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The Shadow Isle: A 3D Survival Virtual Reality Game using A* Search Algorithm

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Abstract— Virtual reality is the new emerging games where gamers experience a real world thus elicit emotional activation. The study aims to build a game model using Unity3D for building the game functionality, Blender for the character 3D model, ZBrush, Autodesk for character sketching, Photoshop for character enhancement, and VR box for viewing the game environment and the application of the A* search algorithm in the game. Furthermore, the prototype game model was evaluated by five (5) game developers and ten (10) gamers using the criterion on the Clarity of Rules, Flow, Strategy Luck, Balance, Length, Theme and Mechanics Integration, Tension and Fun. In result the game prototype marked an over-all performance result of 83.22% specifically recorded highest score in two (2) criterion on for both strategy, luck and balance and tension fun of 93.33%.

Keywords— Virtual reality, survival games, A* algorithm

I. INTRODUCTION

Virtual reality is a new trend in video games and entertainment industry [5] which was released in Steam platform in 2017 with a total of 7,249 games [7]. Over the last few years, there has been a technological change in the video game sector. Instead of a conventional two-dimensional (2D) virtual environment, many video games can be played in a stereoscopic three-dimensional (3D) based virtual reality environment [14]. The total experience in virtual reality can be simulated through wearing the VR goggles to feel the surrounding [15]. This type of experience is evidently installed in malls, theme park and other approach is a desktop device. Also assisted by other mechanical devices for the player to interact in the game thus elicit emotional activation and training. Furthermore, virtual reality provides high level of immersion which includes great extent of surrounding [9] where the player can actively respond to threat, barriers and manage on how to survive [10]. Also, it is consider as a therapy tool to overcome fear, anxiety disorder and phobias. On the other hand, most of the games in virtual reality are survival types of games which focus on exploration, combat and crafting. Survival games played in virtual reality can trigger intense anxiety and interesting hunger in the players. Such unique characteristics can thus be exploited not only as a source of entertainment, but also as a tool for both emotion elicitation and emotional training [2].

Background of the Study

Several studies were conducted in different 3D virtual reality games. As this is being preferred by the gamers since it provide realistic experience and immersive. 3D survival games have become a popular training and behaviour analysis tool in the last decades [3]. The term “survival game” usually represents a video game whose primary purpose is training, simulation, education, and exploring, socializing, analyzing and advertising, rather than pure entertainment. [4] Shooting zombies was always going to be one of the most popular things to do in virtual reality [1]. In such popular genre, these are the 3D games which provide the best survival experiences. In State of Decay you need to make your way through the zombie apocalypse, you scavenge not just food, water, weapons, and gear, but more characters, each with their own skills, quirks, and personalities [5]. In Frostpunk you need to survive in a grim and frozen world. Gather resources, hunt for food, and manage your citizens by giving them hope for the future. It's a harsh and beautiful survival game that confronts you with difficult choices at every turn [6]. In Ark: Survival Evolved you need to survive on an expansive map filled with dinosaurs, you'll have to contend with extreme heat and cold, starvation and dehydration. Craft weapons and gear, build a base, tame and ride dinosaurs, and join with other players [8]. This is the rare example of a VR 3D game that offers the full package including an entire campaign that can be played by lets you live out your zombie survival dreams like never before [12]. The above cited studies provides an opportunity for this study to conceptualize a 3D survival game which offers a new story line embedded with animation and effects.

Research Objectives

- To build a game elements, characters, environment and story.
- To apply the A* search Algorithm to make an attack that are visible from the line of sight.
- To implement the prototype game model.
- To test the model using the game criteria.

Conceptual Framework

The study develops a three-dimensional survival virtual reality game using a mobile phone where the game is installed and the VR box used to make the gamer to view the game environment. To develop the game, the characters is created using Autodesk and rendered in a Blender to produce 3D objects. It also apply UV mapping to make a lighting reflection on the character model. This will be enhanced in terms of character color using Photoshop and re-imported to Blender for the integration of its texture and add ridging for the character joints. These characters will be imported to Unity software in order to build the functionality of the game.

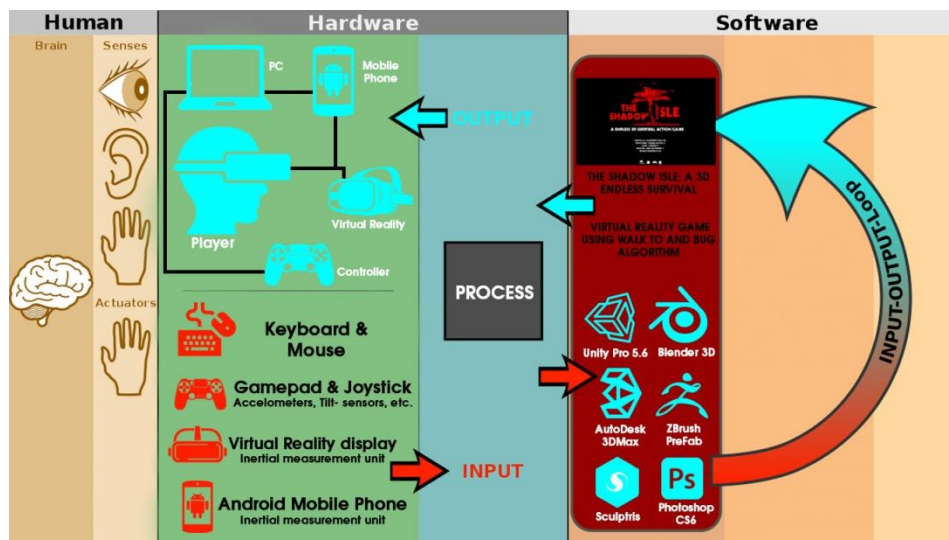


Fig 1. Model of the Study

Theoretical Framework

A*Search Algorithm is one of the best and popular technique used in path-finding and graph traversals thus addresses the problem in finding the shortest path from source to destination and avoiding obstacles. On the other hand, one of the greatest challenges in the design of realistic Artificial Intelligence (AI) in computer games is agent movement [13], as it is the moving agents/bots in virtual games [16]. With this, the game map has to be prepared or pre-processed before the A* algorithm can work that involves breaking the map into different points or locations, which are called nodes. [17] These can be waypoints, the polygons of a navigation mesh or the polygons of an area awareness system. These nodes are used to record the progress of the search. In addition to holding the map location each node has three other attributes. These are fitness, goal and heuristic commonly known as f, g, and h respectively. Different values can be assigned to paths between the nodes [18]. Map or maze is one example of games that using path finding algorithm. Different map and maze images are used to test the system performance of about 85% images can find the shortest path between the selected two points [19].

II. METHODOLOGY

Building game elements, characters, environment and story.

Before a game will be build, a story line is significant as basis for the study to create the character, environment and to know the goal and objectives of the game.

A. Storyline

Kael-wick an Australian hired Mercenary that has been tasked to retrieve an item containing a top-secret data. During his trip heading to the destination an unwelcomed scenario happened the plane crashed. Blasting down from the air an explosion covered the area the Mercenary survives miraculously to the explosion, but he lost his consciousness for a moment waking up to the unfamiliar place that can be described as an abandoned city. Exploring the city, the Mercenary found a laboratory full of unknown humanoid like creatures discovering that the island is covered with, suddenly the creatures become hostile towards him advancing towards his direction at an alarming rate and so did Kael run for his dear life running to the opposite direction. The Mercenary was run across a secured room with weapons unlocated by the unknown humanoid creatures. Preparing to counter the flow of the creatures outside abandoning his mission intending to escape the island with his own hand and doing every means to survive and discover the truth behind the chaos.

- 1) *Character Sketching Process:* The characters of the game was first drawn in a piece of paper then imported to Autodesk application for the initial design. Some of the character designs were inspired from the series The Walking Dead like zombies and cannibals. And to finalize the design, the initial design will then be processed for a 3D modeling.



Fig 2. Character Sketching Process

- 2) *Character 3D Modelling Process:* A 3D scan of a person contains holes and thousands of unordered points. In addition, a 3D scan is a single snapshot of the human body in time, while the shape of the human body changes with motion, breathing, aging. Each object have amount of polygons that can be put in a single model, these polygons are placed together to create a three-dimensional mesh, which produces a 3D image. This figure is the final design in 3D using the Blender 3D.

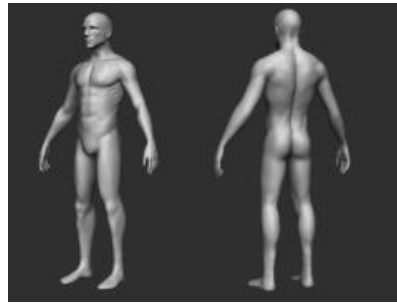


Fig 3. Character 3D Modeling Process

- 3) *Character Texture Process*: The project consisted of a character concepting phase, followed by creating a high-poly model of the character in Zbrush. The placement of textures of each characters is significant for the overall design and give realistic looks to the models.

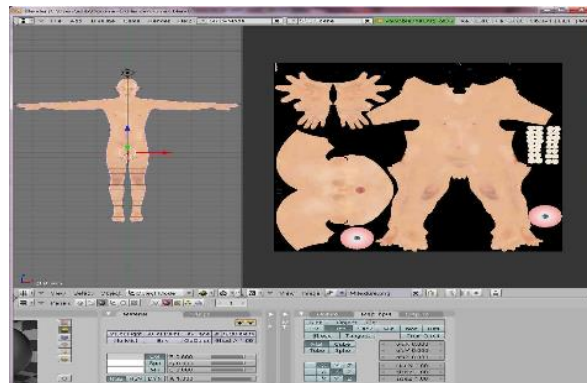


Fig 3. Character 3D Modeling Process

- 4) *Character Ridging Process*: This process involves the movements of the characters through a ridging process which allow placing points to the character model. We create skeleton for a 3D model so it can move. Most commonly, characters are rigged before they are animated because if a character model doesn't have a rig, they can't be deformed and moved around.

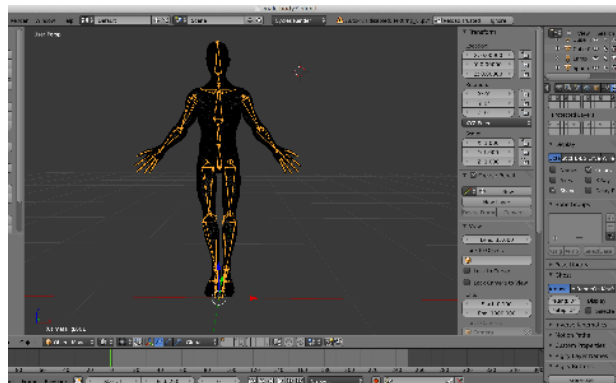


Fig 4. Character Ridging Process

- 5) *Character Animation Process*: This process is responsible for the behaviors of the characters in the game like walking, running and attacking. The animations of each character are built by creating image sequence model for each second or FPS using the rigid pattern of the characters.



Fig 5. Character Animation Process

6) *Rendering Process:* The map is created in Unity 3D since it offers huge array. Each of the elements and terrains (trees, rocks) is part of the huge library of the unity 3D the whole process is done by the dragging the elements to create the map.

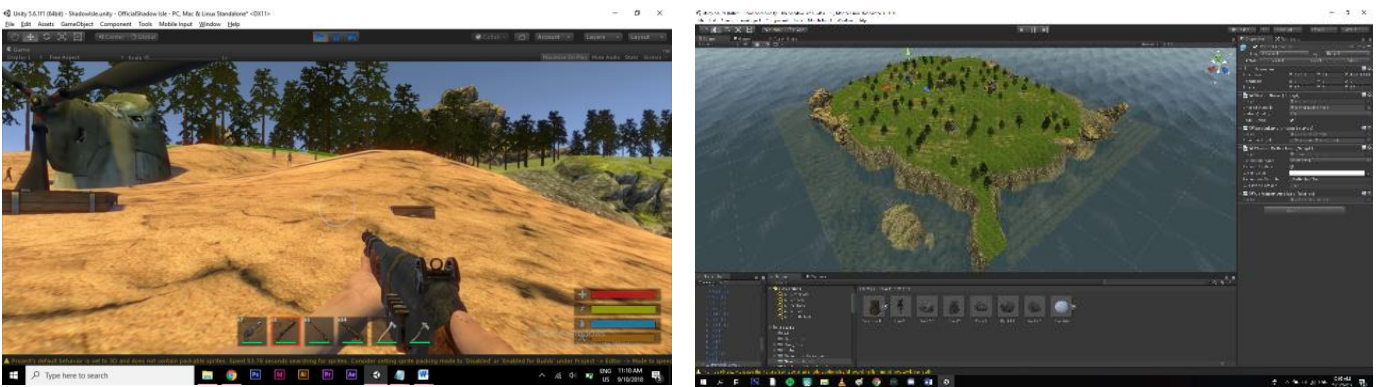


Fig 6. Rendering Process

Application of the A*Search algorithm in the game.

The application of the A* algorithm is integrated based on the obstacles encountered. The games have a starting cell going to the target cell. Once the player reach the target cell. The algorithm applied is used for rescue activity getting a game object from the starting point to a goal which help the gamers to avoid obstacles, enemies thus minimize the costs in finding strategy.

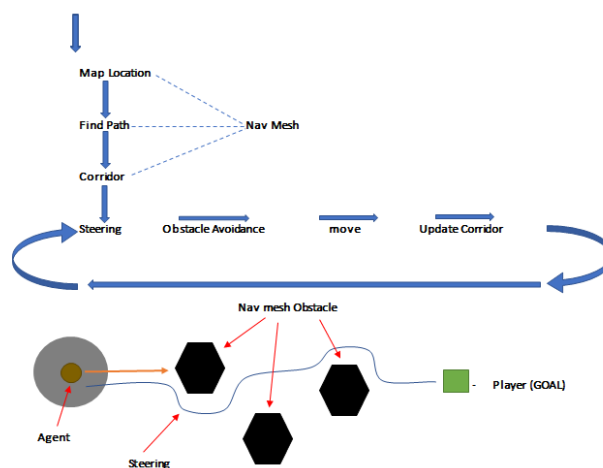


Fig 7. Application of A* Search Algorithm

Building the Prototype Model.

The game was developed using the Unity 3D platform. The study generated the surroundings of the game terrain, environment, sound, effect particles, and objects using the Unity 3D which allows to convert the Unity project into a mobile platform. An Autodesk 3D was used to sketch the character of the game, Blender 3D in creating the character models. ZBrush was used to apply the detailed character UV mapping, texture and in-depth details for versatile modeling that was more compatible to blender. Visual Studio is utilized to create the AI scripts and event handlers and C# was used as the main programming language in written the code requirement of the game.

Testing the Prototype Game Model.

The model was tested and evaluated by five (5) experts who plays a survival game for 12 years and ten (10) gamers who loves to play games for almost 2 to 3 years. The evaluators check the entire concept of the game guided with the following criterion such as clarity of the rules, flow, strategy/balance/lunch, length, them and mechanics integration, tension & fund game.



Fig 8. Gamers

A. Metrics of Evaluation

The prototype game model will be tested by game developers and gamers using the following criteria:

- 1) *Clarity of Rules:* where the players can easily see and understand what's going on in all areas of the games.
- 2) *Flow:* it means that there is no unnecessary procedures or very few if any exception to rules.
- 3) *Strategy/balance/luck:* the game has no strategic loopholes and game is very balanced that is fair for all players and any luck in the game are appropriate in their significance
- 4) *Length:* The game length is appropriate for what is offers.
- 5) *Theme & Mechanics Integration:* The mechanics is strongly complement each other and integrate to create a unified game.
- 6) *Tension & Fun Game Criteria:* Consistent emotion connection or tension throughout the game, strongly engages the imagination of the players and the game fun to play.

III.RESULTS AND DISCUSSION

The evaluation shows that over-all performance of the prototype game model marked the highest average across the criterion of 83.33% however, it also marked a higher performance of 93.33% which means that the game provides interesting activity thus make the players more immerse in playing the game with enjoyment and satisfaction. Likewise the strategy of the game shows the same score in terms of strategy, luck and balance which means that the game has no loopholes and significant since the concept of the game teach the player on how to use the materials for survival. However, the game model needs to consider the length of the game since the game provides fun. In addition the game should create additional activity to prolong the engagement of the gamers but still provides interesting activities since this criteria marked a lowest score of 60.0% followed by the flow of the game that needs to be reviewed accordingly which marked a score of 73.33%.

Criteria	1	2	3	4
Clarity of Board, Bits, Rules	0 or 0%	1 or 6.66%	2 or 13.33%	12 or 80.0%
Flow	0 or 0%	2 or 13.33%	2 or 13.33%	11 or 73.33%
Strategy/Luck/ Balance	0 or 0%		1 or 6.66%	14 or 93.33%
Length	0 or 0%	2 or 13.33%	4 or 26.66%	9 or 60.0%
Theme & Mechanics Integration	0 or 0%	2 or 13.33%	3 or 20.0%	10 or 66.66%
Tension/Fun	0 or 0%		1 or 6.66%	14 or 93.33%
AVERAGE	0%	7.77%	14.44%	83.22%

Table 1. Game Evaluation Results

IV. CONCLUSION AND RECOMMENDATION

In conclusion, there areas of the games need to be improved particularly on the length of the game and the flow of the game because the game get players interest since it marked the highest score of 93.33 among the set criterion. And to further improve the game the following recommend to:

- Re-visit the flow of the game and its length.
- Design a multi-player capability
- Game should cater online mode.
- Add ranking and scoring features of the players.

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