

ARCHIGENIUS - VR MAZE SOLVING USING A* ALGORIHTM

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Abstract - Game is one of the entertainment media that is rapidly growing. On this day, playing games is one way to spare time for refreshing. One of the popular games this year is an action game such as First-Person Shooter (FPS). Besides, the FPS game genre has developed rapidly to make it more interesting for the player. Non-player Character (NPC) has an essential function in artificially and automatically to make a game more immersive and consisting of various kinds. Also, from observation, adding challenges when playing, namely enemy characters, can make a player more enjoyable. Besides, one of modern technology to develop innovations for supporting a game is called virtual reality. So, in this research, the FPS game is built by adding NPC elements with virtual reality technology. Also, the gameplay in this game is a survival maze. Based on the evaluation, this game application can display objects in a virtual reality smoothly, and all feature in this game can display and run effectively. Besides, the respondents also give good feedback for user testing which has average score 4.66 from several users. So, the conclusion from this research is this game can make the FPS game more interesting for users by adding NPC, 3D element, and virtual reality.

Keywords - First-person Game, Virtual Reality, Survival Maze, Non-Player Character, virtual maze environment.

1. INTRODUCTION

Game is one of the entertainment media that is rapidly growing for now, and playing games is one way to fill spare time. Until now, there are so many types and genres of games that are circulating in various market places. Some of these types of games include action games, casual games, racing games, and other games such as serious games. Besides that, the game has both technologically and in methods development such as the existence of artificial intelligence, text mining, natural language, and virtual reality. As well as games also have several target users such as educational games that have targets for students and simulation games that are commonly played by educators. Furthermore, games that have so far developed include the first-person shooter genre game.

Game builder features are always improving so can attract more attention and make players/gamers more comfortable playing, including developing Non-Player Character (NPC) features. NPC has an essential function in artificially the game world so that it is more immersive, consisting of various kinds, one of which significantly adds to the challenges when playing, namely enemy characters. Besides, currently developing innovations supporting a game, especially for games on computers and mobile devices, one of which is a technology called virtual reality.

Survival Maze is a game which player has to survive in labyrinth level. This game is an FPS innovation that will be designed based on the Virtual Reality of Android Devices. As with other virtual reality applications, this game will use a first-person perspective, plus there are enemy characters so that the game is more exciting and challenging for players. Enemy characters will be built in this game with the Finite State Machine (FSM) method in making their behaviour.

The innovation that will be the focus of the submission of this research is new gameplay in the maze puzzle game like previous research that is usually 2D to FPS 3D using virtual reality for Android devices and the implementation of the behaviour of enemy characters using FSM. Players will explore the maze map by surviving from enemies who will attack when the player gets closer to the enemy. This gameplay innovation will expect to become a new experience, making players not quickly feel bored or bored playing the maze game. Also, with this application, it is assumed to have a positive impact on game development, so there are various other innovations in the field of gaming so that it gives more choices for players.

2. LITERATURE REVIEW

- A. In the article titled "**Virtual Reality Maze: Multiplayer Game for Android Smartphone**", In this article, a VR maze game that can provide a player with better user experience while playing game using a VR headset and a smartphone was developed. But not all people can afford to buy the best VR equipment such as HTC Vive, Oculus Rift and PlayStation VR.
- B. **Development of First-Person Shooter Game with Survival Maze Based on Virtual Reality:** In this article, a First Person Shooter (FPS) game is built by adding non-player characters (NPC) elements with virtual reality technology, and the gameplay in this game is a survival maze.
- C. **VR Survival Runner: Aplikasi Exergaming Survival berbasis Virtual Reality:** The result of this research is VR Survival Runner, an android game that allows the player to run, jump, to avoid zombies that are chasing the player, and also this game has a feature of counting the estimated burned calories while playing the games.

D. MuVR: A Multiuser Virtual Reality Framework for Unity. In this article, a framework for mixed interactions based on a novel method of ensuring that inputs, visuals, and networking can all communicate without needing to understand the others' internals is presented.

E. A Glance into Virtual Reality Development Using Unity: The main purpose of this paper was to identify which VR game engine a beginner should be using for their first project and it is concluded that the most suitable game engine in this case is Unity.

F. Building Virtual Reality with Unity and Steam VR : Building Virtual Reality with Unity and SteamVR as discussed by the authors is a survival guide to VR and VR development for any reader, which explores some of the topical issues surrounding virtual reality; including V.R. sickness, telepresence, performance issues and practical ways to diminish these detrimental effects to make a more comprehensive experience.

G. Developing virtual reality applications with Unity: This tutorial will provide an introduction to Unity and several VR components that are designed to work with Unity and will have enough knowledge to start building VR applications using Unity by the end of the tutorial.

3. PROPOSED METHOD

1. **Conceptualization and Design:**

Define the core concept of game: What sets it apart from other FPS games? What is the player's objective? Design the maze layout with a focus on strategic elements, cover points, and areas for combat encounters.

Determine the survival mechanics: Will players need to scavenge for resources, manage health and ammunition, and fend off enemies?

2. **Setting Up Unity:**

Download and install Unity along with the necessary VR development tools (such as Oculus Integration or SteamVR Plugin).

Set up project with the appropriate VR settings and platform compatibility.

3. **Creating the Maze Environment:**

Utilize Unity's terrain tools or 3D modeling software to design the maze environment, ensuring varied terrain and obstacles for tactical gameplay.

Implement textures, lighting, and atmospheric effects to enhance immersion and set the tone for the game.

Add interactive elements like doors, switches, and traps to create dynamic gameplay situations.

4. **Player Mechanics:**

Implement first-person shooter controls optimized for VR, including aiming, shooting, reloading, and weapon switching.

Integrate VR-specific features like hand tracking or motion controllers for realistic weapon handling and interaction.

Develop systems for health management, ammunition conservation, and inventory management to enhance the survival aspect of the game.

5. **Enemy AI:**

Create AI behavior for enemies, including navigation, combat tactics, and interaction with the environment. Design different types of enemies with unique abilities and weaknesses to provide varied challenges for the player.

Implement spawn systems and wave-based encounters to keep the gameplay dynamic and unpredictable.

6. **Testing and Iteration:**

Conduct thorough playtesting to identify bugs, balance issues, and areas for improvement.

Gather feedback from testers and iterate on the game design, level layout, and AI behavior to enhance the overall experience.

Optimize the game for performance, ensuring smooth gameplay and minimal motion sickness in VR.

7. **Polish and Finalization:**

Add sound effects, background music, and voiceovers to enhance immersion and create atmosphere.

Polish visuals, including animations, particle effects, and environmental details, to create a visually stunning VR experience.

Implement a progression system, achievements, or leaderboard to encourage replay ability and competition among players.

4. SYSTEM DESIGN

4.1 System Analysis

This application is built with unity technology so that users can run it on Android devices, which has supported with a gyroscope sensor. This application will create using unity and c# application for creating 3D and Unity objects because both of these applications have provided features that support 3D objects for virtual reality. This application applies virtual reality, so it expects that users can see and feel the real playing experience, of course, coupled with features such as the FPS game that is the presence of an NPC (in this case, the enemy) so that in exploring the maze feels more challenging.

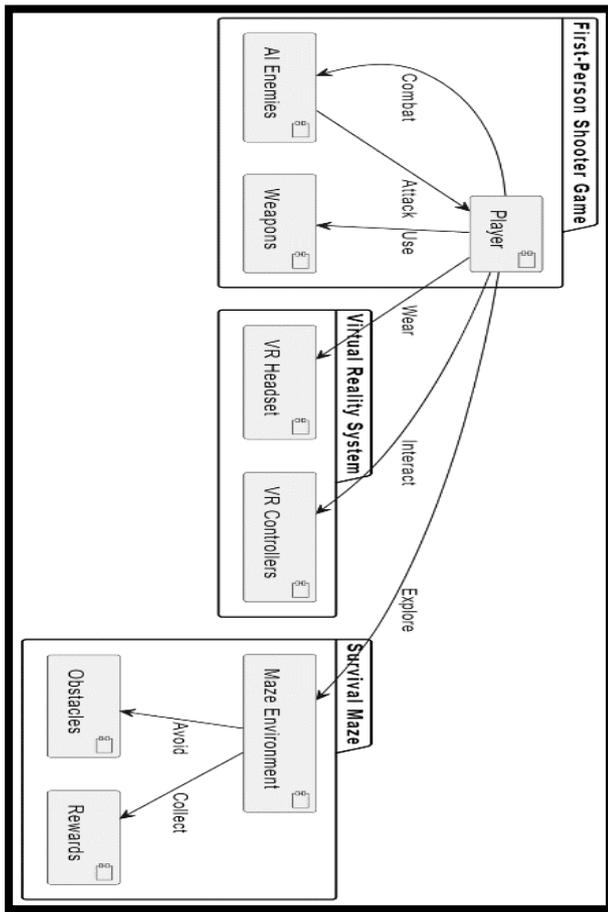


Fig.1: Block Diagram of VR MAZE SOLVING USING A* ALGORITHM

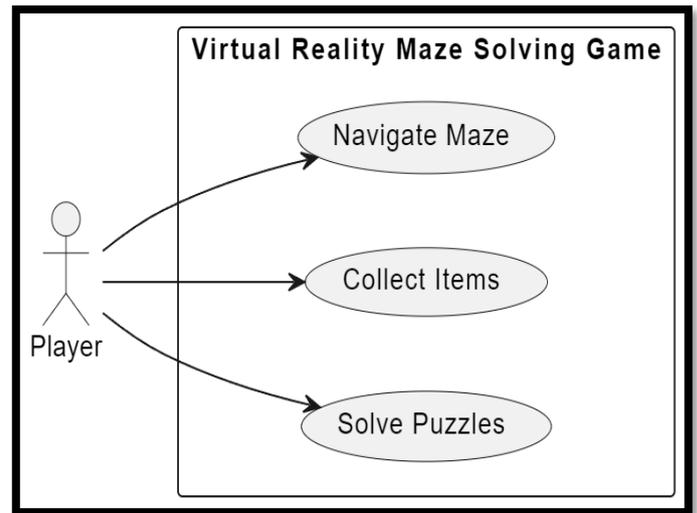


Fig. 2: Use Case of VR MAZE SOLVING USING A* ALGORITHM

1. System architecture

The image describes a First-Person Shooter Game where a player, using a VR headset and VR controllers, navigates through a maze environment. The player's objectives are to avoid enemies and obstacles while collecting rewards. Fig.1: Block Diagram of VR MAZE SOLVING USING A* ALGORITHM

4.2 Use Case Design

In a VR maze solving game, the player uses a VR headset to navigate a maze and collect items to solve puzzles. The game likely requires the player to use their imagination and creativity to progress through the maze

4.3 Design Process

In general, the process flow in this game is only one. The user will open the game and enter the main menu, and then there will be a branching whether the user will start the game or open a tutorial or exit the game. If the user chooses to start the game, the game will start and will return to the main menu if the player chooses the menu again while playing. If the user selects the tutorial menu, then the user will go to the tutorial page and will return to the main menu if the player chooses the menu again while on the tutorial page. If the user chooses to leave while in the main menu, then the game will be closed.

4.4 User Interface Design

This application will build in normal mode and First Person Camera (FPS) mode, so the interface design of this application only amounts to one blank screen that will be filled by objects. The displayed object will fill according to each scene. Besides, the display is also added to the stereoscopic appearance to deepen the visual. The design of this application interface can see in several figure especially for model design.

4.5 Implementation Design

The application of this study was built using a Game Engine called Unity with the C # programming language. In its development, an oculus and google cardboard is also needed to adjust the environment to be built. The assets needed are also made with 3D dimensions to make the game more interesting and realistic. In addition, this research was developed on a computer with a high enough spec so that rendering results can be faster.

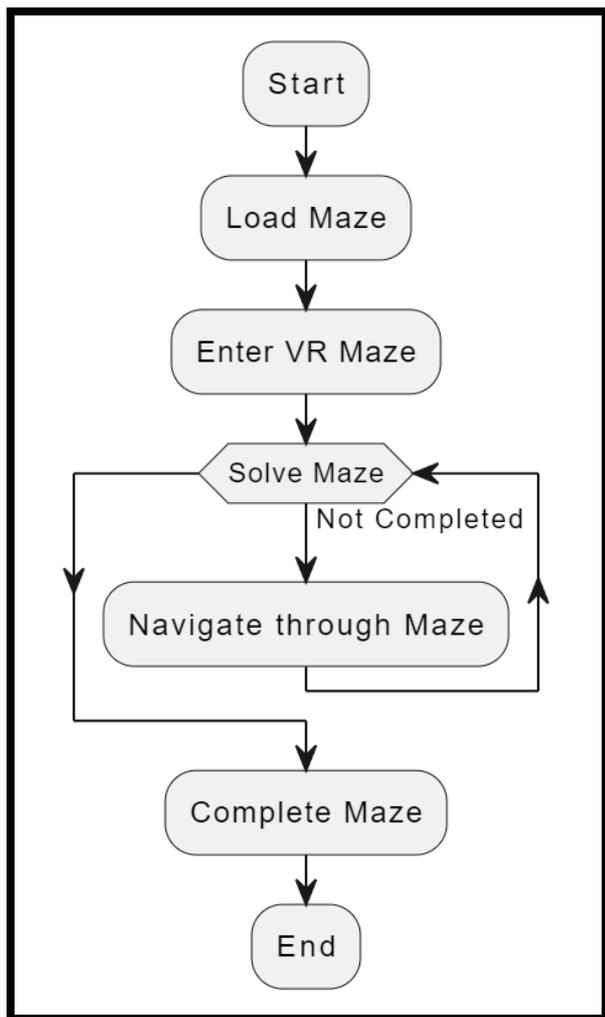


Fig.3: Flowchart of VR MAZE SOLVING USING A* ALGORITHM

5. COMPONENT OF SYSTEM

1. **Meta Oculus Quest:** Meta Quest (formerly Oculus Quest) is a family of all-in-one virtual reality headsets developed by Meta Platforms. Meta Quest headsets are standalone devices that do not require a PC or console to operate. They are powered by the Qualcomm Snapdragon XR2 platform and feature high-resolution displays, spatial audio, and hand tracking. Meta Quest headsets offer a wide range of experiences, including games, entertainment, fitness, and social apps. Some of the most popular Meta Quest games include Beat Saber, Superhot VR, and Resident Evil 4 VR.
2. **Oculus SDK:** The Oculus SDK (software development kit) is a set of tools and libraries that developers can use to create VR experiences for Oculus headsets. The Oculus SDK is a powerful tool that allows developers to create immersive and engaging VR experiences. If you are interested in developing VR applications for Oculus headsets, I encourage you to download the SDK and get started.
3. **Oculus Hand Tracking SDK:** The Oculus Hand Tracking SDK is a set of tools and libraries that

developers can use to add hand tracking to their VR experiences for Oculus headsets. The SDK includes everything developers need to get started, including: A hand tracking runtime that provides the basic functionality needed to track hands in VR. A set of APIs that allow developers to access the hand tracking data, such as the position and orientation of each finger

4. **Unity:** Unity can refer to various concepts across different domains. In the context of game development, Unity is a cross-platform game engine released by Unity Technologies in 2005, focusing on both 2D and 3D game development and interactive content. It supports over 20 different platforms for deployment, with popular platforms being PC, Android, and iOS. Unity provides a comprehensive toolkit for designing and building games, including graphics, audio, and level-building tools, minimizing the need for external programs. It allows users to learn fundamental Unity concepts, game design, and project deployment
5. **C#:** C# (pronounced C-Sharp) is a general-purpose, high-level programming language developed by Microsoft and approved as an ECMA standard in 2002. It is a multi-paradigm language, supporting structured, imperative, object-oriented, event-driven, task-driven, functional, generic, reflective, concurrent, and component-oriented programming disciplines. C# encompasses static typing, strong typing, lexically scoped, imperative, declarative, functional, generic, object-oriented (class-based), and component-oriented programming disciplines.

6. CHALLENGES

1. **Optimization for Performance:** VR games require high performance to maintain a smooth and immersive experience. Optimizing rendering, physics, and AI systems is crucial to ensure consistent frame rates and minimize latency, particularly on VR hardware with limited processing power.
2. **Designing for VR:** Designing environments, interactions, and gameplay mechanics that are tailored for VR presents unique challenges. Developers need to consider factors such as scale, depth perception, and player comfort when designing levels and gameplay elements to maximize immersion and minimize VR-related discomfort.
3. **User Interface and Interaction:** Designing intuitive and user-friendly interfaces for VR can be challenging due to the limitations of VR hardware and the need to maintain immersion. Developers must find innovative ways to present information, prompts, and controls within the VR environment without breaking immersion or overwhelming players.

4. **Testing and Feedback:** Testing VR games effectively requires access to VR hardware and environments, which may be limited and expensive. Gathering feedback from players and addressing issues related to comfort, usability, and immersion is essential for refining the gameplay experience and ensuring it meets players' expectations.
5. **Content Creation and Assets:** Creating high-quality 3D assets and environments for VR requires specialized skills and tools. Developers need to optimize assets for performance while maintaining visual fidelity and realism to create immersive VR experiences.
6. **Cross-Platform Compatibility:** Ensuring compatibility and performance across different VR platforms and hardware configurations can be challenging. Developers must test their game on various VR devices and optimize it to run smoothly on each platform, taking into account differences in hardware capabilities and input methods.

7. ADVANTAGES & DISADVANTAGES:

Developing a first-person game with a survival maze based on virtual reality (VR) offers unique advantages and disadvantages. Let's explore both:

Advantages

1. **Immersive Gameplay:** VR technology allows players to feel fully immersed in the game world, enhancing the sense of presence and making the experience more engaging and realistic.
2. **Unique Interaction:** VR enables innovative interaction mechanics, such as physically reaching out to open doors, manipulate objects, or aim weapons, adding depth and realism to gameplay.
3. **Spatial Awareness:** VR encourages players to explore and navigate the game environment intuitively, improving spatial awareness and creating a more immersive experience compared to traditional gaming interfaces.
4. **Creative Freedom:** VR provides developers with new opportunities for creativity and innovation, allowing them to experiment with novel gameplay mechanics, level designs, and storytelling techniques.
5. **Physical Engagement:** VR games often require physical movement, such as walking, crouching, or dodging, promoting physical activity and offering a more dynamic and engaging experience.
6. **Market Potential:** VR gaming is a growing market with a dedicated user base eager for new and innovative experiences, presenting opportunities for developers to reach a niche audience and stand out in a competitive market.

Disadvantages

1. **High Development Costs:** Developing VR games can be more expensive and time-consuming than traditional games due to the need for specialized hardware, software, and expertise in VR development.
2. **Technical Limitations:** VR hardware has technical limitations, such as processing power, resolution, and tracking accuracy, which can constrain game design and affect performance and visual quality.
3. **Motion Sickness:** VR-induced motion sickness is a common issue that some players experience, especially with fast-paced movement or sudden camera rotations, requiring careful design and optimization to mitigate.
4. **Limited Audience:** VR gaming is still a niche market with a relatively small user base compared to traditional gaming platforms, limiting the potential reach and revenue opportunities for VR games.
5. **Accessibility Barriers:** VR hardware can be expensive and inaccessible to some players, requiring them to invest in VR headsets and compatible hardware to experience VR games, which may deter potential players.
6. **Content Constraints:** Developing content for VR requires specific considerations, such as designing for comfortable VR experiences, optimizing performance for VR hardware, and adhering to platform guidelines, which may restrict creative freedom and add complexity to development.

8. CONCLUSIONS

In conclusion, the development of a first-person shooter (FPS) game with a survival maze based on virtual reality (VR) presents an exciting opportunity to create an immersive and engaging gaming experience. By following a comprehensive methodology, developers can ensure that the game meets high standards of quality and provides players with thrilling gameplay.

Throughout the development process, careful attention should be paid to conceptualization and design, setting up the development environment, creating the maze environment, implementing player mechanics, designing enemy AI, testing and iteration, and finally, polishing and optimization.

Key considerations include designing a compelling maze layout, integrating VR-specific features for immersive interaction, implementing survival mechanics to challenge players, creating intelligent enemy AI for dynamic encounters, and conducting thorough testing to ensure a comfortable and enjoyable VR experience.

With dedication, creativity, and attention to detail, developers can create a first-person shooter game with a survival maze in virtual reality that captivates players and provides countless hours of entertainment. As VR technology continues to evolve, the possibilities for innovative and immersive gaming

experiences are limitless, making this an exciting time for game development in virtual reality.

9. FUTURE SCOPE

Overall, the future scope for the development of first-person games with survival maze elements based on virtual reality is bright, with opportunities for innovation, creativity, and growth. As VR technology continues to evolve and mature, developers will have the tools and resources to create increasingly immersive and engaging experiences that push the boundaries of what is possible in virtual reality gaming.

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