Echoes of the Mind: A VR Horror Game

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***Abstract*— *Echoes of the Mind* is a VR horror project that investigates how adaptive mechanics can heighten immersion and unpredictability beyond traditional scripted design. Developed in Unity with Oculus SDK and C#, the game combines a finite state machine–driven ghost AI, a fear model that responds to player behaviour (e.g., remaining in darkness), and a scream detection system that triggers ghost responses through vocal input. Unlike existing titles such as *Phasmophobia*, which rely partly on scripted events, this project emphasises unscripted jumpscares and symbolic objectives, including the use of voodoo dolls and a Hell Door mechanic, to build psychological tension. Playtesting, primarily qualitative but supported by indicative metrics, showed that most participants experienced increased tension and immersion under adaptive conditions. The findings highlight both the potential of behavioural and voice-based adaptation for VR horror and the future scope of extending these systems with physiological inputs such as pulse monitoring.**

Keywords—Virtual Reality, Psychological Horror, Fear System, Adaptive AI, Finite State Machine (FSM), Voice Detection, Game Design

I. Introduction

Virtual reality (VR) has transformed digital horror experiences by creating heightened immersion and embodied presence, allowing players to feel physically situated within unsettling environments in ways that traditional screen-based games cannot achieve (Slater and Sanchez-Vives, 2016). Unlike conventional horror games, where fear is mediated through a screen, VR horror directly engages the body's perceptual and emotional systems, leading to stronger physiological and psychological responses (Kisker et al., 2021). Studies in affective computing suggest that this increased immersion amplifies emotional intensity, making VR particularly effective for exploring fear-based interactions and adaptive horror design (Chirico et al., 2017).

Building on this context, *Echoes of the Mind* was developed as a VR horror game designed to adapt dynamically to player behaviour. The project integrates a finite state machine (FSM) for ghost artificial intelligence, a scream detection system that directly influences enemy behaviour, and a fear management system that escalates tension when players remain in darkness. These adaptive systems aim to provide unscripted scares, diverging from heavily scripted approaches common in mainstream horror games. Inspirations were drawn from titles such as *Phasmophobia* and *Pacify*, which experiment with environmental and object-based scares, as well as *Jinn* and the symbolic use of dolls in the series *Locke and Key*. Unlike these works, the present project sought to combine environmental adaptation with player-driven voice mechanics to create a less predictable and more personalised horror experience.

The central aim of *Echoes of the Mind* is therefore to investigate how player-centred adaptive systems can heighten fear and engagement in VR horror. By focusing on mechanics such as voice-triggered ghost behaviour and symbolic objectives like voodoo dolls and a Hell Door, the project explores how interactive systems can reinforce both narrative tension and gameplay variety. This report reflects on both the design and testing of the system, highlighting lessons for future VR horror development. In doing so, it builds upon existing debates on immersion (Jennett et al., 2008; Nacke and Lindley, 2008) and ludic horror (Perron, 2018), situating *Echoes of the Mind* within both academic theory and practical game design practice.

II. Background And Relataed Work

A. Horror Game Design in VR

VR changes how horror is felt. Instead of viewing fear through a screen, players are embodied in the scene, which strengthens presence and the immediacy of threat (Slater and Sanchez-Vives, 2016; Skarbez, Brooks and Whitton, 2017). This can raise emotional intensity but also introduces comfort risks such as cybersickness, so pacing, movement and visual cues must be managed carefully (Weech, Kenny and Barnett-Cowan, 2019; Rebenitsch and Owen, 2016). Recent VR titles show different directions: *Don't Scream* links progress to silence, *Shh* uses audio stealth, and *Phasmophobia* combines voice interaction with unpredictable AI, while *Pacify* and *Jinn* explore tension through object-driven and cultural motifs. These examples underline how VR horror diverges from traditional horror and motivate adaptive systems that respond to player behaviour.

B. Adaptive Horror in Games and Media

Adaptive horror tailors events to the player's behaviour or state, trading fixed scares for unpredictability and replay variety (Hudlicka, 2009; Lopes, Coutinho and Bidarra, 2021). In practice, *Phasmophobia* escalates when players speak, *Pacify* ramps hostility via escalating states, and *Don't Scream* and *Shh* bind survival directly to voice control. Beyond games, *Locke & Key* shows how whispers can operate as subtle, responsive cues that shape unease. In *Echoes of the Mind*, these ideas are realized through an FSM ghost that changes state based on player actions, and a fear system that varies events with fear system that varies events with darkness exposure, complemented by voice-triggered ghost responses aiming to make each run feel less scripted and more personal.

C. AI Techniques in Horror Games

Artificial Intelligence (AI) plays a central role in shaping tension and unpredictability in horror games. Among the most widely used techniques are Finite State Machines (FSMs), which represent non-player character (NPC) behaviour as a series of states such as idle, patrol, chase, and attack. FSMs are popular because they are straightforward to implement, transparent for debugging, and efficient for real-time performance (Millington and Funge, 2016). In horror games, these clear transitions help create recognisable yet tense encounters, where the player can anticipate danger but not always control its timing.

More complex approaches such as **behaviour trees** and **planning systems** have also been adopted in modern games, offering layered decision-making and more adaptive responses (Sammut and Webb, 2017). While these techniques allow for increased complexity, they can also be resource-intensive and harder to tune for consistent horror pacing. Research has emphasised that believable adversaries in horror should balance **predictability with surprise**, ensuring that encounters feel tense without appearing scripted (Zook, Riedl and Harrell, 2014). Similarly, AI has been explored as a tool for supporting narrative immersion, with systems that adapt to emotional cues and generate dramatic tension (Suttie et al., 2012).

For this project, an FSM was chosen to implement the **Ghost AI** due to its suitability for a prototype-scale game, where clarity and performance were critical. The ghost transitions between patrol, chase, and hearing states, while also responding dynamically to the player's scream input. Although less complex than behaviour trees, this approach still allowed for unscripted jump scares and unpredictable encounters. In future iterations, more adaptive systems such as utility-based AI or emotionally driven models could be explored to further enhance immersion and unpredictability (Mateas and Stern, 2005).

D. *Emotional Adaptation in Games*

Emotional adaptation in games refers to systems that respond dynamically to a player's psychological or behavioural state, creating experiences that feel personal and unpredictable. In horror, this concept has become increasingly relevant as developers aim to move beyond scripted events and towards experiences that reflect the player's reactions in real time. For example, *Nevermind* (Flying Mollusk, 2015) monitors players' biofeedback such as heart rate to adjust difficulty and intensity, while VR titles like *Affected: The Manor* rely heavily on sensory immersion to amplify fear. Academic research has also highlighted the potential of adaptive systems in enhancing immersion, with Nacke et al. (2010) noting that player-specific adjustments can significantly heighten emotional engagement. This creates opportunities for more personalised and lasting horror experiences.

The project *Echoes of the Mind* applies these ideas by incorporating fear management and scream detection as adaptive mechanics. Instead of relying solely on scripted jumpscares, the system monitors player behaviour, using darkness exposure to escalate fear while vocalisations act as separate triggers for ghost aggression. Although the current implementation does not extend to physiological measures such as heart rate or galvanic skin response, it demonstrates how relatively lightweight inputs like sound and playstyle can create a sense of personalisation. This aligns with the broader direction of emotional adaptation in games, where the aim is not only to frighten the player but also to ensure that fear is responsive, evolving, and unpredictable.

E. *Symbolism and Narrative Objectives in Horror*

Symbolism has long been central to horror narratives, where everyday objects are transformed into sources of dread and psychological tension. Cursed dolls, haunted doors, and ritualistic artefacts often serve as metaphors for hidden fears, repressed memories, or thresholds between worlds (Krzywinska, 2022). Within *Echoes of the Mind*, the inclusion of the voodoo doll and the Hell Door draws from this tradition, transforming simple gameplay objectives into meaningful psychological symbols. The doll functions not only as an object to be collected and destroyed but also as an embodiment of vulnerability, echoing the use of possessed dolls in titles such as *Pacify* (2019) and *Jinn* (2019). Similarly, the Hell Door symbolises a liminal threshold between safety and damnation, inspired in part by the thematic use of keys and whispering objects in the series *Locke and Key* (2019).

From a design perspective, symbolic objectives provide players with a tangible anchor in otherwise unpredictable horror environments. As Juul (2019) argues, symbolic mechanics allow games to communicate narrative stakes without relying solely on exposition. By requiring players to locate and burn dolls in the Hell Door, *Echoes of the Mind* integrates narrative and mechanic in a way that enhances tension: the task i.e. burning voodoo dolls is mechanically simple, yet symbolically framed as destroying sources of fear and sealing away evil, which increases immersion beyond the mechanical act.

Unlike *Pacify* or *Jinn*, where symbolic artefacts are tied to scripted encounters, *Echoes of the Mind* embeds these objectives within an adaptive fear system. This ensures that symbolic meaning is not only narrative but also dynamically connected to player behaviour, increasing replayability and psychological impact.

F. *Summary of Inspirations*

Echoes of the Mind draws on a range of games and media to shape its adaptive VR horror mechanics and narrative style. *Phasmophobia* (Kinetic Games, 2020) informed the integration of vocal-triggered ghost behaviour, illustrating how speech recognition can heighten tension, though often within limited scripted contexts. *Pacify* (Hitchcock Games, 2019) inspired the voodoo-doll mechanic, where players interact with cursed dolls to influence ghost aggression. The upcoming *Jinn* (MyMadHouse, 2024) extends this lineage by exploring shape-shifting entities that mirror player fears, aligning with the psychological depth sought in this project. Beyond games, the Netflix series *Locke & Key* (Hill and Cuse, 2020) demonstrated how whispering or possessed objects can carry symbolic weight, a concept reimagined in the Hell Door and voodoo dolls of this design.

Unlike *Phasmophobia* and *Pacify*, which rely heavily on scripted encounters, *Echoes of the Mind* aims to deliver a more adaptive system, where player actions and vocal responses directly shape ghost behaviour, emotional pacing, and symbolic narrative elements. This distinction positions the project not as a replication, but as an evolution of existing horror frameworks.

III. Narrative Premise and Gameplay Structure

A. *Story Premise*

The player assumes the role of Sha, a police officer investigating the disappearance of his friend, who was last seen entering the long-abandoned Ravenswood Asylum. Local rumours describe the building as cursed, once home to a mentally unstable patient believed to have engaged in occult rituals. According to legend, this patient performed a dark incantation on his deathbed, allowing a demonic entity to possess him. Since then, the asylum has been plagued by paranormal activity. Among its most sinister elements are voodoo dolls, cursed artefacts that inflict torment on the trapped spirits of the missing.

Sha enters the asylum to uncover the truth and end the curse. To succeed, he must locate and destroy the dolls while evading a malevolent ghost influenced by sound and fear. The experience is designed to heighten vulnerability through VR's immersive presence, offering a psychological intensity beyond traditional screen-based horror (Slater & Sanchez-Vives, 2016).

B. *Core Gameplay Loop*

The game begins with a narrated cinematic sequence that establishes the backstory and tone. Players are introduced to a magical book, which acts as a diegetic interface for delivering hints and instructions. After acquiring a flashlight and restoring power through the fuse box, the first cursed voodoo doll manifests, signalled by directional whispers that intensify with proximity and encourage exploration.

Each collected doll initiates a **hunt phase**, during which the ghost pursues the player with escalating aggression. Survival depends on reaching the **Hell Door**, a ritual portal that spawns randomly, and destroying the doll inside. Each cycle ends with a blackout before the loop repeats. With every successful doll destruction, the ghost grows faster; in the later stages it also gains the ability to teleport, introducing unpredictability and heightened pressure.

The system integrates a **fear mechanic** where darkness amplifies the player's vulnerability, while light reduces it. Player voice input further modulates ghost behaviour: loud speech draws the ghost closer, while a scream instantly teleports it nearby, transforming real-world reactions into gameplay triggers (Meta, 2023).

The climax occurs after the destruction of the final doll, initiating an endless hunt with all ghost abilities enabled. The player must survive until a glowing exit door appears, symbolising release from the curse. This design combines environmental storytelling, procedural tension, and reactive AI to sustain immersion and dread throughout the experience (Fullerton, 2018; Unity Technologies, 2024).

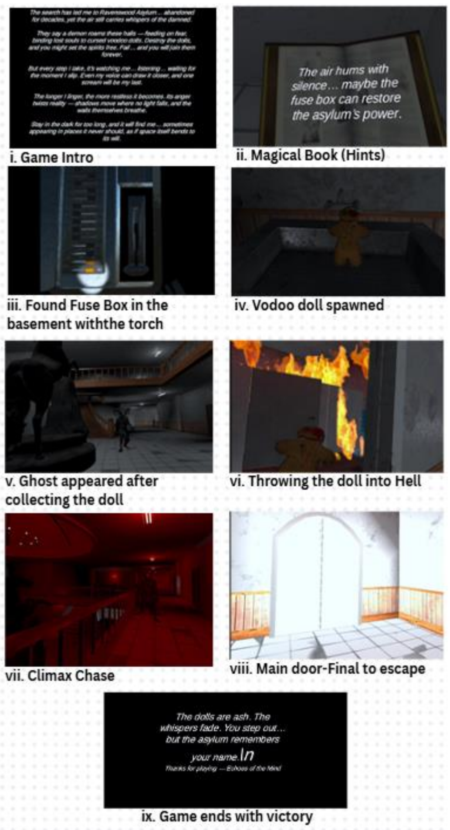


Figure.This figure illustrates the successful gameplay loop of *Echoes of the Mind*.

IV. Design and Implementation

A. *Overall Architecture*

The architecture of *Echoes of the Mind* follows a modular design philosophy, where each core gameplay feature is encapsulated within a dedicated manager or controller. These modules are orchestrated by a central Game Director, which governs sequencing, transitions, and high-level game flow. This approach reflects established best practices in game software engineering, where modularity supports scalability, maintainability, and iterative testing (Gregory, 2019).

At the highest level, the system is organised into eight interacting subsystems:

1. **Fear Manager** – continuously tracks the player's fear level (0–100) based solely on darkness and light exposure. The system is tiered into three thresholds: Tier 1 (33) triggers mild jump scares, Tier 2 (66) escalates to heavy jump scares, and Tier 3 (85) initiates timed ghost hunts. This ensures fear progression is structured and predictable, while still leaving space for adaptive escalation.

2. **Lighting and Fuse Box Controller** – manages room illumination, blackout events, and player interactions with fuse boxes. This introduces an agency-vulnerability loop, where players regain control at the cost of risk exposure.

3. **Ghost AI** – implemented as a finite state machine (FSM) with patrol, investigate, and chase states. The FSM was chosen over more complex architectures (e.g., behaviour trees or utility AI) due to its clarity, performance efficiency, and suitability for iterative development in Unity (Millington and Funge, 2016). Ghost behaviours are further influenced by the Fear Manager, introducing adaptive unpredictability.

4. **Voice Input (Scream Detector)** – integrates microphone input to distinguish between normal speech and high-threshold screams. Loud speech draws the ghost to the player's location, while a scream triggers an immediate teleportation very close to the player. This system transforms vocal expression into both a survival risk and an immersive mechanic. (Jiang et al., 2019; Schuller et al., 2018).

5. **Voodoo Doll Mechanic** – represents the primary progression system, requiring players to collect and burn cursed dolls. This mechanic not only drives the objective loop but also reinforces the narrative of trapped spirits tied to ritual artefacts. Each destroyed doll temporarily banishes the ghost, trips the fuse box, and spawns the next doll. With every destruction, the ghost's movement speed increases by 10%, and when fewer than three dolls remain, it gains the ability to teleport near the player every 20 seconds. This mechanic tightly couples symbolic progression with dynamic difficulty scaling

6. **Hell Door Mechanic** – serves as the final ritual portal, unlocked after all dolls are destroyed. It provides both a narrative conclusion and a mechanical win condition.

7. **Jumpscare Manager** – coordinates audio-visual scare elements such as whispers, apparitions, and sudden audio stings. These are synchronised with the Fear Manager to ensure that scares scale with tension rather than relying on static triggers.
8. **Game Director** – functions as the coordinating layer that holds references to all managers and orchestrates narrative flow. It governs sequencing from the initial UI and tutorial hints through doll spawns, escalating ghost behaviour, and the final Hell Door climax. The Game Director also mediates adaptive difficulty, linking progression milestones to system-wide changes (e.g., increasing ghost speed by 10% after each doll destruction and unlocking teleportation when fewer than three dolls remain). By centralising these adjustments, it ensures consistent pacing and integration across subsystems

This architecture allows flexibility in design iteration. For example, the Ghost AI could be extended with behaviour trees for greater nuance, or the Scream Detector could be replaced with biometric sensors such as heart-rate input, without requiring major changes to the rest of the framework.

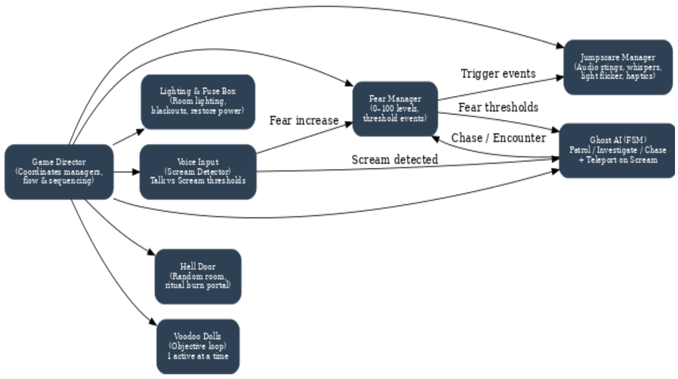


Figure 1 illustrates the data flow and event-driven connections between subsystems. Fear thresholds and scream detection feed directly into both the Ghost AI and Jumpscare Manager, while the Game Director ensures that objective progression (via dolls and Hell Door) integrates seamlessly with environmental control and player feedback loops.

B. *Core Gameplay Mechanics*

The core mechanics in *Echoes of the Mind* are designed to create an escalating psychological experience through layered interactions, environmental storytelling, and adaptive threat systems. Drawing from principles of immersive horror and symbolic narrative design (Perron, 2018; Juul, 2019), each gameplay element is crafted to elicit tension, unpredictability, and a sense of vulnerability in the player. These systems work together to create a cohesive loop. Fear increases in darkness, voodoo dolls serve as ritual objectives, the ghost dynamically adapts its behaviour, and the player's own voice can compromise safety. Collectively, these mechanics support the game's central themes of isolation, fear, and desperation.

1. Fear and Jumpscare Systems

The fear system is central to the player's psychological journey in *Echoes of the Mind*, functioning both as a pacing mechanism and as a dynamic trigger for escalating tension. Fear is modelled internally as a floating-point value ranging from 0 to 100, increasing when the player lingers in darkness or encounters disturbing stimuli, and gradually decreasing under safe lighting conditions. This mechanic draws on the tradition of adaptive difficulty in horror games, where systems respond to player state to create dynamic pacing and maintain immersion (Hunicke, 2005; Perron, 2018).

Fear accumulation is updated in real time using Unity's trigger volumes and light intensity thresholds. Entering dark zones steadily raises fear, while surpassing specific thresholds activates escalating consequences: Tier 1 at 33 introduces mild audio-visual scares, Tier 2 at 66 triggers heavy jumpscares, and Tier 3 at 85 initiates full ghost hunts. These thresholds are orchestrated within the *FearManager* class, which coordinates with the *JumpscareManager* and *GhostAIController* to synchronise intensity across systems. This tiered structure creates a rhythm of anticipation, dread, and release, echoing established models of horror tension design (Klevjer, 2020).

The jumpscare system is designed as a complementary layer to deliver unpredictable spikes of fear. Triggers include entering haunted zones, interacting with cursed objects, or randomised events during high fear phases. While jumpscares are tied to fear thresholds, randomisation ensures that they remain unpredictable and avoid becoming formulaic. When activated, the system instantiates a ghost prefab near the player, accompanied by scream audio, glitch post-processing effects, and rapid camera shake to maximise disorientation. This integration prevents feedback loops that would otherwise overwhelm players, while maintaining psychological tension through uncertainty (Kirkland, 2021; Ekman, 2021).

The modular architecture of the *JumpscareManager.cs* script allows integration with the *GameDirector* for flexible event orchestration. This modularity not only enhances scalability but also reflects broader design principles of horror games, where layered systems sustain unpredictability and escalating dread (Boon, 2021; Unity Technologies, 2023). Collectively, the fear and jumpscare systems establish an emotional pacing framework that balances long-term dread with momentary shocks, aligning with theories of symbolic horror design and supporting the game's overarching themes of isolation and vulnerability (Juul, 2019; Perron, 2018).

2. Lighting, Fuse Box, and Environmental Controls

Lighting serves as both a functional mechanic and a symbolic element in *Echoes of the Mind*, regulating fear progression, guiding spatial navigation, and shaping the psychological atmosphere. Within survival horror traditions, light is frequently used to balance safety with vulnerability, encouraging players to manage resources and weigh risk against exploration (Perron, 2018; Kagen, 2017). In this project, lighting systems are tightly integrated with the fear mechanic, ensuring that time spent in darkness carries both emotional and mechanical consequences.

The flashlight, managed via the *TorchLightController*, provides a narrow cone of illumination, creating a fragile zone of safety while leaving the periphery shrouded in darkness. This constrained field of view echoes established design principles in horror games, where restricted perception heightens suspense and intensifies vulnerability (Boyan et al., 2015). Complementing this, environmental lighting can only be restored through the fuse box system. Implemented via the *FuseBoxController* and *FuseBoxLever*, this interaction requires players to locate the main power source and engage the lever, activating associated *RoomLightController* scripts.

This creates a pacing mechanism where progress is punctuated by moments of relief, contrasting oppressive darkness with temporary safety.

Each room incorporates a *RoomZoneTrigger*, which determines whether the player is situated in a lit or unlit space. This status is communicated to the *FearManager*, directly influencing the player's fear value in real time. Prolonged exposure to darkness accelerates fear accumulation and activates escalating responses, including audio distortions, whispering voices, and potential jumpscares. In this way, the lighting system dynamically shapes the player's psychological state while reinforcing environmental storytelling.

This layered approach mirrors techniques found in *Phasmophobia* (Kinetic Games, 2020), where lighting not only regulates navigation but also modulates threat perception. By combining environmental controls with systemic fear feedback, *Echoes of the Mind* encourages player agency in managing risk, pacing exploration, and negotiating tension. Ultimately, lighting becomes more than a tool for visibility; it evolves into a narrative device that underscores the game's themes of fragility, desperation, and survival (Kirkland, 2021; Perron, 2018).

3. Voodoo Doll Ritual and Hell Door Mechanic

The Voodoo Doll and Hell Door systems form the symbolic and mechanical backbone of *Echoes of the Mind*, merging ritualistic gameplay with escalating threat dynamics. In horror design, ritualised actions often embody themes of curse, sacrifice, and cleansing, providing players with both a goal and a psychological burden (Fernández-Vara, 2014; Perron, 2018). Inspired by titles such as *Pacify* (Shawn Hitchcock, 2019) and *Phasmophobia* (Kinetic Games, 2020), these mechanics create moments of heightened intensity where narrative symbolism directly drives mechanical consequence.

At specific stages, one of five cursed voodoo dolls is randomly spawned within the environment, managed by the *DollManager* script. Only one doll is active at a time to sustain tension and focus player objectives. Upon picking up a doll (*DollPickup.cs*), the ghost AI immediately transitions into an aggressive hunting phase while whispering audio cues intensify, producing an abrupt escalation of pressure. This design leverages psychological payoff: the very act of ritual engagement transforms safety into chaos.

Following doll acquisition, the *HellManager* system summons a Hell Door in a randomised location, its presence marked by red lighting and environmental distortion. The player must quickly locate this door and cast the doll into it, ending the hunt. Doing so destroys the doll, disables the Hell Door, and resets the lighting state, granting a temporary reprieve that contrasts relief against the sustained dread of future encounters.

Internally, each destroyed doll contributes to escalating difficulty: ghost speed increases by 10% per ritual, and from the fourth doll onward, teleportation becomes available. This progression introduces a mechanically driven difficulty curve that mirrors the rising narrative stakes. The ritual system thus functions as both symbolic and structural pacing, providing milestones that punctuate the gameplay loop while steadily intensifying challenge.

By intertwining symbolic objects (voodoo dolls) with ritualistic gameplay (Hell Door sacrifice), *Echoes of the Mind* reflects the principles of narrative game design where objects hold emotional weight and drive player progression (Fernández-Vara, 2014; Kirkland, 2021). This synergy of story, environment, and system deepens immersion, ensuring that each ritual feels like a transformative moment in the unfolding psychological horror.

4. Ghost AI System

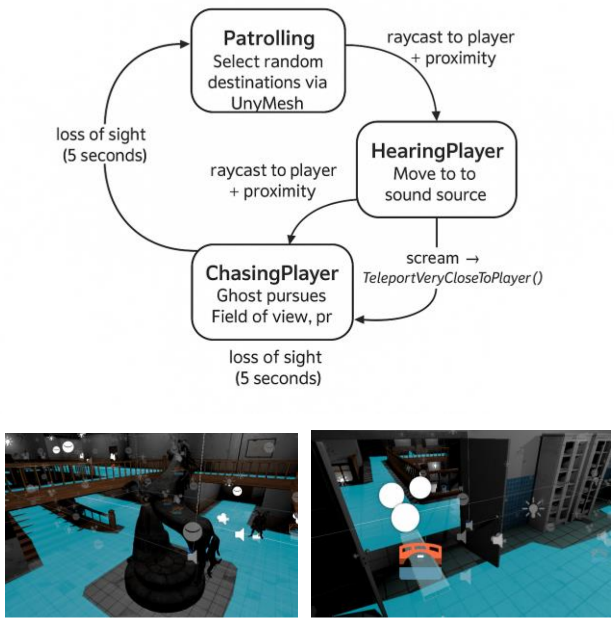
The ghost in *Echoes of the Mind* is driven by a finite state machine (FSM) that governs adaptive and psychologically engaging behaviours. It transitions between states based on visual, auditory, and spatial cues, simulating intelligent decision-making and unpredictability.

The FSM consists of three core states: *Patrolling*, *ChasingPlayer*, and *HearingPlayer*. In *Patrolling*, the ghost uses Unity's *NavMeshAgent* to select random destinations on surfaces defined by *NavMesh Surfaces* and connected through *NavMesh Links* (Unity Technologies, 2023). When the player enters its field of view, detected through raycasting from an eye point within horizontal and vertical bounds, or comes within 3.5 units, the ghost transitions into *ChasingPlayer*.

The *HearingPlayer* state is triggered when the player produces voice input. Normal speech prompts the ghost to move toward the sound source, while louder inputs, such as screams, trigger *TeleportVeryCloseToPlayer()*, instantly relocating the ghost near the player (Björk, 2021). Additional behaviours include blinking, where the *SkinnedMeshRenderer* is temporarily disabled, causing disorienting vanish-and-reappear effects without interrupting navigation.

If the ghost loses sight of the player for more than five seconds, as defined by the *lostSightGrace* timer, it reverts to *Patrolling*. This predator-inspired design choice helps maintain believability and avoids repetitive scripted behaviour (Rollings and Adams, 2003).

All behaviours are implemented in *GhostAIController.cs* and coordinated with the *GameDirector* and *ScreamDetector*, ensuring dynamic responses to both player actions and environmental conditions. **Figure 2** presents a visualisation of the FSM alongside Unity Editor screenshots of the navigation setup (NavMesh Surface and Navmesh Link). .



5. Voice Input Integration

The voice input system in *Echoes of the Mind* allows players' real-world vocal behaviour to directly influence in-game events, intensifying immersion and psychological tension. This mechanic is managed by the *ScreamDetector* script, which samples microphone input in real time and processes audio intensity to detect loud talking and screaming.

Two configurable thresholds define vocal input: *talkThreshold* (0.07 in the Inspector; 0.25 in code) and *screamThreshold* (0.25 in the Inspector; 0.55 in code). Loudness is calculated using the root mean square (RMS) of the audio buffer. Exceeding the talk threshold fires an *OnLoudTalk* event, while surpassing the scream threshold triggers *OnScream*. In practice, *OnScream* typically results in the ghost teleporting close to the player via *TeleportVeryCloseToPlayer()*, producing sudden, high-stress encounters.

To prevent repetition and false positives, the system employs cooldowns of 0.5 seconds for talking and 2 seconds for screaming. This ensures that microphone-based reactions remain impactful without becoming overwhelming. Optional features include audio feedback (e.g., scream sound effects) and debug settings for performance monitoring.

The event-driven architecture is a key strength: *ScreamDetector* is decoupled from the ghost's finite state machine (FSM), enabling *OnLoudTalk* and *OnScream* to be reused across other systems, supporting modularity and scalability (Gamma et al., 1994). For example, environmental responses to loud noise could be integrated with minimal refactoring. Visual indicators, such as microphone meters and debug logs, further support threshold calibration during playtesting.

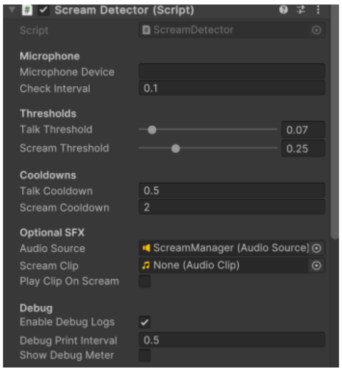


Figure 3. Unity Inspector for the ScreamDetector script, showing threshold sliders, cooldown values, and debug options.

6. UI and Player Feedback

The UI design in *Echoes of the Mind* follows a minimal and diegetic approach to preserve immersion and tension. Instead of relying on standard HUD elements, the game integrates feedback into the environment through lighting, sounds, and screen-space effects. One notable example is the book-based hint system, where floating books display cryptic guidance for mechanics such as the Hell Door (Figure 4). These hints are implemented as world-space canvases with subtle glow effects, encouraging players to investigate naturally without breaking immersion.

Another core feedback element is the screen overlay system, managed by the ScreenOverlayController under the central GameDirector script. This system displays introductory text, game over screens, and endgame messages on a darkened background, ensuring that narrative transitions feel impactful without disrupting gameplay flow. Additionally, the same system supports subtle screen flashes during jumpscares or fear spikes, generating momentary disruptions that reinforce horror pacing (Isbister, 2017).

Overall, this lightweight UI approach enhances immersion by embedding narrative and gameplay cues directly into the world space. This design minimises reliance on non-diegetic interfaces while still ensuring the player receives essential information, striking a balance between usability and psychological engagement.

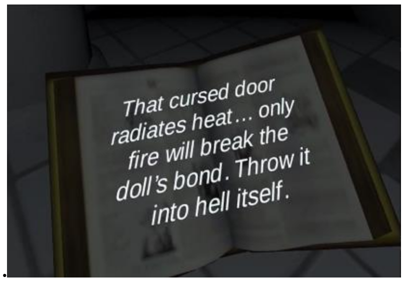


Figure 4. Screenshot of the implemented magical book hint system in Unity.

7. Game Director Logic

The *GameDirector* script centralises control over major gameplay systems in *Echoes of the Mind*, acting as the core flow controller. Early iterations used separate scripts for scream detection, ghost states, fear thresholds, and UI transitions, but this distributed approach quickly became difficult to maintain and debug. To resolve these issues, a single coordinating script was introduced to streamline logic and improve scalability.

The *GameDirector* maintains direct references to key managers such as *FearManager*, *GhostAIController*, *JumpscareManager*, and *ScreenOverlayController*. This enables it to serve as the central hub for decision-making, including triggering jumpscares, handling scream responses, progressing doll sacrifices, and displaying end-game overlays.

This architecture promotes clarity, modularity, and maintainability, particularly in a solo development context. By reducing dependencies between subsystems, the design aligns with established best practices in game architecture and software engineering (Rollings and Adams, 2003; Unity Technologies, 2023).

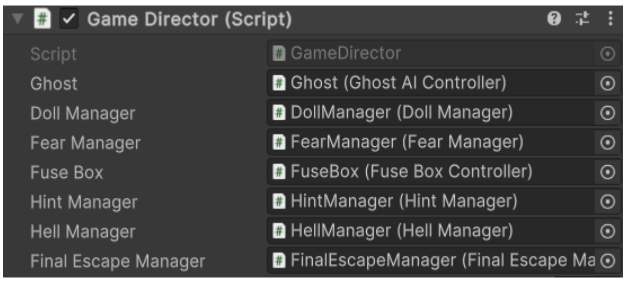


Figure 5. Unity Inspector showing the GameDirector script with linked manager references (FearManager, GhostAIController,JumpscareManager,ScreenOverlayController).

V. Playtesting and Evaluation

Throughout development, multiple iterative playtests were conducted with peers, a cousin, and the project supervisor between April and August 2025. Each session focused on specific mechanics such as fear thresholds, microphone input detection, ghost AI responsiveness, and hint clarity, allowing for targeted feedback and measurable refinements.

Data on fear levels, microphone volume thresholds, player movement, and jumpscare triggers were logged and adjusted in real time. For example, scream detection thresholds were raised after players reported premature game-over events, and ghost teleportation logic was modified to avoid overwhelming less experienced players. Similarly, the hint delivery system evolved from static text displays to a contextual book-based interface after feedback highlighted its immersion-breaking presentation.

These evaluations enhanced gameplay balance, accessibility, and engagement while maintaining psychological tension. Iterative testing ensured that mechanics were tuned for both immersion and fairness, reflecting best practices in user-centred design and horror game research (Nacke and Lindley, 2008; Jennett et al., 2008). A detailed timeline of playtesting sessions, participant feedback, and subsequent adjustments is included in Appendix A.

VI. Discussion

The development of *Echoes of the Mind* aimed to create a reactive horror experience rooted in psychological tension, with minimal reliance on scripted events. A key challenge was balancing immersion with usability, ensuring that features such as voice input, fear escalation, and environmental cues worked intuitively without overwhelming players.

The fear system was central to this balance. Instead of functioning as a health bar, it acted as an emotional metric tied to lighting, ghost presence, and audio cues. This design drew partial inspiration from modern horror games such as *Phasmophobia* (Kinetic Games, 2020), where environmental factors and player input dynamically shape tension. Unlike *Phasmophobia*, which emphasises multiplayer dynamics and investigative tools, *Echoes of the Mind* centres on a solitary and internalised horror loop driven by sound sensitivity and unpredictable AI. This reflects Perron's (2009) argument that horror games derive much of their impact from isolation and psychological unease rather than mechanical challenge.

Voice input introduced an unusual layer of player agency, particularly through scream detection. Early versions struggled with sensitivity and false positives, but after threshold and cooldown adjustments based on feedback, the mechanic became more reliable. Playtesting also informed key refinements, such as separating fear accumulation from jumpscare triggers to prevent overstimulation. These changes allowed for controlled pacing and brief recovery periods, aligning with principles that emphasise rhythm and relief in sustaining horror tension (Perron, 2009).

The ghost AI's finite state machine (FSM) developed iteratively. Behaviours such as blinking, teleportation, and eye-level detection added unpredictability to its actions, while Unity's NavMesh Surfaces and Links supported smooth navigation in vertically layered environments. This approach reflects established practices in game AI design, where modular FSMs and navigation meshes balance behavioural depth with maintainability (Millington and Funge, 2016). The result was an AI that could patrol and chase effectively without relying on pre-scripted paths, thereby improving replayability.

The user interface was similarly refined to enhance immersion. Static on-screen hints were replaced with an in-game book, reducing visual clutter while maintaining narrative consistency. This change, prompted by peer feedback, aligns with UX best practices for horror games (Schell, 2019).

Nevertheless, the project faced limitations. As a solo developer under tight deadlines, opportunities for implementing diverse assets, voice work, or alternate endings were limited. Playtesting was largely restricted to peers, reducing the demographic diversity of feedback. Furthermore, optimisation targeted the Meta Quest 3S specifically, leaving performance on other VR platforms untested. Accessibility features, such as optional difficulty adjustments for sensitive players, were identified during feedback but not fully realised within scope. These constraints echo Kennedy et al.'s (1993) emphasis on adaptive pacing in mitigating simulator sickness and align with Stanney et al.'s (2020) argument for inclusive VR design.

Despite these constraints, *Echoes of the Mind* demonstrates how adaptive AI, voice integration, and environmental storytelling can work together to produce a psychologically engaging VR horror experience. The process also highlighted the importance of modular architecture, iterative feedback, and sensory design in delivering emotionally impactful gameplay.

VII. Conclusion and Future Work

Echoes of the Mind set out to create an immersive psychological horror experience that harnessed dynamic systems such as scream detection, adaptive fear levels, and emergent ghost AI within a VR environment. Development was guided by iterative prototyping and feedback, responding to challenges such as motion sickness and overstimulation while preserving the game's unsettling atmosphere. Modular systems, including the *GameDirector* and *FearManager*, provided flexibility and maintainability, enabling features to evolve in parallel without excessive coupling.

Core mechanics such as the ghost AI's finite state machine, voice-input-triggered behaviours, and progressive fear escalation were deliberately chosen to evoke dread without relying on repetitive jump scares. The scream detection system presented significant challenges, particularly in calibrating thresholds across different hardware (for example, VR headsets), but ultimately contributed to immersion once refined. Similarly, dynamic lighting and environmental cues reinforced feelings of vulnerability without undermining player agency. Each of these systems was shaped through multiple playtesting rounds, with feedback driving changes to pacing, hints, and overall flow. Taken together, the project demonstrates that even lightweight AI techniques such as FSMs can support horror experiences that feel unscripted and reactive.

Future work will focus on accessibility, technical optimisation, and expanded content. A fear sensitivity slider could support players with lower horror tolerance, aligning with research into VR comfort and sickness mitigation (Stanney et al., 2020). Narrative depth could be enriched through branching storylines or persistent environmental clues, reflecting Jenkins' (2004) concept of narrative architecture. Multiplayer functionality would allow cooperative or competitive dynamics, adding a new social dimension to the horror experience (Perron, 2018). On the optimisation side, incorporating level-of-detail (LOD) models and performance tuning for VR rendering will be essential to support smooth framerates across platforms. Additional design directions include introducing puzzle mechanics for deeper interactivity, multi-layered soundscapes for enhanced spatial awareness, and environmental storytelling to reveal lore progressively. These extensions would preserve the project's psychological horror focus while broadening player agency, technical performance, and replayability.

VIII. Acknowledgment

I would like to express my sincere gratitude to my supervisor, Dr. Laurissa Tokarchuk, for her invaluable guidance, encouragement, and support throughout the development of this project. Her insightful feedback and expert advice greatly enhanced the quality of this work.

I also wish to acknowledge the creators and contributors of various assets and resources used in this project. Special thanks go to:

- **Unity Asset Store** contributors for models and tools such as *Scary Evil*, *Grimoire Style Book*, *Electric Torch*, *Electrical Shield*, *Legacy Particle Pack*, and the *Horror House* environment.
- The developer of the voodoo doll model available on **TurboSquid**.
- Sound designers who contributed to **Pixabay**, whose free sound effects enhanced the game's atmosphere.
- **Fist Full of Shrimp** for the incredibly helpful VR setup tutorial series on YouTube.

Finally, I would like to acknowledge the assistance provided by ChatGPT in refining the development process and improving the clarity and coherence of this dissertation paper. The AI support helped me to articulate my ideas more effectively while maintaining an academic tone.

IX. References

A. Academic & Books

- Fullerton, T. (2018) *Game design workshop: a playcentric approach to creating innovative games*. 4th edn. Boca Raton, FL: CRC Press.
- Jenkins, H. (2004) 'Game design as narrative architecture', in Wardrip-Fruin, N. and Harrigan, P. (eds.) *First person: new media as story, performance, and game*. Cambridge, MA: MIT Press, pp. 118–130.
- Jennett, C., Cox, A.L., Cairns, P., Dhoparee, S., Epps, A., Tijs, T. and Walton, A. (2008) 'Measuring and defining the experience of immersion in games', *International Journal of Human-Computer Studies*, 66(9), pp. 641–661. https://doi.org/10.1016/j.ijhcs.2008.04.004
- Kennedy, R.S., Lane, N.E., Berbaum, K.S. and Lilienthal, M.G. (1993) 'Simulator sickness questionnaire: An enhanced method for quantifying simulator sickness', *The International Journal of Aviation Psychology*, 3(3), pp. 203–220. https://doi.org/10.1207/s15327108ijap0303_3
- Meta (2023) *Accessibility in Meta Quest*. Meta Platforms. Available at: https://www.meta.com (Accessed: 18 August 2025).
- Nacke, L.E. and Lindley, C.A. (2008) 'Flow and immersion in first-person shooters: measuring the player's gameplay experience', in *Proceedings of the 2008 Conference on Future Play: Research, Play, Share*, Toronto, Canada, November 2008. New York: ACM, pp. 81–88. https://doi.org/10.1145/1496984.1496998
- Nielsen, J. (1994) *Usability engineering*. San Francisco, CA: Morgan Kaufmann.
- Perron, B. (2018) *The world of scary video games: A study in videoludic horror*. London: Bloomsbury Academic.
- Schell, J. (2019) *The art of game design: a book of lenses*. 3rd edn. Boca Raton, FL: CRC Press.
- Stanney, K.M., Fidopiastis, C.M. and Foster, L. (2020) 'Virtual reality is sexist: but it does not have to be', *Frontiers in Robotics and AI*, 7, 4. https://doi.org/10.3389/frobt.2020.00004

B. Technical/Web

- Unity Technologies (2023) *Unity Manual & Scripting API.* [online] Available at: https://docs.unity3d.com/ (Accessed: 19 August 2025).

C. Audio / Voice Detection

- Jiang, D., Sahidullah, M., Li, H., Kinnunen, T. and Hanilçi, C. (2019) 'Deep learning for scream and shout detection in speech', *Proceedings of Interspeech 2019*, pp. 609–613.

D. Games

- *Kinetic Games (2020) Phasmophobia [PC Game]. United Kingdom: Kinetic Games.*
- *Hitchcock, S. (2019) Pacify [Video game]. United States: Shawn Hitchcock.*
- *Visser, J. and Henson, J. (2023) Don't Scream [Video game]. United States: Indie.*
- *Papargyriou Studios (2023) Shh [Video game]. Greece: Papargyriou Studios.*
- *Khan, A. (2020) Jinn [Video game]. Pakistan: Adnan Khan.*

X. Appendix A – Playtesting and Evaluation

A. *Overview of Playtesting Process and Instrumentation*

Six formative playtests were conducted between April and August 2025 using iterative builds of *Echoes of the Mind*. Sessions lasted 15–30 minutes and involved five participants, including peers and family members. Tests were conducted on Meta Quest 3S in a quiet room. Following best practices in game user research, each session used a combination of think-aloud observation, short gameplay tasks (e.g., restoring power, surviving a chase), and post-test interviews (Fullerton, 2018).

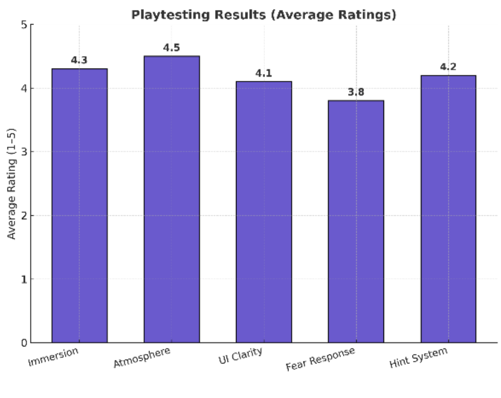
Instrumentation included tracking simulator sickness using the Simulator Sickness Questionnaire categories (Kennedy et al., 1993) and categorising usability issues with heuristics such as clarity of goals and feedback (Nielsen, 1994). Telemetry was also captured on mic input, fear thresholds, ghost speed, and jumpscare frequency.

B. *Playtesting Sessions Summary*

Date	***Build Features***	***Participant(s)***	***Issues Observed***	***Design Responses***
Apr 11	XR simulator build, early scream to fail mic logic	Peer	Mic over-sensitivity; loud talking triggered scream logic too easily	Increased scream threshold to avoid false positives from loud speech
May 20	First VR prototype; mic integration; early locomotion setup	Peer & Self	Motion sickness; slow movement; mic not triggering consistently	Increased player speed (1.0 → 2.2); lowered texture quality; pipeline debugging led to final RMS-based ScreamDetector
Jun 16	Full asylum layout; hand grab; NavMesh patrols; AI chase; interactable doors	Peer	Chase felt too fast; ghost lost player occasionally; interactable doors fiddly during chases	Slowed ghost speed; added Rigidbody + height tweak to fix visibility; replaced interactable doors with auto proximity triggers
Jul 20	Ghost blink; spatial whispers on dolls; hell door;background music	Cousin	Whispers didn't stop after grabbing dolls; environment too dark if torch lost; music too repetitive	Stop/start whisper logic on grab/drop; lit key areas; added subtle music loop; moved hints to world props
Aug 11	Hint system; random doll/hell spawns; fusebox loop; tiered fear; teleport on scream; five dolls total	Peer	Hints were visually intrusive; unclear backstory; no intro/end screens; more jump scares requested	Moved hints to book; added intro/outro narration (ScreenOverlayController); implemented tier-aware JumpscareManager
Aug 15	Final climax pass: red lights, infinite hunt, final door with escape ending	Cousin	Fear spiked too early; jump scares too frequent	Added tier gating pause; cooldown between scares; blocked fear gain during scares/intro to maintain tension balance

C. *Quantitative Summary*

Telemetry from the final sessions confirmed slower early fear rise after tier gating was enabled. Ghost speed rose 120% (1.0 → 2.2) across builds. Jump scares capped at 6 per minute with local cooldowns. Scream threshold tuned to 0.55 removed false triggers.



(Figure A1: Quantitative ratings from final two sessions)

D. *Accessibility Features*

Telemetry Voice reactivity could be toggled off. Microphone sensitivity sliders allowed customization. Jump-scare intensity modes were provided. Diegetic hints and candle lighting supported immersion and comfort (Meta, 2023).