DESIGN AND IMPLEMENTATION OF 3D PLATFORMER GAME FOR ENDANGERED ANIMALS

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DESIGN AND IMPLEMENTATION OF 3D PLATFORMER GAME FOR ENDANGERED ANIMALS

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This report is submitted in partial fulfillment of the requirements for the Bachelor of [Computer Science (Software Development)] with Honours.

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2021

DECLARATION

I hereby declare that this project report entitled

[ENDANGERED: 3D PLATFORMER GAME ABOUT ENDANGERED ANIMALS**]**

is written by me and is my own effort and that no part has been plagiarized

without citations.

STUDENT : _NUR RIEZMAN NAIM BIN ZAMRI Date : _27/5/2021___

I hereby declare that I have read this project report and found

this project report is sufficient in term of the scope and quality for the award of

Bachelor of [Computer Science (Software Development)] with Honours.

SUPERVISOR : _____DR.ULKA CHANDINI PENDIT_____ Date : _27/5/2021___

([NAME OF THE SUPERVISOR])

DEDICATION

Praise to Almighty Allah S.W.T

To my supervisor, Dr.Ulka Chandini Pendit
Who always giving so much motivation and attention in term of guiding me throughout the project development process and report writing.

This study is wholeheartedly dedicated to my beloved parents, Zamri Bin Alus and Hafizah binti Mohd Ashim who have been my source of inspiration and gave me strength when I thought of giving up, who continually provide their moral, spiritual, emotional, and financial support.

To my classmates, Muhammad Amar Taufiq bin Mohd Nazri, Wan Muhammad Ariff Bin Wan Aziz and Muhammad Irfan Bin Mohd Razdi who shared their words of advice and encouragement to finish this study.

Finally not to forget to Universiti Teknikal Malaysia Melaka that giving such a great opportunity for me to enhance my skills and resources to make this project possible.

ACKNOWLEDGEMENTS

I am grateful to Almighty Allah S.W.T. and His blessings for providing me with the strength and ability to finish the project on time and to my satisfaction.

I'd want to express my gratitude to Dr. Ulka Chandini Pendit, my supervisor. My heartfelt thanks to her for assisting me through the entire project development process, from report writing through game production. Not to mention her unwavering commitment and focus, which served as incentive to keep the working momentum moving forward.

For my classmates,Muhammd Irfan bin Mohd Radzi, Muhammad Amar Taufiq bin Mohd Nazri and Wan Muhammad Ariff Bin Wan Aziz, thank you for giving feedback and idea for me to add for further research and development of my Final Year Project.

Also, a major thank you to my wonderful parents, Zamri Bin Alus and Hafizah Binti Mohd Ashim for their patience and unwavering support when it came to words of encouragement and motivation throughout this difficult period.

Finally, I want to thank Universiti Teknikal Malaysia Melaka for providing me with such a fantastic opportunity to improve my abilities and resources in order to complete this project.

ABSTRACT

This project focused on the creation of a 3D Platformer Game inspired by the current state of endangered animals. The purpose of this game is to educate young generation about endangered animals. with the goal of teaching the player about endangered animals. The game is developed for Personal computer platform. The game was developed using Blender 3D for assets creation and Unity engine .The goal of the project is to raise awareness about endangered animals among young generation so that they understand the importance of these animals to ecosystems.

ABSTRAK

Projek ini memfokuskan pada penciptaan Permainan Platformer 3D yang diilhami oleh keadaan haiwan terancam semasa. Tujuan permainan ini adalah untuk mendidik generasi muda mengenai haiwan yang terancam punah. dengan tujuan untuk mengajar pemain mengenai haiwan yang terancam. Permainan ini dibangunkan untuk platform komputer Peribadi. Permainan ini dikembangkan menggunakan Blender 3D untuk penciptaan aset dan mesin Unity. Matlamat projek ini adalah untuk meningkatkan kesedaran mengenai haiwan yang terancam di kalangan generasi muda sehingga mereka memahami pentingnya haiwan ini terhadap ekosistem.

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LIST OF ABBREVIATIONS

FYP	**Final Year Project**
UI	User Interface
3D	3-Dimensional
RPG	Role-Playing Games
FPS	First-Person Shooter
A.I	Artificial Intelligence

CHAPTER 1: INTRODUCTION

1.1 Project Background

This project was established to save endangered animals. Many people are unaware of the situation of endangered animals. As a result, this project was developed to entertain people while also educating them about endangered animals.

1.2 Genre

- First-person 3D platformer

1.3 Gameplay

- Press WASD to move the character. Spacebar is use to jump and and CTRL is use for crouching.Right mouse button can be use to grab boxes and Left mouse button can be use for grappling. The player can pause the game with TAB button.

1.4 Target Group

- Teenager and young adult from age 12-30 years old

1.5 Problem Statement

1.5.1 Current Problem

Lack of information and knowledge about endangered animals (Hance, 2021), Many severely endangered species are unprotected because they are considered "uncharismatic" and hence do not attract attention. Thus,can lead to unaware of the endangered animals.

Lack of edutainment platform about endangered animals.(Endangered, 2021). Nowadays, not so many games developed for endangered animals that also can lead to it lack of information and decrease of endangered animal awareness.

1.5.2 Ideal Situation

People should save endangered animals as they are important for our ecosystem. But they lack of knowledge about it. And there should be edutainment platform to educate people.

1.5.3 Proposed Solution

There is a need to developed game about endangered animals.

1.6 Objectives

- To study how 3D platformer game can promote awareness towards endangered animals.
- To reconstruct 3D platformer game about endangered animals.
- Create awareness of endangered animal.
- To measure player through questionnaire based on their understanding and enjoyment playing Endangered.

1.7 Goals and Genre

- The goal of this game is to educate people about endangered animals in an entertaining way. This can be achieved by playing Endangered.
- The genre of this game is 3D platformer. This can be seen from the mechanics and the ways the game will be played in Endangered

1.8 Conclusion

This chapter tells about the the introduction of this report on what are the background of the project, problem statement, objectives, goals and genre for this project.

The next chapter will discusses about the literature review and project methodology of this project development.

CHAPTER 2: LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction

This chapter introduces about the genre of the game, list of existing games that are related to the project, comparison of the existing games, and the project methodology used during the project development process.

2.2 Fact and Finding

The next subsections provide facts and finding about endangered animals and edutainment platform for endangered animals

2.2.1. Extinction of endangered animals

A species is defined as endangered or threatened when it is suffers from these factors: damage to its habitat for recreational, or entertainment purposes; disease or predation of the species; and hazards to the continued life of the species (Journalist, 2017).We have reached a stage in history where the Human-Species should begin to question and demand excellent science, good research based on non-negotiable and well-researched facts.

Elephants, orangutans, Malayan tapirs, Malayan Tigers, pangolins, chimps, polar bears, snow leopards, tigers, mountain gorillas, giant pandas, rhinos, and koala

bears are all expected to become extinct over the next 15 to 40 years. Unfortunately, they are only a few examples of many.

Endangered animals are important to people because it help us to maintain the health of ecosystem. The health of the environment is maintained by a well-balanced ecosystem. This ensures that humans have access to clean air and water, as well as agriculturally fertile land. (Journalist, 2017)

2.2.2. Potential of video games for animal conservation

Video games can be used to teach children about environmental and ecological education. Video games are one form of medium that has expanded significantly in the previous decade.

Games for Change for example is a nonprofit organisation committed to utilising games as a platform for social change. Despite their success, few of the games they manage are now greater enough to draw considerable awareness. Games for Change was founded in 2004 and has raised donations.

Therefore, developing games for endangered animals can help for recognition of endangered animals for the future of our ecosystem and also the endangered animals itself.

2.3 Genre

The genre of this game is 3D platformer game. Platformers are distinguished by the extent to which the player must jump and climb to navigate their surroundings and achieve their goal. Unbalanced ground and floating platforms of varied heights are present throughout the levels and surroundings, requiring the need of the player character's abilities to explore.

This genre provide a simple mechanics that easy to be understand by majority of new player. Player action will not affecting the gameplay but its only can affect the player itself because this genre not has a multiple choice story like RPG genre. This game's theme focuses on endangered animals and includes information about the endangered animals in the game. With the three-level design, players will have to save different animals for each level.

2.4 Existing Games

The next subsections provide explaination about existing games in Platformer genre which are Karlson and Krunker.io.

2.4.1 Introduction to existing games

2.4.1.1.Karlson

Karlson is a First-person 3D Platformer games that brings unique and skill based movement to the table, highly inspired by classic FPS titles, set in a mysterious, futuristic setting (Dani2, 2020). The objectives is for player to fight all the way through the enemies waiting to get the milk at the end of the levels.Beside that,timer is also added so games enthusiast speedrunner can compete with each other of who is faster.

Figure 1: A scene from Karlson game(Karlson by Dani, n.d.)

Figure 2: Ragdoll physics from (Dani2, 2020)

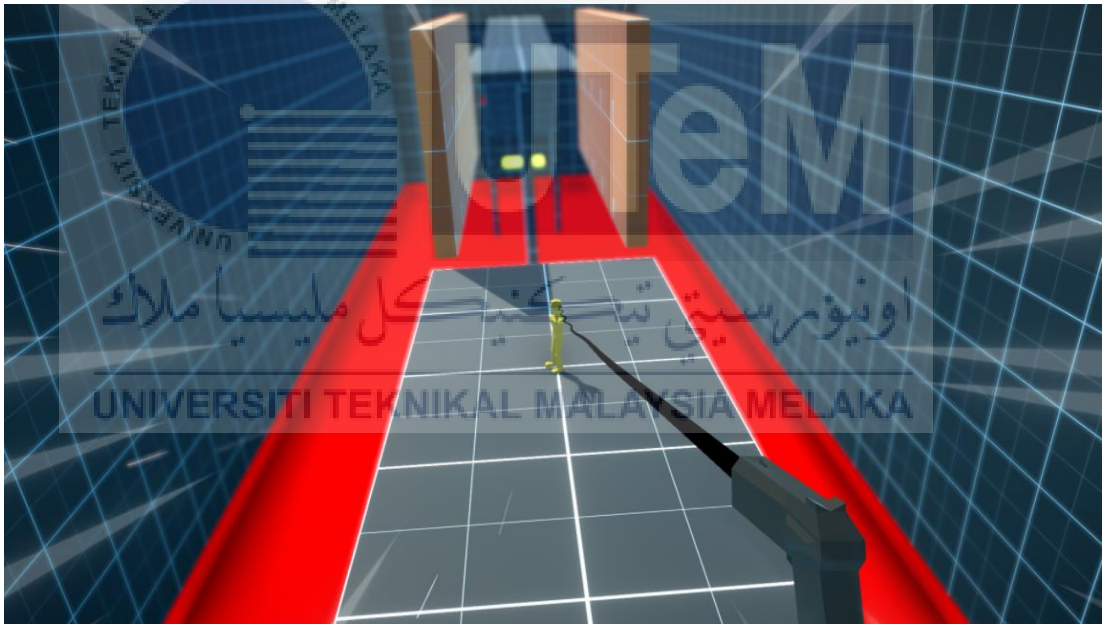


Figure 3: Example of grappling mechanics (Karlson by Dani, n.d.)

2.4.1.2.Krunker.io

Krunker.io is a fully moddable First-Person Shooter with advanced movement mechanics game. Fully Customizable with Mods, Custom Maps and Thousands of Items to Unlock (Krunker on Steam, n.d.).

Figure 4: Poster of Krunker (Krunker on Steam, n.d.)

Figure 5: Example of gameplay in Krunker Browser

2.5 Project Methodology

The project technique used in this project is GDLC. This technique was chosen because it focuses on basic streamlined design methods to maintain a better development process for my final year project development game.

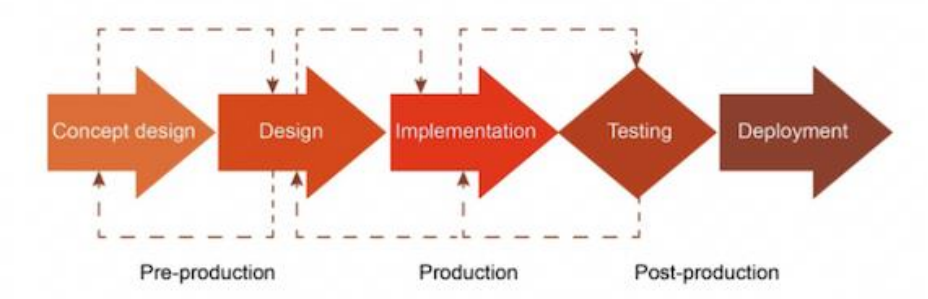


Figure 6: Game development life cycle. (Game Testing and Evaluation on Real Devices: Exploring in the Case of the Open Device Lab Community, n.d.)

2.5.1.Concept Design

To developed Endangered game using the idea generated through the brainstorming. Concept sketch such as the sketch of the levels are done using Blender 2D animation feature implemented inside Blender 3D software that have sketching features.

2.5.2.Design

Then,Unity 3D is used to create the level from concept design using a prototype assets to mapped out the layout of the levels that want to be created.

2.5.3.Implementation

This is the procedure in which source code and programming are implemented in Endangered game . Playtesting is implemented all the time during this process to make sure that the game developed is free of bugs and error. Kanban method also used in this process to make sure that all works done in time.

2.5.4.Testing

This phase is where Endangered game is test to see whether if it still have bug or problem that need fixing before release.Alpha testing is implemented to find the critical issues or fixes to ensure the quality of the product before moving to Beta testing .The Endangered game is tested many times until there are no error and bugs found.

2.5.5.Deployment

Final phase where the Endangered game are now complete also known as master version that are ready to be release to the market which is Itch.io and GameJolt either for free or sell to the public as downloadable executable files.

2.6 Conclusion

In conclusion, this chapter provide explanation about analysis, facts and finding, existing game, project methodology for Endangered game.

The next chapter will discusses about the analysis done during the final year project development.

CHAPTER 3: ANALYSIS

3.1 Requirement Analysis

The next subsections provides technical requirement,

3.1.1 Technical Requirement

3.1.1.1 Mouse & Keyboard

This games uses mouse and keyboard for playing the game. The followings are the control for Endangered:

- WASD for moving around the levels .
- SPACEBAR for jumping.
- CTRL to crouch.
- Left Mouse Button to grapple.
- Right Mouse Button to grab boxes, animals or any intractable object.
- Tab to open and close pause menu
- P to unlocked and locked mouse cursor

3.1.1.2 Unity Engine

- Unity Technologies has created a cross-platform game engine. The engine can be used to develop 3D and 2D games, as well as interactive simulations and other experiences.
- For this project, most function that used to develop a game was the programming. By having programming tools, mechanics and Artificial Intelligence (A.I) can be codes to suit the game objectives.
- Other functions used Unity Engine is physics which is Rigidbody, collision detection, animator for animation and Navmesh baking to create path for A.I to walk on.

3.1.2 Software Requirement

The followings are software requirement for developing the game:

- Unity Engine
- Microsoft Visual Studio
- Blender 3D
- Bosca Ceoil
- Audacity

3.1.3 Hardware Requirement

The followings are hardware requirement for developing the game:

- Mouse
- Keyboard
- Earphone
- A laptops
- Monitor

3.2 Project Schedule and Milestone

The project schedule uses Kanban method for managing the time and proportion on which date to start and stop process of development. (refer to Figure 7)

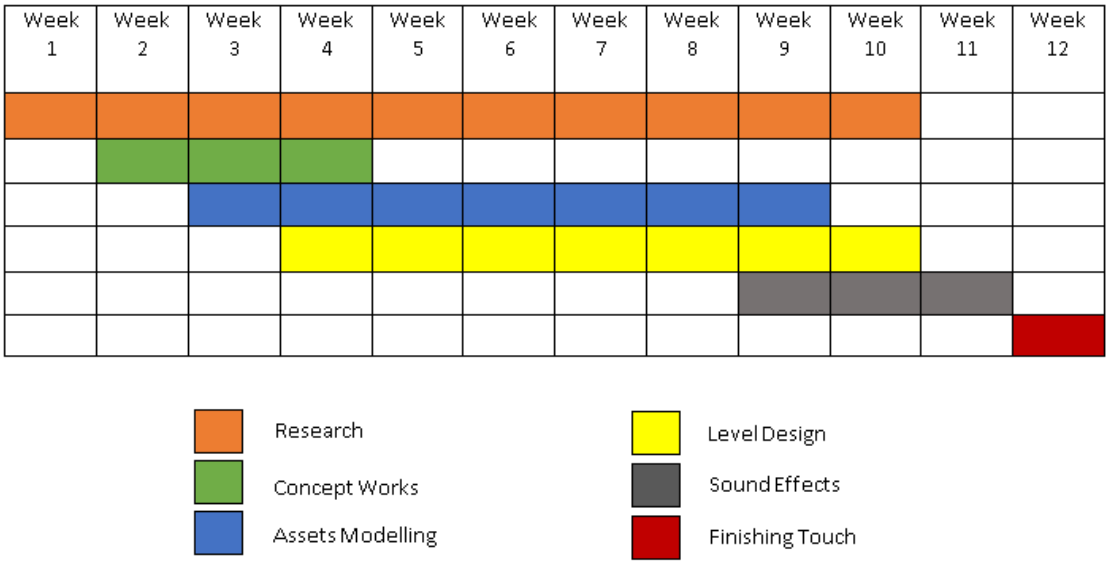


Figure 7: Project schedule

There are 6 phases during the development, which are:

- **Research**

  Research subject matter information through article, research paper and journals.

- **Concept work**

  Working on the concept, conceptualising the original idea for how the research can be portrayed in the game.

- **Asset Modelling**

Fully models assets using Blender 3D by referring the research earlier while implementing texture to makes the assets suitable to be put in the project. There are 3 types of models that a created using Blender 3D which is the enemy, animals and the props for the levels.

- **Level Design**

Design levels based on the research and what theme to used for the project. There are 3 design created using Unity terrain system which is The Laboratory, Dusk Forest and Night Forest.

- **Sound Effects**

Design sound effect based on the research and what theme to used for the project. For the sound effect of the enemy, audacity is used for record the sound of myself as the enemy. For the animals, the sound are collected through researching article and websites.

- **Finishing Touches**

Finishing touch for the games by fixing bugs and adding missing asset or mechanics to complete the development of game.

The next schedule is for report writing (refer to table 1). There are 5 phases done for the report writing schedule

Detailed Schedule for Report Writing

Table 1: Report writing schedule

Phase	Start Date	End Date
Brainstorming	15/3/2021	30/3/2021
Report : Chapter 1	31/3/2021	23/3/2021
Report : Chapter 2	24/3/2021	19/4/2021
Report : Chapter 3	20/4/2021	20/5/2021
Report : Chapter 4	21/5/2021	21/6/2021

3.3 Conclusion

This chapter focused on identifying technical requirements, software requirements, hardware requirements, and other requirements, as well as analysing the differences between similar games that are related to the proposed project. This chapter also depicts project schedules and milestone.

The next chapter discusses about the design process for this final year project development which are Level design, UI design, Character design, and sound effect

CHAPTER 4: DESIGN

4.1 Introduction

Game design is a critical phase in the creation of Endangered game and one of the most significant processes in video game production. It entailed game architecture and game design, which can be broken down into several components such as gameplay, basic mechanics, flowboard, level progression, plot, user interface or interaction model, game art, game world, character design, camera design, audio and sound effects.

4.2 Game Architecture

Base architecture for this project is researched from(System Models Patterns and Software Architectures, n.d.).

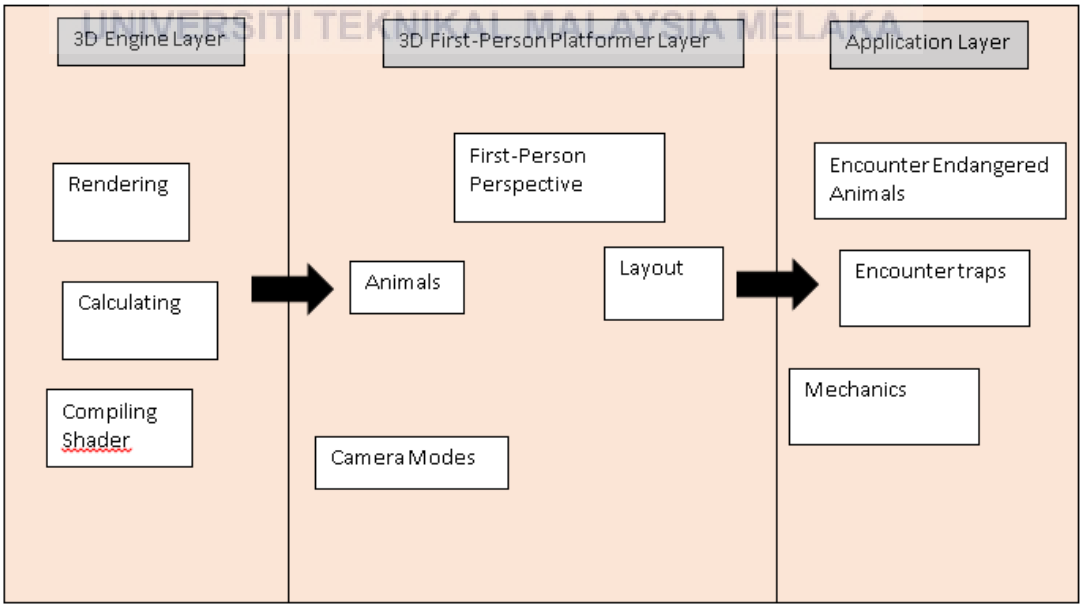


Figure 8: Game Architecture Layer (Wiley 2001).

4.3 Game Design

The parts that follow include gameplay, game mechanics, a flowboard, level advancement, user interface (UI), game art, a game world, character design, camera options, and sound effects.

4.3.1 Gameplay

- **Player roles**

  Player plays as a rescuer that rescue endangered animals that are traped or capture in a level. Once the player got the animals, he/she need to send the animals back to the back of the lorry for the animals to be sent the rehabilitation centre.

- **Rules**

➢ The player is free to move across all of the level, however there is a restriction in place that prevents the player from going outside of the bounds, which breaks the immersion of the game.

➢ Player needs to save the animals require for each levels in order to proceed to the next level.

➢ Player can use the grappling gun given freely to moves around the world faster or with style.

- **Victory Condition**

  Victory condition can be obtained by saving animals require for each levels.

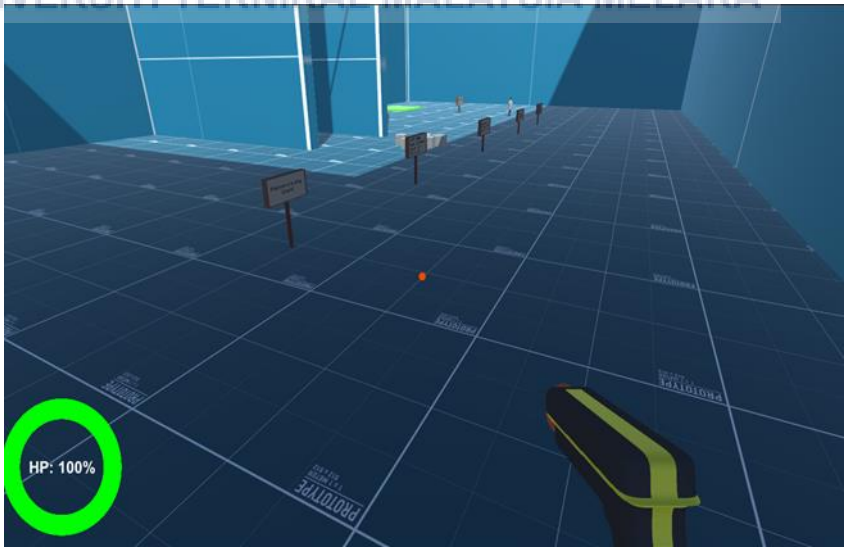
- **Lose Condition**

  Player will be given 100 percent of health point in every start of a level .The enemy can reduce player health by throwing projectile. The levels will restart automatically if their lives get to 0 percent.

4.3.2 Core Mechanics

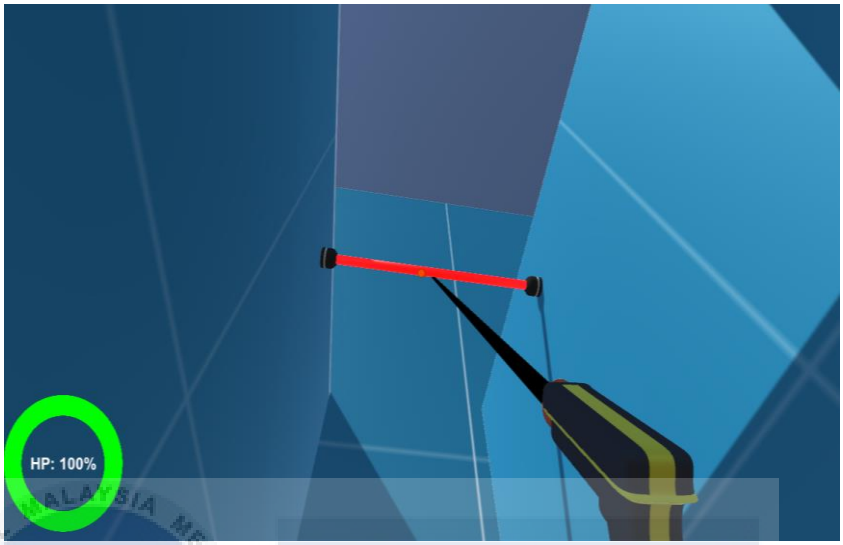
- **Jumping**

  Player can jump by pressing Spacebar to get to higher ground .



- **Grapple**

  Player can hold Left Mouse Button to grapple when looking at the red horizontral pole placed in the levels.

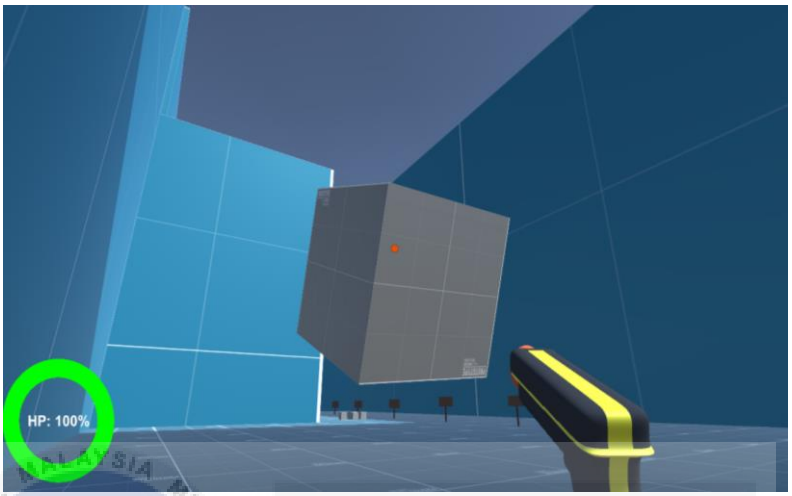


- **Sliding**

  Player can sliding on the ground by running and then pressing CTRL to slides.

- **Pick Up**

  Player can pick up boxes, animals and even enemies by holding Right Mouse Button.



4.3.3 Flowboard

Figure 9 shows the flow board of the Endangered game.

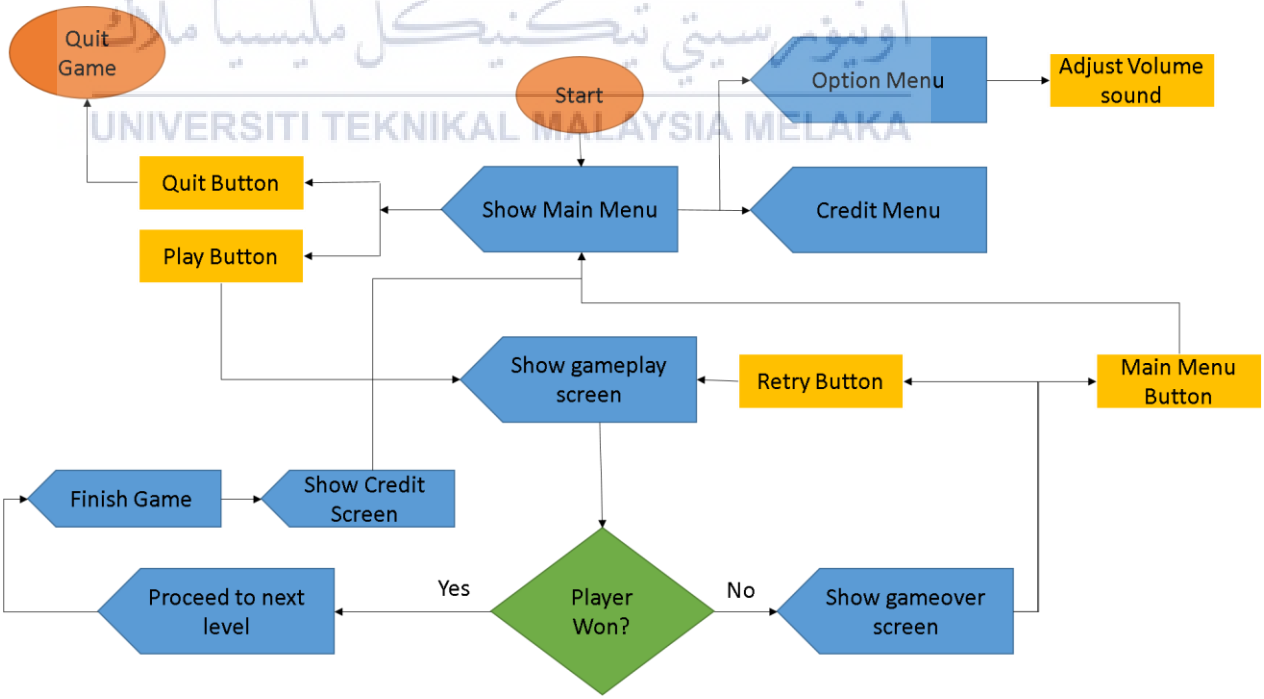


Figure 9: Flowboard

4.3.4 Level Progression

This game ahs 3 levels, which are:

4.3.4.1 Level 1

- **Condition**

  Small sized animal.

  Priotized to save only 2 animals.The more the better.

- **Result**

  Easy level completion.

  Enemy can only attack when near.

4.3.4.2 Level 2

- **Condition**

  Medium sized animal.

  Priotize to save only 4 animals.The more the better.

- **Result**

  Medium level completion.

Enemy can attack at further range

4.3.4.3 Level 3

- **Condition**

Large-Medium sized animal.

Priotized to save only 6 animals.The more the better.

- **Result**

Medium level completion.

Enemy can attack at further range.

4.3.5 User Interface (UI)

There are 3 section of user interface (UI) implemented in this project which is main menu, pause menu and in-game user interface (UI).

Figure 10: Main Menu

Figure 11: Pause Menu

Figure 12: Health UI and Animal saved counter UI

4.4 Game Art

The game art are created using Blender 3D sketching featre which is the 2D animation feature to sketch the early concept for the user interface (UI) and the level layout.

Figure 13:Main Menu early sketch

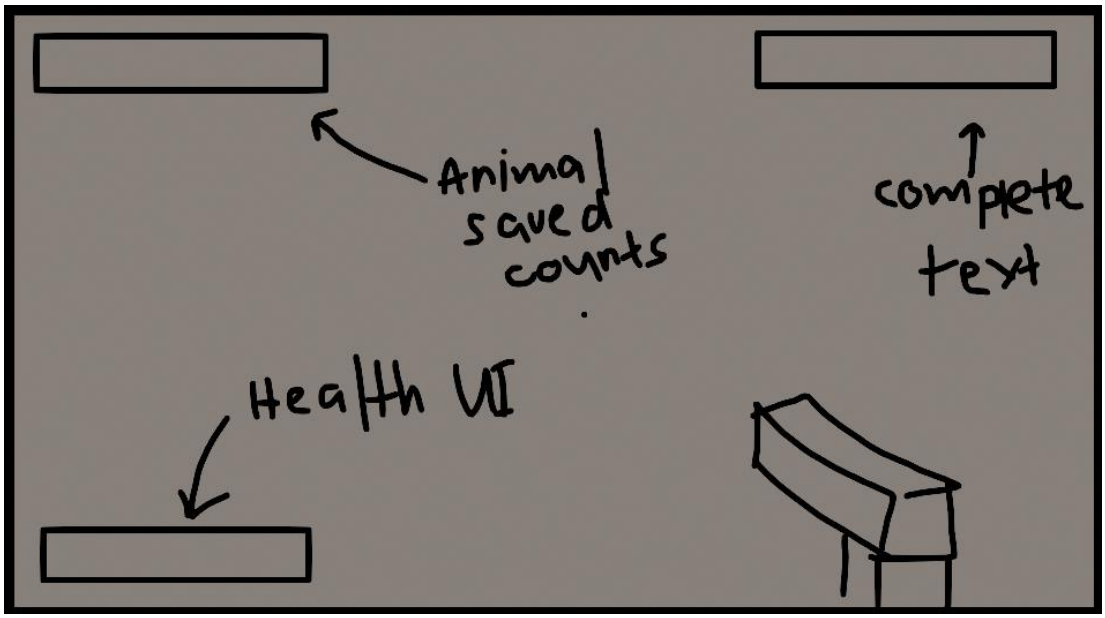


Figure 14: In-Game early sketch

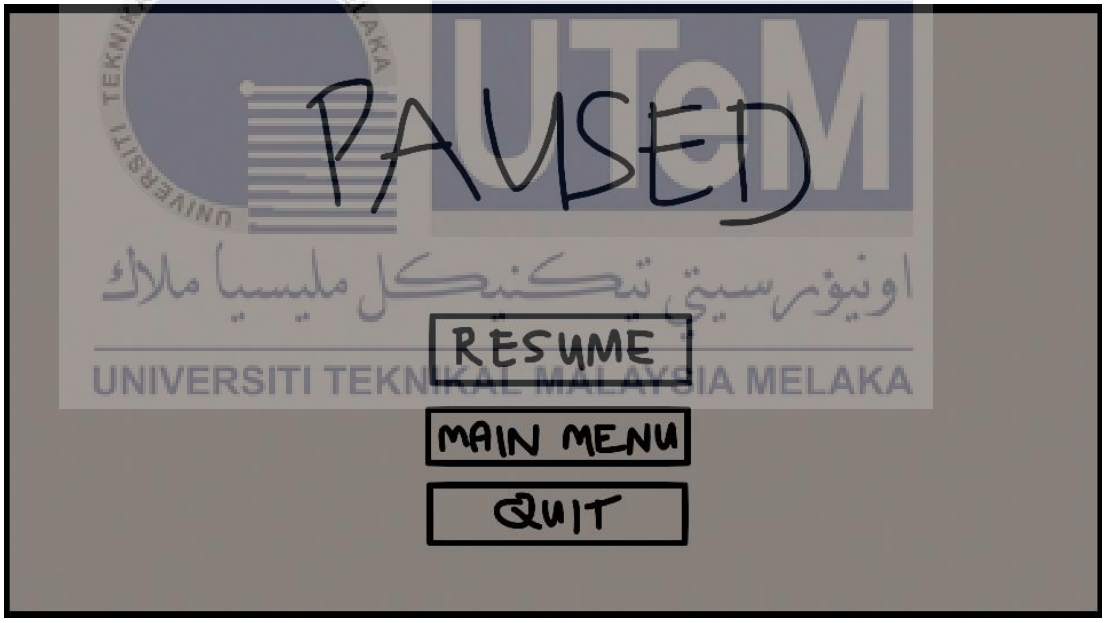


Figure 15: Pause Menu early sketch

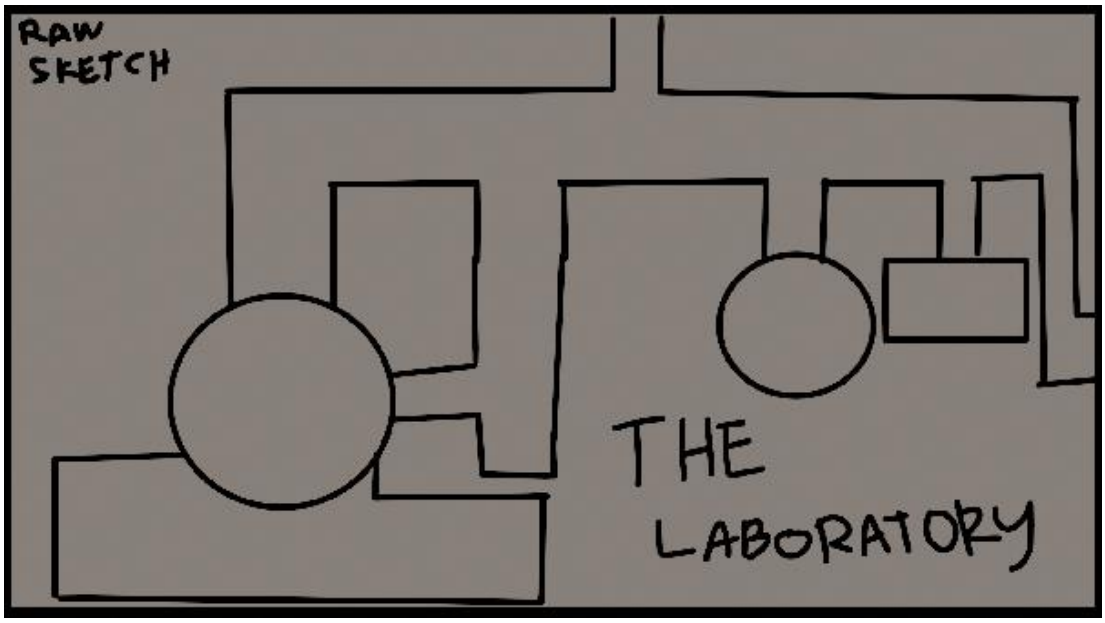


Figure 16: Level 1(The Laboratory) early layout sketch

4.5 Game World

Tutorial Ground

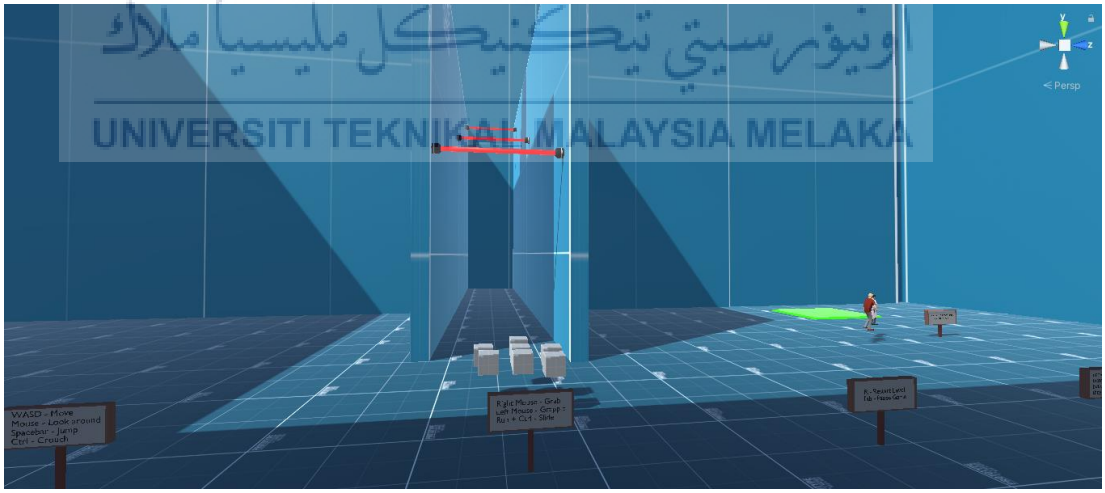


Figure 17: Level where player will learn how to play Endangered

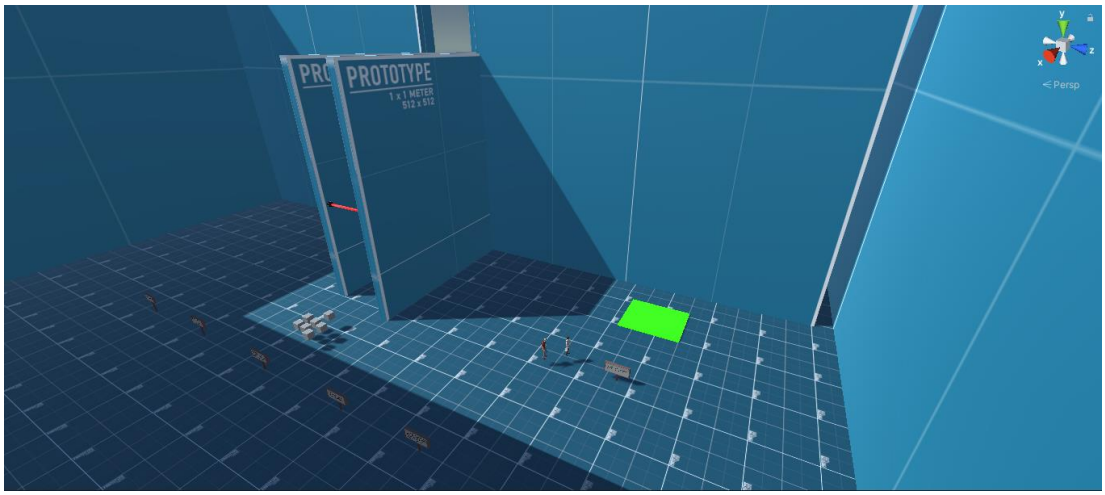


Figure 18: Level where player will learn how to play Endangered

Level 1 (The Laboratory)

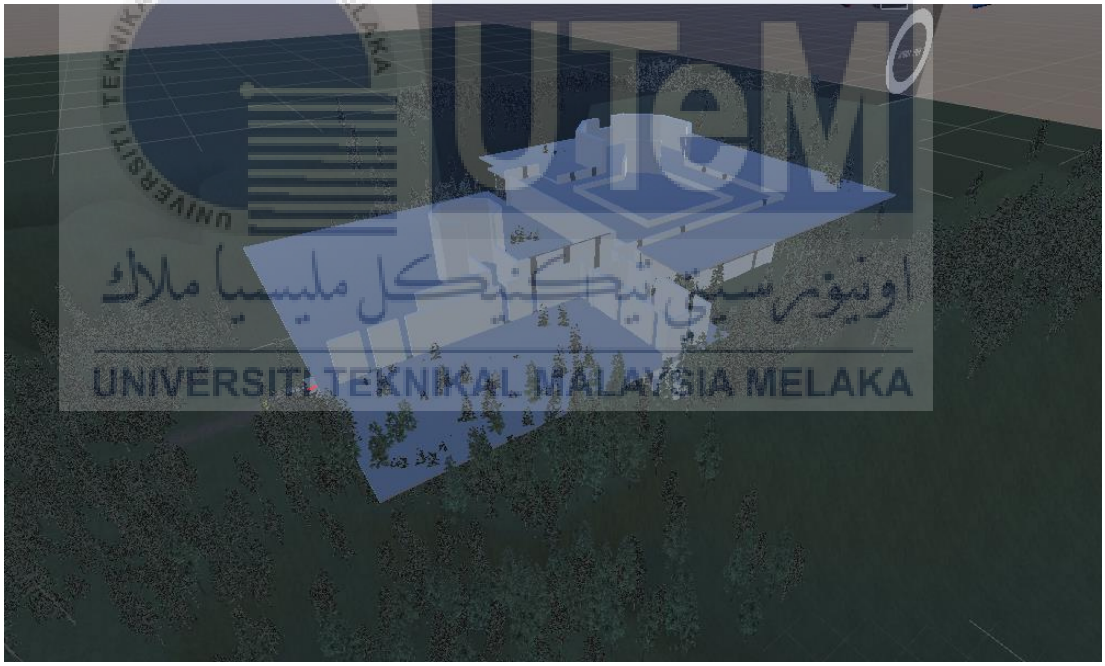


Figure 19: Level 1(The Laboratory) upper layout

Figure 20: Level 1(The Laboratory) room

Figure 21: Level 1(The Laboratory) hallway

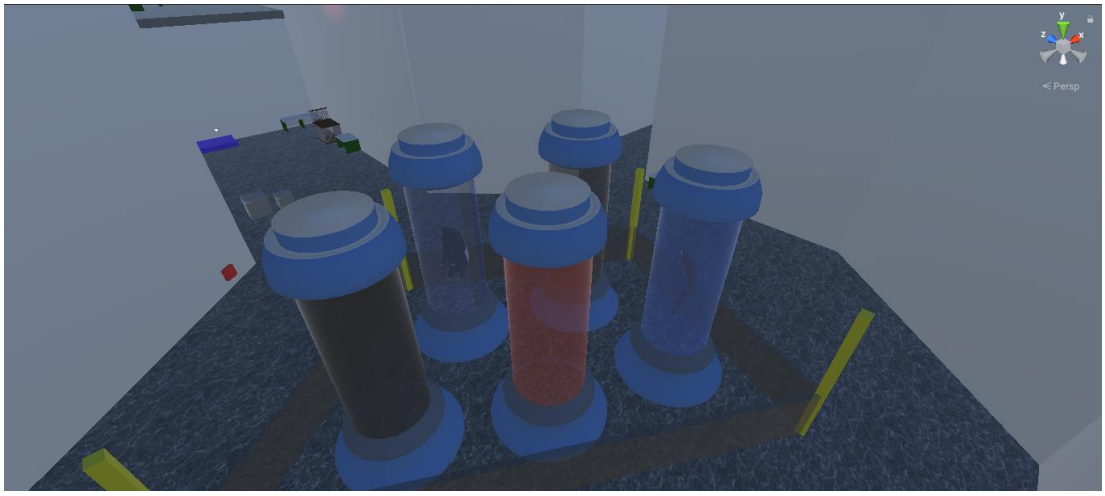


Figure 22: Level 1(The Laboratory) animal pods

Figure 23: Level 1(The Laboratory) mini forest

Level 2 (Dawn Forest)

Figure 24: Level 2(Dawn Forest) first upper layout

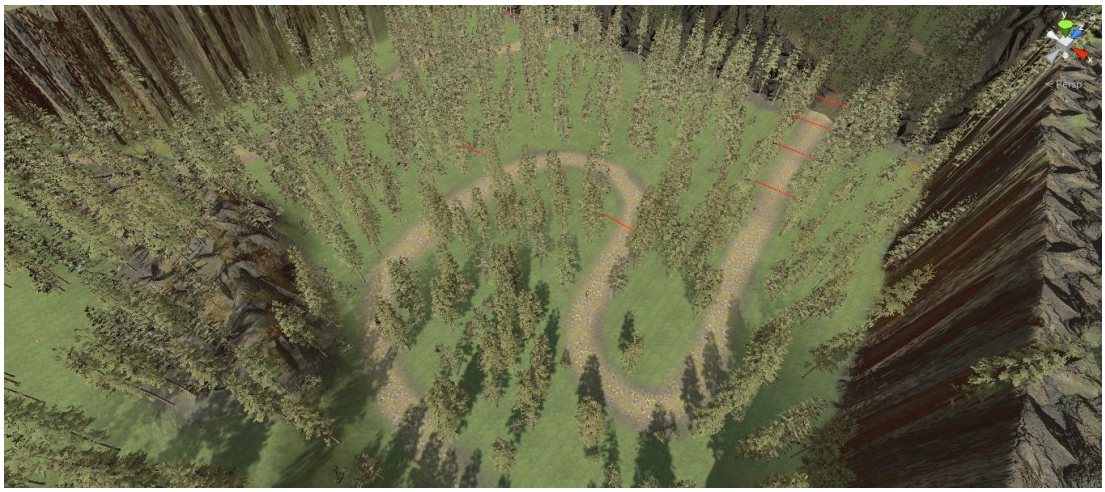


Figure 25: Level 2(Dawn Forest) second upper layout

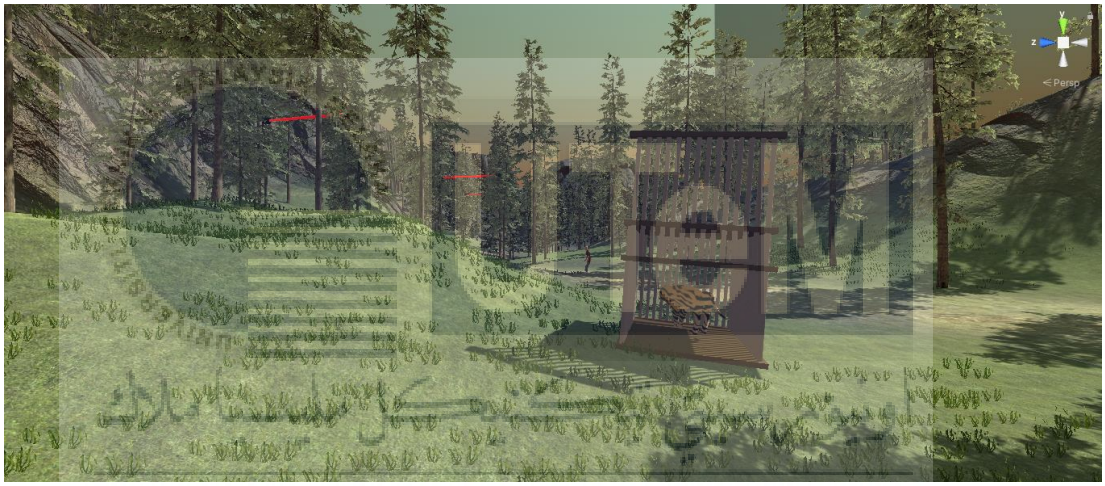


Figure 26: Level 2(Dawn Forest) forest floor

Figure 27: Level 2(Dawn Forest) high ground

Level 3 (Night Forest)

Figure 28: Level 3(Night forest) first upper layout

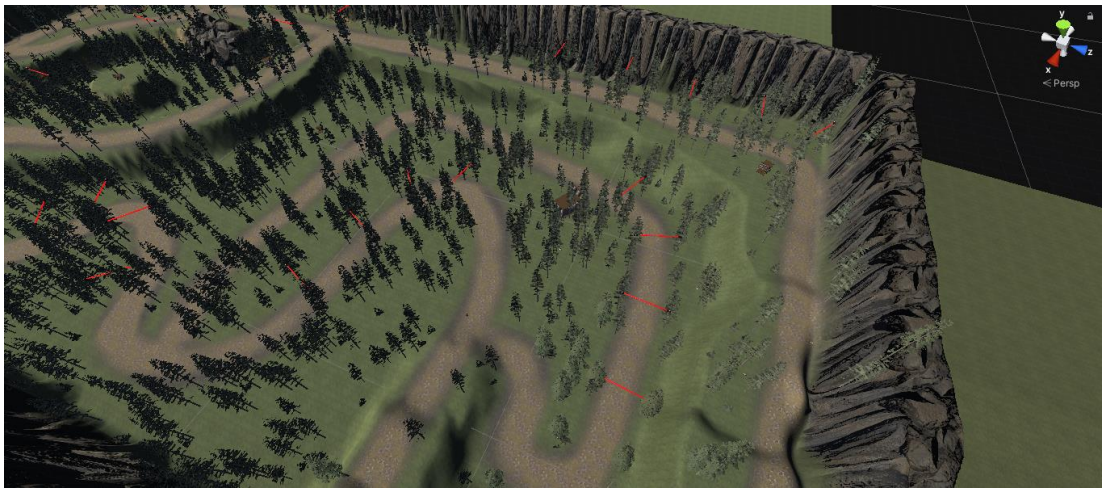


Figure 29: Level 3(Night forest) second upper layout

Figure 30: Level 3 (Night forest) forest floor

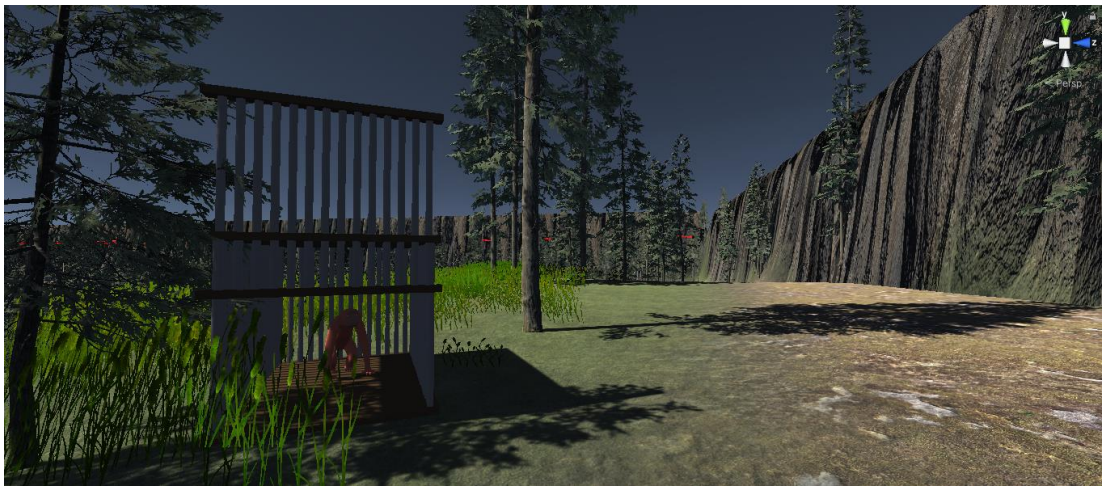


Figure 31: Level 3(Night forest) high ground.

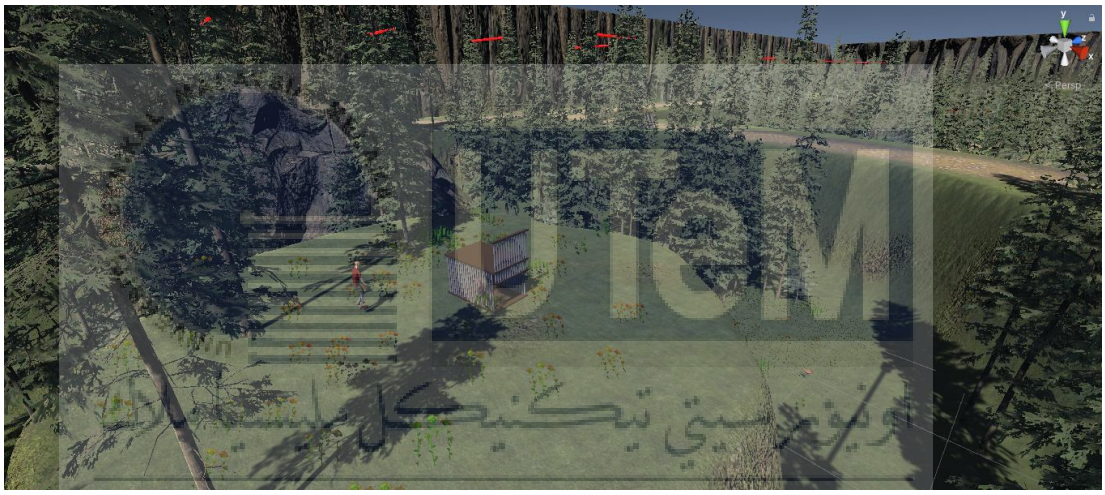


Figure 32: Level 3(Night forest) crater hole.

4.6 Character Design

There are 2 types of characters in this game, which are animals and humans. Animals are the characters to be saved in game, which are modelled using mirror modifier, subdivision surface modifier and using image reference while humans are the enemies of player and animals in the game, which are modelled using low polygon technique and mirror modifier in Blender 3D software.

- **Animals**

There are 24 endangered animals in this games which is 4 pangolins, 4 Malayan tapir, 4 Malayan tiger, 4 Sumatera rhino, 4 elephant and 4 orangutans.

Pangolins are solitary, mostly nocturnal creatures with a thick coat of scales that makes them clearly recognized. When a pangolin is frightened, its front legs cover its head, exposing its scales to any possible predator. The spiky scales on the tail may be utilised to claw out. (Pangolin | Species | WWF, n.d.)

Figure 33: Panggolin

The Malayan tapir has a short tail and a flexible nose. The black and white coloration appears to break up the section of the body in the thick of the jungles where it lives. They have four front hooves and three rear hooves. (Malayan Tapir, n.d.)

Figure 34: Malayan Tapir

The Malayan Tiger is one of the smallest tiger species, found in the southern and central regions of the Malay Peninsula, as well as southern Thailand. This species' body is orange-colored with thin black stripes when stalking prey or retreating into isolation, perfectly hiding its motive. (Malaysian Wildlife, 2019)

Figure 35: Malayan Tiger

Sumatran rhinoceroses are the smallest living rhino species. They have lengthy hair and are more closely linked to extinct woolly rhinos than any other surviving rhino.(Sumatran Rhino, n.d.)

Figure 36:Sumatera Rhino

Elephants are the world's largest land animals. They use their trunks for a variety of purposes, including picking up things and trumpeting warnings. Elephants can also be used for drinking water and greeting other elephants in Africa. The African elephant is one of the most endangered species on Earth. (Elephant | Species | WWF, n.d.)

Figure 37: Elephant

Orangutans live in the Malay language, orangutan means "man of the forest" They eat lychees, mangosteens, and figs, and drink from tree holes to sleep at night and relax during the day. (Orangutan | Species | WWF, n.d.)

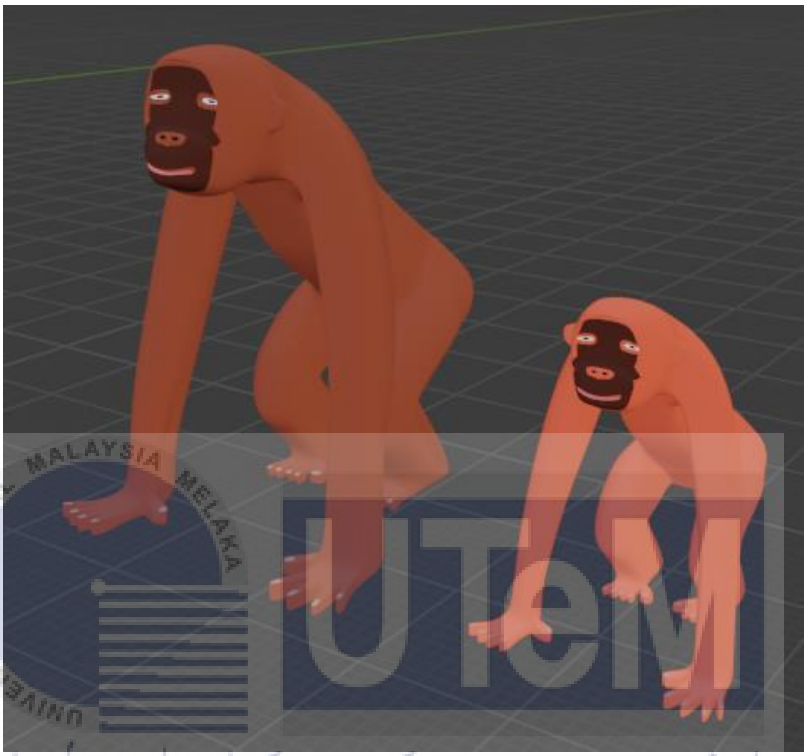


Figure 38: Orangutan

Can be found scattered around Level 2 and Level 3

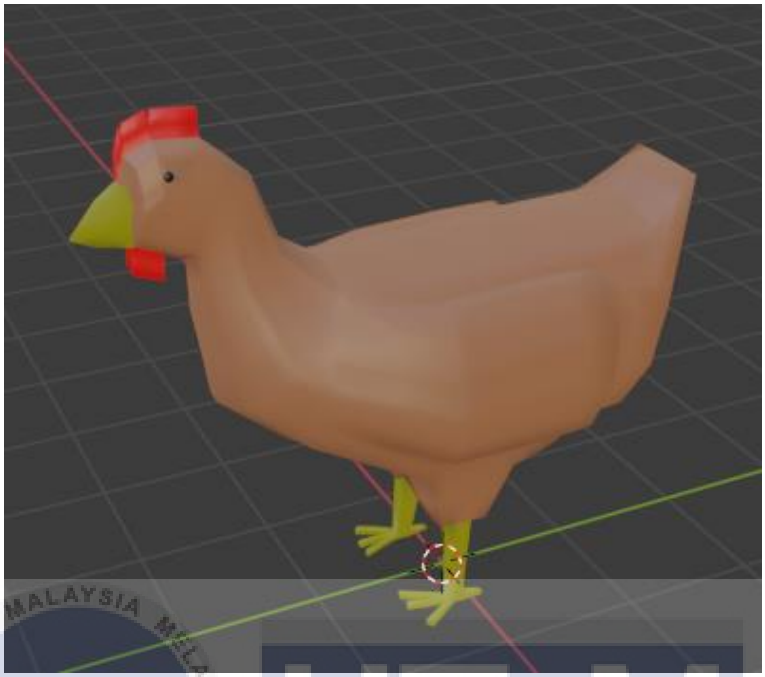


Figure 39: Chicken

Also can be found scattered around Level 2 and Level 3

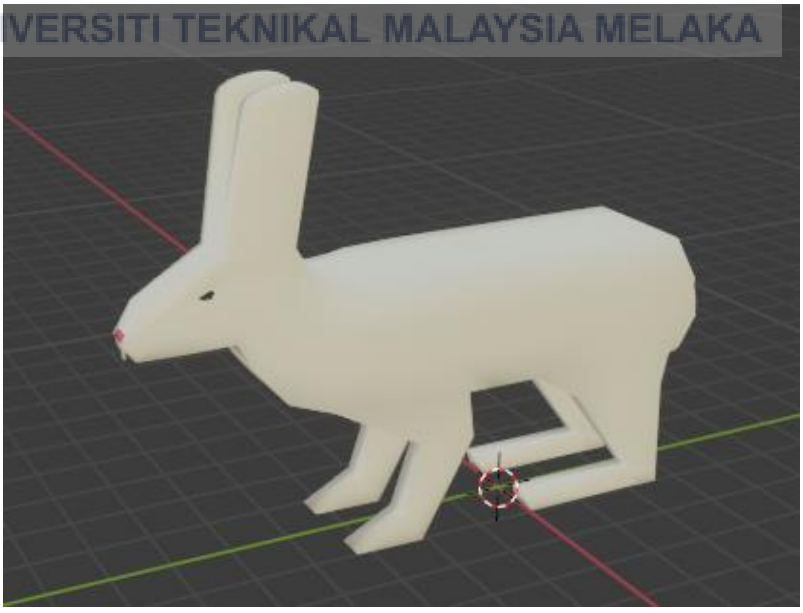


Figure 40: Rabbit

- **Signs for animals information**

There are signs located in every start point of levels so players know what animals need to be saves in the current levels including the information about the animals.

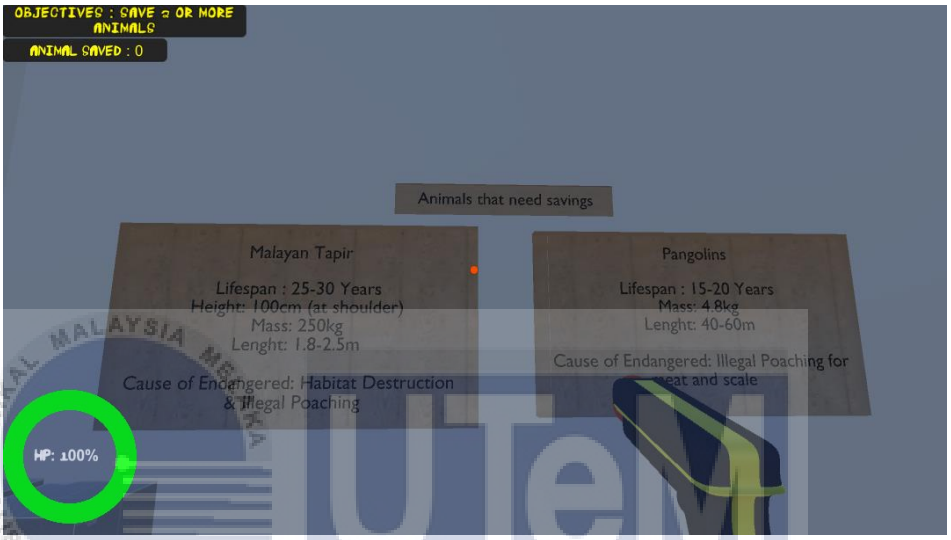


Figure 41: Level 1 (The Laboratory) Sign

Figure 42: Level 2 (Dusk Forest) Sign

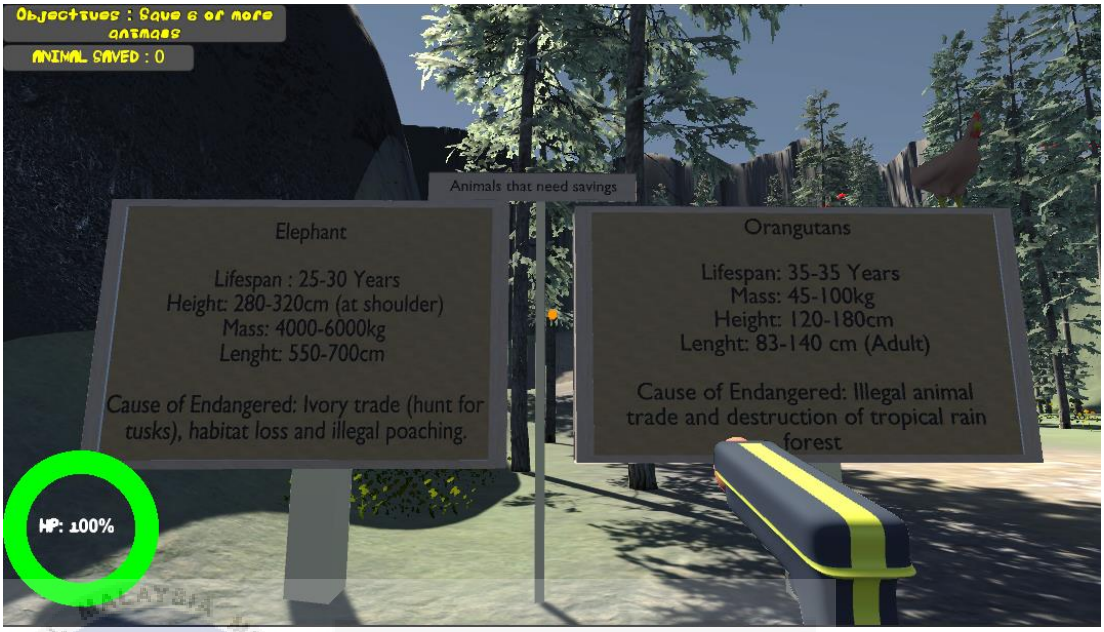


Figure 43: Level 3 (Night Forest) Sign

- **Human**

Name: Laboratory Worker

Job: Scientist

Characteristic:

- Can hurt player in a short distance by throwing punch.
- Run slow than Hunter
- Can detect player if the player walk near.
- Appear in Level 1

Figure 44: Laboratory Worker

Name: Hunter

Job: Animal Hunter

Characteristic:

- Can hurt players in longer distance
- Run faster than Laboratory worker
- Can detect player in a further distance
- Appear in Level 2 and Level 3

Figure 45: Hunter

4.7 Camera Modes

This game uses first-person perspective for te camera mode (refer to figure 43 and figure 44)

Figure 46: Camera position in Unity editor

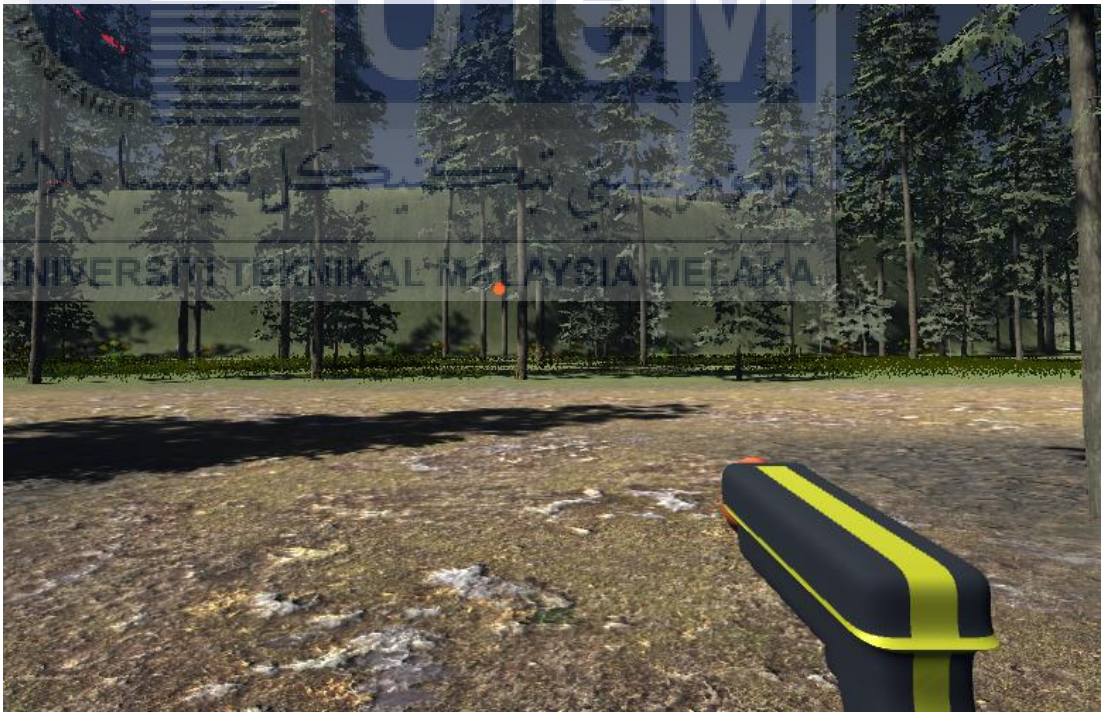


Figure 47: Camera perspectives

4.8 Audio/Sound Effect (SFX)

The followings are the audio/souund effects used in the game:

- Main Menu

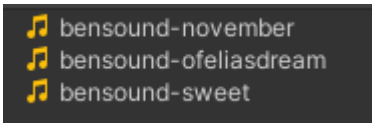


Figure 48: Sound used in main menu

- Loading Screen

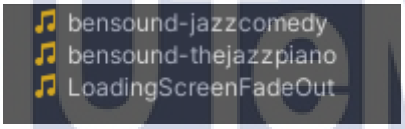


Figure 49: Sound used in loading screen

- In-Game Level

Figure 50:Sound used in in-game gameplay

- A.I Dialogue

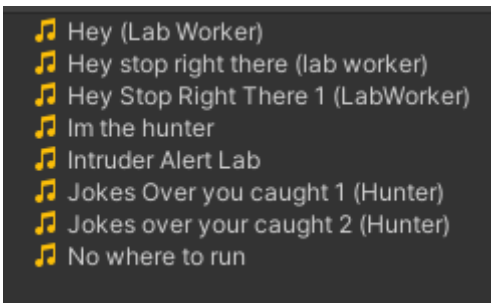


Figure 51: Sound used for enemies

- Animals Sound

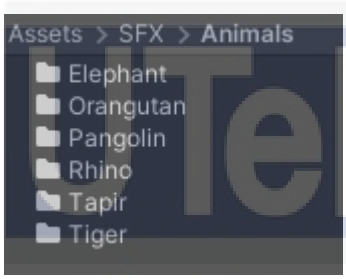


Figure 52:Sound used for animals

4.9 Conclusion

In conclusion, this chapter tells about character models, user interface design, camera modes implemented and sound effects applied in the game. All these phases were important in game development since the early phases of development that would have conveyed concept of game before development of game.

CHAPTER 5: IMPLEMENTATION

5.1 Introduction

In this chapter, one of important phases in game which was implementation is highlighted. This chapter provide information from creation of game art, integration of game component, game configuration management and implementation status.

5.2 Creation of Game Art

The next subsections provides production of graphic, audio and animation.

5.2.1 Production of Graphics

- Unity feature that was used to sculpt and shaping surface of the terrain for level design.

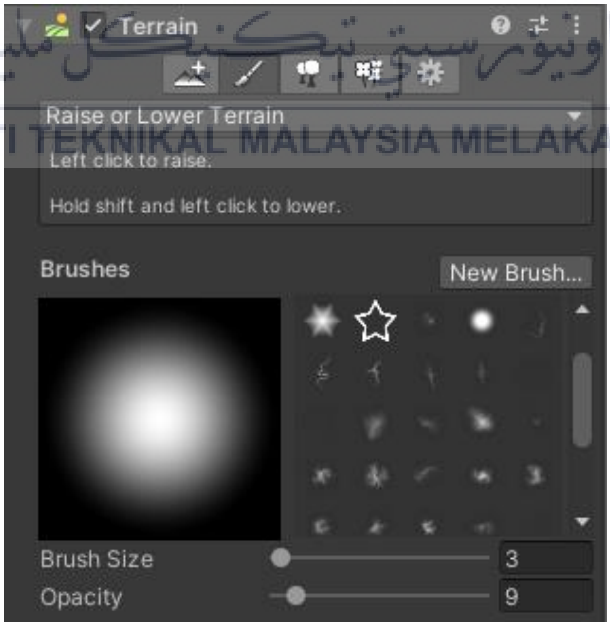


Figure 53: Unity Terrain sculpt feature

- Unity feature that was used to add trees in level design.

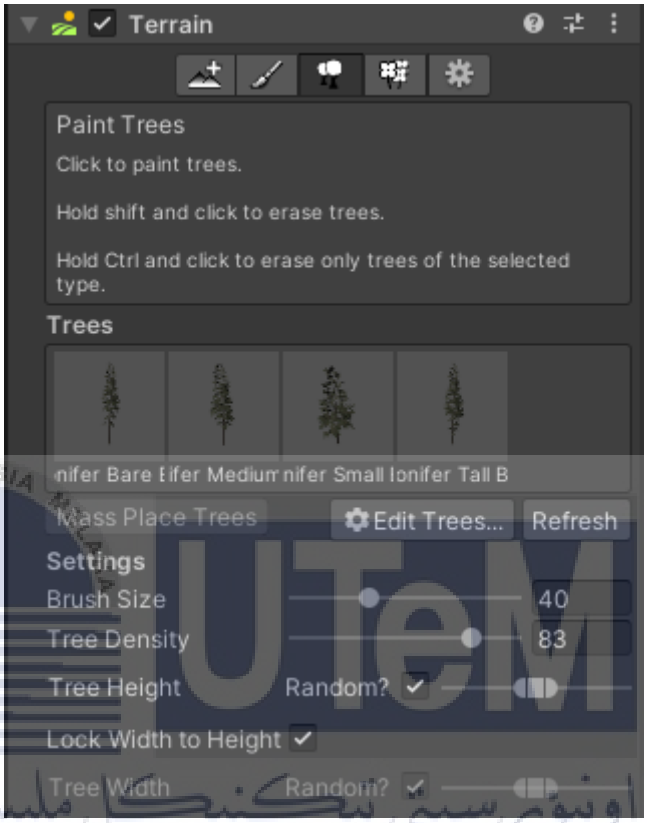


Figure 54: Unity Terrain paint trees feature

- Unity feature that was used to add foliage on level design floor.

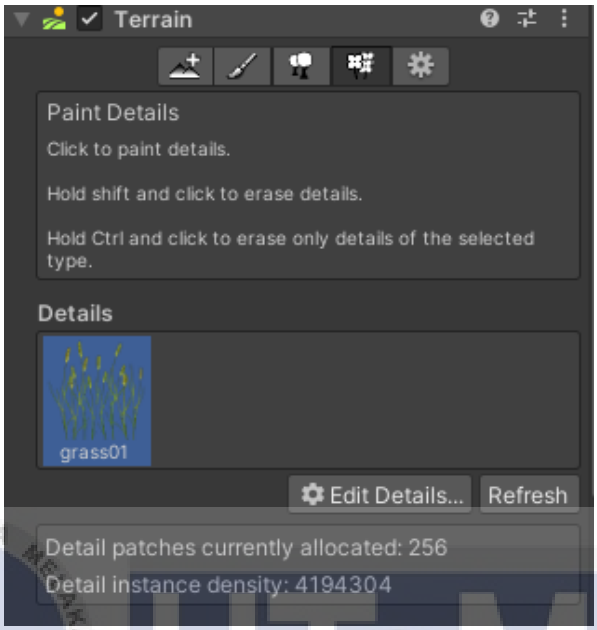


Figure 55: Unity Terrain paint details feature

Figure 56: Blender 3D software for modeling, texturing and animation.

5.2.2 Production of Audio

There a 3 sounds that was used to make the game more immersive excluding the background music which is animals sound, enemy dialogue which is recorded and swing mechanic.

Table 2: Audio used

Sound	Description
Animal sound	Used for animals and implementing 3D sound so player can pinpoint from where the sound is coming from.
Enemy dialogue	Used for enemy to makes player aware of enemy nearby. Enemy will speak the dialogue when detect player.
Swing mechanic sound	Used when player swing across using the red pipe for swinging.

First step is find the suitable sound effect. After the audio file was imported into the audio source, the developer was allowed to configure its setting such as 3D spatial effect, volume, looping, pitch and much more.

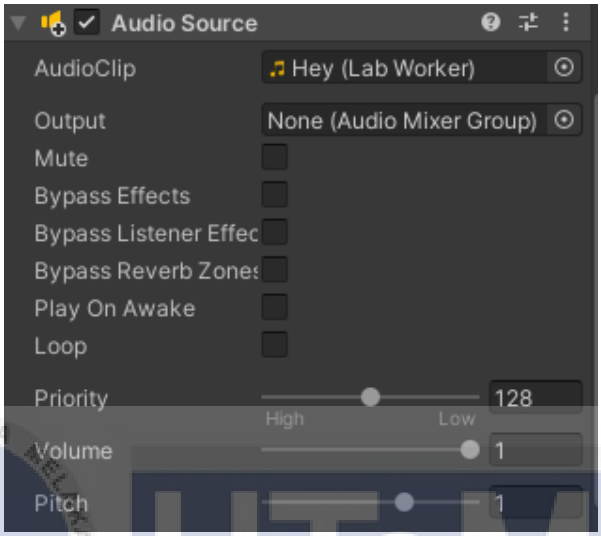


Figure 57: Audio used on one of the enemy

After the audio were implemented in audio source. There will be an volume icon near the game object where the audio was applied.It also can be done by simply drag and drop the audio to the game world but it will not be as precise as drag it into the audio source.

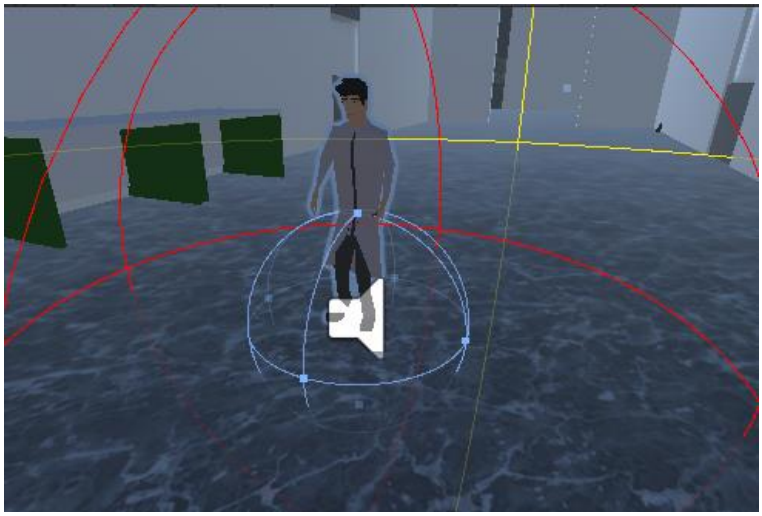


Figure 58: Audio implemented for enemy dialogue

5.2.3 Production of Animation

There are 2 animation per animal species. The 2 animation is idle animation but with slight different variation of animatiom. All the rigging for the animals were customed rigging because Adobe Mixamo can't do rigging for animals (refer to figure 59). There are 10 species in Endangered which 8 species of the animals were endangered and 2 species of the animals were not endangered.

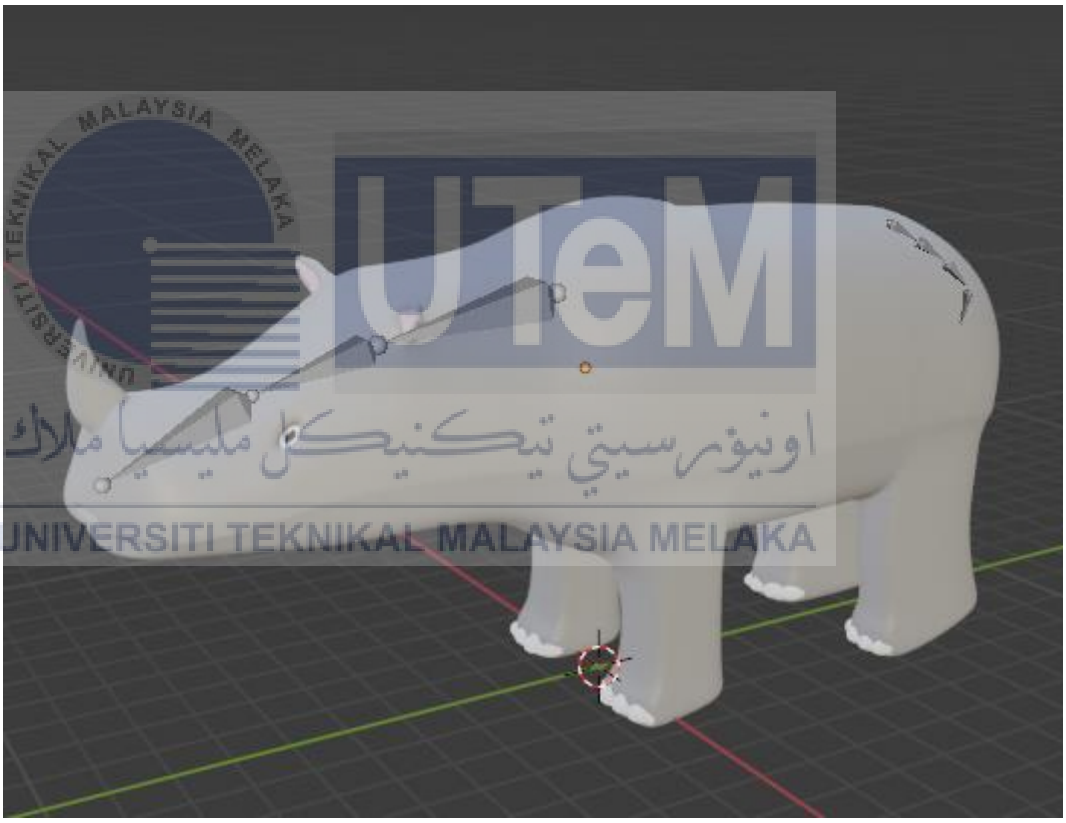


Figure 59: Rigging of Sumatera Rhino

The 3D character was modeled using Blender 3D software. But rigging was created by using Adobe Mixamo (refer to figure 61).

Figure 60: Rigging of hunter

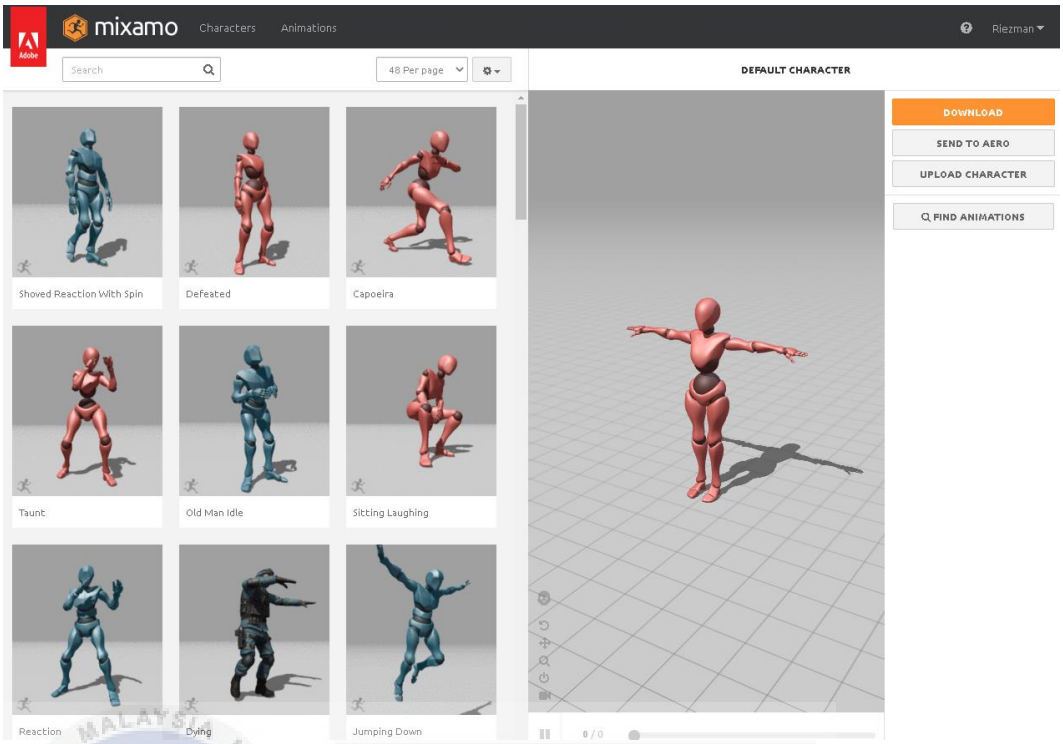


Figure 61: Adobe Mixamo

Then, the next process is make transition animation for the Laboratory Worker (refer to figure 61). Transition of enemy animation and parameters used from Idle, Walking, Running and Punching for Laboratory worker.

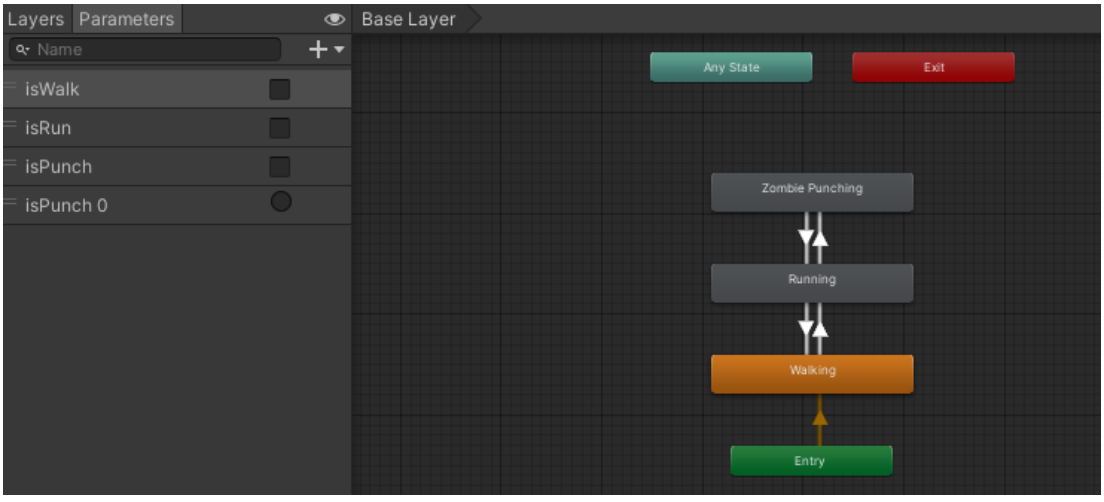


Figure 62: Animation transition of Laboratory Worker

5.3 Integration of Game Component

- **Player Character System**

  Implement inside character blueprint that contains all the main function for the character from the movement, interaction and other mechanics features. (Refer to figure 63)

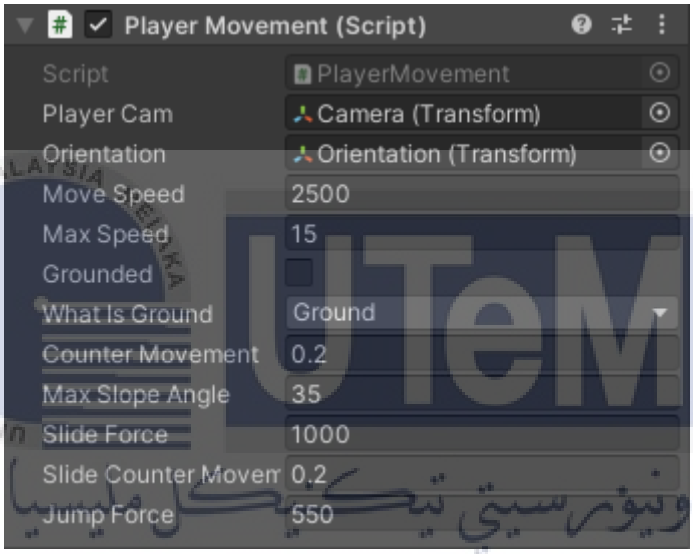


Figure 63: Player Movement setting

- **Camera System**

  Allow the camera to be place at the position of player character eye level. (Refer to figure 64)

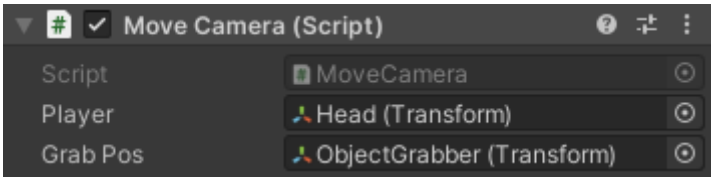


Figure 64: Camera setting

- **Player health system**

  Player character health system to show of how much health point does the character have using user interface. (Refer to figure 65)

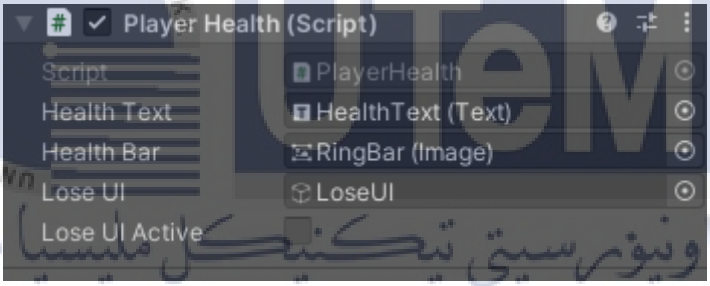


Figure 65: Player health setting

- **Scoring system**

  Score system is link with the UI animation. (Refer to figure 66)

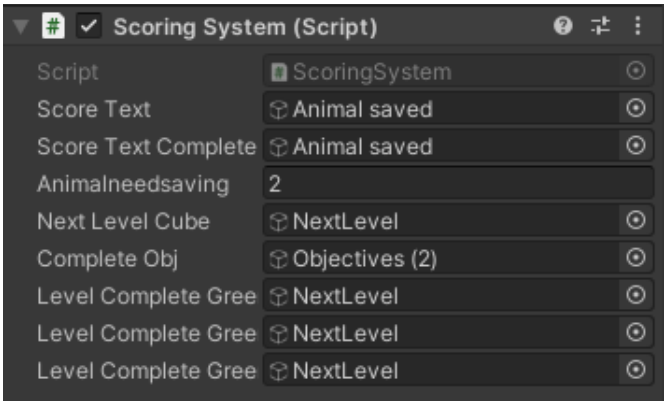


Figure 66: Scoring system setting

- **Enemy AI system**

  This is the setting used to make sure that the enemy will detect player, chase and attack at player. (Refer to figure 67)

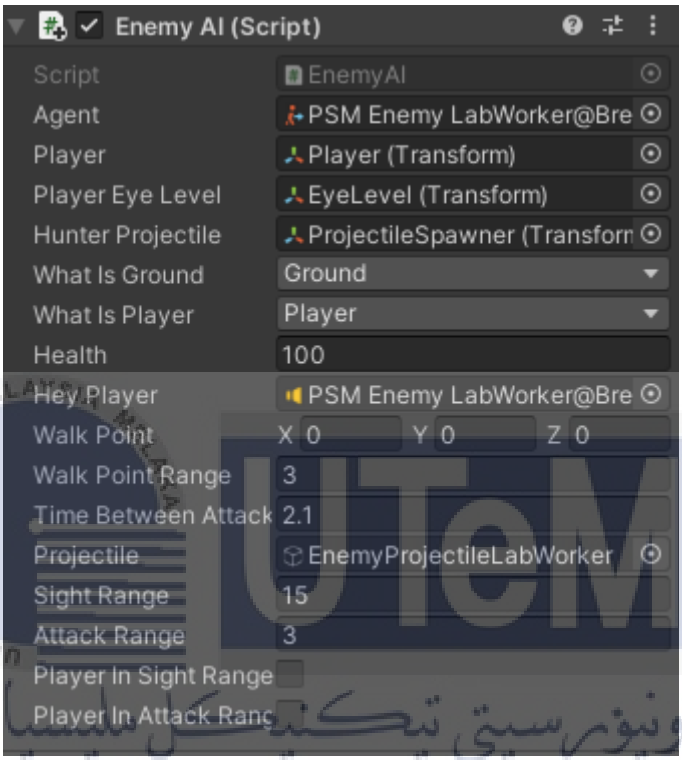


Figure 67: Enemy AI setting

- **Enemy Projectile**

  Allow enemy projectile to deal damage to player character and create sound if the projectile collide with game object which have a "Player" tag. (Refer to figure 68).

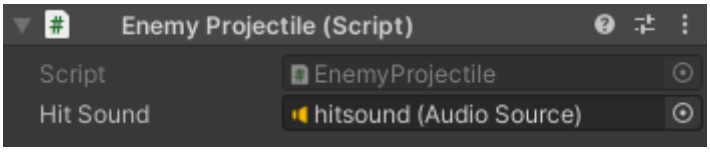


Figure 68: Enemy projectile setting

- **Grappling Gun**

  This is the setting that are used to allow player to swing in the levels for extra movement speed. (Refer to figure 69).

Figure 69: Grappling gun setting

- **Animal collect system**

  Collect animal setting is linked with the score script to allow the value of animal collected to be put in the score system. (Refer to figure 70).

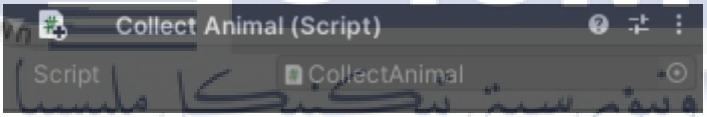


Figure 70: Collect animal setting

- **Pause Menu UI system**

  Allow pause menu UI to be enable and disable with a single button. (Refer to figure 71).

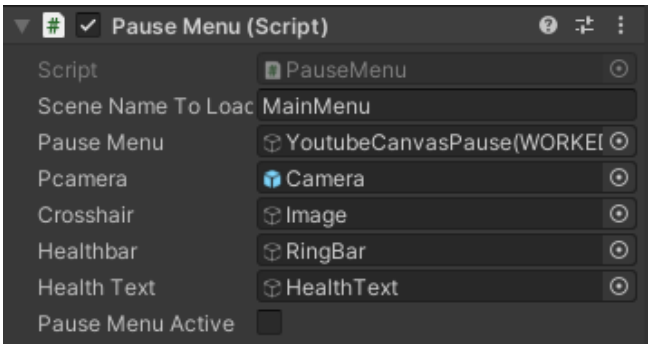


Figure 71: Pause Menu setting

5.4 Game Configuration Management

The game can be played by just downloading the executable files from the given download link either from Google Drive or from Game Jolt website.

5.4.1 Configuration Setup

This project were published using Unity Engine for Windows 64-bit. The game doesn't need any required setup. Player can download the game from Google Drive or GameJolt website and start playing after extracting the zip file of the game files.

5.4.2 Version Control Procedure

Table 3: Testing Phase Table

Testing Phase		
Endangered version 1 (Alpha)	The game will be programmed to see what works and what doesn't, as well as major issues that impact the game in major ways.	It must be playable and in the form of an early prototype. The majority of the time will be spent on mechanics and identifying information. This will be implemented during Final Project 1 in the final year.

Endangered Version 2 (Beta)	The game will be tested by a target focus group, and feedback and questionnaires will be collected from them in order to improve the game further.	Following the evaluator's and supervisor's feedback during the Final Year Project 1 presentation. The game will enter a Beta phase, during which it will be improved in terms of critical features such as the game's goal. Then, during Final Year Project 2, it will reach the final phase, where input from the target focus group will be obtained.
Endangered Version 3 (Golden Version)	The final version where the game is ready to publish to the market.	After evaluation in Final Year Project 2.

5.5 Implementation Status

By narrowing down the phase in the Gantt Chart and Milestone Table, developers will be focusing on the specific components during implementation phase.

Table 4 : Implemenation phase table

Component	Description	Duration To Complete	Completed Duration	Status
Character and 3D Modelling	Modelling, Texturing, Rigging and Animating 3D models inside Blender.	**7 weeks**	**7 weeks**	**On time**
Level Design	Sculpting the terrain, put foliage in the environment, placing game asset and painting different type of textures.	**7 weeks**	**5 weeks**	**On time**
Interface Element and Implementation	Designing game user interfaces and user interfaces in the game engine using 2D and 3D elements.	**3 weeks**	**5 weeks**	**Delay**
Game Mechanic Implementation	Implement all the functions and mechanics inside the game from the	**7 weeks**	**8 weeks**	**Delay**

	gameplay element until interface functionality.			
Animation Management and Implementation	Managing different type of animations that requires different type of skeletons which will be retargeted if needed.	**3 weeks**	**4 weeks**	**Delay**
Texturing and Lighting Build	Texturing level designed using build in texture feature and texturing 3D models using Blender 3D software.	**2 weeks**	**2 weeks**	**On time**
Polishing All Aspects	Polishing any leftover or small details for final touch. Including project settings that need to be configure before exporting.	**1 weeks**	**2 weeks**	**Delay**

5.6 Conclusion

Implementation phase was very important for the game mechanics to work and playable. Its included the creations of the game art which involves production of graphics, audio, video and animation. In term of game integration and C++ language were use for this project by using Microsoft Visual IDE to build the code for the game. In the next chapter, testing for the target group user was conducted for evaluation through questionnaires.

CHAPTER 6: TESTING AND EVALUATION

6.1 Introduction

This chapter will state on the test plan, test strategy, test implementation, test results and analysis. The purpose of this game is to educate young generation about endangered animals with the goal of teaching the player about endangered animals based on the studies of problem statement and requirement of the project to the target users.

6.2 Test Plan

The purpose of this testing is to evaluate the game developed. The testing is conduct during the Beta Phase in Game Development Life Cycle (GDLC) methodology to focus on user acceptance of the project. The method of testing in this project is using Game User Experience Satisfaction Scale (GUESS) questionnaire purposed by Phan, M. H, Keebler, J. R, & Chaparro, B. S (2016). The elements being tester are Demographic of the users, Usability/Playtesting, Enjoyment/Creative Freedom, Visual Aesthetics and Knowledge Improvement after using the product.

6.2.1 Test User

The game will be tested by young gamers around age 12 until 27 years old and above. However due to Movement Control Order(MCO) for Covid-19, the testers will be given the options to play the game through the download link or watch the walkthrough video play by the developer in order to understand the game core concept more specific. The testers then required to answer a set of questionnaires create by the developer.

6.2.2 Game Feature

The main goal of this testing is to assess a variety of factors, including the demographics of the respondents, the game's usability/playtesting, the player's enjoyment/creative freedom, the visual aesthetics of the game, and the player's knowledge gain from playing the game. First, demographics are used to collect specific data from respondents and will be used as manipulative data to influence how respondents respond to other questionnaire sections. Second, usability/playtesting is used to determine whether the GUI, GUX, and control system are user-friendly and responsive. Third, the enjoyment/creative freedom are used to determine how well the game captures the player's feelings and attention, resulting in a desire to play the game. Fourth, visual aesthetics are used to assess the player's satisfaction with the game's graphics and visual elements. Finally, after playing the game, knowledge improvement is used to learn and measure the intensity with which the player's knowledge of the Endangered increased.

6.3 Implementation

The test implementation process started from the game tester registration where the developer setup the the testing procedure through discord channel in order to captured candidates who are interested on being a tester for this project. The group of registered testers then will be given the game download link and required to play the game in their free time. The testers need to report the test completion answering a set of questionnaires

- This test is implemented by 2 phase which are Testing Setup and Answering Questionnaires:

1. Testing Setup
    - Link to game files in Google Drive and GamJolt are sent to discord channel as involvement registration.
    - The target audience can play the game and answer the questionnaire in their free time.
2. Playing Time
    - The participants that are given and accept the links can play the game and answer their opinions in their free time.
3. Answering Questionnaire
    - The tester then will be given a set of questionnaires with total of 7 question in pre-game questionnaire and 30 question in post-game questionnaire.

6.3.1 Test Description

The questionnaire used to evaluate the game is Game User Experience Satisfaction Scale (GUESS) purposed by Phan, M. H., Keebler, J. R., & Chaparro, B. S. (2016). In the purposed questionnaire, there are a set of demographic finding and a total of 9 factors were considered for evaluating the game which are Usability/Playability, Narratives, Play Engrossment, Enjoyment, Creative Freedom, Audio Aesthetics, Personal Gratification, Social Connectivity and Visual Aesthetics but 4 factors were chosen based on its relevance for evaluation test of the game. The chosen factors are Usability/Playability, Narratives, Play Engrossment and Enjoyment. The score method used in the questionnaire is based on Linkert Scale where tester need to answer the question based on the score and its description.

Table 5: Linkert Scale Table

Description	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
Score	1	2	3	4	5	6	7

Table 6: Demographic Factors Table

Demographic
Gender
Age
Race
Platform of games usually played on
Types of video game played
Hours spend playing game per day
Educational game likeness

Table 6 shows Demographic items picked from GUESS questionnaire and used for the project evaluation testing. The picked items were considered relevant for evaluation testing of the project. Demographic factor was chosen to observe how the demographic data can manipulate the respondent behavior and experience with the game. Respondents background will assist to determine if the data can be linear based on the same demographic group

Table 7: Usability/Playtesting Factors Table

Usability/Playtesting
I feel it is easy to use the controls.
I think the user interface elements (eg: font, button) are easy to understand.
It is easy to play the game.
I am satisfied with the player's ability.

Table 7 shows Usability/Playtesting items used for the project's evaluation testing. The items were used to evaluate the responsivity of the game controls and how well the user interface from the user perspectives. This evaluation will indicate either the control and user interface is user friendly or too complex for the user to understand.

Table 8: User Interface Factors Table

User Interface
The main menu design is suitable with the educational games.
I can understand the main objectives.
I know what task I need to do in each level.
I can complete the task easily with the user interface shown.

Table 8 shows User Interface items used for the project's evaluation testing. The items were to evaluate of how the user interface have affect the players attention in understanding for in-game material such as the objectives. User Interface can make player figure out what they are need to do next in order to complete the objectives.

Table 9: User Experience Factors Table

User Experience
I can see the environment setup for the games.
The player should have more life point.
I can hear the animals that are needed help in the levels.
I am satisfied with the sound design in this game.

Table 9 shows User Experience items used for the project's evaluation testing. The items were used to evaluate the abilities of the game to capture audience attention and immersion into liking the game. User Experience can be the overall indicator either the game is fun or not from the player perspectives.

Table 10: Gameplay Factors Table

Gameplay
I enjoy playing Endangered.
I can play the game the way I want.
I will recommend this game to others.
I find the game is unique or original.

Table 10 shows gameplay elements needed for project assessment testing through gaming, the objects were utilised to assess how players perceive the game itself. Gameplay may also be utilised to determine whether or not the user believes the game has its own originality and whether or not they would suggest it to their friends for further data.

Table 11: Visual Aesthetics Factor Table

Visual Aesthetics
I enjoy the game's graphics.
I find the graphics of the game fit the mood or style of the game.
I find the GUI is easy to understand.
I find the level design of the game is good.

Table 11 shows Visual Aesthetics items used for the project's evaluation testing. The items were used to measure the graphical and visual level that satisfy the player. This also will evaluate how the game graphic can affect user experiences when playing the game

Table 12: Understanding / Knowledge Improvement Factors Table

Understanding / Knowledge Improvement
The game increases my knowledge about endangered animals.
The game increases my awareness towards endangered animals.

Table 12 shows Knowledge Improvement items that has been alter a little bit to fit the projects evaluation. This item are used to evaluate the effectiveness of the game to increase player knowledge and awareness about Endangered after playing the game.

6.4 Test Result and Analysis

The next subsections provides introduction, Demographics, Usability/Playtesting, User Interface, User Experience, Gameplay, Visual Aesthetics, Knowledge Improvement and respondents suggestion

6.4.1 Introduction

The purpose of survey questionnaire is to gather the data of five parts from questionnaire which are user Demographics, Usability/Playtesting, User Interface, User Experience, Gameplay, Visual Aesthetics, Knowledge Improvement and respondent suggestion. The reasons why questionnaire was used is to replace a face-to-face interview and to confirm with the result of observations. The survey taking time less than 5 minutes for responses to answer and complete all the given questions.

6.4.2 Demographics

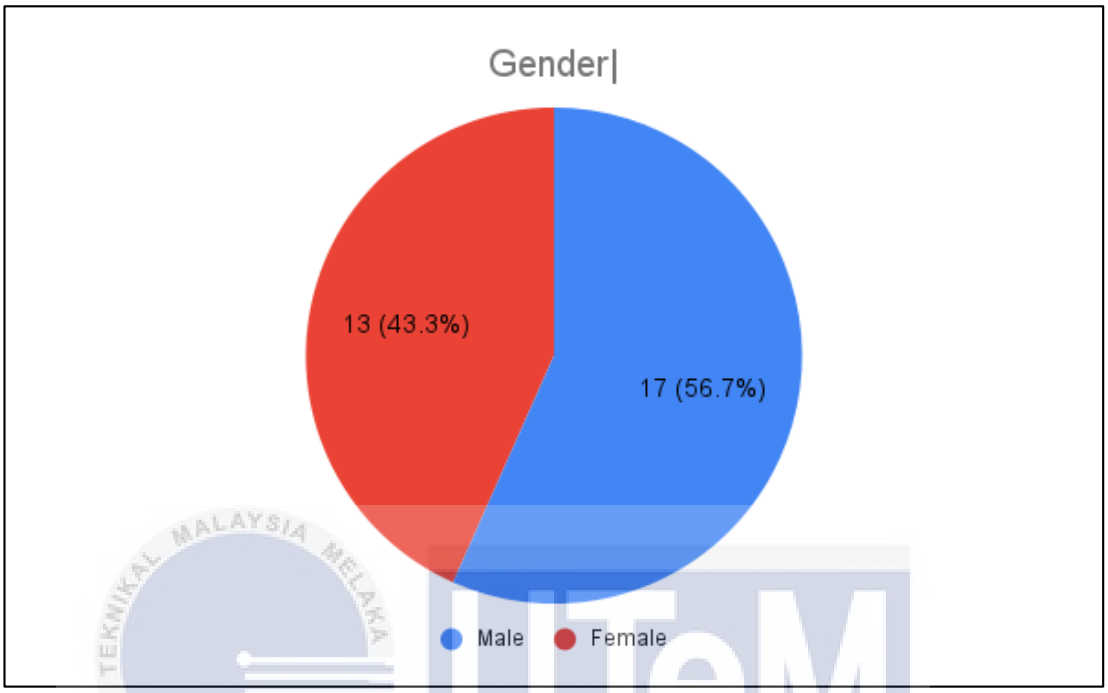


Figure 72: Gender Data Pie Chart

Figure 72 shows that out of 30 respondents there are 17 male respondents (56.7%) and 13 female respondents (43.3%) participate in the testing.

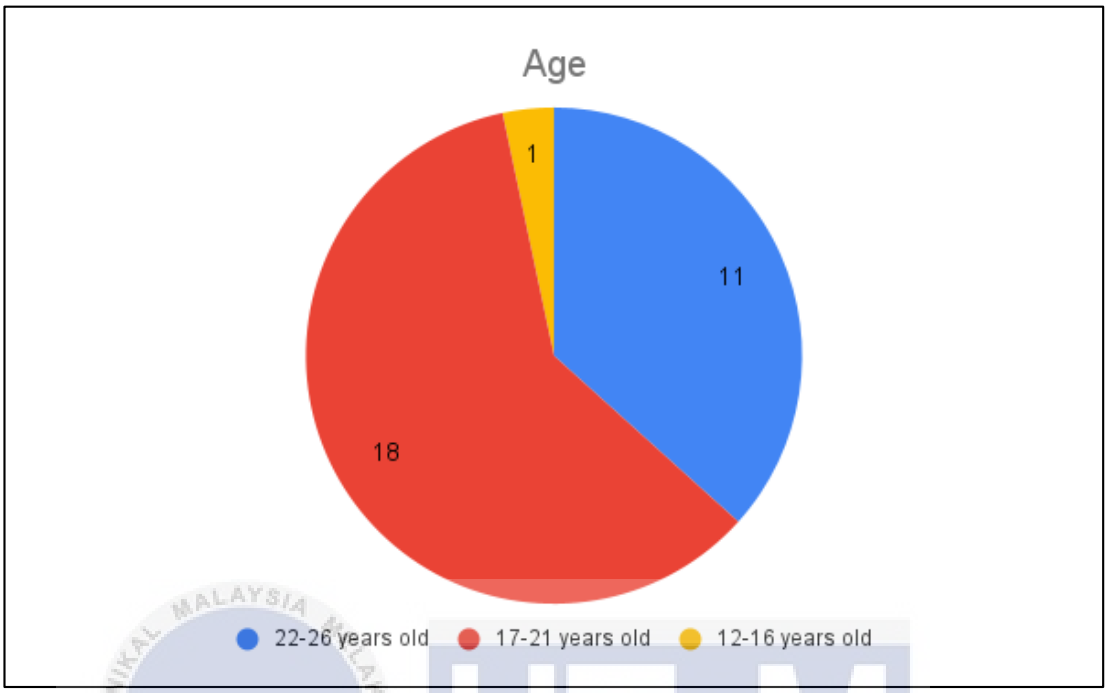


Figure 73: Age Data Pie Chart

Figure 73 shows that out of 30 respondents participate there are 1 respondent (3.3%) from age 12-16 years old, 11 respondents (36.7%) from age 17-21 years old, 18 respondents from age 22-26 years old and none from age 27 and above.

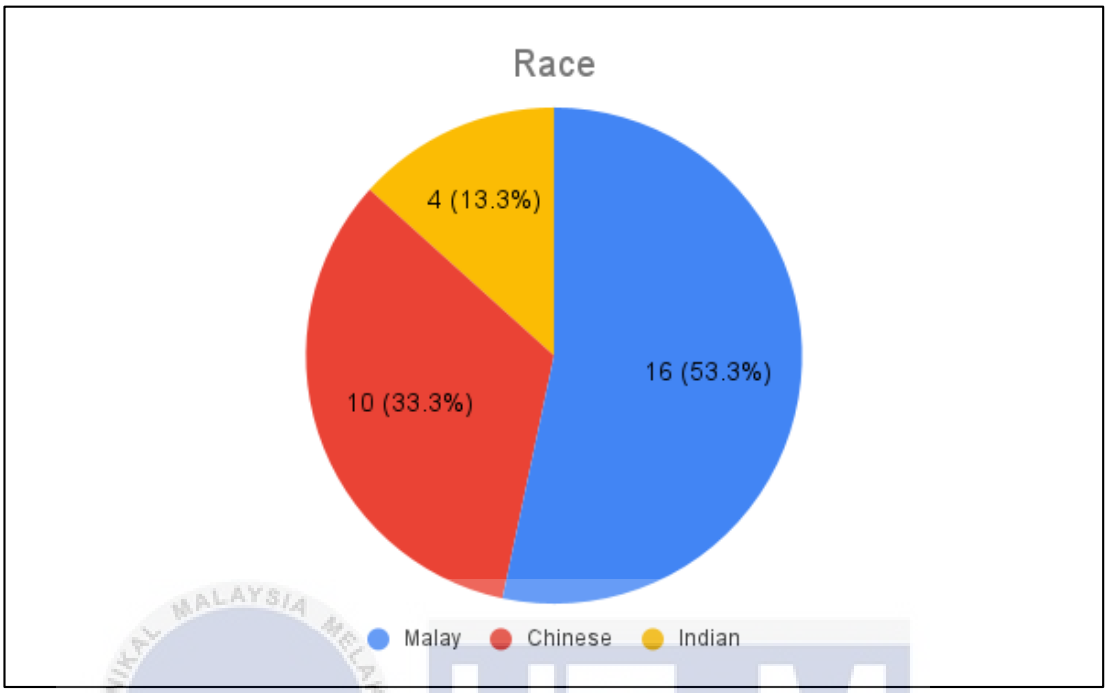


Figure 74: Race Data Pie Chart

Figure 74 shows that out of 30 respondents participate there are 16 respondents (53.3%) from Malay race, 10 respondents (33.3%) from Chinese race and 4 respondents (13.3%) from Indian race.

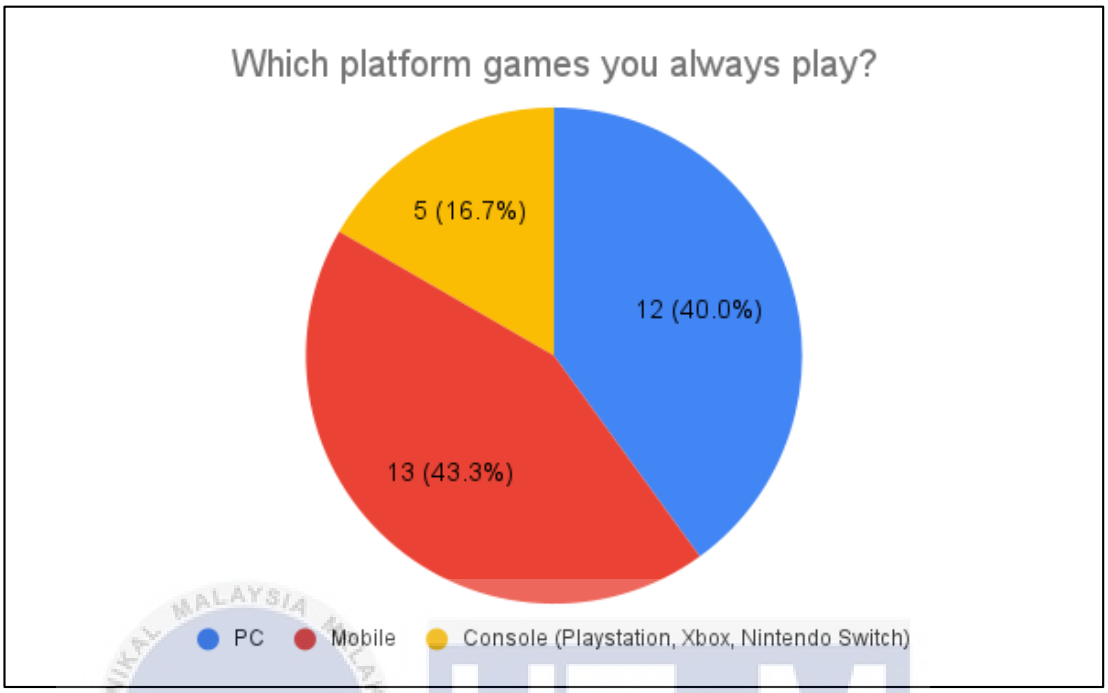


Figure 75: Platform Played Data Pie Chart

Figure 75 shows that out of 30 respondents participate there are 12 PC gamer (40%), 13 Mobile gamer (43.3%) and 5 Console gamer (16.7%).

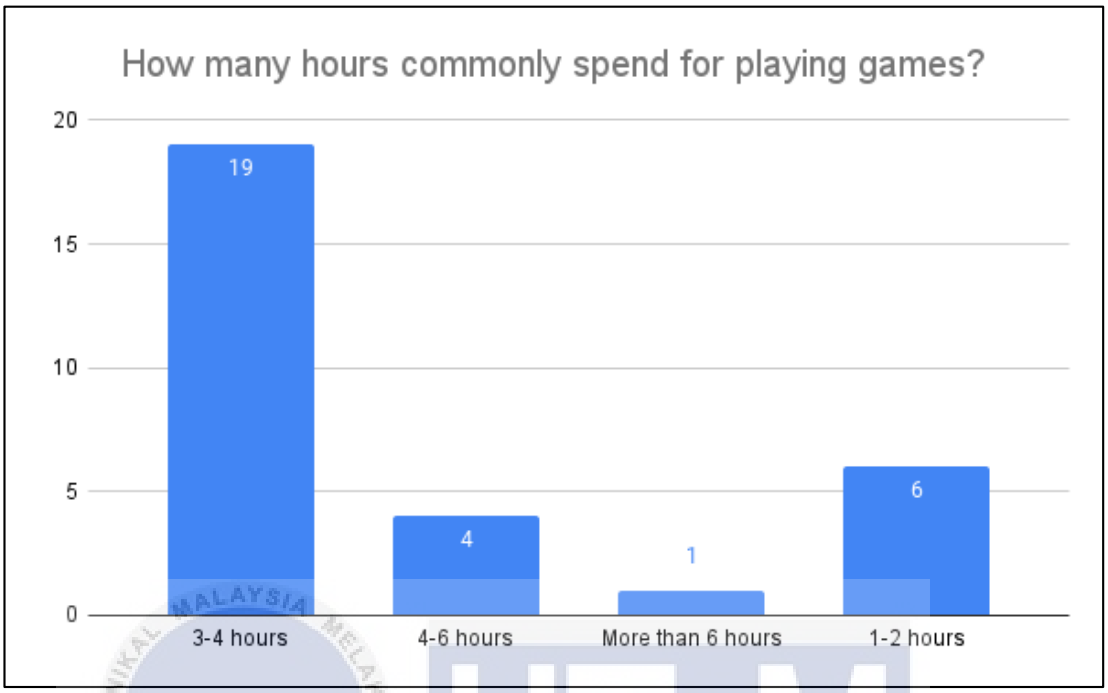


Figure 76: Hours Spend Data

Figure 76 shows that out of 30 respondents participate there are 6 respondents (20.0%) spends 1-2 hours, 19 respondents (63.3%) spends 3-4 hours, 4 respondents (13.3%) spends 4-6 hours and 1 respondent (3.3%) spends more than 6 hours playing video games.

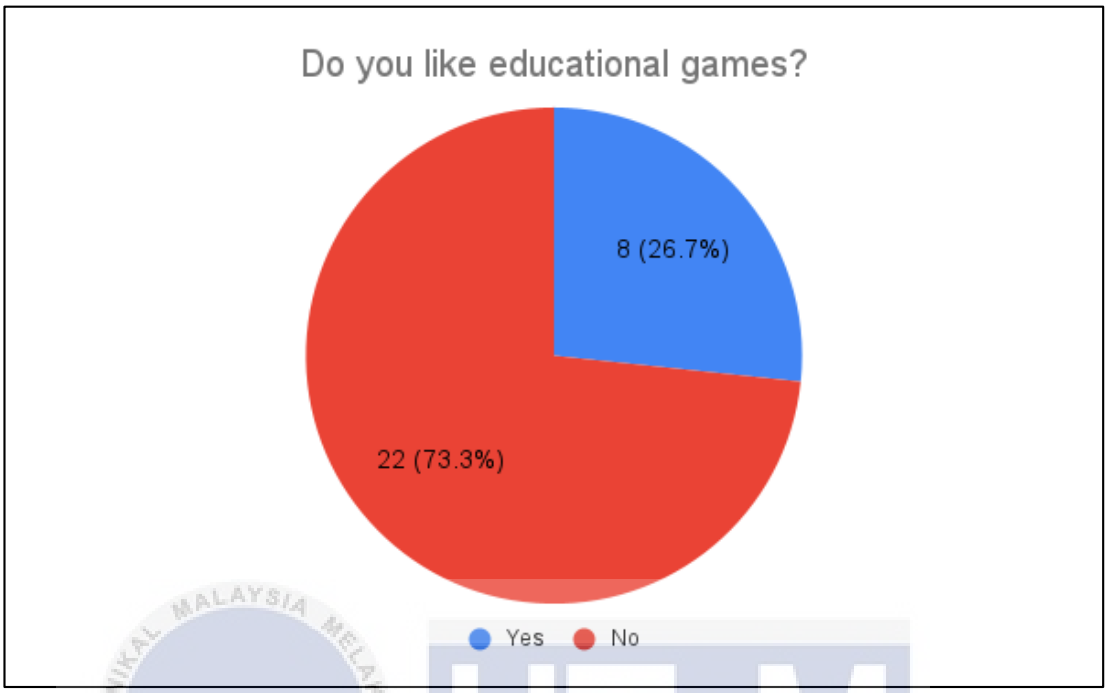


Figure 77: Educational Game likeness Data Pie Chart

Figure 77 shows that out of 30 respondents participate there are 8 respondents (26.7%) like educational games and 22 respondent (73.3%) doesn't like educational game before playing Endangered.

6.4.3 Usablity/Playtesting

Table 13: Usability/Playtesting Mean and Standard Deviation

	Mean	Standard Deviation
I feel it is easy to use the controls.	**5.7**	**0.49**
I think the user interface elements (eg: font, button) are easy to understand.	**5.63**	**0.36**
It is easy to play the game.	**5.67**	**0.36**
I am satisfied with the player's ability.	**5.47**	**0.45**

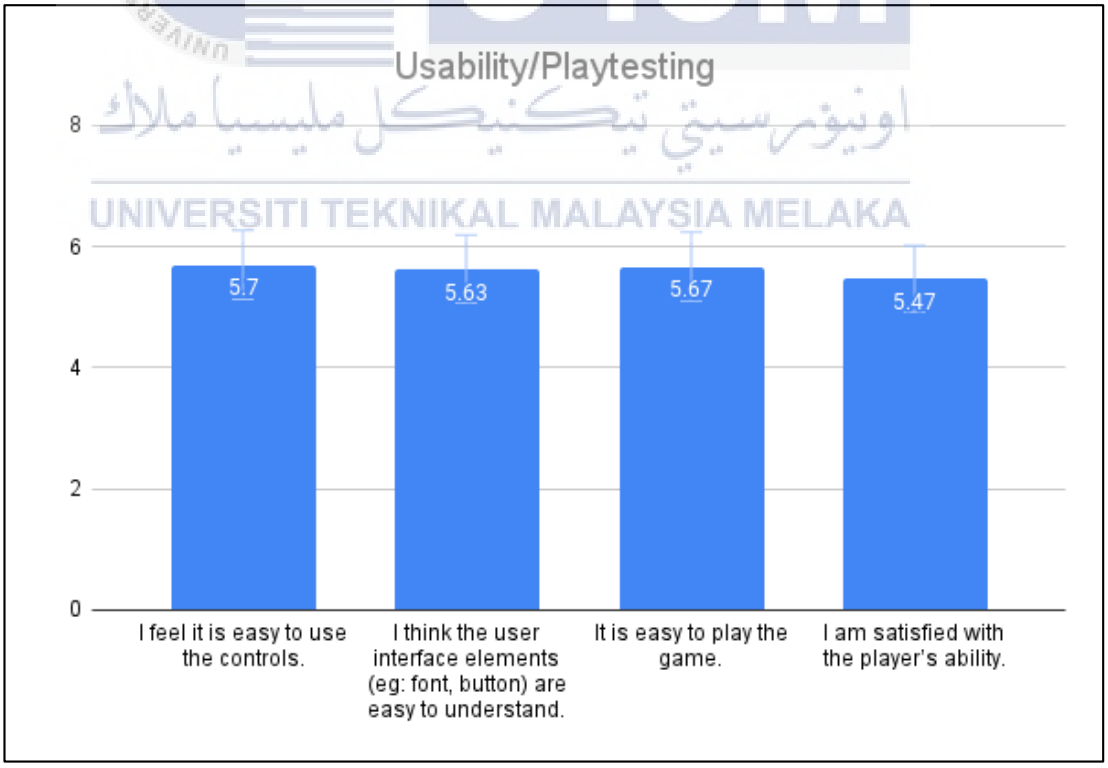


Figure 78: Usability/Playtesting Mean and Standard Deviation Graph

Based on mean graph figure 78, there are 4 evaluations including on how easy to use the controls, user friendly menus, how easy player can play the game and satisfaction of player with player's ability. The mean for all four evaluations is between range 4 and above, indicating that the majority of respondents agree with the assessment. Based on the findings, we can refer that the system's design and usability are as they should be; yet, it appears to be a little too complex for certain people, particularly those unfamiliar with this genre.

6.4.4 User Interface

Table 14: User Interface Mean and Standard Deviation

	Mean	Standard Deviation
The main menu design is suitable with the educational games.	**5.67**	**0.45**
I can understand the main objectives.	**5.63**	**0.365**
I know what task I need to do in each level.	**5.73**	**0.39**
I can complete the task easily with the user interface shown.	**5.63**	**0.365**

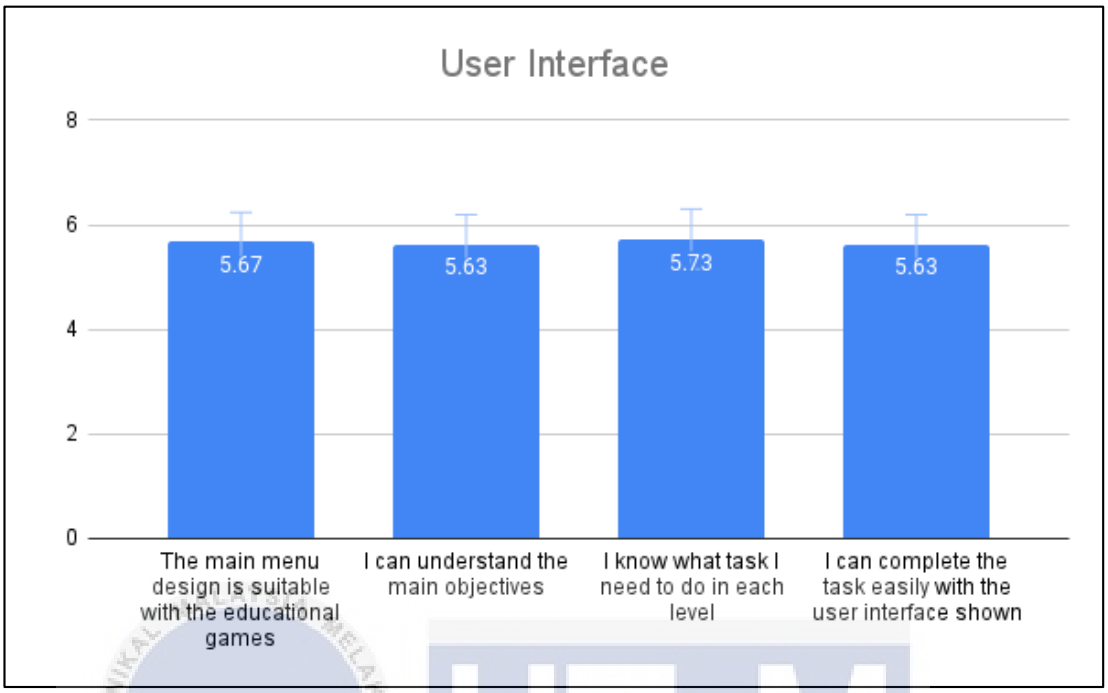


Figure 79: User Interface Graph

Based on mean graph figure 79, there are 4 evaluations including on the main menu design of the game, player understanding of the main objective, player decision making of what task to do and design of user interface design that help player to complete the task easily. The mean for all four evaluations is between range 4 and above, indicating that the majority of respondents agree with the assessment.

6.4.5 User Experience

Table 15: User Experience Mean and Standard Deviation

	Mean	Standard Deviation
I can see the environment setup for the games.	**5.6**	**0.37**
The player should have more life point.	**3.33**	**1.96**
I can hear the animals that are needed help in the levels.	**5.83**	**0.34**
I am satisfied with the sound design in this game.	**5.53**	**0.38**

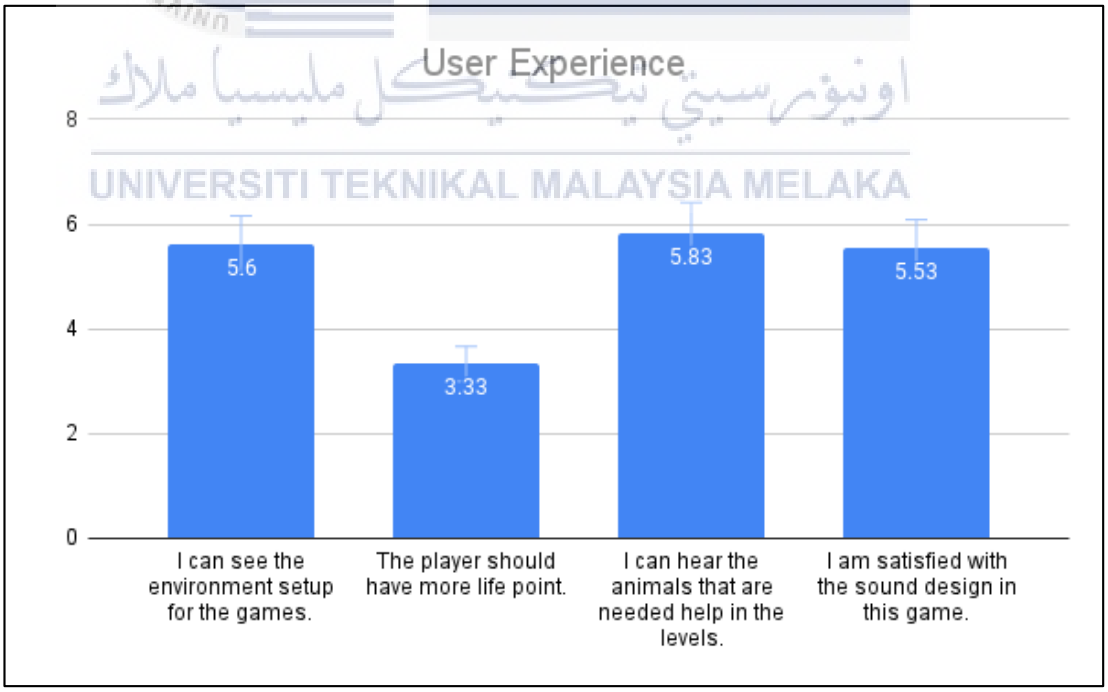


Figure 80: User Experience Graph

Based on mean graph figure 80, there are 4 evaluations including environment setup quality, value of player life point, audio of animals in danger and sound design in the game. Only three evaluations is between range 4 and above, indicating that not majority of respondents agree with the assessment.

6.4.6 Gameplay

Table 16: Gameplay Mean and Standard Deviation

	Mean	Standard Deviation
I enjoy playing Endangered.	**5.6**	**0.37**
I can play the game the way I want.	**5.73**	**0.396**
I will recommend this game to others.	**4.9**	**1.157**
I find the game is unique or original.	**6.3**	**0.41**

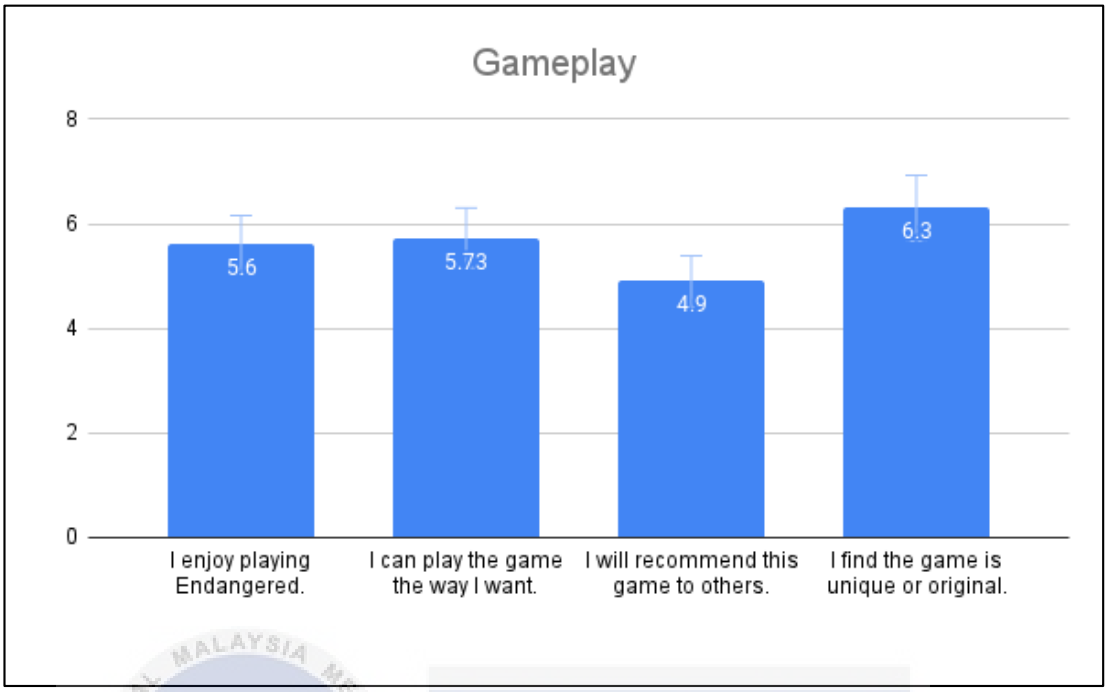


Figure 81: Gameplay Graph

Based on the mean graph 81, there are 4 evaluations including player enjoyment when playing the game, tendency for player to recommend the game to others, how well the game gives the sense of freedom to the player and do player agree that the game is unique and original. As we can see, all four of the evaluation mean scored between range 4 and above which indicate the majority of the respondents agree with the evaluation. From the result we can conclude that most of the player feel the enjoyment from the game due to a lot of game mechanics implemented to make an educational game enjoyable.

6.4.7 Visual Aesthetics

Table 17: Visual Aesthetics Mean and Standard Deviation

	Mean	Standard Deviation
I enjoy the game's graphics.	**5.47**	**0.316**
I find the graphics of the game fit the mood or style of the game.	**5.43**	**0.312**
I find the GUI is easy to understand.	**5.67**	**0.36**
I find the level design of the game is good.	**5.567**	**0.312**

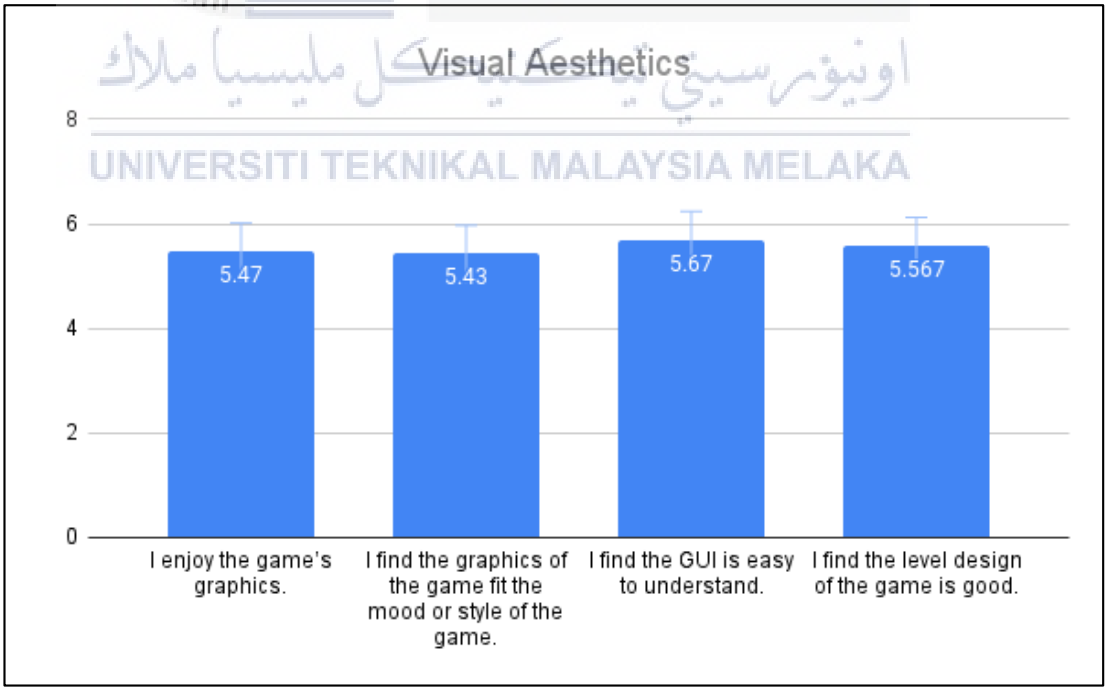


Figure 82: Visual Aesthetics Graph

Based on the mean graph 82, there are 4 evaluations including the user satisfaction with the graphics, how well the graphics blend and fit the mood and style in the game, how visually appealing was the graphic to user and how level design appealing to player.The result shows that majority of the respondents agree with the evaluation, however we can conclude that the graphic and visual presentation in the game still have some weakness to receive maximum satisfaction from the user.

6.4.8 Knowledge Improvement

Table 18: Knowledge Improvement Mean and Standard Deviation

	Mean	**Standard Deviation**
The game increases my knowledge about endangered animals.	**5.367**	**0.366**
The game increases my awareness towards endangered animals.	**5.4**	**0.37**

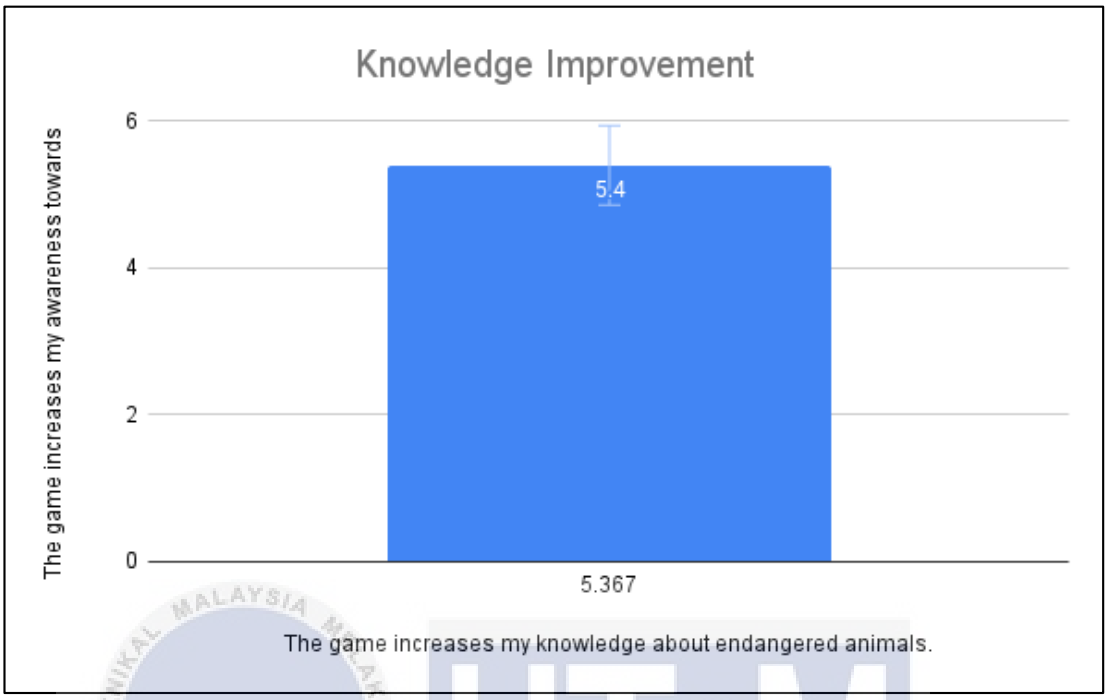


Figure 83: Knowledge Improvement Graph

Based on the mean graph figure 83, we see that the mean score above 4 with a less standard deviation which stated that all the respondents agree that they gained new knowledge and awareness about endangered animals while playing Endangered.

6.4.9 Respondents Suggestion

Out of 30 respondents, 10 of them were giving suggestion for the further improvement. 2 of them were giving specifically suggestion on fixing bugs that they found while playing which makes the player can flying above the levels. Another 3 of them suggested on improving and adding the sound effect for more immersive

gameplay. Lastly, 7 of them suggested on improving for the visual affect and level design to make it proper with the animal theme.

6.5 Conclusion

As a conclusion, this chapter briefly describes the testing and responses from respondents who participated in the game or watched the walkthrough video before filling out surveys. A total of 37 questions were asked, with 30 people responding. The majority of respondents firmly believe that the game is beneficial in all aspects, according to the results. The game's presentation and aesthetics, such as realistic visuals and audio elements in the game that include ambient sound and level design, may be improved, according to the respondents' suggestions. The observation of strengths and shortcomings, as well as suggestions for development and contributions, will be covered in the next chapter.

CHAPTER 7: CONCLUSION

7.1 Strength and Weakness of Endangered

Endangered game is gameplay mechanics and level design are its strongest points. The gaming mechanics offer the user a variety of ways to enjoy the game while searching for endangered species. For example, employing the swing mechanics to offer the player flexibility of movement, the player can travel faster. This variety of gameplay mechanisms is critical in order to create a free environment in which players can do whatever they want while enjoying the sandbox type game.

For the level design, developer was inspired by the concept and scenery of forest from around Malaysia. Each forest have its own time of a day such as day, dusk and night to give feels of time flow. Also many variation of trees, bush and animals are put into the level design so the levels doesn't feels empty while player roaming around.

As for weaknesses from self observation and user feedback. It can be conclude that the game have major and minor flaws. The major weaknesses in the game are the audio aesthetics. The game world have animals sound, enemy sound and swing sound . However there is no sound for UI interaction and other mechanics sound effect such as walking, jumping and pickup.

The minor weaknesses are the graphical and visual aesthetics where the geography in the game world are not interesting or fascinating as it should be compared to real forest around Malaysia. Some issues can be fix with current limited resources

such as world representation design that could be improved to make the world more realistic.

7.2 Future Work

From the result of evaluation, there are a lot of proposition for future improvement to be made for the Endangered game based on user feedback and suggestion asked.

Firstly, major improvement that can be made is level design. There are some saying the levels design is a bit not match with the animals theme because the player not understand why that levels design it chosen in the first place. More props and foliage can be add to create a more immersive level design for player to explore.

Secondly, major improvement that can be made is the audio itself. In order to create a good levels design, audio is needed to balance and create immersiveness of the levels. This can be done by adding ambient sound such as wind, bird chirping and insect sound effect to the levels.

Finally, there other minor improvement that can be made such as fixing bugs and polishing the mechanics implement in the game for smoother and fluid movement mechanics.

7.3 Contribution

The development of this game are actually intended to create a 3D platformer game through design and implementation. The objectives for this development are to set a new approach for a young generation to have more awareness and knowledge about endangered animals in endangered animals. So, this game contributes to the preservation of endangered game and game industry itself.

7.4 Conclusion

This chapter will be concluded for all other chapter written that provide the introduction, literature review and project methodology, analysis, design, implementation, testing and evaluation.

The main objectives of Endangered have been achieved where young generation can increase their knowledge and awareness about endangered animals through design and implementation of 3D platformer game. The product also have a lot of potentials that can be polished to increase game industry marketability in Malaysia.

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