PUSL3190 Computing Individual Project

PROJECT INITIATION DOCUMENT

Smart enemy AI for video games

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Contents

Chapter 1: Introduction

The journey begins with a personal exploration into the realm of online multiplayer gaming, dating back to 2009, when the allure of virtual worlds first captivated the imagination. Over the years, a deep dive into legendary titles like Call of Duty, Special Force 2, and numerous competitive gaming competitions has not only honed gaming skills but also unveiled a critical realization – the heart of the online gaming experience lies in the unpredictable and strategic nature of human-controlled adversaries.

As a passionate gamer and aspiring game developer, the recognition of a void in the traditional gaming experience emerged. Offline games, despite their compelling narratives and diverse environments, lacked the dynamic and competitive edge that online multiplayer games inherently possess. The challenge became clear – how to infuse the offline gaming experience with the strategic complexity and adaptability of human-controlled opponents.

The motivation behind this project is to develop a gaming environment that transcends the conventional limitations of offline games. Using the cutting-edge Unreal Engine 5, the goal is to create an immersive gaming experience where players encounter adversaries boasting the intelligence, adaptability, and skill sets reminiscent of human players in the online multiplayer realm.

Chapter 2: Business case

Technology is always updating every seconds. AI is the most common technology in these days. Using AI, we can make anything including video game industry.

Chapter 2.1: Business needs

- AI Development Milestones.
- Immersive Environment Creation.
- Player-Adversary Interaction.
- Testing and Iteration.
- Competitive Edge in Offline Gaming.
- Community Engagement and Marketing.
- Technical Optimization.
- Monetization Strategy.

Chapter 2.2: Business objectives

- AI Development Milestones:
    - Achieve AI development milestones within defined timelines.
    - Implement a learning algorithm for in-game adversaries.
    - Attain a benchmark level of adaptability in AI behaviors.

    - Demonstrate AI opponents' ability to simulate human decision-making processes.
- AI Development Milestones:
    - Achieve AI development milestones within defined timelines.
    - Implement a learning algorithm for in-game adversaries.
    - Attain a benchmark level of adaptability in AI behaviors.
    - Demonstrate AI opponents' ability to simulate human decision-making processes.
- Player-Adversary Interaction:
    - Enhance player experience through realistic interactions with AI-controlled adversaries.
    - Implement dynamic responses from AI based on player actions.
    - Create a diverse set of challenges requiring strategic thinking and adaptability.
    - Achieve a balance between difficulty levels to cater to a broad player audience.
- Technical Optimization:
    - Ensure optimal performance across various gaming platforms.
    - Optimize game performance for a range of hardware specifications.
    - Conduct thorough testing on different devices to identify and address compatibility issues.
    - Provide regular updates to address technical concerns and improve overall gameplay.

- Monetization Strategy:
    - Develop a sustainable monetization strategy for the game.
    - Implement fair and enticing in-game purchases or subscription models.
    - Monitor and adjust monetization strategies based on player feedback and market trends.
    - Achieve a balance between revenue generation and maintaining a positive player experience.

Chapter 3: Project objectives

- AI Development Milestones
    - Objective: Complete the implementation of the learning algorithm for in-game adversaries.
    - Measurable Outcome: Achieve an 80% accuracy rate in simulating human decision-making processes.
- Immersive Environment Creation:
    - Objective: Design and implement three visually stunning game environments.
    - Measurable Outcome: Conduct player surveys, with a minimum 90% positive rating on the visual appeal of environments.
- Player-Adversary Interaction:
    - Objective: Implement dynamic responses from AI based on player actions.

    - Measurable Outcome: Achieve a 75% player satisfaction rating for the realism of AI interactions.
- Testing and Iteration:
    - Address 95% of reported bugs and glitches during the beta testing phase.
    - Measurable Outcome: Achieve a 90% positive rating from beta testers regarding the overall gameplay experience.
- Technical Optimization:
    - Objective: Achieve a minimum of 30 frames per second (fps) on devices with varied specifications.
    - Measurable Outcome: Conduct successful testing on at least five different hardware configurations.

Chapter 4: Literature review

Font's work in "Genes of War" (2012) stands as a pioneering contribution to the realm of evolutionary game development. The introduction of a grammar-guided genetic program marked a paradigm shift in how game environments evolve. By implementing this novel approach, the study aimed to create a dynamic system where the adaptability of enemy AI patterns becomes intricately tied to player performance. Notably, the study delved into the intricate task of dynamically adjusting challenge levels based on the player's skill and engagement, presenting a groundbreaking concept for the gaming industry.

One of the key highlights of Font's work was the focus on enhancing player satisfaction. By allowing the AI patterns to adapt in real-time, the gaming experience became not just challenging but uniquely tailored to individual players. The demonstration of promising results underscored the viability of this approach, positioning it as a potential game-changer in the ongoing pursuit of creating immersive and player-centric game environments.

In essence, "Genes of War" laid the groundwork for a new era in game development, where adaptability and dynamic challenge levels become integral components of player engagement and satisfaction. The study provided a tangible framework for infusing games with an ever-evolving intelligence, marking a critical step towards more personalized and captivating gaming experiences. (Font, 2012)

Kristo Radion Purba's research in "Optimizing Action RPG Game Difficulty" (2016) ventured into the intricacies of enhancing enemy AI strategy within the realm of Action RPG games. The study not only explored but introduced an innovative approach, challenging the conventional norms of AI behavior. By leveraging advanced techniques such as K-Means Clustering and Fuzzy Logic, Purba sought to revolutionize the grouping of enemy units and the determination of their behavior.

The emphasis on creating more sophisticated AI tactics highlighted the ambition to transcend traditional gaming AI limitations. The application of K-Means Clustering provided a nuanced classification system for grouping enemy units based on attributes and coordinates, while Fuzzy Logic introduced a dynamic and responsive layer to AI behavior determination. This approach aimed to elevate the cooperative and reactive abilities of in-game characters, ultimately contributing to the broader field of game artificial intelligence.

Purba's work in "Optimizing Action RPG Game Difficulty" not only presented a novel methodology for enhancing AI strategy but also opened doors to a more nuanced

understanding of the potential applications of clustering and fuzzy logic in the context of gaming. This research not only promised to make enemies within games trickier but also hinted at the broader implications for advancing the sophistication of AI in gaming environments.(Purba, 2016)

3. Additional References:

- (Lim, 2022)
- (Schrier *et al.,* 2008)
- (Spronck, Sprinkhuizen-Kuyper and Postma, no date)

Chapter 5: Method to approach

Before embarking on the project, a crucial preliminary step involves acquiring a comprehensive understanding of Unreal Engine 5. Recognizing that game development is a nuanced and intricate process, distinct from conventional software development, underscores the necessity for a thorough grasp of this powerful game development engine. Indie game development, in many ways, mirrors the creative process of world creation, where every aspect, from coding the player's interactions to crafting immersive soundscapes, intricate 3D modeling, and meticulously designing diverse gaming environments, contributes to the overall gaming experience. The complexity of this task necessitates a profound knowledge of Unreal Engine 5's functionalities.

To delve into the intricacies of game development akin to crafting a virtual universe, a profound exploration into Unreal Engine 5 is indispensable. This encompasses not only grasping the fundamental principles of how the engine operates but also delving into its myriad features, tools, and capabilities. The learning journey extends beyond the superficial aspects of the engine, encompassing a deep dive into its application in creating dynamic and captivating gaming experiences.

Moreover, post-acquiring a comprehensive understanding of Unreal Engine 5, the focus shifts to unraveling the intricacies of UE5's Artificial Intelligence (AI) capabilities. Learning how UE5 AI operates is pivotal for infusing the game with adaptive and intelligent elements, ensuring that the adversaries within the gaming environment possess a human-like responsiveness and adaptability. This phase of the learning process involves understanding the algorithms, functionalities, and best practices for implementing AI in Unreal Engine 5, laying the foundation for the subsequent development of sophisticated and engaging AI patterns within the game.

In essence, the preparatory phase of learning Unreal Engine 5 and delving into the intricacies of UE5 AI is akin to honing the skills required for a masterful orchestration of the gaming development process. It serves as the scaffolding for the creative journey ahead, equipping the developer with the tools and knowledge necessary to bring the envisioned gaming experience to life. This immersive learning experience sets the stage for a more informed and adept approach to the subsequent stages of the project, ensuring a robust and well-informed foundation for the development of an innovative and captivating game environment.

Upon completing an in-depth study of the requisite knowledge and skills, the next pivotal phase involves the practical implementation of Artificial Intelligence (AI) within the game development process. This crucial step marks the transition from theoretical understanding to hands-on application, where the insights gained from study sessions are translated into

tangible elements that will define the gaming experience. Implementing AI is akin to infusing the game with a dynamic and responsive intelligence, creating a virtual ecosystem where adversaries evolve and adapt based on player interactions.

The implementation of AI is a multifaceted endeavor that demands a synthesis of programming expertise and creative ingenuity. Crafting algorithms that not only simulate human-like decision-making but also dynamically adjust challenge levels based on player performance is a testament to the intricate nature of this process. This stage involves fine-tuning parameters, testing various scenarios, and ensuring that the adaptive AI seamlessly integrates into the fabric of the game, contributing to an engaging and unpredictable gameplay experience.

Post-implementation of AI, the focus broadens to encompass other crucial elements that collectively shape the immersive gaming environment. Sound effects, often an underestimated yet profoundly impactful aspect of gaming, come into play. Crafting an auditory landscape that complements the game's narrative and enhances player engagement requires meticulous attention to detail. From ambient sounds that set the mood to dynamic sound effects synchronized with in-game events, the audio elements contribute significantly to the overall sensory experience.

Simultaneously, the intricate art of environment design unfolds. This involves creating visually captivating and contextually relevant game settings that not only serve as backdrops but actively contribute to the narrative. Leveraging the creative potential of tools like Unreal Engine 5, the environment design phase breathes life into the virtual world. Attention is given to details such as lighting, textures, and spatial layout, all of which play pivotal roles in creating a visually stunning and immersive gaming experience.

The seamless integration of these components—adaptive AI, captivating sound effects, and meticulously designed environments—culminates in the creation of a holistic gaming experience. This iterative process often involves testing, refinement, and collaboration within the development team to ensure coherence and excellence in every facet. As each element harmonizes with the others, the game begins to take shape, transforming from a conceptual idea into a fully-fledged, dynamic, and engaging virtual reality.

In essence, the implementation of AI and the subsequent refinement of sound effects and environment design represent the synthesis of creativity and technical prowess. It is a transformative journey where theoretical knowledge is translated into a tangible, interactive, and captivating gaming experience, providing players with an immersive journey into the realms of the created virtual world.

Chapter 6: Initial project plan

Stage	Deadline	Deliverable
Proposal submission	21/11/2023	Get the supervisor meetings and confirm the project idea.
PID submission	10/12/2023	Get the first 3 supervisor meetings and submit the Project initiation document
Interim I submission	Not mentioned	Interim report I
Interim II submission	Not mentioned	Interim report II
Final submission	21/04/2024	Final product and the report
Defense	21/04/2024 onwards	Demonstration

Chapter 7: Risk analysis

1. Technical challenges
    a. In the Unreal Engine 5 is required a more performance. In the project was expanding the during the development time so hard to run sometimes. so, using version control manage that.
2. Learning Curve for Unreal Engine 5
    a. Acquiring proficiency in Unreal Engine 5 may take time, leading to potential delays in project timelines.
3. Integration and Compatibility Issues
    a. Integrating various elements like AI, sound effects, and environment design may lead to compatibility issues within Unreal Engine 5.

Reference

1. Font, J.M. (2012) 'Evolving third-person shooter enemies to optimize player satisfaction in real-time', in *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, pp. 204–213. Available at: https://doi.org/10.1007/978-3-642-29178-4_21.
2. Lim, W.S. (2022) *MIMICKING HUMAN-LIKE BATTLE BEHAVIOR OF ENEMIES IN A GAME A Project*.
3. Purba, K.R. (2016) 'Optimization of ai tactic in action-RPG game', in *Lecture Notes in Electrical Engineering*. Springer Verlag, pp. 131–137. Available at: https://doi.org/10.1007/978-981-287-988-2_14.
4. Schrier, Karen. *et al.* (2008) *Proceedings, Sandbox Symposium 2008 : 3rd ACM SIGGRAPH videogame symposium, Los Angeles, California, August 9-10, 2008*. Association for Computing Machinery.
5. Spronck, P., Sprinkhuizen-Kuyper, I. and Postma, E. (no date) *ONLINE ADAPTATION OF GAME OPPONENT AI IN SIMULATION AND IN PRACTICE*.