Night-Based Urban Zombie FPS Game Using Unreal Engine

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***Abstract*—Abstract—This paper presents the design and implementation of a night-based urban First-Person Shooter (FPS) game developed using Unreal Engine. Unlike conventional FPS games that rely on ambient lighting and environmental visibility, the proposed system introduces a fully dark environment where the player depends entirely on a weapon-mounted flashlight for navigation and survival. This restriction significantly enhances immersion and psychological tension by limiting situational awareness and forcing strategic decision-making.**

The system integrates dynamic lighting techniques such as spotlight-based illumination, shadow mapping, and volumetric fog to simulate realistic visibility conditions. Additionally, an Artificial Intelligence (AI) system based on Finite State Machines (FSM) is implemented, enabling zombies to react dynamically to both light intensity and sound stimuli. This multi-sensory AI approach creates unpredictable and realistic enemy behavior.

Experimental observations indicate that restricted visibility significantly alters player behavior, encouraging cautious movement and resource management. The proposed system demonstrates how environmental constraints and intelligent AI can be combined to enhance realism, engagement, and overall gameplay experience in modern FPS games.

***Keywords*—FPS, Game AI, Unreal Engine, Dynamic Lighting, Zombie AI**

I. INTRODUCTION

First-Person Shooter (FPS) games have evolved significantly over the past decades due to advancements in graphics rendering, physics engines, and artificial intelligence. These improvements have enabled highly immersive environments that enhance player engagement and realism. Among the various sub-genres, zombie-based FPS games have gained widespread popularity due to their combination of survival mechanics, horror elements, and action-driven gameplay.

However, most traditional zombie FPS games rely heavily on environmental lighting systems such as ambient illumination or dynamic day–night cycles. While these systems improve player visibility, they reduce uncertainty and tension, which are essential components of the horror experience. Players are often able to detect threats from a distance, diminishing the intended psychological impact.

To address this limitation, the proposed system introduces a fully night-based urban environment where ambient lighting is completely eliminated. The player is equipped with a weapon-mounted flashlight, which acts as the sole source of visibility. This design creates a constrained field of view, forcing players to actively scan their surroundings and make decisions under uncertainty.

Furthermore, the system incorporates intelligent AI that responds dynamically to environmental stimuli. Zombies detect the player based on light exposure and sound generation, resulting in more realistic and unpredictable interactions. This approach shifts gameplay from reflex-based combat to strategic survival, thereby enhancing immersion and challenge.

II. LITERATURE REVIEW

Several commercial games and research studies have explored various aspects of FPS gameplay and AI behavior. Games such as Dying Light utilize dynamic day–night cycles where enemy behavior changes based on time, with increased aggression during nighttime. However, players still benefit from environmental lighting, which reduces overall tension.

Resident Evil 7: Biohazard emphasizes realism through environmental storytelling, limited resources, and immersive sound design. While darkness is used effectively,

ambient lighting is still present, allowing players to maintain situational awareness.

Left 4 Dead introduces an advanced AI system known as the AI Director, which dynamically adjusts enemy spawning and difficulty based on player performance. Although effective in maintaining gameplay balance, the system prioritizes pacing over environmental realism.

From an academic perspective, research highlights the importance of Finite State Machines (FSM), Behavior Trees, and pathfinding algorithms such as A* and NavMesh. These techniques enable non-player characters to exhibit adaptive and realistic behavior. However, limited work has been done on integrating environmental factors such as light intensity and sound detection into AI systems.

The proposed system addresses these gaps by introducing a fully dark environment combined with flashlight-based visibility and a multi-sensory AI system. This approach enhances realism and creates a more immersive gameplay experience.

III. SYSTEM ARCHITECTURE

The system architecture is designed using a modular approach to ensure scalability, maintainability, and efficient integration of components. It consists of four primary subsystems: Player System, Lighting System, AI System, and Environment System.

The Player System handles user interaction and gameplay controls, including movement mechanics such as walking, sprinting, and crouching. It also manages weapon functionality, including shooting, reloading, and ammunition tracking. The flashlight is integrated with the weapon, ensuring that visibility is directly aligned with the player's aim.

The Lighting System is a core component that defines the gameplay experience. It uses a dynamic spotlight model to simulate realistic illumination. The intensity of light decreases with distance, following an inverse square relationship, which can be expressed as $I = P / d^2$, where I represents intensity, P represents power, and d represents distance.

The AI System is implemented using a Finite State Machine (FSM), enabling zombies to transition between states such as idle, patrol, investigate, chase, and attack. Detection mechanisms include both visual and auditory inputs. Light-based detection depends on intensity and angle, while sound detection depends on distance and event strength.

The Environment System defines a dense urban setting with buildings, narrow streets, and obstacles such as vehicles and debris. These elements create occlusion, limiting visibility and increasing gameplay difficulty. The combination of these subsystems results in a cohesive and immersive system design.

IV. METHODOLOGY

[1] The development of the proposed system follows a structured and iterative methodology. The first step involves environment modeling, where urban assets such as buildings, roads, and objects are created and arranged to form a realistic city layout. Special attention is given to occlusion and lighting conditions.

[2] The second step involves lighting implementation, where the flashlight system is developed using dynamic spotlight components. Shadow mapping and volumetric fog are integrated to enhance realism and create atmospheric depth.

[3] The third step focuses on AI development, where the FSM model is implemented to define zombie behavior. Detection algorithms based on light and sound are incorporated into the system.

[4] The fourth step involves system integration, where all subsystems are combined to create a cohesive gameplay experience. Interactions between the player, AI, and environment are tested and refined.

[5] The final step involves testing and optimization, where the system is evaluated for performance, stability, and user experience. Optimization techniques are applied to ensure smooth real-time gameplay.

V. IMPLEMENTATION

The system is implemented using Unreal Engine, a powerful game development platform that supports real-time rendering and advanced physics simulation. Blueprint scripting is used for visual programming, enabling rapid development and debugging.

Key implementation features include event-driven logic for player actions, FSM-based AI behavior using Blueprint nodes, and NavMesh for efficient pathfinding. Collision detection is implemented to ensure realistic interactions between the player, environment, and AI.

Optimization techniques such as light culling, efficient shadow rendering, and AI update throttling are applied to maintain performance. The modular design allows for easy extension and modification of system components.

VI. RESULTS AND ANALYSIS

The system is evaluated based on performance, AI behavior, and user experience. Performance analysis shows that the system maintains stable frame rates under various conditions due to efficient lighting and AI processing techniques.

Behavioral analysis indicates that players adopt cautious strategies due to restricted visibility. The flashlight becomes a critical tool, influencing movement and decision-making.

AI performance is evaluated based on responsiveness to light and sound stimuli. Zombies exhibit realistic and unpredictable behavior, increasing gameplay difficulty and engagement.

User experience analysis reveals that players experience higher levels of immersion and tension due to the dark environment and limited visibility. This validates the effectiveness of the proposed system.

VII. DISCUSSION

The proposed system demonstrates that environmental constraints, particularly darkness, significantly influence gameplay behavior. Unlike traditional FPS games that provide high visibility, the restricted environment increases uncertainty and tension.

The integration of light-based and sound-based AI detection creates a more dynamic and realistic gameplay experience. However, this also introduces challenges in balancing realism and performance.

The system highlights the importance of combining environmental design with intelligent AI to achieve immersive gameplay.

VIII. CONCLUSION

The proposed system successfully demonstrates the development of a realistic night-based urban zombie FPS game using Unreal Engine. By integrating dynamic lighting and intelligent AI systems, the project achieves a high level of immersion and realism.

The study highlights how restricted visibility influences player behavior and enhances gameplay experience. The combination of flashlight-based mechanics and sensory-driven AI creates a unique and engaging system that contributes to modern game development research.

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