

Virtual Reality Horror Chronicles: Exploring Fear in Virtual Reality

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Abstract

Virtual reality (VR) provides a distinctive and immersive experience, enabling users to engage in digital environments in an exceptionally realistic manner. It offers a sense of presence and immersion, making users feel as though they are physically present within a virtual world. Games can be single-player or multiplayer, and they often involve challenges, objectives, or narratives for players to engage with. Gaming is a powerful tool for promoting VR technology because, through VR gaming, users can experience firsthand the sense of presence and immersion that VR offers, leading to greater interest and enthusiasm for technology. The horror genre has established popularity among gamers which makes it a strategic choice for promoting VR, as it attracts a dedicated fan base eager to explore new and thrilling experiences. VR horror games provide an unmatched immersive experience through their first-person perspective, lifelike graphics, and interactive gameplay. Through immersive environments, we aim to showcase the transformative potential of interactive computing. Players experience the game world from the protagonist's perspective, which enhances their sense of presence and amplifies the horror experience. This VR horror game offers an approachable entry point into the immersive world of VR. The VR horror game is built on the Unity Game Engine, where we utilize 3D models for environments, AI enemies, and objects. These models are animated to add movement and life to the game world, including character animations, object interactions, and environmental effects. The enemies will have advanced behaviors such as patrolling, chasing, and attacking the player, adding to the challenge and tension of the game. We are implementing a system to dynamically spawn items and objects throughout the game world. This includes tools, keys, and other essential items needed to progress through the game and overcome obstacles. The game contains a variety of sound effects and environmental sounds to enhance immersion and atmosphere. This includes footsteps, distant screams, environmental sounds, and other auditory cues to heighten tension and suspense. We are implementing

a quest system to provide players with objectives and goals to complete throughout the game. These quests may involve finding key items and surviving encounters with enemies. Victory conditions are defined based on completing all quests and achieving the ultimate goal of survival.

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INTRODUCTION

The VR horror game features detailed 3D models for environments, enemies, and objects with

animations for lifelike movements. AI enemies are programmed to patrol, chase, and attack players to enhance their challenges and tensions. A dynamic item-spawning system provides essential tools and items throughout the game to aid progression. Immersive sound effects such as footsteps and distant screams heighten the atmosphere. A quest system sets objectives for players, such as finding items and surviving encounters, with victory achieved by completing all quests and surviving encounters.

One way of introducing VR technology to a wider audience is to develop VR games. Gaming is one of the biggest industries in the world that will allow VR to obtain a platform where it can showcase its endless possibilities to the world. Horror Games are some of the biggest games in the industry, as they allow players to become immersed in the environment. This makes the horror genre one of the best genres to showcase the capabilities of VR.

Games may have a cultural impact by influencing perceptions of VR technology and shaping immersive gaming experiences. Through innovative storytelling and gameplay mechanics, the game contributes to shaping the narrative surrounding VR and its potential impact on entertainment and society. By promoting VR technology through a popular gaming genre, such as horror, the game contributes to expanding the market for VR hardware and software. This attracts new players to the VR ecosystem and encourages existing gamers to explore the possibilities of VR gaming.

Why Opted for Horror Genre?

Opting for the horror genre in VR gaming is a strategic choice for several compelling reasons. First, horror games consistently rank highly across demographics and gaming platforms, showing their widespread appeal and engagement. In VR, horror games excel in delivering an immersive experience that transports users to another world, creating a heightened sense of fear and suspense that effectively showcases VR capabilities. The use of eerie sounds and immersive audio further enhances this sense of immersion by drawing players deeper into the game environment. In India, where horror stories and supernatural themes hold cultural significance, VR horror games have the potential to resonate strongly with audiences, particularly younger consumers who are enthusiastic consumers of horror content. By leveraging the universal appeal and emotional impact of horror games, VR technology can be effectively promoted and embraced as a powerful medium for immersive experiences and storytelling.

LITERATURE SURVEY

A literature survey reviewed existing studies on VR technology, horror game mechanics, and player experiences to identify trends, gaps, and opportunities for innovation. It contextualizes research within the evolving landscape of immersive gaming and its psychological impact, as shown in Table 1.

REQUIREMENTS ANALYSIS

The requirement analysis for a VR horror game delineates the boundaries of the game's design and functionality, including the extent of the interactive elements and environmental details. It also defines the specific immersive experiences and emotional impacts to be achieved, ensuring alignment with the project goals and technical constraints.

Scope

A VR horror game is crafted to showcase VR capabilities and its associated advantages, such as immersive experience and entertainment. One way of introducing VR technology to a wider audience is to develop VR games. Gaming is one of the biggest industries in the world that will allow VR to obtain a platform where it can showcase its endless possibilities to the world. Horror Games are some of the biggest games in the industry, as they allow players to become immersed in the environment. This makes the horror genre one of the best genres to showcase the capabilities of VR.

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Table 1. Literature survey reviews.

S.N.	Title	Author	Methodology	Advantages	Results
1	Virtual Reality Horror Games and Fear in Gaming (2023)	Tammy Jin-Hsuan Lin [1]	• Evolutionary mechanism • Excitation transfer theory and model of suspense • Three-factor model	• Immersion in VR • Audience experience • Valuable insights into human behavior and emotions • Interactive storytelling	• Deeper understanding of human behavior and media effects • Helps address various phobias.
2	Research on the Application of VR in Games (2023)	Shijie Bian [2]	• Application of VR in horror, role playing, and rhythmic games	• Strong sense of immersion • Realistic environments and gaming experience • Enhanced fun and entertainment	• Scope of VR • Future gaming experience • Evolution of VR in games
3	Research on the Progress of VR in Game (2023)	Ruiqi Zhang [3]	• Application in VR in Action Simulation, Education, Scenario experienced Games	• Enhanced gaming experience • Improved teaching • Enhanced Immersion	• Strong game immersion • Real-time human-machine interaction • Analysis of trends and characteristics.
4	Adaptive virtual reality horror games based on Machine learning and player modeling (2022)	Edirlei Soares de Lima, Bruno M.C. Silva, Gabriel Teixeira Galam [4]	• Conceptual framework development • Machine learning algorithms • Player modeling • Adaptive game design • Evaluation	• Personalized gaming experience • Enhanced immersion • Optimized gameplay • Improved player retention • Innovative game design	• Effectiveness of adaptive features • Impact on player behavior • Player satisfaction and retention • Performance metrics • User feedback and preferences
5	Analysis of the design aesthetics and player emotions of horror games (2022)	Ziwen Zhang [5]	• Qualitative research • Quantitative research • Biometric measures	• Triangulation enhances the validity and reliability of results. • Combining approaches increases accuracy, strength, and generalizability. • Corroborates and cross-validate results. Decreases biased interpretation	• Horror games evoke emotions such as fear and excitement. • The number of experienced players affects the players' comfort and overall mood. • Players' satisfaction with the game depends on factors such as a sense of achievement, excitement, and puzzle-solving.
6	Horror game design—what instills fear in the player? A study on the effects of horror game design theories and level design patterns on player behavior in a horror environment (2020)	T Årnell, N Stojanovic [6]	• Dark environments • Environmental design, sound design, lighting, and gameplay narrative • Auditory hallucinations, such as human screams	• Dark environments • Environmental design, sound design, lighting, and gameplay narrative • Auditory hallucinations, such as human screams	• Horror game design theories can be successful in scaring players when combined with level design and navigation patterns. Literature Survey, VR horror game using Unity.

S.N.	Title	Author	Methodology	Advantages	Results
7	Monstrous forms: Moving image horror across media (2019)	Hart, Adam Charles [7]	A tool to be used by aspiring horror game developers, to design more horrifying and immersive horror experiences by distributing the psychological aspects of fear into a spectrum of emotional components that could represent different states in a horror game	Provides methods and strategies to make the gaming experience immersive for the user	Results in the creation of enhanced, immersive, and interactive gaming experiences.
8	“Level of fear”: Analysis of fear spectrum into a tool to support horror game design for immersion and fear. (2018)	Konstantinos Ntokos [8]	- Level of Fear - Analyze Fear into Spectrum - Communication and Collaboration - Pacing and Relief Injections	- Tool for measuring fear in horror games - Help developers calibrate difficulty and scariness - Plot intensity levels throughout the game - Classifies in-game elements based on their “level of fear”	- Tools to measure and categorize fear in horror games. - Help developers calibrate difficulty and scariness. - Plots intensity levels of fear. - Marks fear levels of different game components.
9	So scary, yet so fun: The role of self-efficacy in the enjoyment of a virtual reality horror game. (2018)	Jih-Hsuan Tammy Lin, Dai-Yun Wu, and Chen-Chao Tao [9]	- Experimental Design - Measurement of Enjoyment - Quantitative and Qualitative Data Collection - Ethical Considerations	- Insights into Psychological Factors - Relevance to the VR Gaming Industry - Methodological Rigor - Practical Implications - Interdisciplinary Collaboration	- Positive correlation between self-efficacy and enjoyment. - Impact of self-efficacy on immersion. - Differences are based on experience. - Implications for game design.
10	Uncanny behavior in survival horror games (2010).	Angela Tinwell, Mark Grimshaw and Andrew Williams [10]	Participants were asked to rate thirteen video clips of twelve different virtual characters and one human	Characters rated as the least synchronized were perceived to be the most frightening	It indicates that attributes of motion and sound do exaggerate the uncanny phenomenon and how frightening that character is perceived to be.

Feasibility Study

A feasibility study of a VR horror game evaluates the practicality of the project by analyzing technical, financial, and operational aspects, as well as assessing user behavior and market demand. This ensures that the necessary resources, technology, and player engagement align with the project objectives and constraints.

Market Analysis

- Demographics
- Market demand
- Market trends
- Budget power

Technical Feasibility

- High computational power
- Rendering
- Power usage

Financial Feasibility

- Hardware cost
- Entry cost
- Spending power

Legal Considerations

- Copyrights

PROBLEM STATEMENT

Virtual reality (VR) is an emerging technology with the potential to revolutionize the way we interact with games and other experiences. However, VR is still a relatively new and expensive technology, and many people lack an understanding of how it works. This limits the application of VR technology and prevents it from becoming an integral part of our lives.

Developing a VR horror game involves addressing significant challenges, including accessibility and affordability concerns owing to the high cost of VR hardware and the niche market for VR gaming. In addition, technical constraints such as hardware limitations, performance optimization, and platform compatibility must be overcome to ensure a smooth and seamless gameplay experience. Balancing these factors is crucial for creating an inclusive and enjoyable VR horror game that appeals to a broad audience while promoting VR and delivering immersive and engaging gameplay.

One way of introducing VR technology to a wider audience is to develop VR games. Gaming is one of the biggest industries in the world that will allow VR to obtain a platform where it can showcase its endless possibilities to the world. Horror Games are some of the biggest games in the industry, as they allow players to become immersed in the environment. This makes the horror genre one of the best genres to showcase the capabilities of VR.

PROPOSED METHODOLOGY

Creating a VR horror game in Unity involves careful planning and step-by-step building. First, you must document the story, how the game works, and what players will do. Then, you keep trying different ideas and fixing any problems until the game feels just right. The Unity Game Engine is the main tool used to create the game, and it is important to create VR games because it supports several VR headsets. Additionally, we used C# for scripting gameplay mechanics, implementing AI behaviors, and integrating VR features. Technologies such as 3D modeling software for asset creation and audio engines for immersive sound design have also been utilized to enhance the horror atmosphere. By leveraging a combination of these methodologies, technologies, and programming languages, developers can craft a compelling and terrifying VR horror game that immerses players in a chilling experience.

PARAMETERS OF SEVERITY IN HORROR GAMES

1. *Environment*: The environment in which horror stories occur plays a significant role. Dark and eerie settings with limited visibility can increase fear.
2. *Sound design*: Eerie sounds, sudden noises, and unsettling music contribute to the overall atmosphere and intensify the feeling of dread.
3. *Visuals and graphics*: Realistic visuals, detailed character designs, and gruesome imagery evoke strong emotional responses from players or viewers.
4. *Narrative and storytelling*: A well-crafted storyline with suspenseful twists, unexpected events, and a sense of mystery can keep the audience engaged.

5. *Gameplay mechanics*: Interactions with the game world, such as jump scares, timed events, and survival mechanics, can increase intensity and adrenaline rush.

HARDWARE AND SOFTWARE REQUIREMENTS

Ensure optimal performance by meeting both hardware and software requirements: compatible devices, updated drivers, and the necessary software specifications (Table 2).

Hardware Requirements

- *Android device*: This serves as a platform for our VR game, leveraging its processing power and display capabilities to provide immersive experiences through compatibility.
- *Gyroscope*: A gyroscope enables precise motion tracking in VR horror games, enhancing immersion by accurately detecting head movements for a more realistic experience.
- *Gamepad controller*: The Gamepad controller is a handheld device that makes gaming easier and more fun with its buttons and joysticks and enhances player interaction in VR horror games, providing intuitive input for navigating environments and engaging with immersive gameplay mechanics.
- *VR headset*: The VR headset immerses players in the virtual world using the lenses attached to it and the screen of the Android device used by the user.

Software Requirements

- *Google Cardboard SDK*: Transforms your Android device into a VR headset, offering immersive experiences with stereoscopic rendering and head tracking.
- *Game Engine—Unity*: Unity serves as the ideal game engine for VR game development, providing powerful tools and capabilities for creating immersive and terrifying experiences.
- *Version Control System—GitHub*: This provides a user-friendly interface for managing code repositories on GitHub, facilitating collaboration and version control for Unity projects with ease.
- *Scripting Language—C#*: A powerful and versatile programming language used to build a wide range of software applications and systems.
- *IDE—Visual Studio*: A versatile integrated development environment (IDE) equipped with powerful tools for software development across multiple platforms.

PROJECT DESIGN

Project design includes game architecture and methodology, detailing the flow of gameplay, integration of game mechanics, and the interaction between hardware and software components. It maps how immersive elements and player interactions are orchestrated to deliver a seamless and engaging horror experience.

Game Architecture

The game architecture for a VR horror game integrates the game engine with rendering and audio systems to create immersive experiences by utilizing the VR headset for visual and sensory input. It also incorporates gyroscope sensors and gamepad controllers to ensure precise motion tracking and interactive gameplay (Figure 1).

Table 2. Hardware and software requirements.

Hardware	Software
Android device	Google Cardboard SDK
Gyroscope	Game Engine—Unity
Gamepad controller	Version control system—GitHub
VR headset	Scripting language—C#
	IDE—Visual Studio

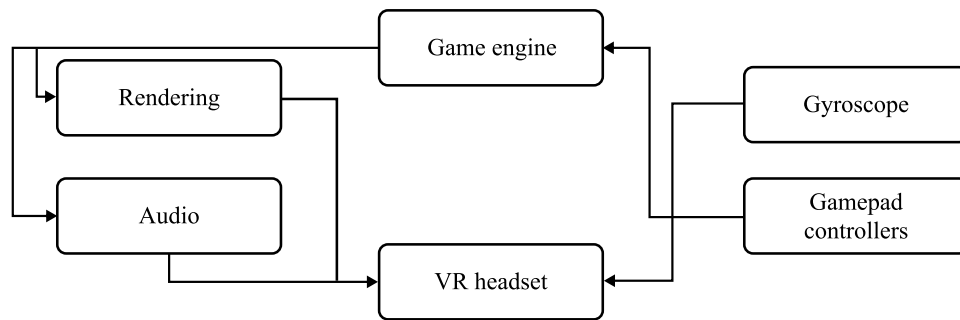


Figure 1. Game architecture.

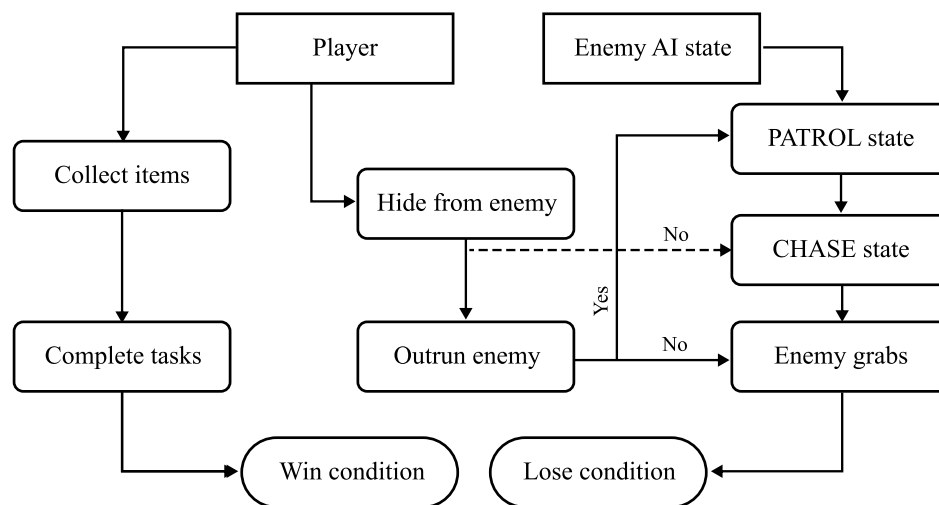


Figure 2. Game mechanism.

METHODOLOGY

The game is a survival horror experience, challenging players to complete all the quests to achieve victory (Figure 2).

1. *Object collection*: Players collect various items essential for completing tasks and progressing.
2. *AI enemies*: AI enemies relentlessly search for players, instilling a constant sense of terror.
3. *Google Cardboard SDK*: Integrates VR functionalities on Android devices, including stereoscopic rendering and head tracking.
4. *Gyroscope*: Utilizes sensor data to track players' head movements, enhancing immersion.
5. *Game manager*: The central hub oversees game elements, such as states, user interface (UI), input, events, logic, and win-loss conditions. It synchronizes the elements to ensure a cohesive player experience.
6. *Item spawner*: This algorithm enhances game replay ability by randomly spawning items from strategically positioned points across the map.
7. *Audio management*: Implements 3D spatial audio, ambient music, and eerie sounds for a heightened atmosphere.
8. *User interface*: VR-friendly UI elements provide essential information and enhance player interactions.
9. *Win condition*: Victory is achieved by completing all tasks and escaping pursuing enemies.
10. *Lose condition*: Failure occurs when players are caught by enemies, leading to a game over.

IMPLEMENTATION DETAILS

Implementation details refer to the specific technical and design elements required to bring the game to life, including how head tracking, item interactions, enemy AI, and environmental features are developed and integrated. These details ensure that all the components work seamlessly to deliver an immersive and engaging horror experience.

System Features

System features include head tracking for immersive player movements, item pickup and spawner systems for dynamic interactions, advanced enemy AI for challenging encounters, and a detailed game map for engaging exploration and navigation. These elements combine to create a compelling and interactive experience of horror.

Head Tracking

Head tracking in VR horror games on Android will be implemented using Google Cardboard SDK, which uses the device's built-in sensors, particularly a gyroscope. These sensors detect a user's head movements, including rotation and tilt. Unity's Android VR integration allows access to this sensor data and updates the position and orientation of the virtual camera accordingly (Figure 3).

Item Pickup and Spawner

The game uses ray casting for item pickup, which enables players to interact with virtual objects. When a player's VR camera focuses on an object, a ray is cast from the camera's position. If this ray intersects with an interactive object, players can trigger a pickup by pressing a button on their VR controller. Ray casting offers a natural and intuitive interaction method that enhances immersion and gameplay in a VR horror experience.

The game objects spawned at specified spawning points. The game engine randomly selects spawn points from the corresponding lists and instantiates objects based on the specified count, ensuring a varied and engaging gameplay experience. This approach adds randomness and unpredictability to the game world, thereby enhancing player exploration and interaction with objects throughout the game (Figure 4).

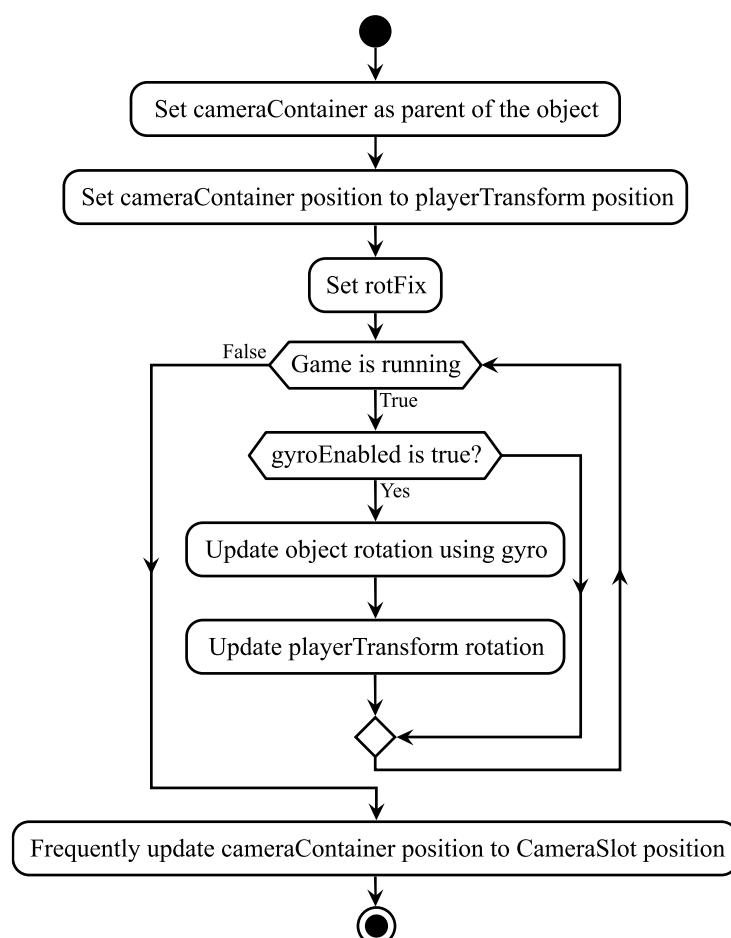


Figure 3. Gyroscopic head tracking flowchart.

Enemy AI

The enemy's AI is designed in various states, such as idle, patrol, chase, grab, and return to patrol. These states dynamically change based on player proximity and randomized movement algorithms, thereby creating suspenseful gameplay. To navigate the terrain, the enemy uses a mesh agent for smooth movement. The patrol radius gradually reduces over time, adding strategic depth to the enemy's movements and behavior (Figures 5–7).

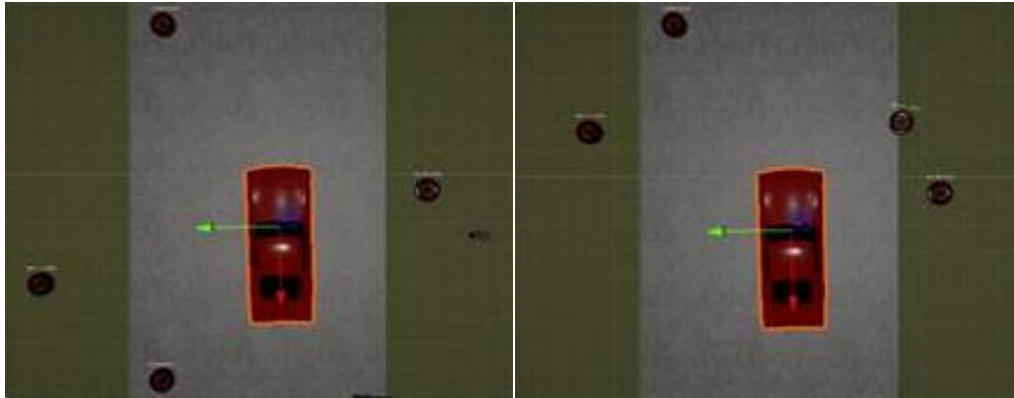


Figure 4. Random item spawner.

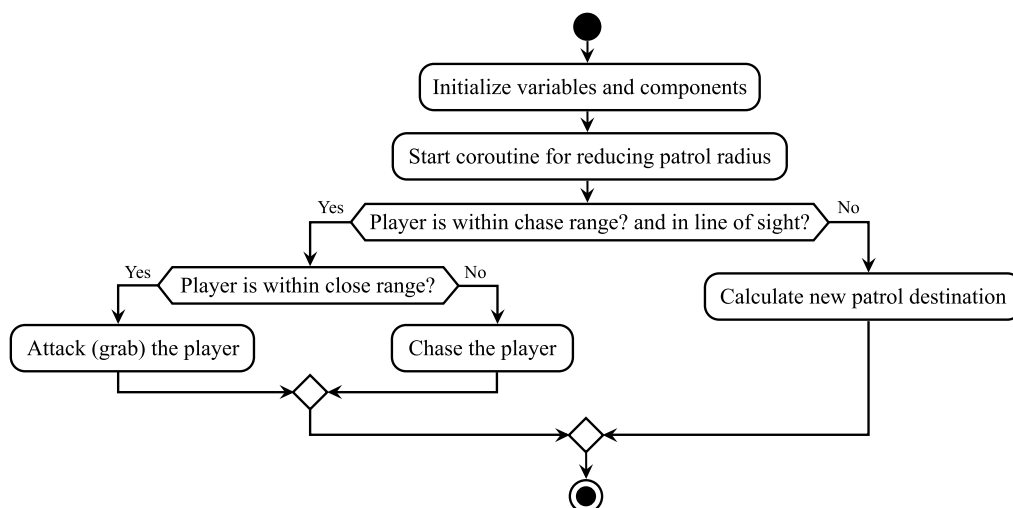


Figure 5. Enemy AI behavior flowchart.

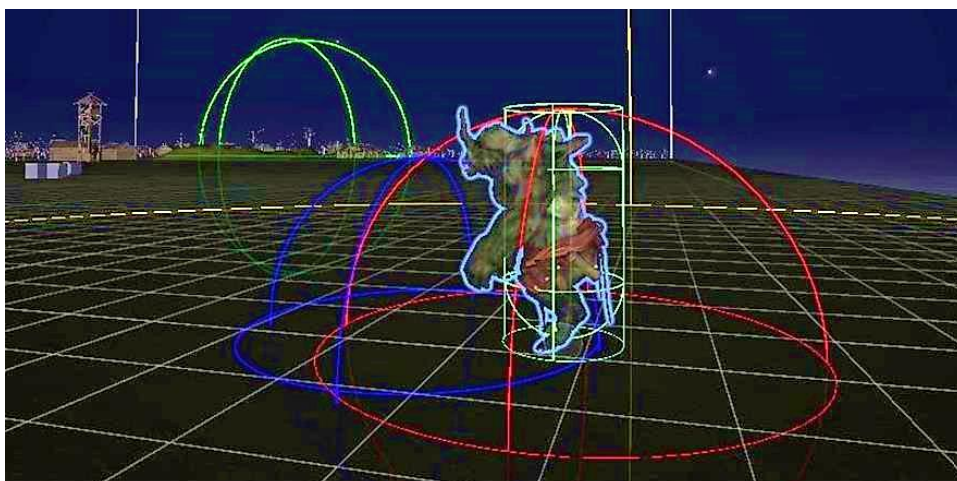


Figure 6. Enemy in PATROL state.

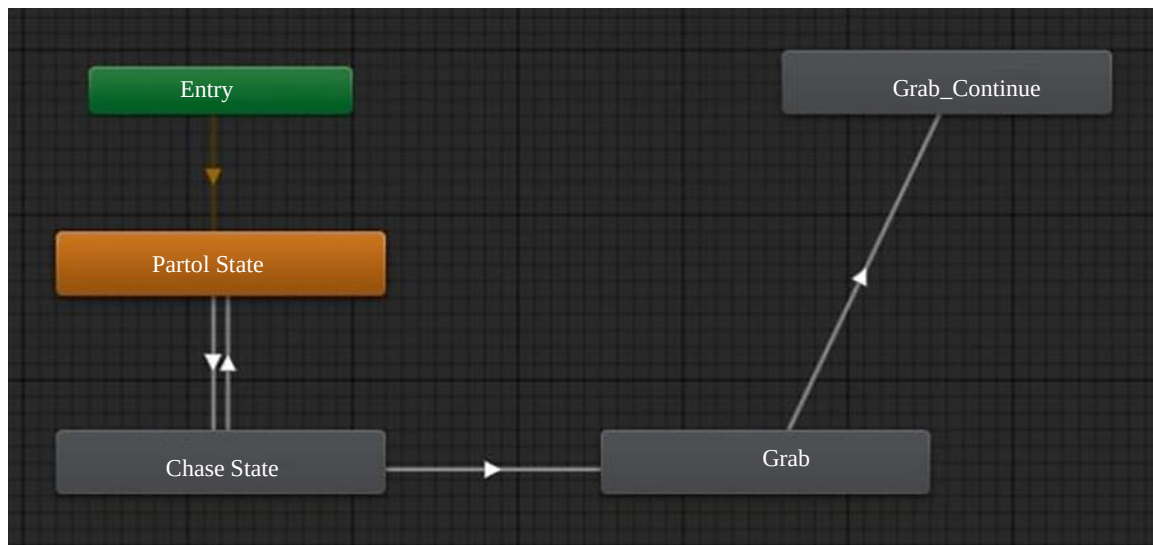


Figure 7. Enemy <Animator> Component

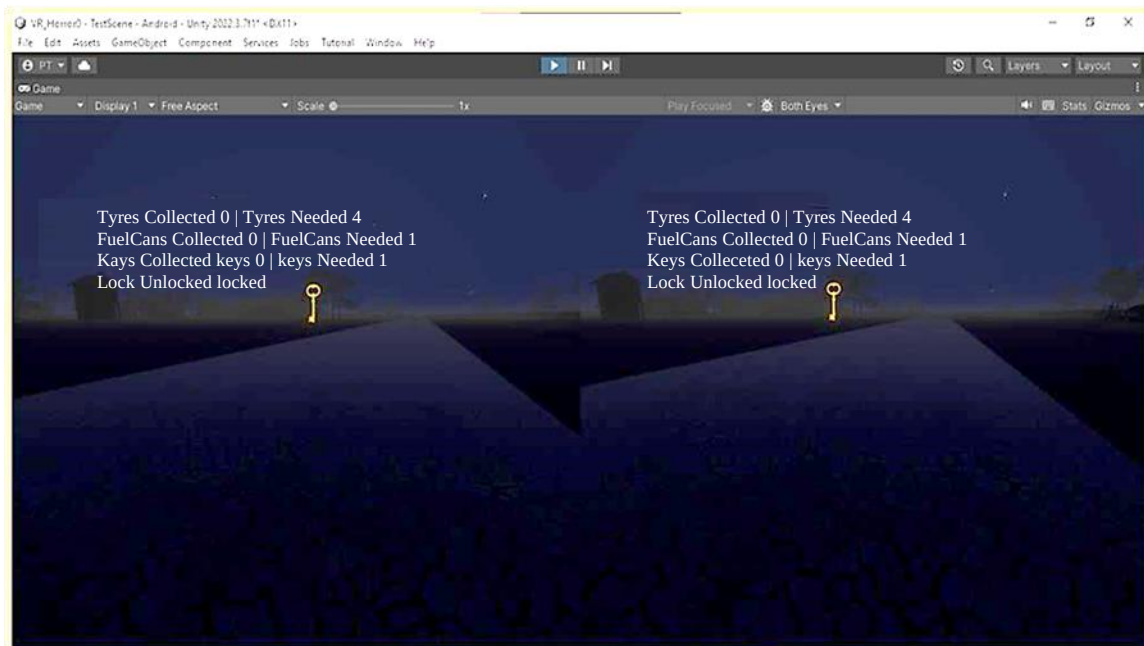


Figure 8. Stereoscopic game interface.

Game Map

Game maps play a crucial role, as they provide players with a structured environment to navigate and explore. Well-designed maps not only guide players through the game but also prevent confusion and aimless wandering. The map is crafted with diverse topographies, offering various challenges and opportunities. It includes strategically placed elements and eerie audio settings, creating an immersive atmosphere that enhances the overall gameplay experience (Figure 8).

CONCLUSION

Our VR horror game incorporates a holistic approach to gaming, seamlessly blending immersive environments with advanced technology while catering to traditional enthusiasm for consuming horror stories. It embodies a blend of past, present, and future elements, seamlessly integrating VR into everyday life. By adhering to VR rules and integrating cohesive features, our game sets a new standard for immersive entertainment.

Integration of advanced comfort settings and locomotion techniques, such as teleportation, snap turning, and field of view, to minimize motion sickness symptoms. Implementation of dynamic storytelling elements, nonlinear narratives, and branching paths to enhance player agency and immersion in VR horror environments. To address concerns about eye health due to prolonged VR headset use, future VR games may incorporate features such as regular breaks, adjustable display settings, and eye-tracking technology to mitigate potential risks and promote safe VR experiences.

Expanding multiplayer capabilities, future beginner VR horror games could introduce cooperative or competitive modes for shared immersive experiences. Additionally, offering downloadable content (DLC) can extend the longevity of gameplay with new levels, characters, or storylines. Optimization efforts will focus on enhancing performance across VR platforms for smoother and more immersive gameplay experiences.

Declaration of Interest

The authors, Shruti Swami Sabbani, Ritvik Mahendra Babre, Hitesh Ramesh Behera, Swapnil Jagdishprasad Yadav, and Ms. Punam Bagul declare that there is no conflict of interest regarding the publication of this manuscript.

Permission

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Abbreviation and Nomenclature

VR—virtual reality
DLC—downloadable content
AI—artificial intelligence
3D—three-dimensional
SDK—software development kit
IDE—integrated development environment

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