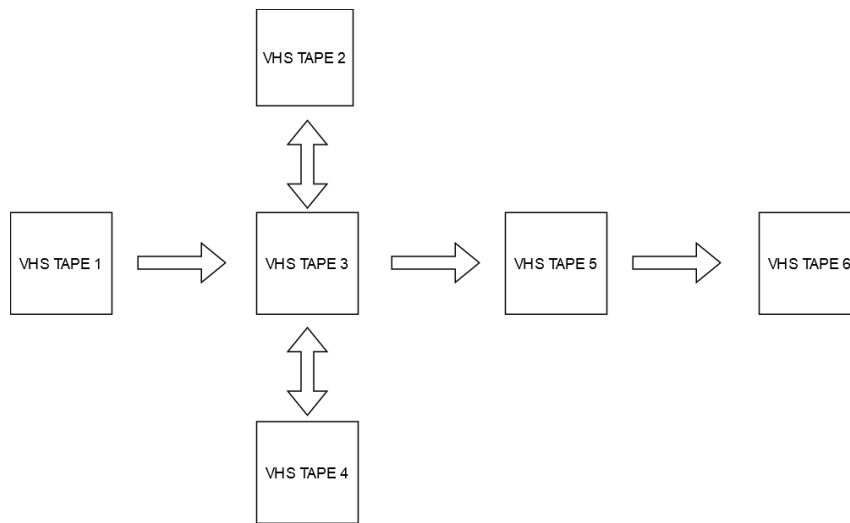
Figure 3.2: VHS Tape Collection Diagram

controls. The player will be made aware of The Fragment's presence but cannot interact with it until collecting VHS TAPE 1. *Game State: 0/6*

- **VHS TAPE 1**: Upon collection of VHS Tape 1, the player is instantly made aware of the 'active state' of The Fragment. Since the player is not yet entirely familiar with the environment, the distortion impact will not be as severe compared to the other tapes but will remain noticeable. *Game State: 1/6*

- **VHS TAPE 2**: Could be the next tape obtained by the player after collecting VHS Tape 1. The Fragment's behavior and appearance change. The map slightly changes. *Game State: 2/6*

- **VHS TAPE 3**: Could be the next tape obtained by the player after collecting VHS Tape 1. The Fragment's behavior and appearance change. The map slightly changes. *Game State: 3/6*

- **VHS TAPE 4**: Could be the next tape obtained by the player after collecting VHS Tape 1. The Fragment's behavior and appearance change. The map slightly changes. *Game State: 4/6*

- **VHS TAPE 5**: Is the next tape obtained by the player after accomplishing the collection of 4 VHS tapes. The Fragment's behavior and appearance change severely. The map dramatically changes. *Game State: 5/6*

- **VHS TAPE 6**: Is the next tape obtained by the player after collecting VHS Tape 5. The Fragment's behavior and appearance reach their final state of escalation. The map changes for the last time. *Game State: 6/6*

### 3.3.2 Player-AI Interactions

The Fragment's in-game AI has multiple states:

1. **The walking state**: The Fragment moves throughout the map, from destination to destination, until it detects the player or a player action. This is the default state.

2. **The idle state**: when The Fragment reaches a destination or spawns into the environment, it stands still for a brief moment.

3. **The chase state**: if The Fragment's distance from the player is less than or equal to searchDistance, it will begin sprinting after the player until it either captures the player, loses the player, or a set duration of time elapsed.

4. **The searching state**: if the player is within a set distance of The Fragment's field of vision, The Fragment will begin searching. After some number of seconds, The Fragment will switch to the walking state if the player goes fully undetected.

Each state corresponds with an animation. For prototype purposes, the animations are simple, as is the model for The Fragment itself (to be completed next semester). The states and their corresponding animations are logically organized in a finite state machine. Each state/animation can be accessed or led to by the other, but will not overlap (ex: The Fragment cannot walk and chase simultaneously). The sole exception to this accessible flow is the jumpscareAnimation, which triggers when The Fragment 'catches' the player. When this occurs, the player respawns in Room 3 where the game began. However, progress will not reset—the current number of VHS tapes collected will remain.
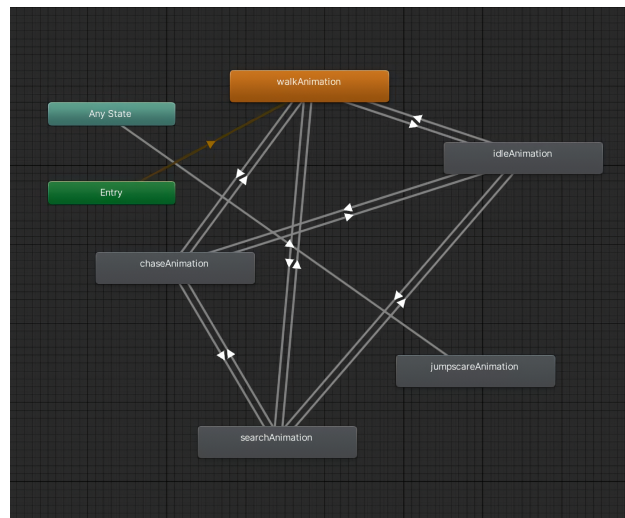


Figure 3.3: AI Finite Statement Machine (FSM)

As previously stated in Section 3.3.1, the behavior and appearance of The Fragment change as the gameplay state escalates from 0/6 to 6/6 VHS tapes collected. Specifically, The Fragment becomes more aggressive and sensitive to player actions (to be implemented). Its appearance also becomes less abstract and more defined, monstrous-like (to be implemented).

The player can hide from The Fragment by pressing the primary button of the Meta Quest 2's right controller when near a locker. When entering the locker a sufficient distance from The Fragment during a chase, The Fragment will give up the chase but may

remain in the area (switches from the chase state to the walking or searching state). If the player enters the locker while too close to The Fragment during a chase, The Fragment will ignore the locker hiding condition and catch the player. Additionally, as The Fragment is sensitive to sounds, the opening and closing of the locker may attract the attention of The Fragment if it happens to be near during the action.
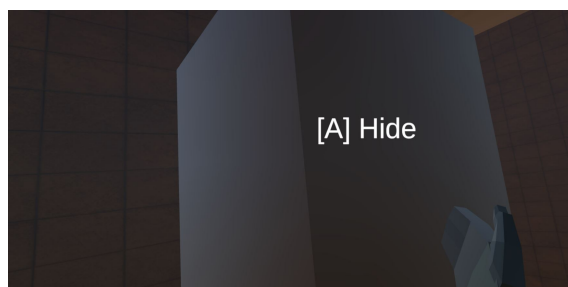


Figure 3.4: Interaction with a locker

### 3.3.3 Seeing the Antagonist

The player cannot see The Fragment with the naked eye. Besides being able to hear audio cues, the sole way for the player to discern The Fragment is via a handheld mirror made available at the beginning of the game. Using their right hand and holding down the grip trigger of the Meta Quest 2's right controller, the player can hold the mirror up to their face (the gameplay camera) to see behind them. This gameplay mechanic introduces a unique way to enhance both immersion and engagement by amplifying tension by limiting the player's perception and increasing the sense of vulnerability. The use of a VR Grab Interactable makes this action feel physical and deliberate, as though the player is genuinely lifting the mirror and orienting it to see behind them.

Implementing mirrors in video games is notoriously difficult due to the computational cost. To achieve an accurate or semi-realistic in-game mirror, the scene must be rendered twice: once from the player's perspective (primary game camera), and once from the mirror's reflected perspective (secondary camera). Maintaining realistic reflections requires consistently precise calculations for lighting, shadows, and object placement. In resource-intensive environments like VR, optimizing the implementation of mirrors to prevent frame rate drops is crucial to avoid motion sickness and maintain immersion.

To make this mechanic feasible in a VR setting:

- Low-Resolution Reflections: Render reflections at a lower resolution than the main view to reduce performance costs.

- Culling: Use frustum culling to render only the objects visible in the mirror's view.

- Dynamic Level of Detail (LOD): Reduce the detail of objects reflected in the mirror when performance is critical.
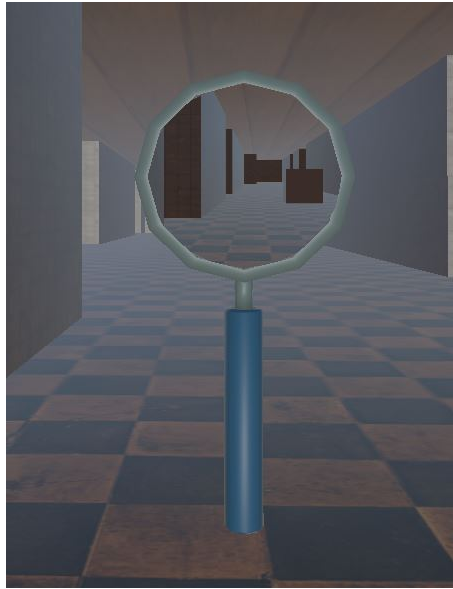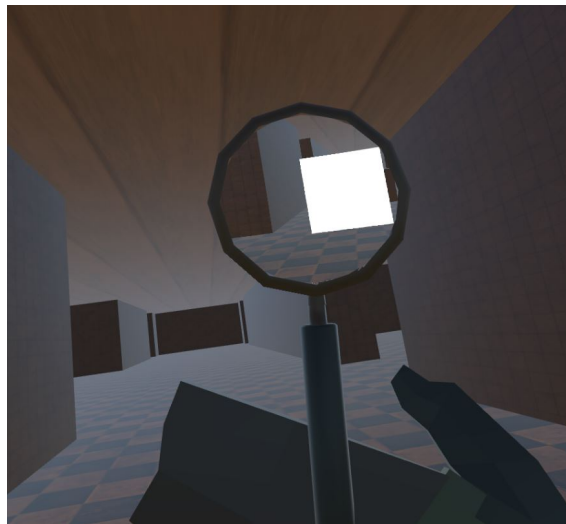
Figure 3.5: The player's handheld mirror



Figure 3.6: Example of the mirror revealing a GameObject

The mirror mechanic functions by a conditional check waiting for an object tagged under the 'Revealable' layer to appear within the bounds of the mirror's camera perspective. An object with the 'Revealable' layer has a specific shader equipped that makes it transparent until the object is within the camera's field of vision. If the 'Revealable' object is within the bounds of the camera, it will manifest in the in-game environment solely through the reflection in the mirror, which is a texture observable by the player. If the mirror's camera is moved off of the 'Revealable' object, the player will no longer be able to see the object. Figure 3.6 above demonstrates an example of this mechanic using a cube.
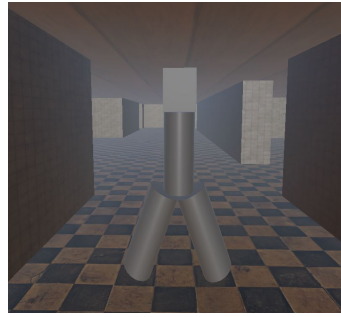
Figure 3.7: Prototype model of The Fragment

### 3.3.4 AI Pathfinding

The Fragment's pathfinding ability is dependent on the UnityEngine.AI NavMesh scripting class. Unity's NavMesh (Navigation Mesh) system is a pathfinding AI navigation system that enables The Fragment to move around the map without requiring active user intervention. An AI agent with the NavMesh component equipped automatically calculates optimal paths to reach some designated location. Additionally, it will always avoid objects with collision boxes that are viewed as static in the environment. For example, The Fragment will never walk through a wall to get to the player—it will have to walk through the hallway and around the corner. Then, if The Fragment happens to spot the player while it is in the walking state, it will abandon its path toward whatever destination it chose to go toward. Finally, The Fragment enters the chase state to subdue the player. For testing purposes, there are destination nodes statically placed across the playable map that The Fragment will randomly choose to navigate toward.
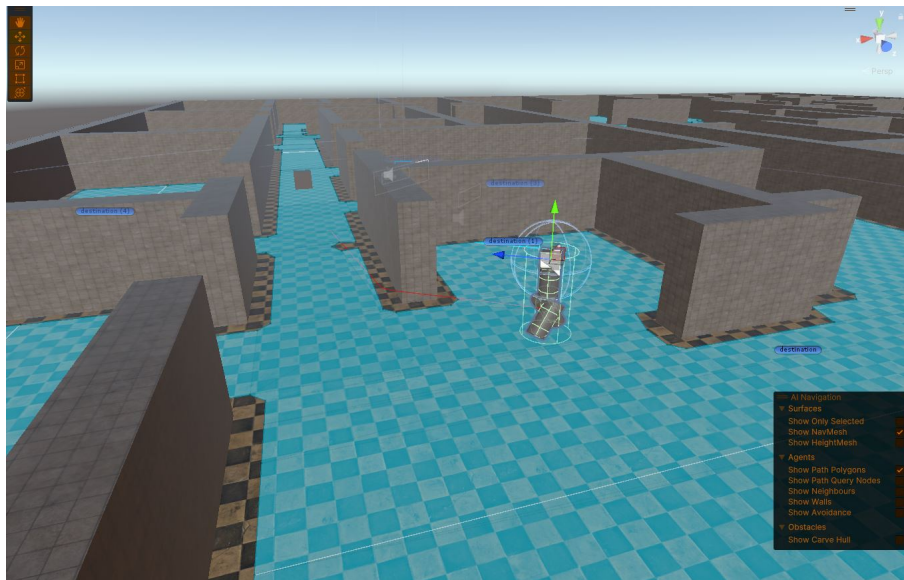


Figure 3.8: The Fragment walking on a determined path

In Figure 3.8, there is a red line coming out from The Fragment's model. This red

line indicates the current path that the AI decided to take. As previously mentioned, it prioritizes taking optimal paths to reach its destination. To achieve this, the AI tends to hug the walls of the map. In the final implementation of the game, this will no longer be the case. Instead, The Fragment will use more of the given hallway and room spaces in its navigation calculations. The blue, rounded rectangles in Figure 3.8 are text boxes for the destination nodes placed around the map. During the testing instance displayed in this figure, The Fragment was heading towards 'destination (3).'

The blue overlay on the map depicted in the Figure 3.9 below is the NavMesh surface. The NavMesh is permanently baked into the scene based on the map geometry, so if I ever had to change the map layout, I would need to rebake the NavMesh. In the final implementation of the game, the map will change when the player collects certain VHS tapes. In these cases, the NavMesh must be rebaked to consider the difference in positioning of specific rooms and hallways.



Figure 3.9: Viewable NavMesh Surface

# 4   Related Work

Before conceptualizing *Saudade*, I sought to gather some inspiration from successful horror video games throughout the decades. I primarily examined franchises and games such as *Silent Hill* and *Alien: Isolation*.

The Silent Hill franchise (referring to the first four main games,) while featuring subtle jump scares via loud noises or the sudden introduction of an antagonist, is hailed as an industry example of artistic direction and sound and atmospheric design. The developers, Team Silent, focused their efforts on constructing the horror experience through oppressive soundtracks and audio cues serving to constantly keep players on the edge of their seats. My project's ambition to maintain the sense of dread and paranoia is shared with the ambitions behind the game design of the Silent Hill installments.

The primary source of inspiration for the relationship between the player and the AI antagonist is from the design and implementation of the 'Xenomorph' in Alien: Isolation. A survival horror game based on the *Alien* film franchise, published in 2014, Alien: Isolation is potentially the best example of sophisticated AI in horror video games. The game features two AI systems: a 'director-AI' and an 'alien-AI.' The director-AI, which always knows the state of the game and the player's location and movements, feeds hints to the alien-AI that is initially unaware of the player activity [8]. The alien-AI constantly searches for the player based on audio cues and the provided hints, while also responding to repetitive behaviors. This sense of anxiety stemming from the gameplay loop of cat-and-mouse is exactly what I want to recreate in *Saudade*—with my own unique approach, of course.

# 5 Conclusion

This project explores the intersection of virtual reality, psychological horror, and adaptive artificial intelligence to redefine player immersion and engagement. Through the development of *Saudade*, the project demonstrates the potential of integrating heuristic-driven AI and virtual reality to deepen psychological tension and player investment. By leveraging VR's unique capacity for sensory and spatial immersion, *Saudade* creates an emotionally and cognitively engaging environment that challenges players both narratively and interactively. This project advances the understanding of immersion and engagement by illustrating how tightly coupled mechanics and narrative can evoke profound emotional responses. It lays a foundation for future work on AI and immersive design not only in VR but in other forms of media. Hopefully, developers and creatives alike will be motivated to further explore how such technologies can shape the future of storytelling and interactive media.

# 6 Future Work

The work accomplished during this semester is part of a year-long project concluding in April 2025. *Saudade* will receive further development in ART 496 of the 2024-2025 spring semester. Before concluding ART 496 in Spring 2025, the following will be completed:

- The Fragment featuring more dynamic behavior and adaptive capacities.

- Videos for the VHS tapes.

- A textured Fragment model equipped with polished animations and sound effects.

- A detailed in-game environment with high-quality textures, models, and atmospheric sound design.

- Interactive elements within the environment (e.g., picking up items).

- Dynamic lighting.

- Environmental storytelling via objects and interactive elements.

The rough development timeline is as follows (using Unity and Blender):

- **Phase 1**: Fragment Modeling, Texturing, and Animation

    - Complete the 3D model of the antagonist.
    - Create and apply detailed textures to the model.
    - Rig the model for animation and interactions with the environment and the player.
    - Develop idling, walking, running, attacking, and successful subduing animations.
    - Integrate the animations into the game environment.

- **Phase 2**: Player Modeling, Texturing, and Animation

    - Complete the 3D model of the player.
    - Create and apply detailed textures to the model.
    - Rig the model for animation and interactions with the environment and the antagonist.

- – Develop animations for interactions with interactive objects and the antagonist.

- **Phase 3**: Environment Modeling and Texturing

  - – Model main areas of the facility (e.g., hallways, rooms).
  - – Model major environmental assets.
  - – Create and apply detailed textures to the modeled environment and its assets.

- **Phase 4**: Object Modeling, Texturing, and Animation

  - – Complete the 3D models for the interactive objects (e.g., flashlights).
  - – Create and apply detailed textures to the objects.
  - – Rig the models for animations and interactions with the environment, the player, and the antagonist.

- **Phase 5**: Sound Design

  - – Create and implement ambient sounds, sound effects, and dynamic music (e.g., when chased by the antagonist).
  - – Implement positional/spatial audio to emphasize the VR experience.

- **Phase 6**: Polishing and Presentation

  - – Conduct extensive playtesting to resolve any issues or bugs.
  - – Refine and finalize all elements to ensure a smooth in-game performance.
  - – Construct the physical presentation for the undergraduate exhibition.

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