VR SMART SCIENCE MAZE

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Bachelor Of Computer Science (Graphic and Multimedia Technology)

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VR SMART SCIENCE MAZE

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ABSTRAK

Kaedah pembelajaran yang efektif di sekolah sangat memberi impak kepada sistem pendidikan negara. Zaman mula berubah, ramai guru yang mula sedar akan kaedah pembelajaran yang lama masih tidak cukup untuk membuktikan kefahaman pelajar tentang apa yang mereka pelajari di sekolah. Pelbagai pendekatan yang diambil oleh guru-guru di negara ini demi membantu kefahaman pelajar dalam pembelajaran. Antara pendekatan pembelajaran yang boleh diaplikasi pada pelajar sekolah adalah dengan bermain sambil belajar. Oleh itu, permainan yang bertemakan strategi dan penerokaan dicipta bagi membantu guru dalam memastikan kefahaman pelajar. Permainan ini juga dicipta dengan menggunakan teknologi realiti maya, di mana pelajar dapat melihat object atau benda yang sukar untuk di dilihat di dunia nyata tetapi dapat dilihat secara maya. Sepanjang permainan pelajar akan dapat melihat paparan dengan motif dan informasi yang berbentuk tiga dimensi (3D).

ABSTRACT

Effective learning methods in schools greatly impact the country's education system. Times are changing, many teachers are starting to realize that the old learning methods are still not enough to prove students' understanding of what they learn in school. Various approaches are taken by teachers in this country to help students understand learning. One of the learning approaches that can be applied to school students is playing while learning. Therefore, games with the theme of strategy and exploration were created to help teachers in ensuring student understanding. This game is also created using virtual reality technology, where students can see objects or things that are difficult to see in the real world but can be seen virtually. Throughout the game, students will be able to see displays with motifs and information in three dimensions (3D).

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LIST OF SYMBOLS

LIST OF ABBREVIATIONS

UMP   Universiti Malaysia Pahang

VR   Virtual Reality

3D   Three Dimensional

CHAPTER 1

INTRODUCTION

1.1   Introduction

Science is one of the types of knowledge that is often associated with natural phenomena that occur in this world. The existence of this science aims to reveal the truth that is the question of the occurrence of something in the world in the daily life of humans and nature. For example, the famous English philosopher, Isaac Newton introduced Newton's laws in explaining the gravitational attraction that occurs on earth and in space and made it a reference until today.

In Malaysia, science education is given to children as young as three or four years old in formal schools. Based on observations, teachers at school often conduct physical science experiments to show their students unravel the reactions from the experiments they conduct. Each experiment requires materials and tools that require the school and teachers to incur costs in experimenting at school, especially in science subjects. If the students at school nowadays lack interest in learning science, technology, and mathematics, this has cost the school money and it has become a waste and wasted effort. Some school students prefer to spend their free time playing video games instead of studying at home. Varied game genres have made students download unlimited video games on their devices to try and explore these games for free. Not only that but playing video games has also become part of the students' hobbies at school.

Science learning can be delivered to students with the use of the latest technology such as Virtual Reality (VR). Virtual Reality is a visual 360-degree environment produced by a computer. Humans can interact with objects produced by computers virtually in real-time. Learning content can be designed into a video game developed with the help of virtual reality technology to enable students to improve their knowledge and

memory in science. Students can play while learning in a fun atmosphere with displays provided in virtual reality.

1.2   Problem Statement

One of the problems is that students nowadays are more interested in playing video games than studying at home. Every day they spend more of their time playing video games (Dr. Ananya Mandal, 2020). This is because there are many video games available on the Play Store and App Store platforms that are ready to be downloaded for free on their devices. As a result, their academic performance tends to decrease and they fail in their studies.

According to statistics, the most popular video game genre downloaded and played in Malaysia is a strategy (Elliott, 2020). Therefore, by using the interest of students who like to play video games, strategy video games with educational contents will be developed in this project using virtual reality technology. In this video game, knowledge related to science subjects will be introduced to the player. So with that, players can play while learning and adding knowledge. Also, it can replace old learning methods such as the teachers need to print the pictures or materials using paper related to the topic they want to teach in the classroom, especially in grade six science subject topic five *Pemeliharaan dan Pemuliharaan* which involves animals and plants that do not exist and are difficult to see in the real world.

The benefit of this VR application is that players can explore the world of science and add knowledge through the content provided in the game while strategizing to win. Indirectly, the player's memory can be strengthened while using this application. Compared to other strategy games, players only play and strategize just to win and to their own satisfaction. It cannot help players in improving their knowledge and cannot apply that knowledge at school during exams.

1.3   Objective

i.   To study the existing VR applications related to the syllabus of Chapter 5 in Science subject for standard six at primary school.

ii.   To develop a VR application that can foster students' interest in learning while playing

iii. To test the functionality of the VR application in helping students improve their level of knowledge about chapter five science subjects *Pemeliharaan dan Pemuliharaan* especially about endangered animals and plants, extinct animals, and examples of preservation and conservation

1.4   Scope

1.4.1   System Scope
- Display the 360-degree virtual environment

- Player movement and interaction

- Android Apllication Package (APK)

1.4.2   User Scope
- The target audience is 6th-grade school students

- Open game application

- Move 360 degrees and interact with objects in the virtual reality

1.4.3   Topic Cover

- Grade 6 science subject chapter 5: PEMELIHARAAN DAN PEMULIHARAAN (endangered animals and plants, extinct animals, and examples of preservation and conservation)

1.5 Project Significant

i. The significance of this project is to expose students to science knowledge using Virtual Reality (VR).

ii. The importance of this project is to ensure students can get benefit from this game application of Virtual Reality (VR) and improve their knowledge about sciences.

iii. The use of VR Technology is a new learning method that can attract students to play while learning.

1.6 Thesis Organization

This thesis consists of 5 chapters. Chapter 1 outlines the introduction to the project, the problem statements, the objectives, the scope, the significance, and the thesis organization of the entire project. Chapter 2 describes the literature review of three other previous projects of a maze game using Virtual Reality (VR) and a comparison between the previous projects. Chapter 3 focuses on the methodology of the entire project in the development of the project. Based on the research, the model chosen for this project is the Agile model. Chapter 4 describes the implementation, results, and discussion of this project. Every result obtained during the development and implementation is documented and discussed in this chapter. Chapter 5 is the summarization of the entirety of the results gained from this project. The limitation and constraints of this project were also mentioned, and future work is also discussed in this chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Chapter 2 covers the review of projects of three maze games and two science educational games that using Virtual Technology (VR). A study was made to find out more about the technology developed in the game, along with its advantages and disadvantages. A comparison is also carried out in this chapter which includes three selected applications.

2.1.2 Virtual reality (VR)

Virtual reality (VR) is a form of computer technology that combines computer-generated images of the actual world with software to let users observe, explore, and interact with it. By using the principle of a virtual 3D space that resembles the actual world within a certain region, it simulates the real world in the virtual realm. (Said et al., 2020)

By using Virtual Reality(VR) in developing educational games, three things need to be focused on, which are immersion, usability, and playability (Gao et al., 2019). Usability refers to how easily players can understand and learn about the environment of the game, especially in controlling and interacting inside the game. This is important because it can affect the player's experience while playing the game and then contribute to the low likeability of the player if the game is not easy to play. The less likeability, the less learning outcome the player will get. Playability refers to the satisfying experience while the player playing the game. Good design of game mechanics can contribute to a player's attractiveness to play the game. Immersion refers to the objective quality of virtual reality balance and the satisfaction of players interacting in the virtual reality world. The quality of delivering a good virtual environment and the freedom to interact in the virtual world to the player can add to the fun experience for the player when playing the game, then help improve the player's knowledge and gain new knowledge.

There are two kinds of virtual reality modeling methods, one is the method that is based on 3D graphics and using computer graphics technology to model and render virtual environment.The second is based on images and using multiple points of view, panoramic view, or any direction image to create a virtual environment. Basing on the method of computer graphics has high interactivity, but due to the complexity of the modeling and rendering process, and in order to ensure the real-time effect so has a high requirement for hardware and software (Kuang & Bai, 2018).

Through this technology, we must also determine whether virtual reality is advantageous or disadvantageous. One of the benefits of learning using virtual reality technology is being able to explore new knowledge in learning. Learning is delivered without limitations because it can realize something that no longer exists in the world or is impossible to find exhibited in this world through virtual reality. For example, animals that have become extinct on earth can be brought back to life with the help of virtual reality for student learning. In general, the teacher will use physical learning techniques such as bringing materials to print pictures or materials that involve experiments that need to be done in the lab and then shown to the students. However, in reality teaching, the teaching effect of many schools is not good enough to meet the learning needs of each student (Jiang et al., 2019). So, with the help of this technology, it can be an assistant to teachers in teaching students at school by introducing learning games for their students to play at home as an early preparation for learning. When at school, it helps facilitate the teacher's learning session in providing understanding to the students on a certain topic in the class. This is because, they only rely on a virtual environment that requires a mouse, keyboard, and VR interaction tools to move while learning. So students will think, they only need to use technology like this for them to learn regardless of the actual learning taught by teachers at school.

The use of VR technology today is still relevant in conveying something. This technology should be used in a direction that brings good so that it can be applied by everyone, especially in learning so that knowledge can increase.

2.1.2 Maze

A maze is an intricate design with numerous interconnected pathways. The phrase is also used to describe a two-dimensional visual puzzle that represents a maze. It is thought of as a puzzle that has to be solved, and the person who solves it must move from the entry to an exit or another area. Since it may be challenging to navigate a maze, the word has become a slang term for onerous procedures. (Mary McMahon, 2022)

Almost anything may be used to construct a three-dimensional labyrinth. Garden mazes come in a variety of shapes and sizes and are created with plants, trees, and hedges. One constructed in a garden is frequently low and has a viewing window. A maze can also be made from materials like brick, stone, wood, and other things. In both scenarios, the path is typically pre-planned on the ground using a pattern that was first drew on paper and then scaled up. (Mary McMahon, 2022)

2.1.3 Science

Science is a methodical, logical approach to information discovery, natural world comprehension, and phenomenon explanation. Through experimentation, data collection, and observation of the natural world, theories and models that can predict and explain natural events are developed. Science is also a mode of thinking that uses observation, experimentation, and logic to try to grasp the basic principles that govern the universe. Physics, biology, chemistry, earth science, and other disciplines are all included in the broad category of science. Science seeks to develop human knowledge of the world and enhance quality of life.

2.2   Existing Works

This study was conducted to obtain information about the advantages and disadvantages of existing applications to be used as a reference for improvement in this project. VR MAZE SOLVER ADVENTURE, VR MAZE GAME, VR MAZE 3D, TITANS OF SPACE AND 4DKID EXPLORER: DINOSAURS were selected for review. The similarity between these five applications is the content is displayed in 3 Dimensional and has the same game mechanic with different contents.

2.2.1   VR MAZE SOLVER ADVENTURE

VR Maze Solver Adventure is developed by Romale Game Studio. This game was released on 19 October 2016. To date, more than 500,000 people have downloaded this game. In the game, players are allowed to figure out how to get out of the difficult maze challenge according to the level of the game.
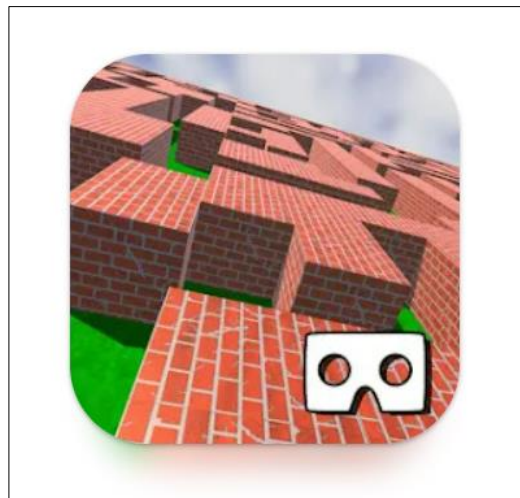
Figure 1.0 Game Logo
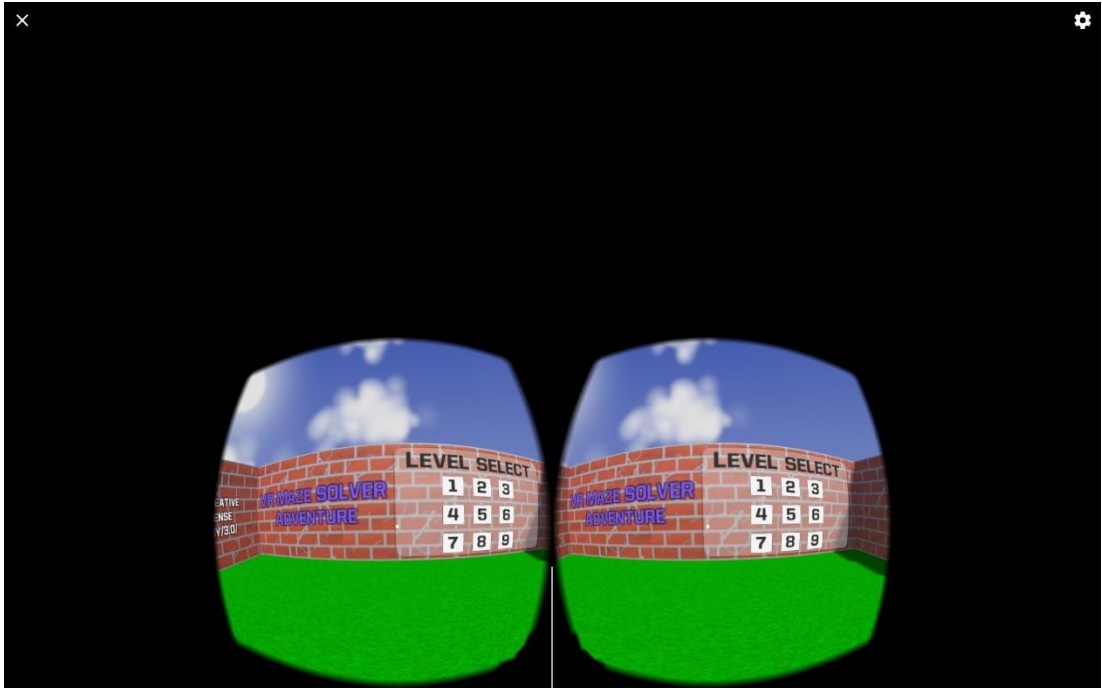
Figure 1.1 The Main View of VR Maze Solver Adventure
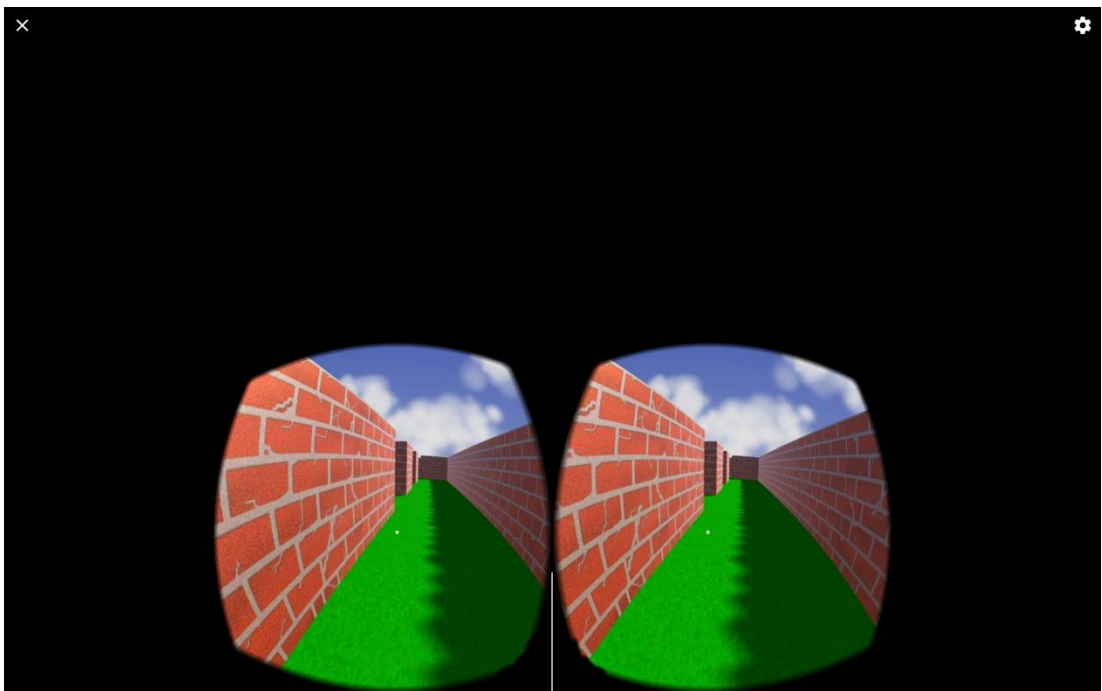
Figure 1.2 The environment inside the game

2.2.2   VR MAZE GAME

VR Maze Run Journey is offered by Vyrom. This game was released on 2 December 2016. To date, more than 100,000 people have downloaded this game. Offers a friendly game atmosphere to first-time players and offers two mazes with different difficulty levels.

Figure 1.3 Game Logo

The theme and colours used to display green which show the natural colour. It is applied to the buttons on the main interface. The interfaces are shown in Figure 1.4

Figure 1.4 The Main Menu of VR Maze Game
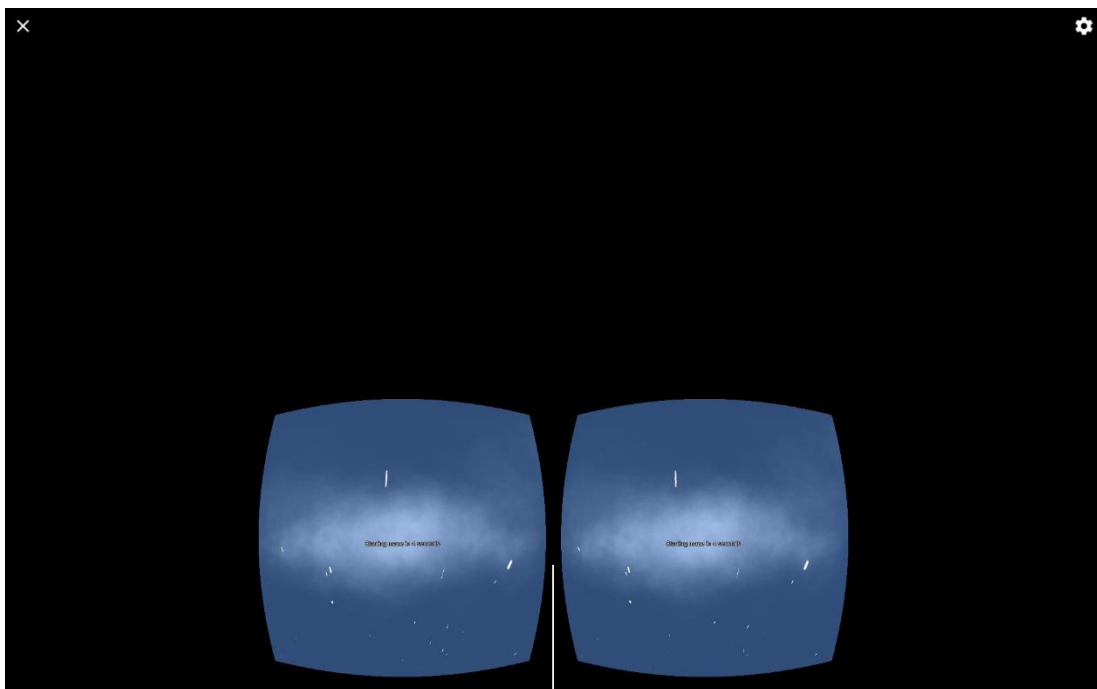
Figure 1.5 The loading page of VR Maze Game

2.2.3   VR MAZE 3D

VR Maze 3D is offered by Amik. This game was released on 8 October 2021. To date, more than 1000 people have downloaded this game. Players will be offered different locations at each level. So, the player can feel and explore the exciting environment throughout the game.

Figure 1.6 Game Logo
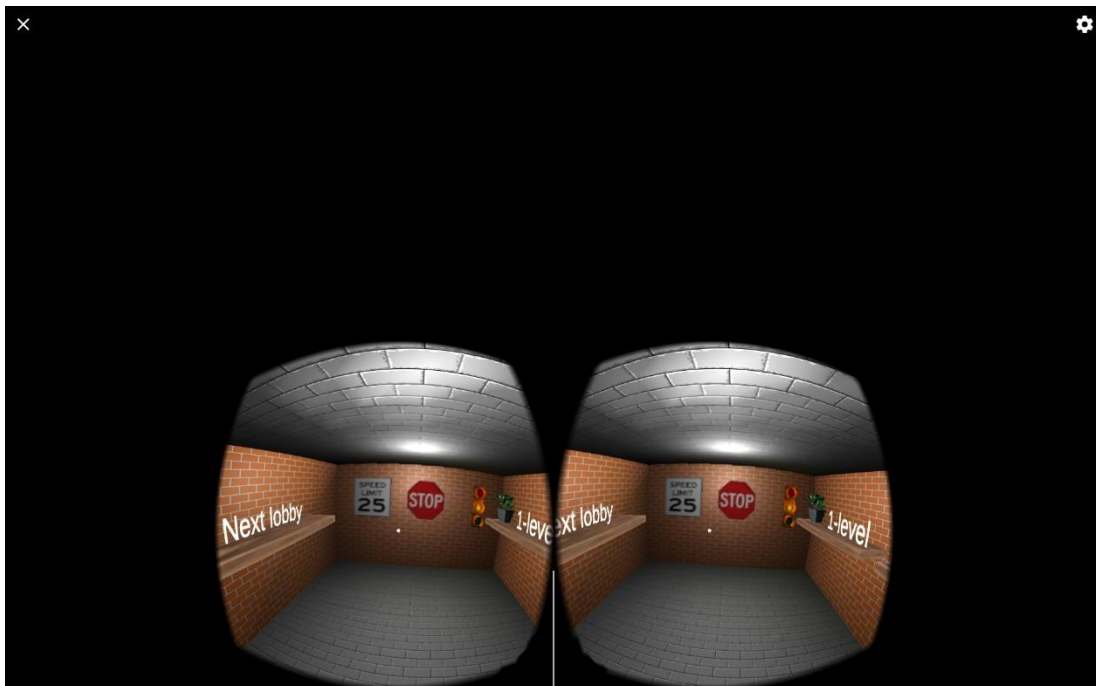
Figure 1.7 The Main View of VR Maze 3D

The environment created in this game is 3 Dimensional. Each environment has a different display. The environment and atmosphere are shown in Figure 1.8 until Figure 2.3.

Figure 1.8 The atmosphere is in the city
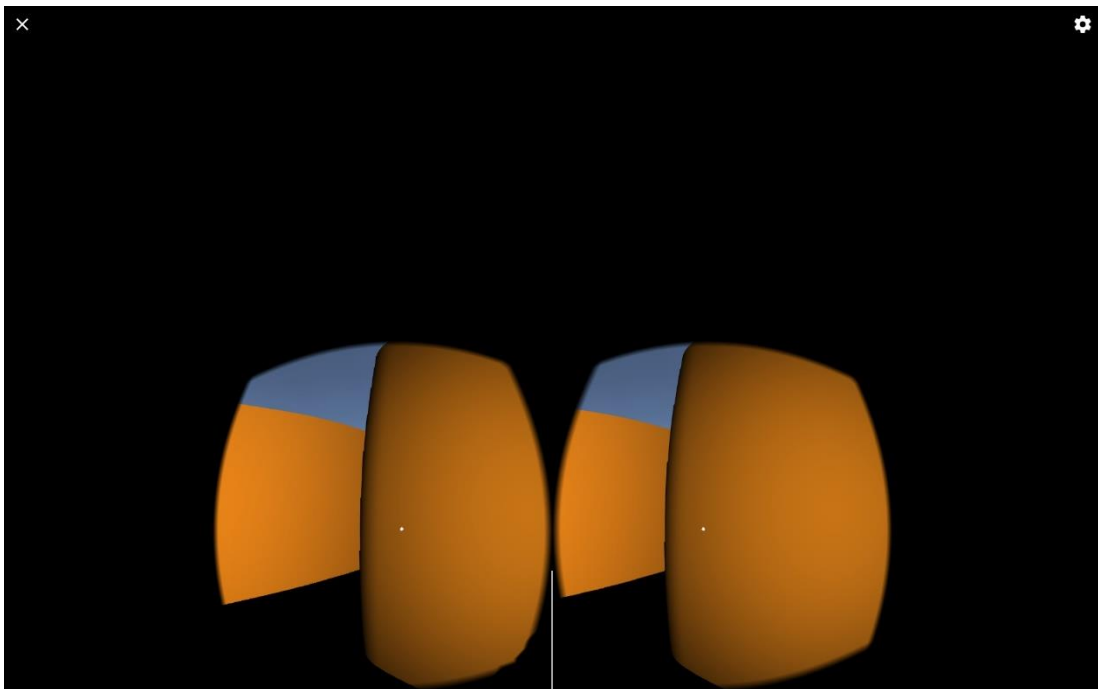
Figure 1.9 The atmosphere is in the maze

14
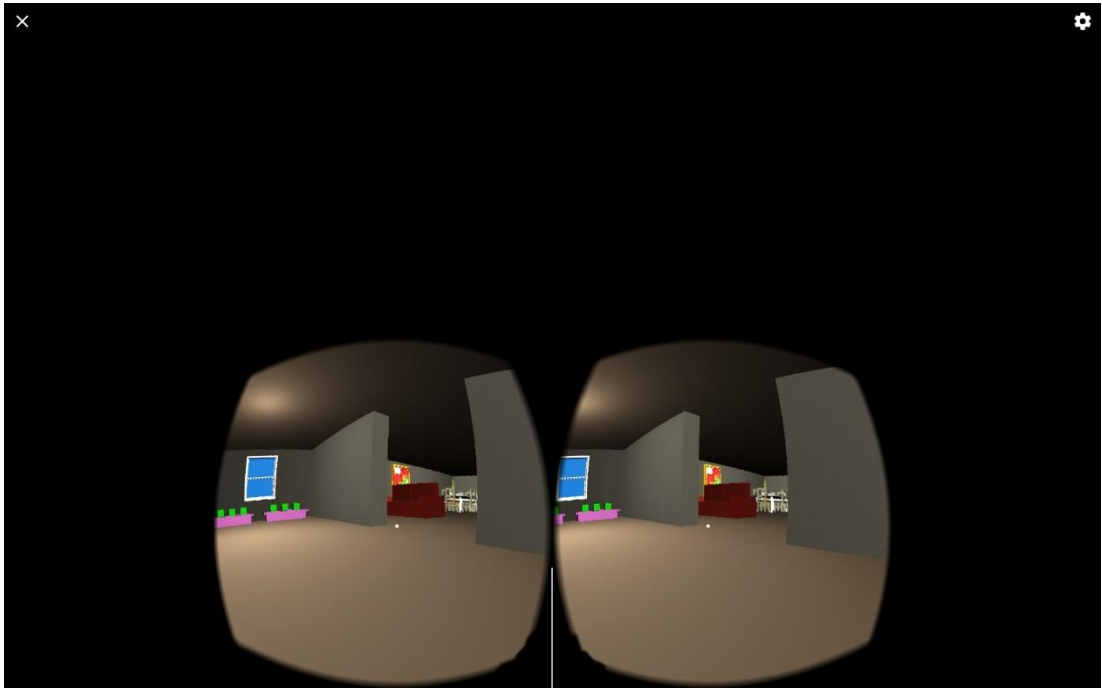
Figure 2.0 The atmosphere is in the house
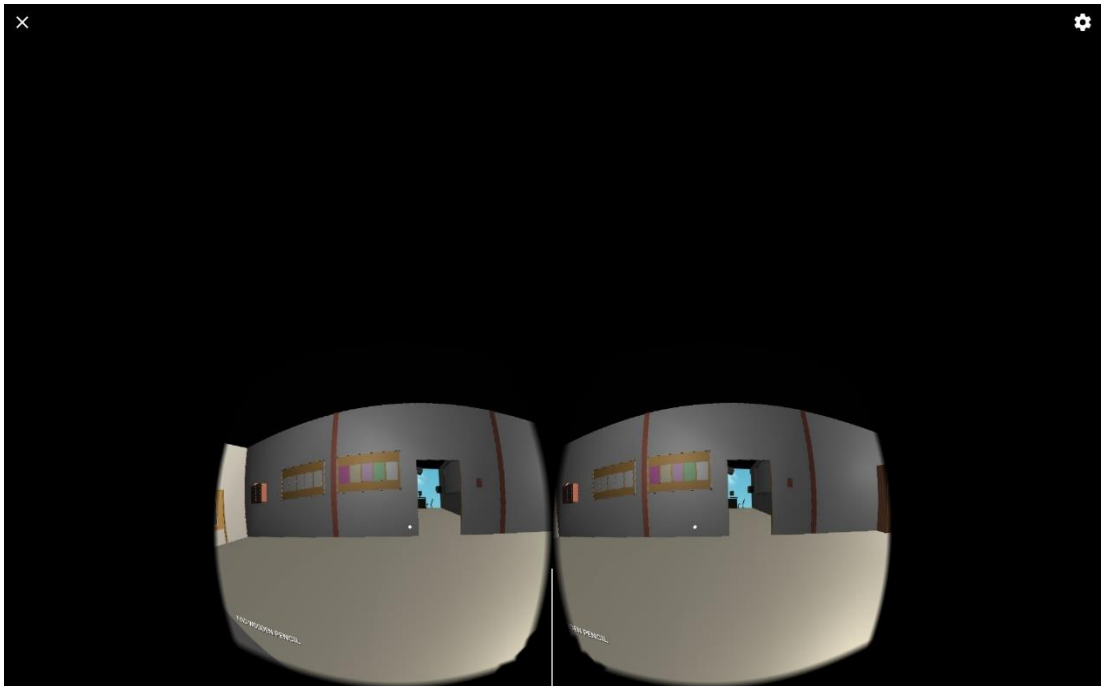
Figure 2.1 The atmosphere is in the classroom

Figure 2.2 The atmosphere is in the server room

Figure 2.3 The atmosphere is in the playground
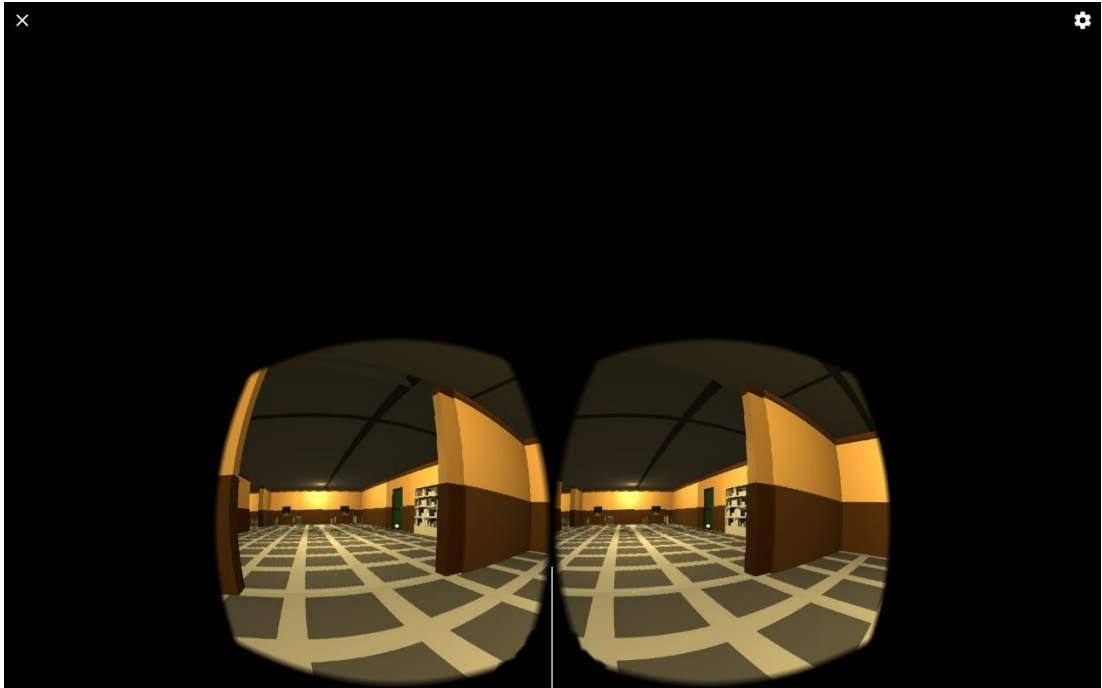
Figure 2.4 The atmosphere is in the office

2.2.4   TITANS OF SPACE

Titans of Space is offered by DrashVR LLC. This game was released on 19 February 2015. To date, more than 1000000 people have downloaded this game. In this game, players will be taken to virtual space exploration about solar system in no time.

Figure 2.5 Game Logo

While in space, players will be able to see different types of planets and stars that exist in the universe. Players will see facts about these stars and planets. The information given is the name of the planet, the distance between the planet and the sun, the diameter of the planet, and the types of stars.

Figure 2.6 Shows important info related to planets
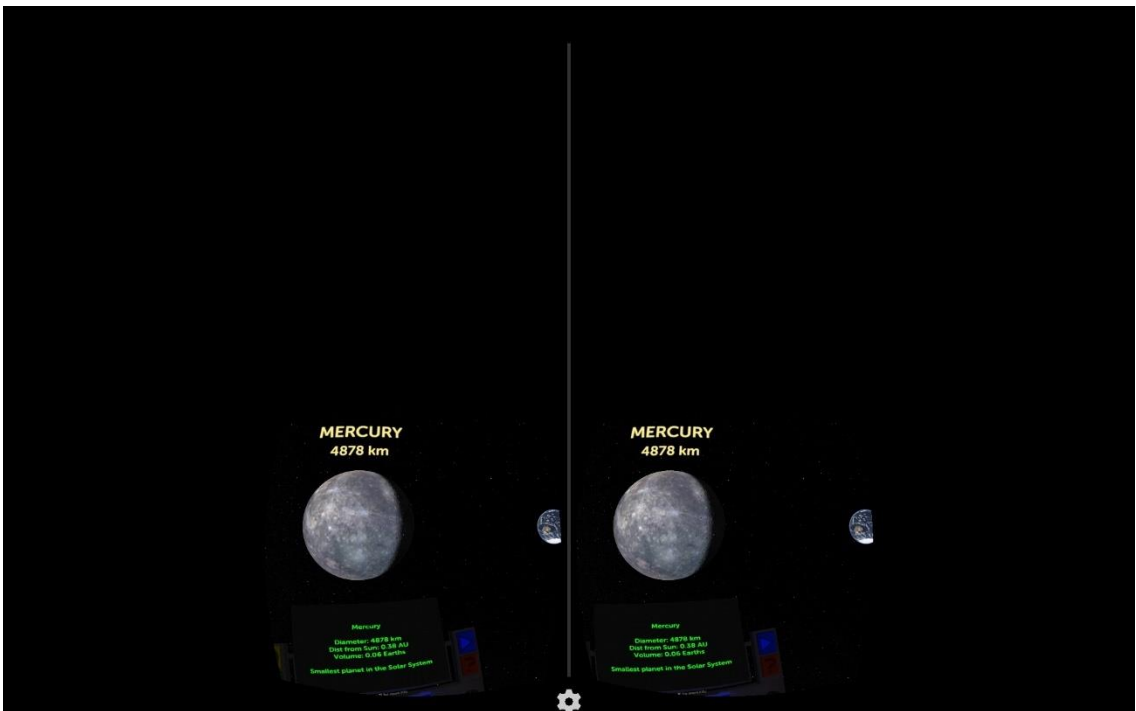
Figure 2.7 Shows the name of the planet

2.2.5 4DKID EXPLORER: DINOSAURS

4DKid Explorer:Dinosaurs is offered by Knbmedia. This game was released on 27 November 2021. To date, more than 100000 people have downloaded this game. This game is an educational game that uses VR. This game will give players the experience to explore extinct animals, namely Dinosaurs in the virtual world.

Figure 2.8 Game Logo

In the game, the player will explore to see the different types of dinosaurs that are there. Information related to dinosaurs will be given throughout the game.
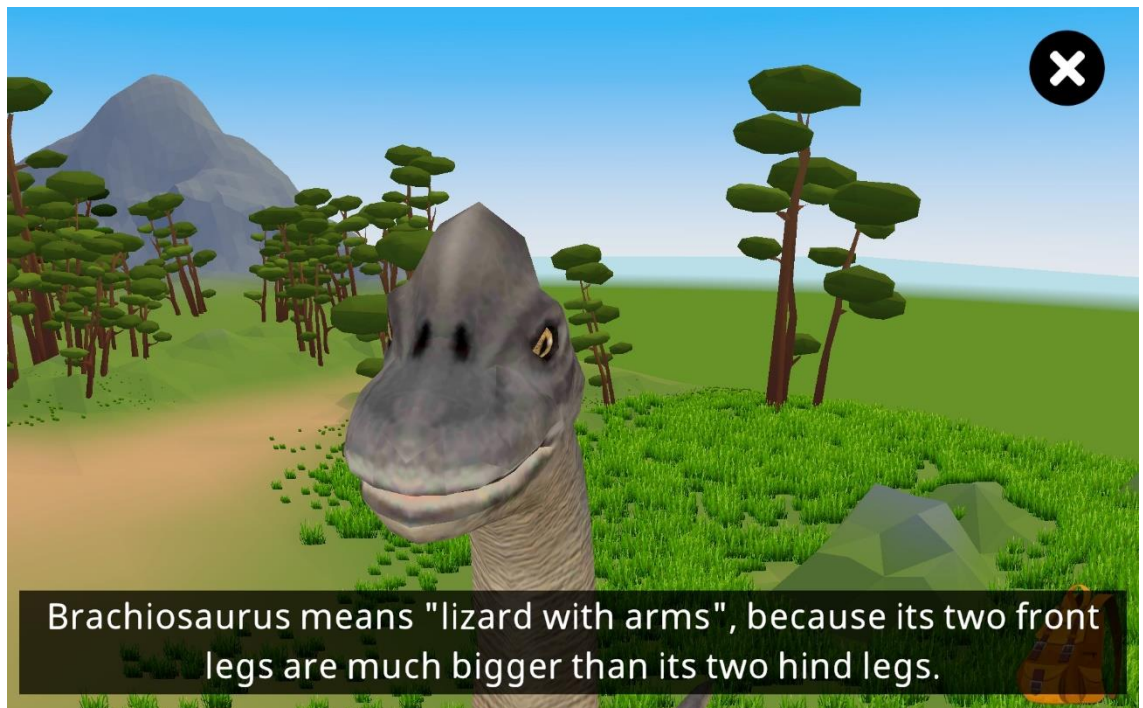
Figure 2.9 Shows names and facts about dinosaurs

2.3　Analysis/ Comparison of Existing System

Based on the review done in Section 2.2, Table 1.0 shows a comparison of three existing maze games. Six elements will be evaluated through comparison, which are Modules, Display, Content Focus, Objective, Multimedia Element, and Platform.

Table 1.0 Comparison between three existing VR maze game

System Characteristic	VR MAZE SOLVER ADVENTURE	VR MAZE GAME	VR MAZE 3D	TITANS OF SPACE	4DKID EXPLORER : DINOSAURS
Modules (Level)	Nine modules only	Two modules only	Seven modules only	One module only	Thirty-six modules
Display	3 Dimensional	3 Dimensional	3 Dimensional	3 Dimensional	3 Dimensional

Content Focus	Maze game	Maze game	Maze game but not stuck in one environment	Explore and learn about the planets and stars in space (solar system)	Explore while learning facts about dinosaurs
Objective	To give players a chance to complete missions while playing	To provide a challenging experience to players in the maze game	To let players, explore different environments while playing	To recognize the planets and stars found in the solar system virtually	To know the types and facts about dinosaurs that once existed in this world
Multimedia Element	Audio, Text, Graphic	Audio, Text, Graphic, Animation	Text, Graphic	Audio, Text, Graphic, Animation	Audio, Text, Graphic, Animation
Platform	Android	Android	Android	Android	Android and Apple IOS

From this comparison, we can see that the objective is the most important thing in developing a game. Therefore, by taking the five objectives from these five VR games, I propose to take these the objectives as a reference for me to use in the project so that I can produce a project that provides enjoyment and benefits to the players.

2.4 Summary

In chapter 2, a comparison was made between three existing games, namely VR Maze Solver Adventure, VR Maze Game, VR Maze 3D Titans of Space and 4DKid Explorer: Dinasours. The comparison made has shown the advantages and disadvantages of the features in each game based on the set characteristics. With that, it can be used as a reference to the proposed project so that it can help us produce a better game.

CHAPTER 3

METHODOLOGY

3.1   Introduction

This chapter covers the methodology approach for the entire project. The chosen methodology, which is Software Development Life Cycle (SDLC) Model will be focused on in detail. The project requirement follows, which describes the constraints and restrictions as well as the functional and non-functional needs.

3.2   SDLC Model

For the chosen methodology, I propose using the SDLC model to develop the project. Agile is the best concept for the development process because of is flexible and suitable for the timeline given for this project. There are six phases inside the Agile model, which are Requirements, Design, Development, Testing, Deployment, and Review. Figure 2.5 show the Agile development process.
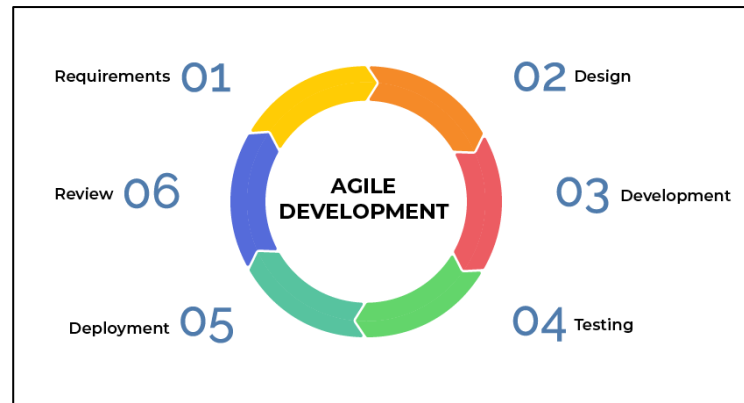
Figure 3.0 Agile Model

3.2.1 Requirements

This phase is the process of gathering the required information needed before going to the design phase. The information will be gained from the problem proposal and some observations.

3.2.2 Design

After the requirement process is done, the project design is specified by designing a storyboard of the product interface and establishing a user interface, and graphic assets.

3.2.3 Development

In development process is where the production begins, all assets will be applied to the project here as planned in the design phase.

3.2.4 Testing

This is an important phase; the system would be tested to make sure all the requirements are functioning as they should.

3.2.5 Deployment

In this phase, the project or system will deploy and launch and then be available to use. But this phase also monitors the system to ensure that system keeps in a good performance.

3.2.6 Review

After the launch of the project, this phase needs to do a review of the project, which is feedback from the user. From, that some improvement will be action.

3.3 Project Requirement

In this part, the outline for functional and non-functional requirements is discussed with the constraints and limitations also elaborated.

3.3.1 Functional Requirement

- Allow users to move 360 degrees inside the VR game

- Allow users to interact with the features provided inside the VR

- Allow users to open and close the VR application without problem

3.3.2 Non -Functional Requirement

- Motion speed in VR for users. For example, the user can move at a speed of 5 delta time

- The time taken by the system to abstract the environment and objects displayed in VR.

3.3.3   Constraints and Limitations

- This VR game is not a multiplayer game. Therefore, players do not compete.

- Not all content displayed in the game can be interacted with by players

- The content displayed is limited because only one or two topics are selected to be included in the game.

3.4 Propose Design

This section will show the proposed project design through suitable diagrams, namely Flow Chart, Use Case Diagram, Context Diagram, and Storyboard. This diagram will display the organization and process involved with the application that will be developed later.

3.4.1 Use Case Diagram
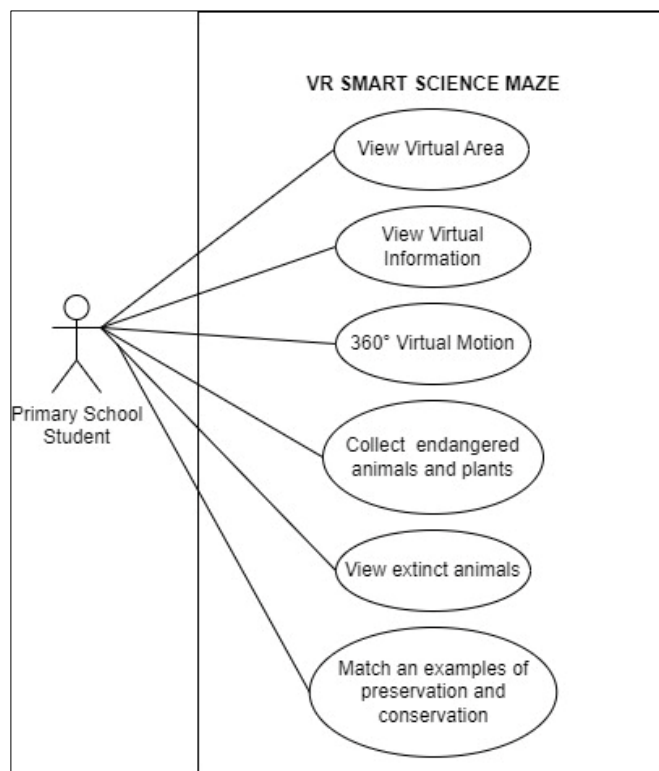
Figure 3.1 Use Case Diagram

3.4.2 Context Diagram
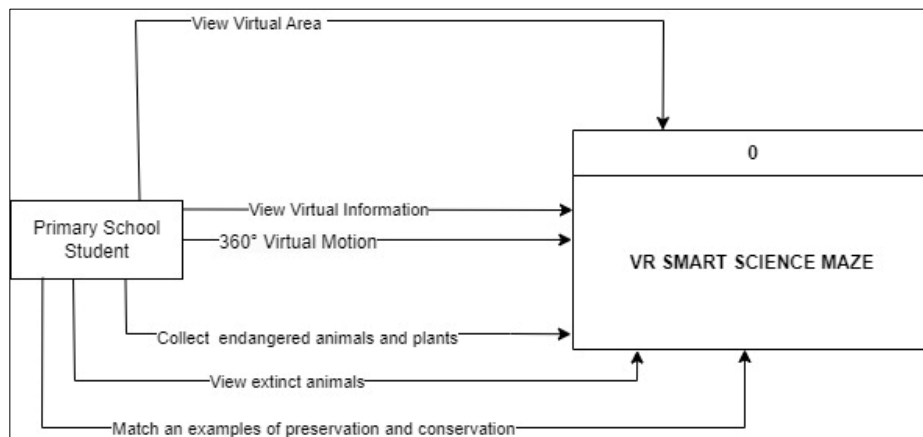
Figure 3.2 Context Diagram

3.4.3 Flowchart
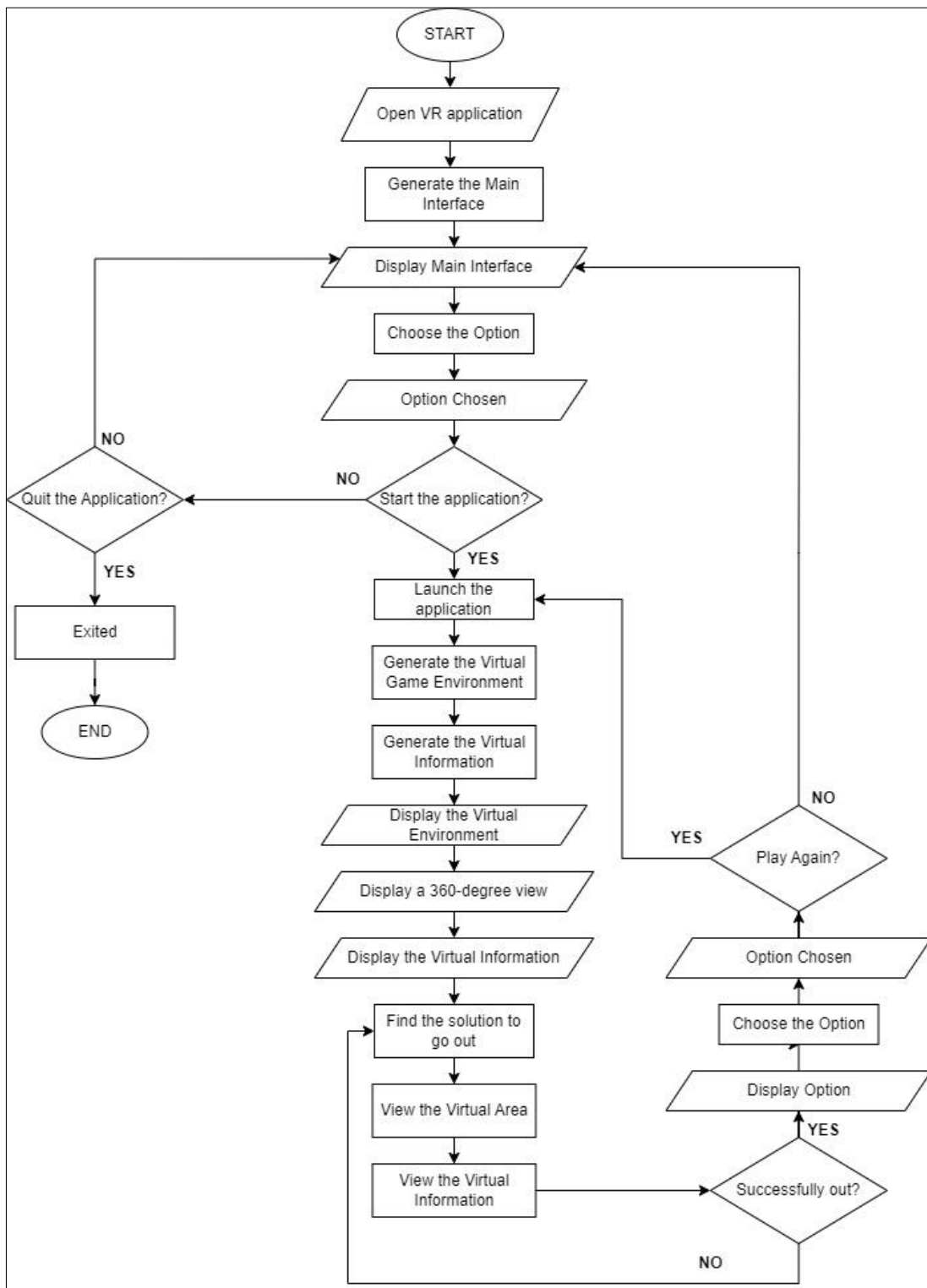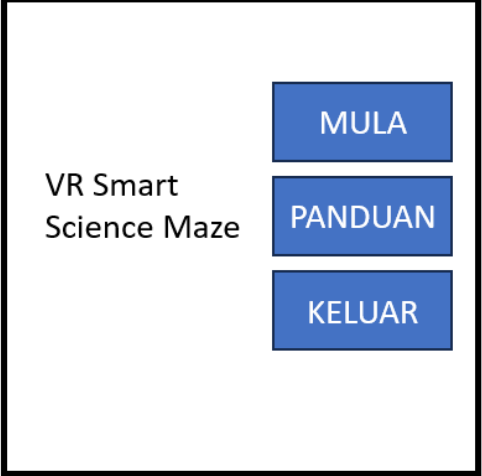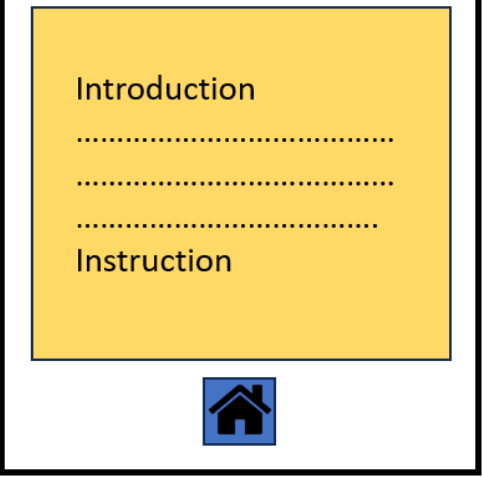
Figure 3.4 Flowchart Diagram
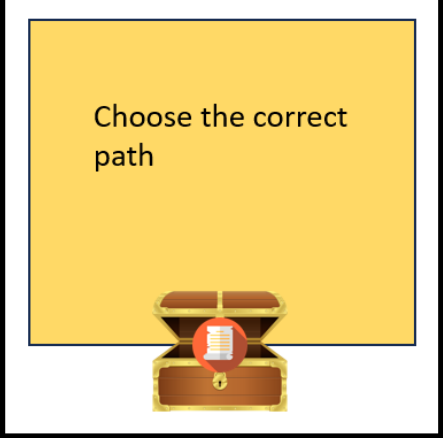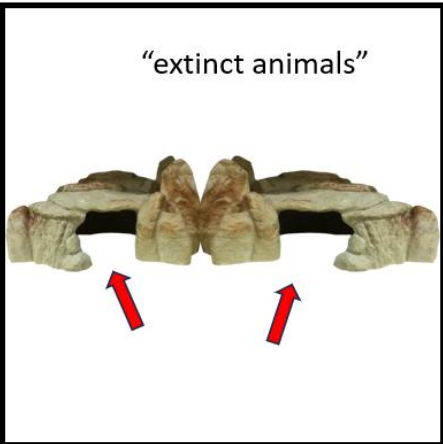
3.4.4 Storyboard
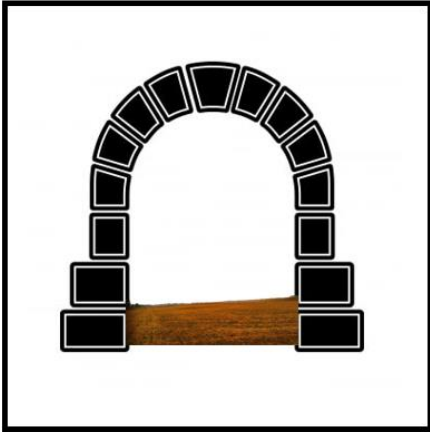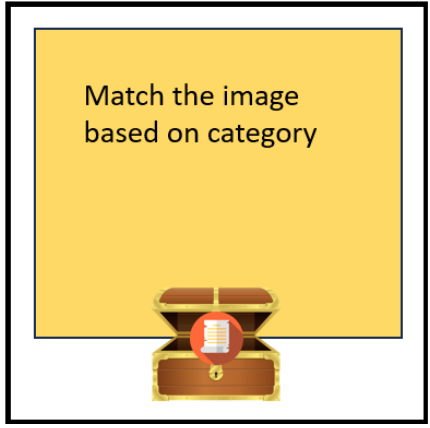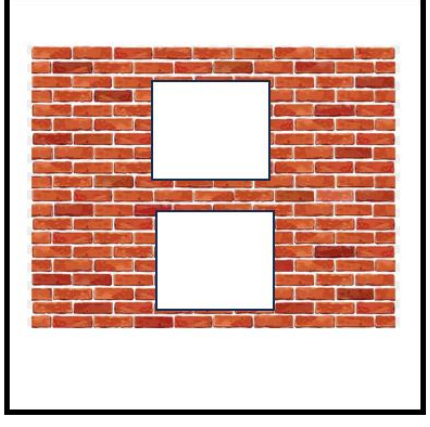
Table 1.1 Storyboard of VR Smart Science Maze
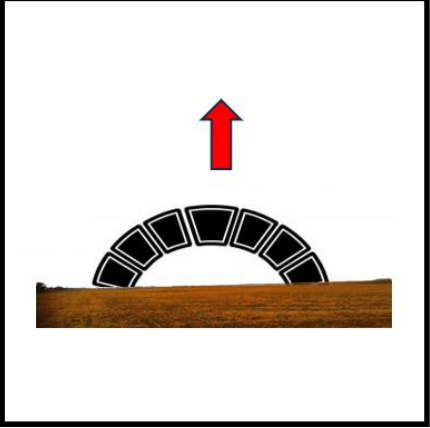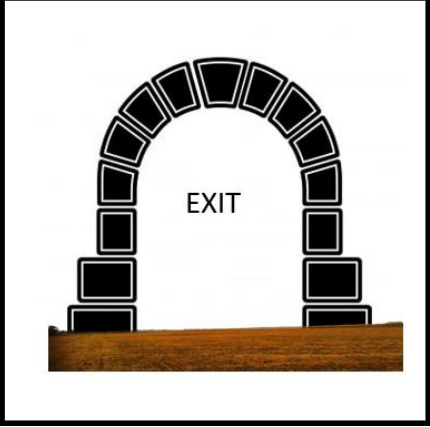
No.	Scene	Descriptions
1.		Open the Application. The Main Menu Display will open to the player. There are three buttons in the main menu such as "MULA" to start the game, "PANDUAN' for game guideline and "KELUAR" is for quit the game. To start the game, select the "MULA" button
2.		Players are brought into the game. Players will see instructions to play the game and also provide a home button to play the menu

3.		Find the treasure box. There are game missions in it
4.	Collect endangered animals and plants	Open the treasure box. The mission will be displayed to the player Players need to find and collect endangered animals and plants
5.	"tongkat ali" +1	Players will get 1 point if they collect correctly

6.		If the points are enough 6/6, the player will be able to see a heart-shaped crystal at the gate
7.		The heart-shaped crystal is the key to the gate
8.		Point the white dot at the heart-shaped crystal and the gate will open. Enter to complete the next mission

9.		Find the treasure box and see the mission. The mission is to choose a path that has extinct animals
10.		It has two paths. Choose the right path
11.		The path is selected and sees extinct animals and information

12.		Finally found an exit. Enter the door
13.	Match the image based on category	See and open the treasure box to know the last mission. The last mission is to match the image according to the appropriate category
14.		The image should be placed on the stone wall provided

15.		Match correctly and an exit appears out from underground
16.		Enter the exit
17.		Finally, the player managed to get out. Players can play again or go to the play menu.

3.5   Data Design

In this section, several assets will be used to help realize this project. The assets that will be used are 3D models that will be developed later, and assets taken from external sources for free that will be modified according to the suitability of the model. Color, text, and font type are also listed as assets for developing this project.

3.5.1   3D Models

Table 1.2 Element of assets

Assets Name	Texture and Material
Maze	-Natural colors -Rough, Shiny -Lambert
Tongkat Ali	-Green, Brown -Rough, Smooth -Lambert
Pitcher Plant	-Red, Brown, Yellow, Green, Black -Rough -Lambert

Rafflesia	-Red, White, Black, Yellow, Green -Rough, Shiny -Lambert
Malayan Tiger	-Orange, Yellow, White, Black -Rough, Lambert
Turtle	-Brown, White, Black -Rough, Shiny -Lambert
Tapir	-Black, White -Smooth -Lambert
Mammoth	-Black, Brown, White, Yellow -Smooth, Rough -Lambert

Quagga	-Black, Brown, White -Rough -Lambert
Dodo	-Black, Brown, White - Smooth -Lambert
T-Rex	-Black, Brown, White -Rough -Lambert
Crystal	- Red, Blue, Green - Shiny - Glass
Medal	- Gold, Silver, Bronze - Shiny

	- Glass
Rock	- Black, Brown, Grey
	- Rough
	- Lambert
Grass	- Green
	- Rough
	- Lambert
Ground	- Natural colors
	- Rough
	- Lambert

3.5.2 Font Type

The font that will be used to display text on the main menu, buttons, and information in this application is Arial. This font is suitable to use because it is more contra and makes the user focus and understands what is to be conveyed through the text.

3.6   Proof of Initial Concept

3.6.1   Autodesk Maya 2023

Figure 3.5 Autodesk Maya 2023

Autodesk Maya 2023 software will be used to develop a 3D model for this project, while assets taken from external sources will also be imported into this software for the modification processes. The figure below shows the 3D design of the model for the maze developed using this software.
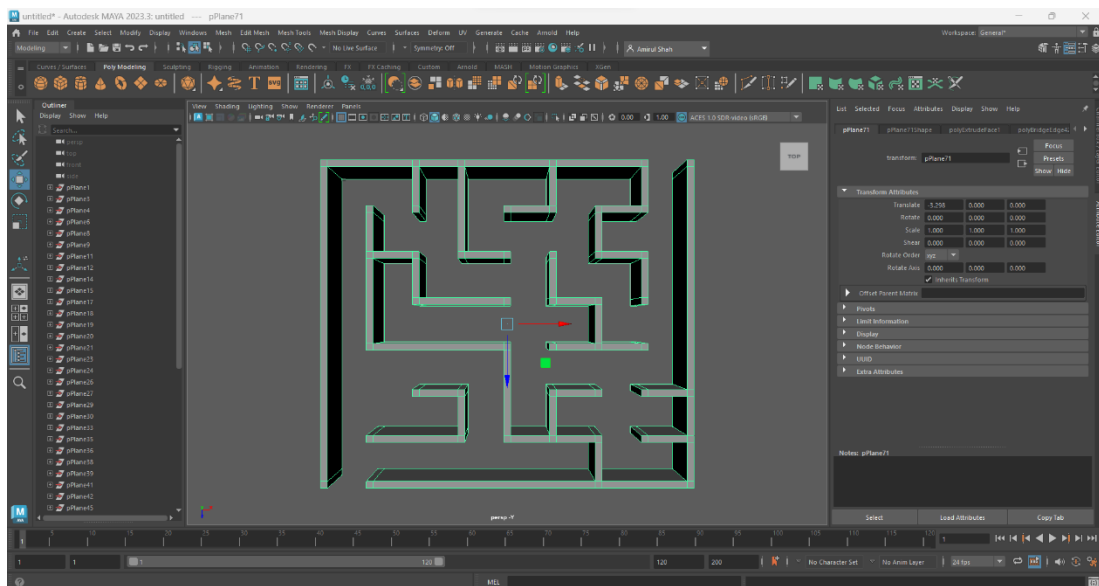
Figure 3.6 Modelling process

3.6.2 Unity
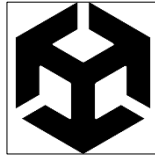
Figure 3.7 Unity

For VR the Unity game engine will be used, where this software provides the XR-Kit features and VR camera code to developers to develop VR technology. Therefore, this software was chosen as a platform to realize this project. The figure below shows the script used for the VR camera.

```
public class UserController : MonoBehaviour
{
    private bool walking=false;
    public Vector3 spawnPoint;

    // Start is called before the first frame update
    void Start()
    {
        spawnPoint= transform.position;
    }

    // Update is called once per frame
    void Update()
    {
        if(walking){
            transform.position=transform.position+ Camera.main.transform.forward*5f* Time.deltaTime;
        }

        if(transform.position.y<-10f){

            transform.position=spawnPoint;
        }

        Ray ray=Camera.main.ViewportPointToRay(new Vector3(.5f,.5f,0));
        RaycastHit hit;

        if(Physics.Raycast(ray, out hit)){

            if(hit.collider.name.Contains("pPlane71")){
                walking=false;
            }

            else{
                walking=true;
            }
```

Figure 3.8 Scripting the functionality

The 3D model created will be imported into Unity. The figure below shows the

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3D model imported into Unity.
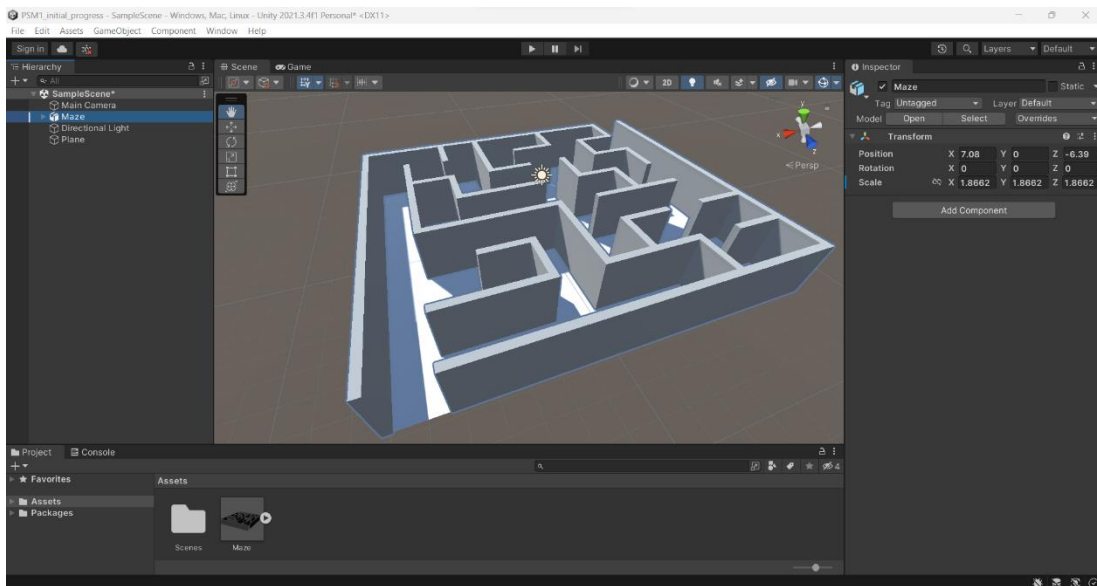
Figure 3.9 Import the 3D model

The figure below shows the position of the VR Camera after the 3D model is Imported to Unity.
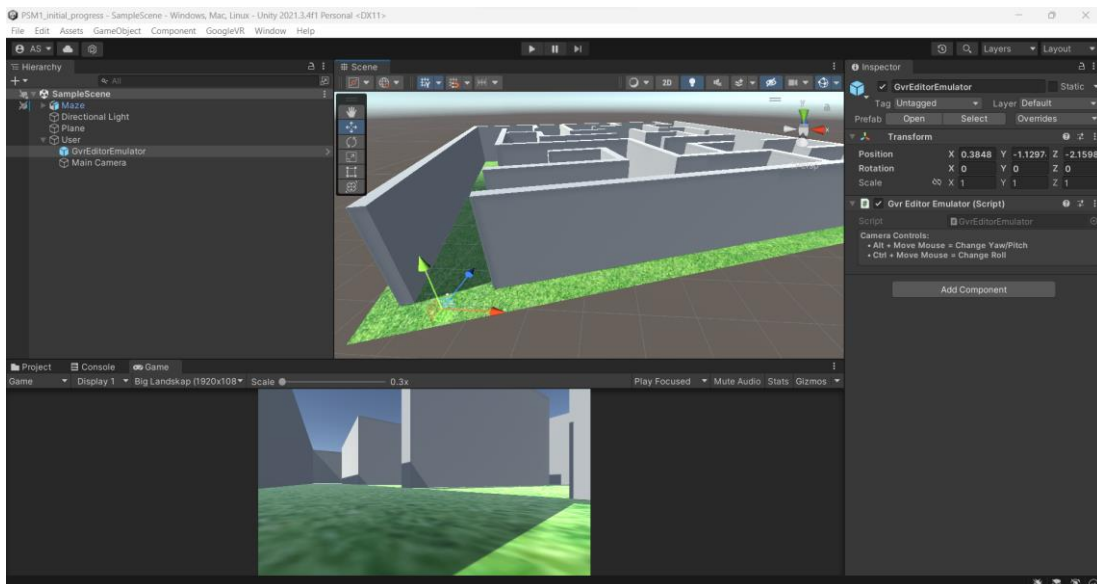
Figure 4.0 Camera functionality

The figure below shows the functionality of the VR camera and movement in Unity.
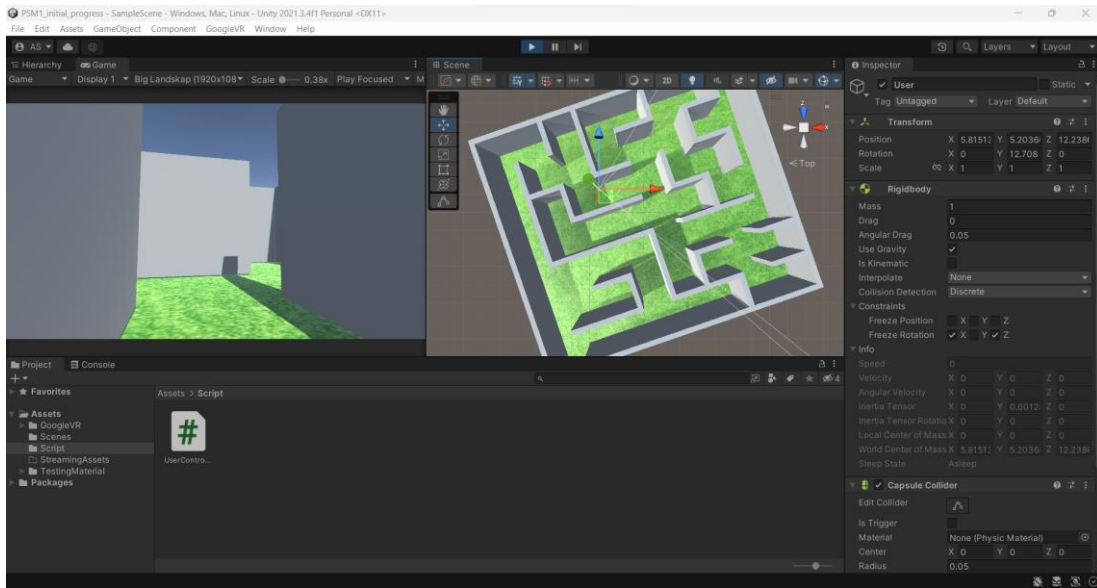
Figure 4.1 Movement functionality

3.7   Testing/Validation Plan

3.7.1   Functionality Testing

For functionality testing, testing will be done by experts first, which is the Supervisor. The purpose is to check that the functions and features of this application work properly and can be used by teachers and school students.

Table 1.3 Functionality Testing

No.	Module	Activity	Expected Output	Result Pass/Fail	Comment
1.	Open the application	The user opens the VR application	Open the VR application for the user		
2.	Display	Display the interface well according to the screen size	The interface display is perfect according to the size of the hardware screen		
3.	Start	Start the game	The game begins		

4.	Quit	Exit the application	Application exited successfully		
5.	Home	Go to Main Menu	Successfully returned to the Main Menu		
6.	Joystick right	Move forward when the joystick is pressed to the right	The user successfully moves forward		
7.	Joystick left	Move backward when the joystick is pressed to the left	The user successfully moves backward		
8.	Joystick down	Move right when the joystick is pressed to the down	The user successfully moves right		

9.	Joystick up	Move left when the joystick is pressed to the up	The user successfully moves left		
10.	Pointer Ray cast	Show the direction	Player will move according to pointer ray cast		
11.	Maze	Display 3D Model	3D models are successfully displayed along with material and texture models		
12.	Tongkang Ali				
13.	Pitcher Plant				
14.	Rafflesia				
15.	Malayan Tiger				
16.	Turtle				
17.	Tapir				
18.	Mammoth				
19.	T-Rex				

No.	Object	Action	Expected Result		
20.	Quagga				
21.	Dodo				
22.	UI Button	Hit the button using pointer ray cast then the information will pop up	The information will pop-up after the pointer ray cast hit the UI button		
23.	UI Panel	Hit the button using pointer ray cast then the information will pop up in the UI Panel	The information in the UI Panel will pop-up after the pointer ray cast hit the UI button		
24.	Tongkang Ali	Point the ray cast to the object and the object will destroy	The object will be destroyed after player point the ray cast to the object		
25.	Pitcher Plant				
26.	Rafflesia				
27.	Tiger				

28.	Turtle				
29.	Tapir				
30.	Score	Add one score when object destroy	The score will add one score for each object. Total 6/6 score		
31.	Score Display	Show current score and change score point	The score displays the current score and change the score point		
32.	Wall	Wall go down	The wall goes down after score 6/6		
33.		Wall go up	The wall goes up after player finish the last mission		
34.	Cube with Image (*Kitar Semula*)	Grab the cube object	The cube object will be grabbed when the "B" button on the		

35.	Cube with Image (*Penanaman Semula Pokok*)		controller is pressed		
36.	Cube with Image (*Kitar Semula*)	Release the cube to the target	The cube object will be released when the "C" button on the controller is pressed		
37.	Cube with Image (*Penanaman Semula Pokok*)				

3.7.2 Content Verification

Before this application is published, the content displayed in this application will be checked and verified by an expert or school teacher who teaches Science subject in grade 6. The purpose of this content check is to ensure that the information given to student is accurate and reliable.

3.7.3 User Testing

For user testing, some teachers and ten of grade six school students will be selected to be testers of this application. They will try to open and play while interacting with this application. Every action they do will be evaluated by the developer to ensure that this application can be used well.

Table 1.4 User Testing

No.	Task / Requirement	Expected Result	Actual Result	Pass / Fail
1.	User open the application	Navigate to Main Menu screen	System response	
2.	User press on "Start" button	Navigate to game screen	System response	
3.	User press the 'Guide' button	Pop-up the guideline screen	Guideline screen pop-up	
4.	User press the 'Exit' button	Pop-up the exit screen	Exit screen pop-up	
5.	User press "Yes" button to exit	Close the application	Application closed	
6.	User can move forward	Player moves forward	Player moves forward	
7.	User can move backward	Player moves backward	Player moves backward	
8.	User can move right	Player moves right	Player moves right	
9.	User can move left	Player moves left	Player moves left	

10.	User can view 360 degree	Player view 360 degree	Player view 360 degree	
11.	User collects "Tongkat Ali"	Destroy the tongkat ali and add one score	Tongkat ali is destroyed and one score is added	
12.	User collects "Periuk Kera"	Destroy the periuk kera and add one score	Periuk Kera is destroyed and one score is added	
13.	User collects "Bunga Pakma"	Destroy the bunga pakma and add one score	Bunga pakma is destroyed and one score is added	
14.	User collects "Harimau"	Destroy the harimau and add one score	Harimau is destroyed and one score is added	
15.	User collects "Tapir"	Destroy the tapir and add one score	Tapir is destroyed and one score is added	
16.	User collects "Penyu"	Destroy the penyu and add one score	Penyu is destroyed and one score is added	
17.	User can view current score	Display current score	Current score is displayed	
18.	User can view the crystal	Display crystal	Crystal is displayed	

19.	User can view the UI Information	Display information	Information is displayed	
20.	User can grab object	Object is grabbed by user	Object is grabbed by user	
21.	User can release the object	Object is released by user	Object is released by user	
22.	User can view the wall go down	The wall goes down	The wall goes down	
23.	User can view the wall go up	The wall goes up	The wall goes up	

3.8   Potential Use of Proposed Solution

This project will benefit the delivery of learning to users, especially primary school students, using Virtual Reality (VR) technology. VR can be used as one of the alternative learning methods for teachers to convey information about subjects taught at school to students. Thus, students will have more fun while studying and not be bored as usual when only focusing on old learning methods such as printing pictures using paper. With VR, students will memorize more of what they see and learn because the use of VR applies visualization, where it displays visuals like in the real world. Therefore, this opportunity is taken to help school students learn.

3.9   Gantt Chart

The figure below shows the Gantt chart for the VR Smart Science Maze which consists of the Requirement, Design, Development, Testing, Deployment, and Review phases. The duration of the project starts from the second week of October 2022 and is expected to be completed at the end of June 2023, which is the third week.

Tasks	October				November				December				January				February			
	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
Requirements:																				
Proposed title		■																		
Explain the purpose of the project			■																	
Identify the content				■																
Identify the problem statement					■															
Analyze the problem statement					■															
Verify the problem statement					■															
Identify the objective					■															
Verify the objective					■															
Verify the scope					■															
Identify the existing game							■													
Analyze the existing games								■												
Design:																				
Identify the development process									■											
Identify the methodology									■											
Analyze the methodolgy									■											
Verify the methodology									■											
Design the flowchart										■										
Design the use case diagram										■										
Design the context diagram										■										
Design the storyboard										■										
Identify the development assets											■									
Development:																				
Create the 3D Modelling													■	■	■	■	■	■	■	■
Place the texture and material													■	■	■	■	■	■	■	■
Create the user interface																				
Create VR Camera																				
Create player movement																				
Coding and scripting																				
Testing:																				
Render the 3D model																				
Export the 3D model to FBX file																				
Import the FBX file into the game engine																				
VR camera functionality																				
Movement functionality																				
Deployment:																				
Deploy the game																				
Get the user feedback																				
Review:																				
Improve the game content																				
Deploy the game																				

Figure 4.2 Gantt Chart

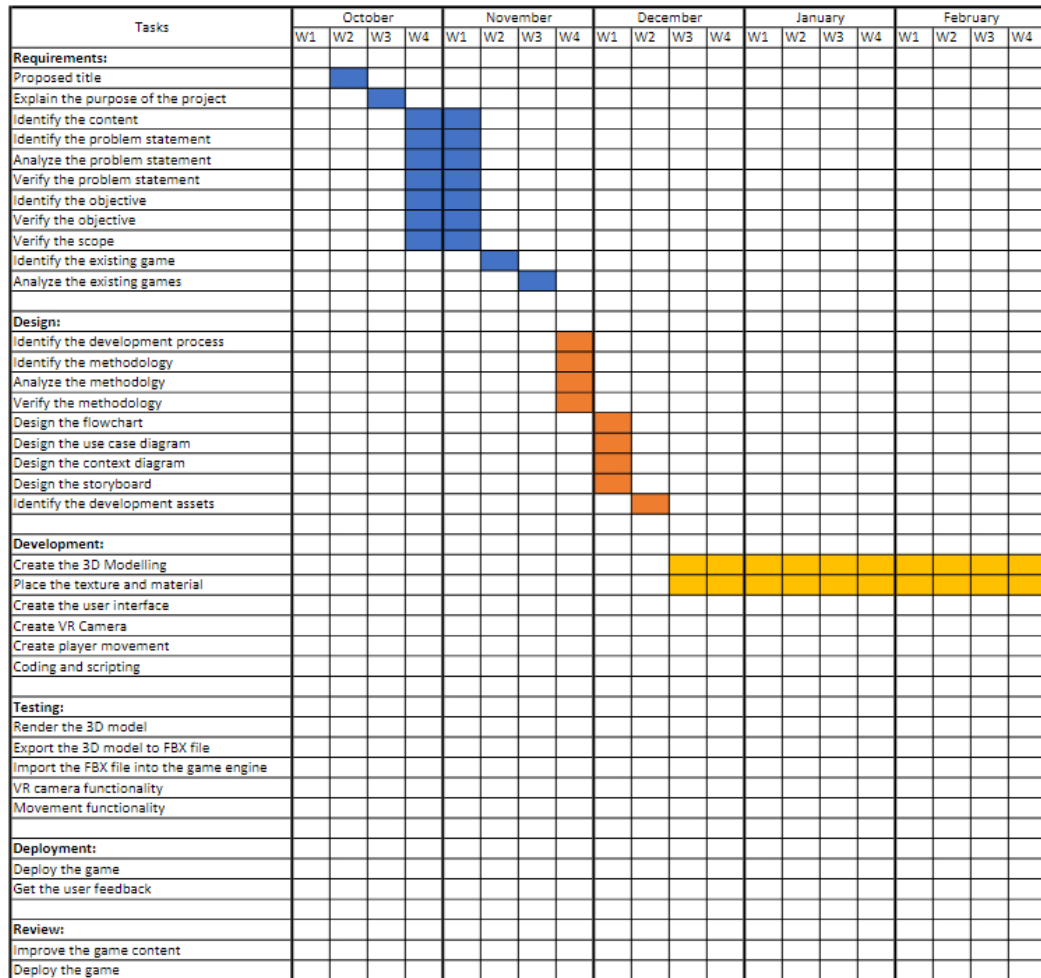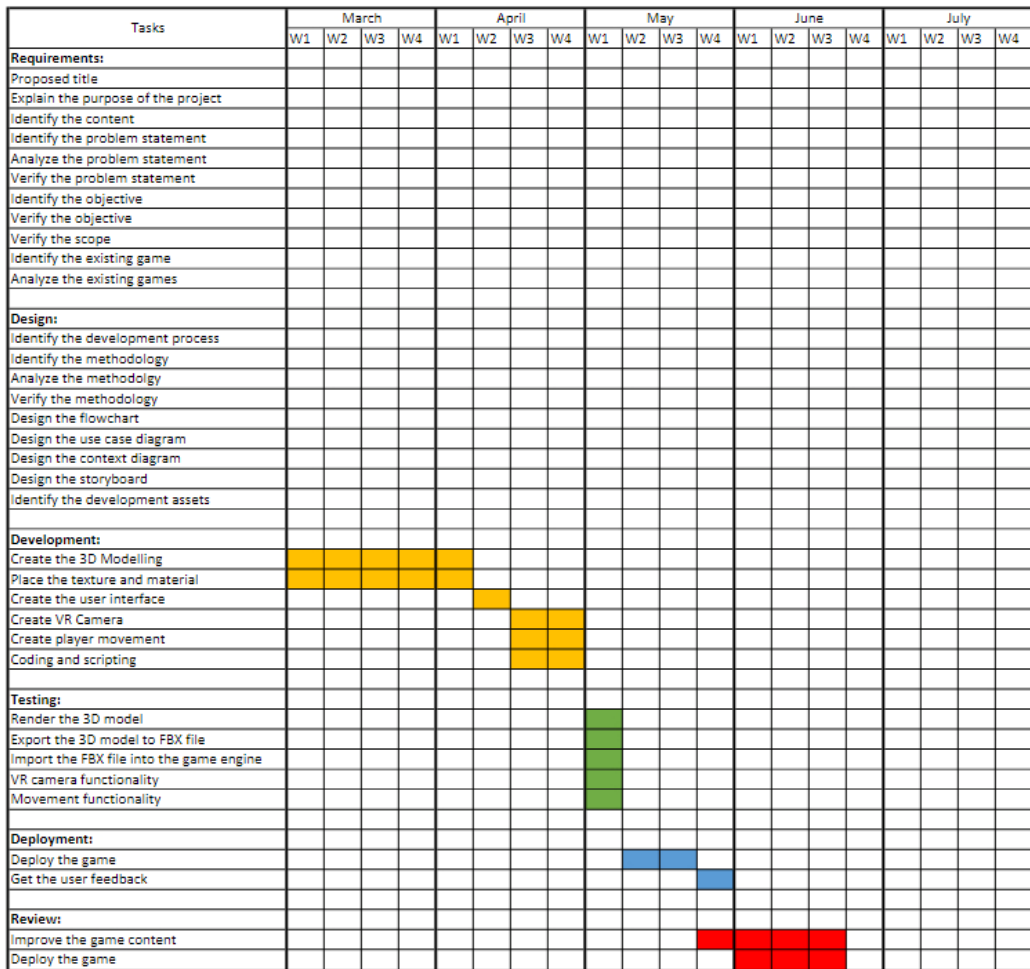| Tasks	March W1	March W2	March W3	March W4	April W1	April W2	April W3	April W4	May W1	May W2	May W3	May W4	June W1	June W2	June W3	June W4	July W1	July W2	July W3	July W4
Requirements:																				
Proposed title																				
Explain the purpose of the project																				
Identify the content																				
Identify the problem statement																				
Analyze the problem statement																				
Verify the problem statement																				
Identify the objective																				
Verify the objective																				
Verify the scope																				
Identify the existing game																				
Analyze the existing games																				
Design:																				
Identify the development process																				
Identify the methodology																				
Analyze the methodolgy																				
Verify the methodology																				
Design the flowchart																				
Design the use case diagram																				
Design the context diagram																				
Design the storyboard																				
Identify the development assets																				
Development:																				
Create the 3D Modelling	■	■	■	■	■															
Place the texture and material	■	■	■	■	■															
Create the user interface						■														
Create VR Camera							■	■												
Create player movement							■	■												
Coding and scripting							■	■												
Testing:																				
Render the 3D model									■											
Export the 3D model to FBX file									■											
Import the FBX file into the game engine									■											
VR camera functionality									■											
Movement functionality									■											
Deployment:																				
Deploy the game										■	■									
Get the user feedback												■								
Review:																				
Improve the game content													■	■	■	■				
Deploy the game													■	■	■	■				

Figure 4.3 Gantt Chart

CHAPTER 4

IMPLEMENTATION, RESULT AND DISCUSSION

4.1   Introduction

Chapter 4 will discuss the implementation, results, and discussion of the Smart Science Maze VR application. To develop this application, the software used is the game engine software Unity, Maya, Adobe 3D Substance Painter, Adobe Photoshop, Microsoft Visual Studio, and Audacity. 3D Model, Image, Audio, and Text are multimedia elements applied in this project. The Google VR SDK is also used to design virtual reality world applications that can be accessed on mobile devices such as Android. Tests on the application are carried out to identify any possible errors and are immediately corrected.

4.2   Implementation Process

The implementation process is done to record the steps involved in developing this VR application. This app can be downloaded on Android mobile devices through an APK file. It only involves storage space on the user's mobile device. This application requires the help of equipment such as VR Box or Google Cardboard to feel the experience of being in the world of virtual reality.

4.2.1   Developments of Environments

To have a more interesting experience in the world of virtual reality, the environment or game space needs to be developed according to the theme. This

environment is developed using the Unity game engine software. Special functions such as terrain provided by Unity are used to create hills and mountains. Trees, rocks, and other asset are also taken and imported through the Unity Asset Store and other free platforms such as Free3D and Skectfab to add interest in the virtual world environment.

Figure 4.4 The Environments

Text is used to deliver information and information about the selected topic, which is standard six Science Chapter 5: *PEMELIHARAAN DAN PEMULIHARAAN*. The information provided to users is related to animal extinction, animals threatened with extinction and factors of animal extinction.

All the information displayed in this project is in accordance with the learning standards used by Malaysia primary school science teachers under the Ministry of Education Malaysia through KPM's Didik TV broadcast on Malaysian television and the official DidikTV KPM YouTube channel. This information also refers to the standard six Science textbook that is used in schools in Malaysia.

Figure 4.5 Example of Information

4.2.2 Developments of 3D Models

For this project, several 3D models were developed and modified from existing sources through materials and textures using Autodesk Maya 2023 and Adobe Substance 3D Painter software. The use of these 3D models is to display models of animals and plants that are threatened with extinction and have become extinct. Among the models found in this project are Tongkat Ali, Pitcher Plant, Rafflesia, Tiger, Tapir, Turtle, Trex, Dodo Bird, Mammoth, and Quangga.

Use Autodesk Maya to develop 3D Models. When the model is ready to be developed, export and save the model as an FBX file.
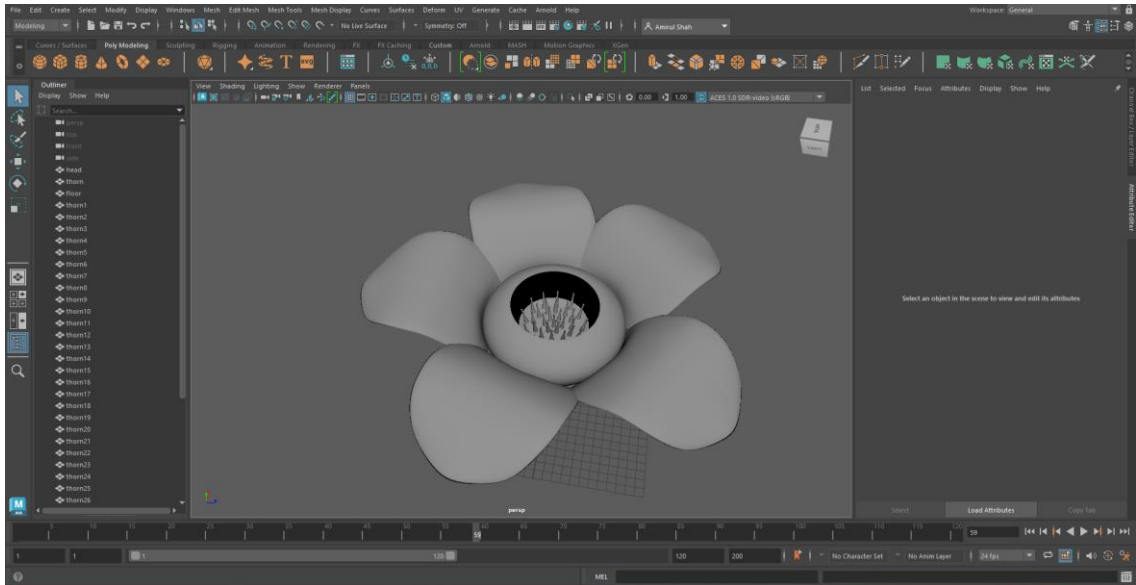
Figure 4.6 3D Model for Rafflesia developed in Autodesk Maya 2023

Import the FBX 3D model file into Adobe Substance 3D Painter. Texture and material are selected according to the suitability of the object. Export textures/materials.
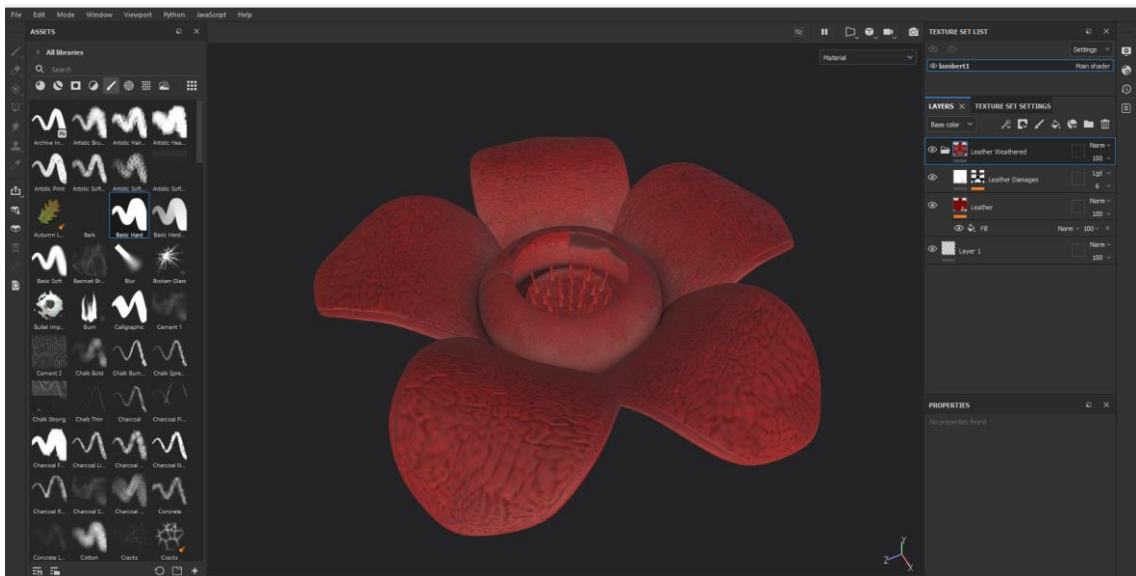

Figure 4.7 Texture and Material Application for Rafflesia in Adobe Substance 3D Painter

Texture and material application that has been exported to 3D Model in Autodesk Maya. Export again as an FBX file.
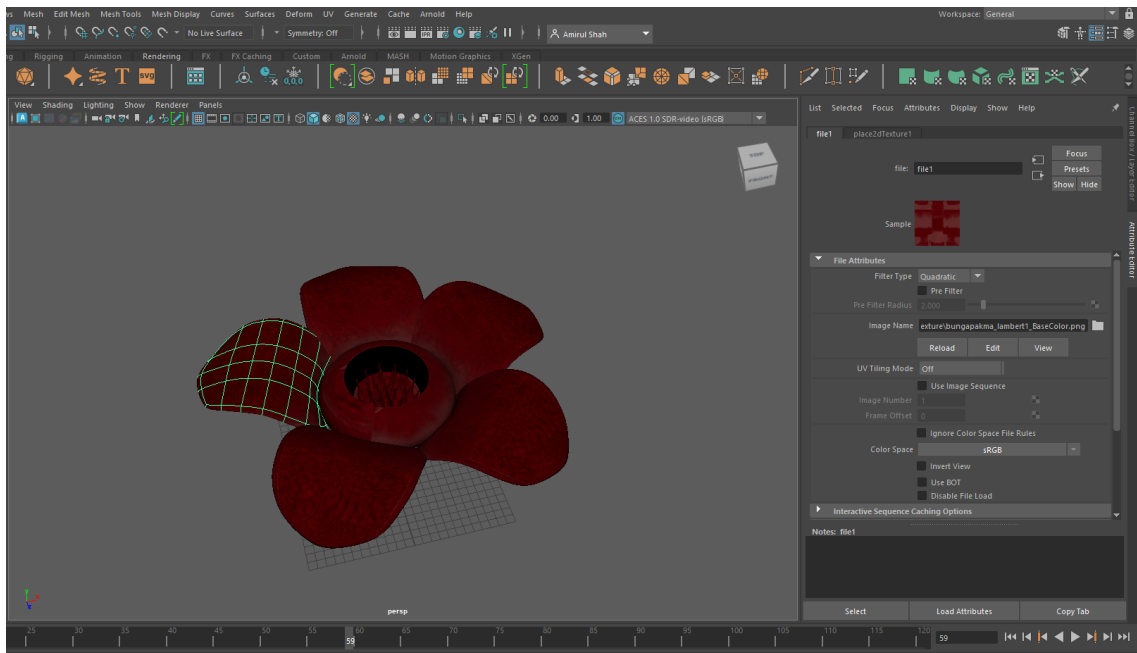
Figure 4.8 Texture and Material Settings for Rafflesia in Autodesk Maya

Import all 3D models that have been developed or modified into Unity according to the Area that has been set.
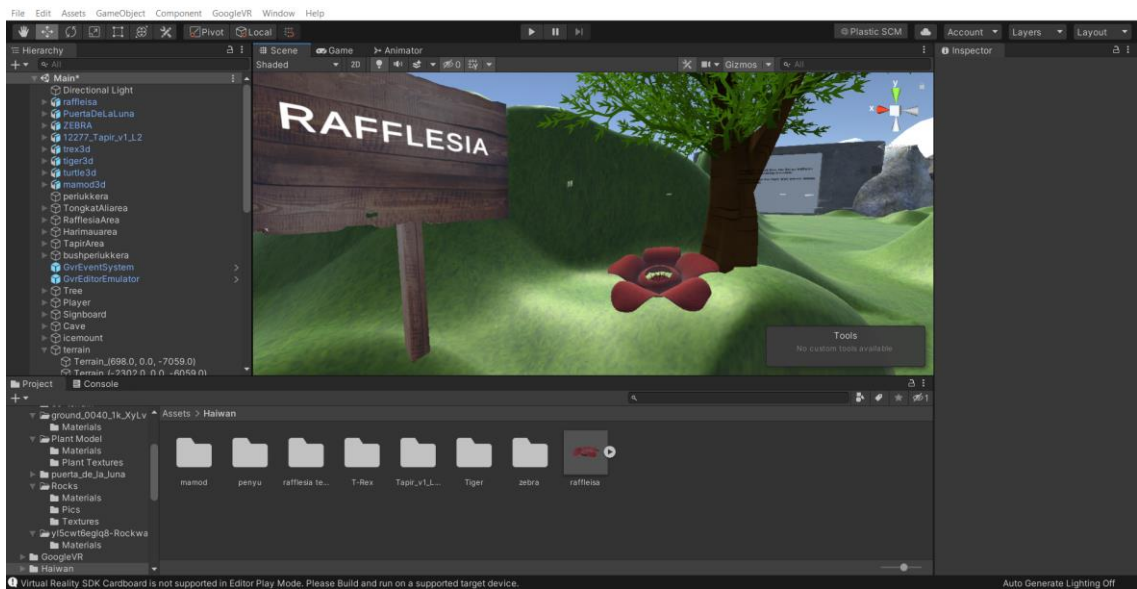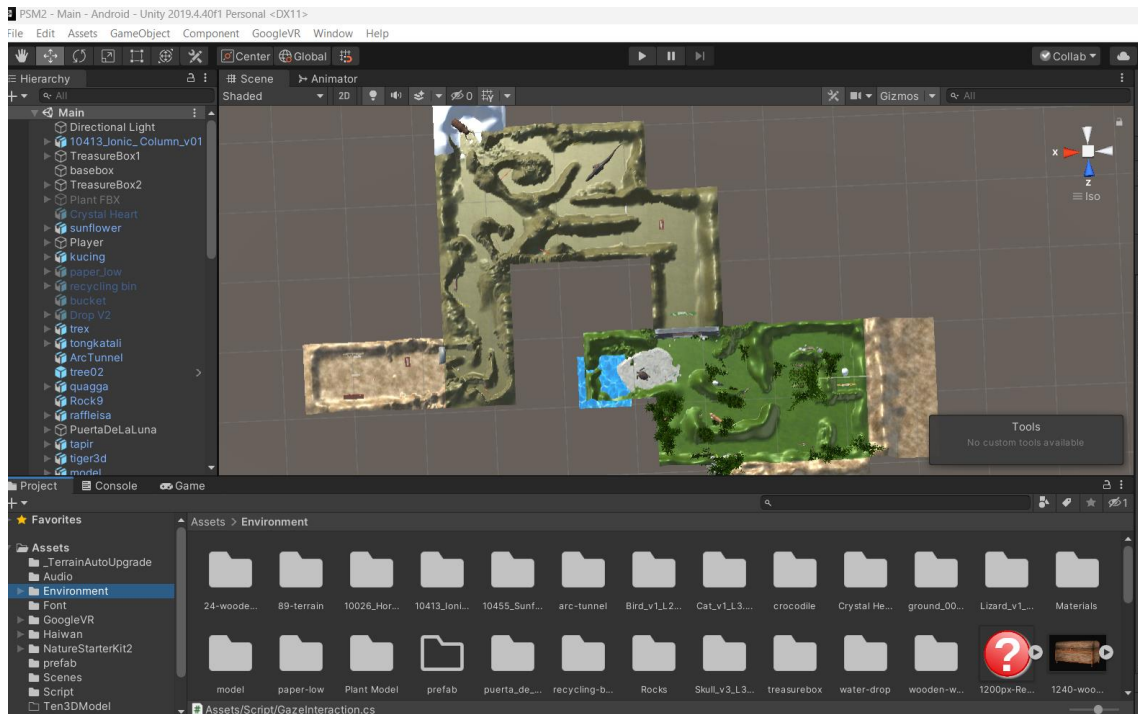

Figure 4.9 Export 3D Model for Rafflesia in Unity

Figure 5.0 Export All 3D Model to Unity

4.2.3 Developments of Virtual Reality (VR) in Unity

For this project, VR was produced using the help of the Google VR SDK. This Google VR SDK will be imported into Unity to allow VR to function properly when the VR application is built on Android mobile devices and can be used. Google VR SDK can be downloaded at Google VR website and it is free.
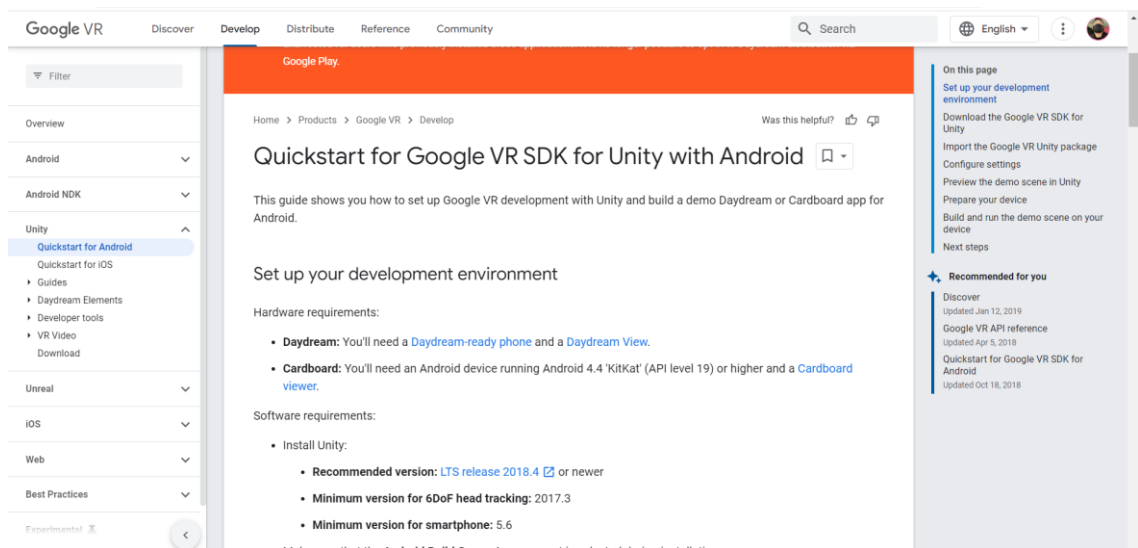

Figure 5.1 Google VR SDK for Unity

Figure 5.2 Import Google VR SDK in Unity

Create a player. The player will be set as Parent while the Camera will be set as Child. Enter GVREventSystem and GVREditorEmulator to start view the 360-degrees VR simulation in Unity.
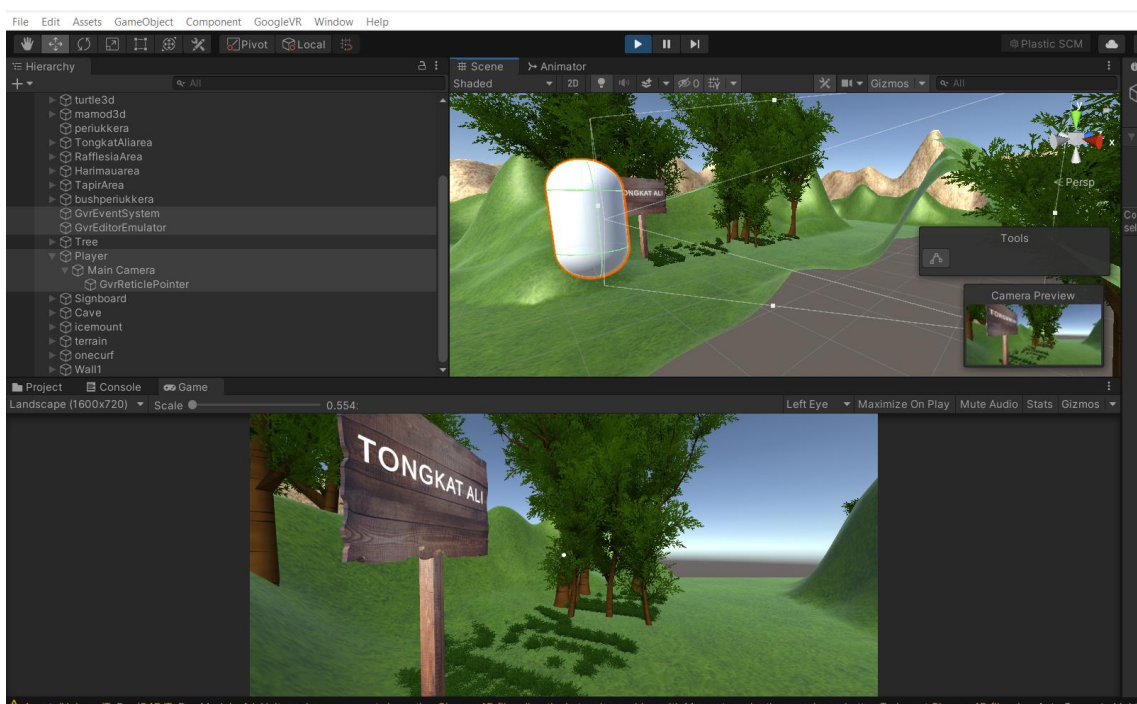

Figure 5.3 Player VR View Setup

4.2.4 Developments of the Audio

For audio, a nature-themed audio selection is used. This audio will be edited using Audacity software for better audio quality.

4.2.5 Developments of the Movement

Scripts will be added to the Player to move forward, backward, left and right in the virtual reality world. Scripts developed using the C# programming language.

```csharp
Playermovement.cs ×
C: > Users > user > Documents > UMP DOC SEM 6 > PSM2Bcup > PSM2 > Assets > Script > C# Playermovement.cs
1    using System.Collections;
2    using System.Collections.Generic;
3    using UnityEngine;
4
5    public class Playermovement : MonoBehaviour
6    {
7        public float speed= 3.5f;
8        public float gravity=10f;
9
10       private CharacterController controller;
11
12       // Start is called before the first frame update
13       void Start()
14       {
15           controller=GetComponent<CharacterController>();
16       }
17
18       // Update is called once per frame
19       void Update()
20       {
21           PlayerMovement();
22       }
23
24       void PlayerMovement(){
25
26           float horizontal= Input.GetAxis("Horizontal");
27           float vertical= Input.GetAxis("Vertical");
28           Vector3 direction= new Vector3(horizontal,0,vertical);
29           Vector3 velocity=direction*speed;
30           velocity= Camera.main.transform.TransformDirection(velocity);
31           velocity.y-=gravity;
32           controller.Move(velocity*Time.deltaTime);
33
34       }
35   }
36
```

Figure 5.4 Script for Movement

4.2.6 Developments of the Collect, Grab and Release Object and Gaze Interaction for information inside VR

Here is the player interaction script where the player can interact with objects in the game such as collecting, grabbing, and releasing objects.

```
        else if (raycastHit.transform.CompareTag("diancamkepupusan"))
    {
        if (!isGazeLoading)
        {
            StartGazeLoading();
        }
        else
        {
            gazeLoadTimer += Time.deltaTime;

            if (gazeLoadTimer >= gazeLoadTime)
            {
                Destroy(raycastHit.transform.gameObject);
                score=score+1;
                scoredisplay.text = score + " / 6";
                scoredisplay.gameObject.SetActive(true);
            }
        }
    }
```

Figure 5.5 Script for Collect Object

```
else if (Input.GetButtonDown("Fire1"))
{

    if (raycastHit.transform.CompareTag("kotakatas"))
    {
    kotakatas.transform.SetParent(myHand.transform);
    kotakatas.transform.position=myHand.transform.position;
    grab=true;
        }

    else if (raycastHit.transform.CompareTag("kotakatas2"))
    {
    kotakatas2.transform.SetParent(myHand.transform);
    kotakatas2.transform.position=myHand.transform.position;
    grab=true;
        }

    else if (raycastHit.transform.CompareTag("kotakatas3"))
    {
    kotakatas3.transform.SetParent(myHand.transform);
    kotakatas3.transform.position=myHand.transform.position;
    grab=true;
        }
```

Figure 5.6 Script for Grab Object

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```
else if (Input.GetButtonDown("Fire2"))
{

    if (grab && raycastHit.transform.CompareTag("batu"))
{
    kotakatas.transform.SetParent(null);
    kotakatas.transform.position=raycastHit.transform.position;
    grab=false;

    Vector3 batu1 = new Vector3(-1661.7f, 36.38377f, -1657.2f); // Replace
    kotakatas.transform.position = batu1;
        }

    else if (grab && raycastHit.transform.CompareTag("batu2"))
{
    kotakatas.transform.SetParent(null);
    kotakatas.transform.position=raycastHit.transform.position;
    grab=false;

    Vector3 batu2 = new Vector3(-1637.956f, -14.11621f, -1728.171f); // R
    kotakatas.transform.position = batu2;
        }
```

Figure 5.7 Script for Release Object

Gaze Interaction is used to set the object's time to respond when the player points the white dot on the object.

```
// Update is called once per frame
void Update()
{

    if (gazedAt)
    {
        timer += Time.deltaTime;

        if (timer >= gazeTime)
        {
            // execute pointerdown handler
            ExecuteEvents.Execute(gameObject, new PointerEventData(EventSystem.current), ExecuteEvents.pointerDownHandler);
            timer = 0f;
        }
    }

}

public void PointerEnter()
{
    gazedAt = true;
    Debug.Log("PointerEnter");
}

public void PointerExit()
{
    gazedAt = false;
    Debug.Log("PointerExit");
}

public void PointerDown()
{
    Debug.Log("PointerDown");
}
```

Figure 5.8 Script for Gaze Interaction

The selected object will be added several components such as Box Collider and Event trigger so that the object can interact with the player such as grab and release.
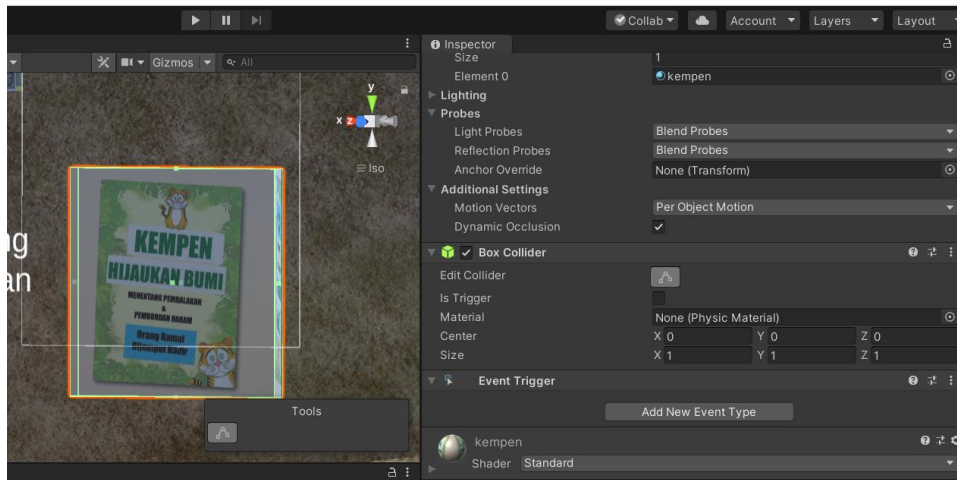

Figure 5.9 Example of an object that has Collider and Event Trigger components

UI Objects such as buttons, images, and panels are also used to display information related to objects. This object has been placed script "ShowInfo" to display information when the white dot pointer hits the object.


```
public void ShowHideInfo(){

    if(!show){
        info.SetActive(true);
        show=true;
        StartCoroutine(HideInfoAfterDelay());

    }

    else{

        info.SetActive(false);
        show=false;
        StopAllCoroutines();
    }
}

    private IEnumerator HideInfoAfterDelay()
    {
    yield return new WaitForSeconds(infoDisplayDuration);

    info.SetActive(false);
    show = false;
    }
}
```

Figure 6.0 Script for Show and Hide Information

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Game objects such as walls are also scripted to provide some response such as moving down and up.

```
public class wall : MonoBehaviour
{
    public GameObject wall1;
    public bool walldown=false;
    public float speed= 1.0f;
    public float destroyPosition = -10.0f;

    // Start is called before the first frame update
    void Start()
    {

    }

    // Update is called once per frame
    void Update()
    {

        if(walldown){

            wall1.transform.Translate(Vector3.down * speed * Time.deltaTime);

            if (wall1.transform.position.y <= destroyPosition)
            {
                // Destroy the wall
                Destroy(wall1);
            }

        }

    }

    public void wallstartdown()
    {
        walldown = true;
    }
}
```

Figure 6.1 Script for Wall go down

4.2.7 Developments of the Main Menu

The Main Menu will be developed in a different Scene which is a new scene in Unity. In the Main Menu will be placed Text for the name of the application and three types of buttons with different functions which are Start, Guide, and Quit buttons.
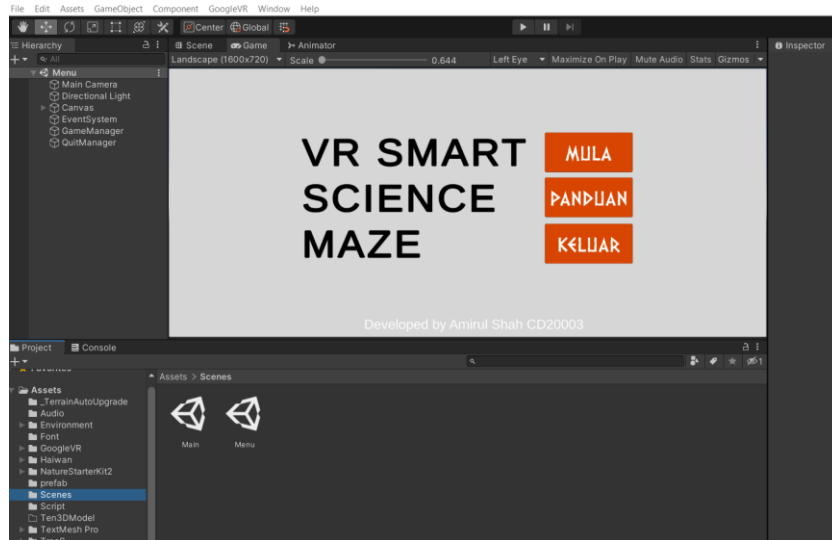
67

Figure 6.2 Scenes in Unity

Figure 6.3 Script for Start the game

Figure 6.4 Script for Quit the game

Figure 6.5 Script for Game Manager

4.2.8 Developments of the Application

The application is developed for Android mobile devices. Therefore, some settings have been applied before the application is launched. The Android platform has been selected and is the target for this application to be downloaded.
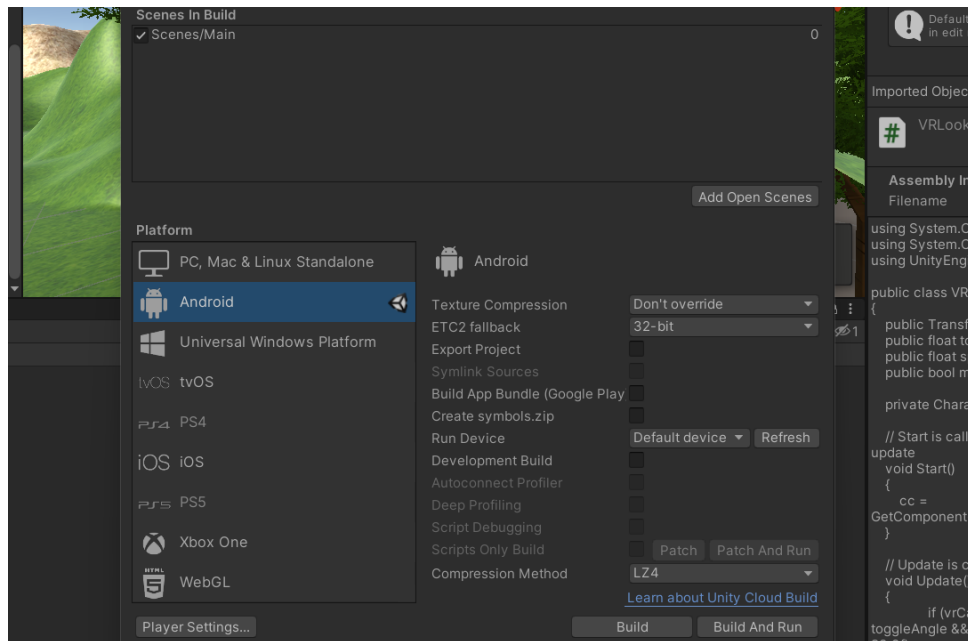
Figure 6.7 Setup for Android Platform in Unity

In the XR Setting, the VR SDK is added and Cardboard is selected as the way to deliver VR to the application.
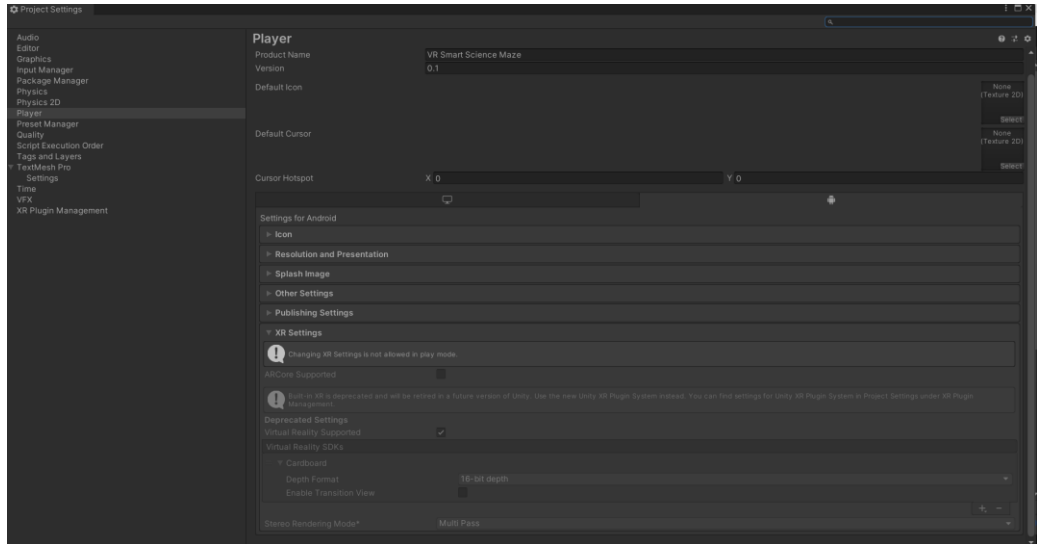
Figure 6.8 XR Setting for VR in Unity

When build on settings is pressed, an APK file will be generated for this application and can be downloaded on the user's Android mobile device.

Figure 6.9 The Application of VR Smart Science Maze

Figure 7.0 VR View on Oppo A3s Smartphone

4.2.9 VR Equipments

The equipment used to experience the world of virtual reality is a VR Box or Google Cardboard together with a suitable Android mobile device. This method is used because it does not consume a high cost and it is affordable and suitable for the target audience of this project. For this project, VR Box and Oppo A3s Smartphones will be used.

Figure 7.1 The Equipment

4.3   Testing

After the implementation phase is complete, the evaluation phase will be conducted. In this phase, the functionality acceptance test and user acceptance test will be done.

4.3.1   Functionality Acceptance Testing (FAT)

The application was tested by Supervisor Dr. Ngahzaifa binti Ab Ghani and Lecturer from Faculty of Computing who teaches the cost of Virtual Reality which is Dr. Saradatul Akma binti Zulkifli. This application was tested with Oppo A3s with VR Box and Controller.

Table 1.5 Functionality Acceptance Test (FAT)

No.	Module	Activity	Expected Output	Result Pass/Fail	Comment
38.	Open the application	The user opens the VR application	Open the VR application for the user	PASS	
39.	Display	Display the interface well according to the screen size	The interface display is perfect according to the size of the	PASS	

			hardware screen		
40.	Start	Start the game	The game begins	PASS	
41.	Quit	Exit the application	Application exited successfully	PASS	
42.	Home	Go to Main Menu	Successfully returned to the Main Menu	PASS	
43.	Joystick right	Move forward when the joystick is pressed to the right	The user successfully moves forward	PASS	
44.	Joystick left	Move backward when the joystick is pressed to the left	The user successfully moves backward	PASS	

45.	Joystick down	Move right when the joystick is pressed to the down	The user successfully moves right	PASS	
46.	Joystick up	Move left when the joystick is pressed to the up	The user successfully moves left	PASS	
47.	Pointer Ray cast	Show the direction	Player will move according to pointer ray cast	PASS	
48.	Maze	Display 3D Model	3D models are successfully displayed along with material and texture models	PASS	
49.	Tongkang Ali				
50.	Pitcher Plant				
51.	Rafflesia				
52.	Malayan Tiger				
53.	Turtle				

54.	Tapir				
55.	Mammoth				
56.	T-Rex				
57.	Quagga				
58.	Dodo				
59.	UI Button	Hit the button using pointer ray cast then the information will pop up	The information will pop-up after the pointer ray cast hit the UI button	PASS	
60.	UI Panel	Hit the button using pointer ray cast then the information will pop up in the UI Panel	The information in the UI Panel will pop-up after the pointer ray cast hit the UI button	PASS	
61.	Tongkang Ali	Point the ray cast to the	The object will be destroyed	PASS	

62.	Pitcher Plant	object and the object will destroy	after player point the ray cast to the object	PASS	
63.	Rafflesia			PASS	
64.	Tiger			PASS	
65.	Turtle			PASS	
66.	Tapir			PASS	
67.	Score	Add one score when object destroy	The score will add one score for each object. Total 6/6 score	PASS	
68.	Score Display	Show current score and change score point	The score displays the current score and change the score point	PASS	
69.	Wall	Wall go down	The wall goes down after score 6/6	PASS	
70.		Wall go up	The wall goes up after player	PASS	

No.		Test Case	Expected Result	Result	
			finish the last mission		
71.	Cube with Image (Kempen Menghijaukan Bumi)	Grab the cube object	The cube object will be grabbed when the "B" button on the controller is pressed	PASS	
72.	Cube with Image (Penanaman Semula Pokok)			PASS	
73.	Cube with Image (Kempen Menghijaukan Bumi)	Release the cube to the target	The cube object will be released when the "C" button on the controller is pressed	PASS	
74.	Cube with Image (Penanaman Semula Pokok)			PASS	

4.3.2 Application Testing

For the application test, 10 questions have been created and printed. Testers will be interviewed based on the questions that have been created. This method is used to ensure that testers can provide good cooperation without any problem during the interview session. The testers are 12-year-old standard six students who live around Taman Mentiga Jaya, Pekan, Pahang. Feedback from testers is recorded for research and use in this project. Testers are also allowed to give their opinion about this application. The full question is attached in Appendix C.

Figure 7.2 One of the participants for application testing

4.3.3 User Acceptance Testing (UAT)

User Acceptance Testing (UAT) is done to ensure that every feature in the application works well. Each element, such as movement and interaction are tested in detail to ensure the application meets functional and non-functional requirements. This UAT has been performed by Akil Aiman, a standard six student who live in Taman Mentiga Jaya, Pekan, Pahang.

Table 1.6 User Acceptance Test (UAT)

No.	Task / Requirement	Expected Result	Actual Result	Pass / Fail
1.	User open the application	Navigate to Main Menu screen	System response	Pass
2.	User press on "Start" button	Navigate to game screen	System response	Pass
3.	User press the 'Guide' button	Pop-up the guideline screen	Guideline screen pop-up	Pass
4.	User press the 'Exit' button	Pop-up the exit screen	Exit screen pop-up	Pass
5.	User press "Yes" button to exit	Close the application	Application closed	Pass
6.	User can move forward	Player moves forward	Player moves forward	Pass
7.	User can move backward	Player moves backward	Player moves backward	Pass
8.	User can move right	Player moves right	Player moves right	Pass
9.	User can move left	Player moves left	Player moves left	Pass

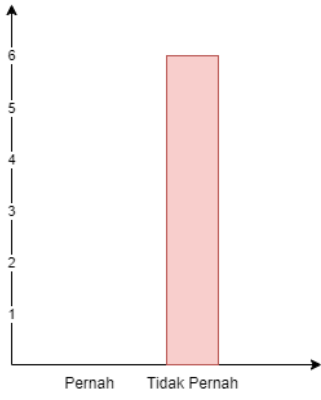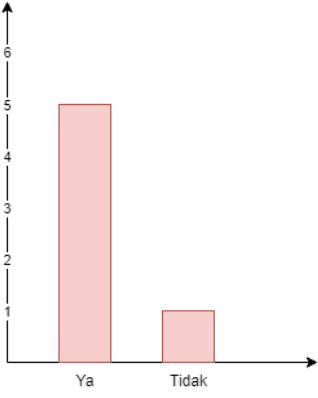| No.		Expected	Result	Status
10.	User can view 360 degree	Player view 360 degree	Player view 360 degree	Pass
11.	User collects "Tongkat Ali"	Destroy the tongkat ali and add one score	Tongkat ali is destroyed and one score is added	Pass
12.	User collects "Periuk Kera"	Destroy the periuk kera and add one score	Periuk Kera is destroyed and one score is added	Pass
13.	User collects "Bunga Pakma"	Destroy the bunga pakma and add one score	Bunga pakma is destroyed and one score is added	Pass
14.	User collects "Harimau"	Destroy the harimau and add one score	Harimau is destroyed and one score is added	Pass
15.	User collects "Tapir"	Destroy the tapir and add one score	Tapir is destroyed and one score is added	Pass
16.	User collects "Penyu"	Destroy the penyu and add one score	Penyu is destroyed and one score is added	Pass
17.	User can view current score	Display current score	Current score is displayed	Pass
18.	User can view the crystal	Display crystal	Crystal is displayed	Pass

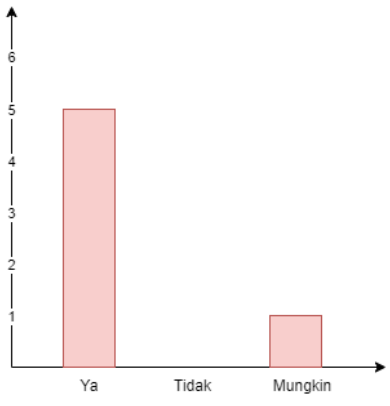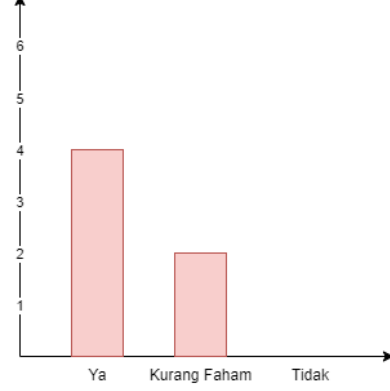| No.				
19.	User can view the UI Information	Display information	Information is displayed	Pass
20.	User can grab object	Object is grabbed by user	Object is grabbed by user	Pass
21.	User can release the object	Object is released by user	Object is released by user	Pass
22.	User can view the wall go down	The wall goes down	The wall goes down	Pass
23.	User can view the wall go up	The wall goes up	The wall goes up	Pass
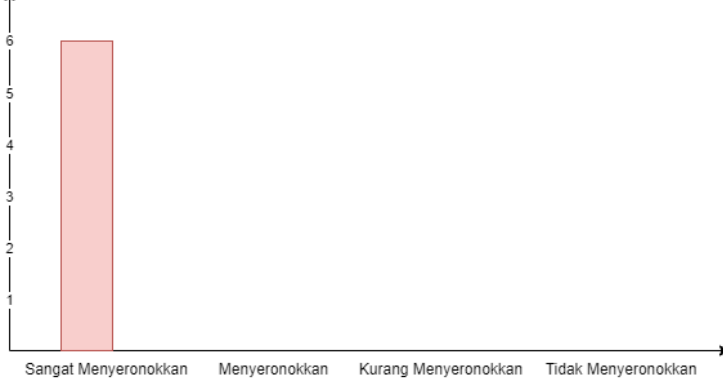
4.4   Result and Discussion

Based on the tests that have been done on the application, the results show positive feedback from the testers. The table below shows the results received for this application.

Table 1.7 Result from Application Testing

No.	Question	Result
1.	Adakah anda tahu tentang Virtual Reality (VR)?	

		Based on this result, one (16.67%) out of six standard six students know about the existence of Virtual Reality (VR)
2.	Adakah anda pernah menggunakan VR?	 Based on this result, all students have never used VR applications
3.	Adakah anda mempunyai telefon pintar atau tablet?	 Based on this result, 83.33% of students have a mobile device and 16.67% do not have a mobile device
4.	Adakah anda gemar bermain permainan video pada telefon pintar/ tablet atau komputer?	 Based on this result, all six students like to play video games on their mobile devices

5.	Selepas anda mencuba bermain VR Smart Science Maze, adakah anda memperoleh sesuatu yang bermanfaat?	 Based on this result, 83.33% of students gained something while playing the VR Smart Science Maze and 16.67% were still unsure of what they gained in this game
6.	Adakah anda faham dengan arahan yang terdapat di dalam VR Smart Science Maze?	 Based on this result, 66.67% of students are clear with the instructions given and 33.33% are still not clear with the instructions given in the game
7.	Apakah perasaan anda ketika bermain VR Smart Science Maze?	 Based on this result, most students think this VR game is fun

8.	Jika VR Smart Science Maze ini Sangat Menyeronokkan/ Menyeronokkan/ Kurang Menyeronokkan/ Tidak Menyeronokkan, berikan sebab kenapa ianya begitu.	Based on the feedback from the students, all of them felt so fun because this was the first time, they tried a VR application with a VR Box and Controller. They also feel like they are in another world while playing the VR Smart Science Maze
9.	Apakah yang anda lihat ketika bermain VR Smart Science Maze? Tuliskan jawapan anda dibawah.	Based on the feedback from the students, they are seen to be more focused on 3D objects such as Animals and Plants and objects that attract their attention. When asked, some of them remember what they saw in this application
10.	Pada pendapat anda, apakah yang perlu ditambahbaik pada permainan bermain VR Smart Science Maze? Tuliskan jawapan anda dibawah.	Based on student feedback, when asked what needs to be improved on this application, a few of them only said that this application needs to have interesting sounds so that it is more fun to play. Anyway, they say they still enjoy playing with this VR

CHAPTER 5

CONCLUSION

5.1   INTRODUCTION

Chapter 5 will summarize the findings of the VR Smart Science Maze to successfully achieve the objective and solve the problem stated in the problem statement. In conclusion, this project almost reached its objective.

5.2   PROJECT LIMITATION

There are some limitations to this VR application. The limitations are:

i.   Platform

This application can only be installed on Android devices. Users of devices other than Android cannot install this application and use it on their devices.

ii.   Display

The VR displayed on the user is a bit less clear than the display on Oculus because this application is developed using Google Cardboard and requires equipment such as VR Box. VR Box is so compact and cheap that it must have a low-quality display compared to Oculus.

iii.   Language

This application is developed in Malay. There is some confusion for those who learn scientific terms in other languages such as English to understand the content provided in the application.

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5.3   FUTURE WORK

Several improvements can be made to the application. The improvements are:

   i.   Platform

   Hope this application can be developed for all mobile device users regardless of Android or Ios operating system.

   ii.   Accessibility

   Developed VR content can be developed and delivered using more sophisticated and quality equipment such as Oculus to experience better virtual world immersion.

   iii.   Language

   Do not develop an application limited to one language only because if you have a choice of language, this application can be used universally.

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APPENDIX A

APPLICATION TESTING

ama: Haikal   Umur: 12

1. Adakah anda tahu tentang Virtual Reality (VR) ?

   A. Tahu
   (B) Tidak Tahu

2. Adakah anda pernah menggunakan VR?

   A. Pernah
   (B) Tidak Pernah

3. Adakah anda mempunyai telefon pintar atau tablet?

   (A.) Ya
   B. Tidak

4. Adakah anda gemar bermain permainan video pada telefon pintar/ tablet atau komputer?

   (A) Ya
   B. Tidak
   C. Mungkin

5. Selepas anda mencuba bermain VR Smart Science Maze, adakah anda memperoleh sesuatu yang bermanfaat?

   (A) Ya
   (B) Tidak
   (C) Mungkin

6. Adakah anda faham dengan arahan yang terdapat di dalam VR Smart Science Maze?

   A. Ya
   (B.) Kurang Faham
   C. Tidak

7. Apakah perasaan anda ketika bermain VR Smart Science Maze?

   (A.) Sangat Menyeronokkan
   B. Menyeronokkan
   C. Kurang Menyeronokkan
   D. Tidak Menyeronokkan

8. Jika VR Smart Science Maze ini Sangat Menyeronokkan/ Menyeronokkan/ Kurang Menyeronokkan/ Tidak Menyeronokkan, berikan sebab kenapa ianya begitu.

   First time wba, selalu tengok kat tiktok je.

9. Apakah yang anda lihat ketika bermain VR Smart Science Maze? Tuliskan jawapan anda dibawah.

   Nampak haiwan macam harimau, penyu, tengkurak

10. Pada pendapat anda, apakah yang perlu ditambahbaik pada permainan bermain VR Smart Science Maze? Tuliskan jawapan anda dibawah.

    Best

ama: Aiman Hakimi   Umur: 12

1. Adakah anda tahu tentang Virtual Reality (VR) ?

   Ⓐ Tahu
   B. Tidak Tahu

2. Adakah anda pernah menggunakan VR?

   A. Pernah
   Ⓑ Tidak Pernah

3. Adakah anda mempunyai telefon pintar atau tablet?

   Ⓐ Ya
   B. Tidak

4. Adakah anda gemar bermain permainan video pada telefon pintar/ tablet atau komputer?

   Ⓐ Ya
   B. Tidak
   C. Mungkin

5. Selepas anda mencuba bermain VR Smart Science Maze, adakah anda memperoleh sesuatu yang bermanfaat?

   Ⓐ Ya
   B. Tidak
   C. Mungkin

6. Adakah anda faham dengan arahan yang terdapat di dalam VR Smart Science Maze?

   Ⓐ Ya
   B. Kurang Faham
   C. Tidak

7. Apakah perasaan anda ketika bermain VR Smart Science Maze?

   Ⓐ Sangat Menyeronokkan
   B. Menyeronokkan
   C. Kurang Menyeronokkan
   D. Tidak Menyeronokkan

8. Jika VR Smart Science Maze ini Sangat Menyeronokkan/~~Menyeronokkan~~/ Kurang ~~Menyeronokkan~~/ ~~Tidak Menyeronokkan~~, berikan sebab kenapa ianya begitu.

   Berada di alam bin

9. Apakah yang anda lihat ketika bermain VR Smart Science Maze? Tuliskan jawapan anda dibawah.

   Harimau , Tengicorak , Haiwan lain

10. Pada pendapat anda, apakah yang perlu ditambahbaik pada permainan bermain VR Smart Science Maze? Tuliskan jawapan anda dibawah.

   Letak bunyi efek

92

Nama: Syahira   Umur: 12

1. Adakah anda tahu tentang Virtual Reality (VR) ?

   A. Tahu
   (B) Tidak Tahu

2. Adakah anda pernah menggunakan VR?

   A. Pernah
   (B) Tidak Pernah

3. Adakah anda mempunyai telefon pintar atau tablet?

   (A) Ya
   B. Tidak

4. Adakah anda gemar bermain permainan video pada telefon pintar/ tablet atau komputer?

   (A) Ya
   B. Tidak
   C. Mungkin

5. Selepas anda mencuba bermain VR Smart Science Maze, adakah anda memperoleh sesuatu yang bermanfaat?

   (A) Ya
   B. Tidak
   C. Mungkin

6. Adakah anda faham dengan arahan yang terdapat di dalam VR Smart Science Maze?

   (A) Ya
   B. Kurang Faham
   C. Tidak

7. Apakah perasaan anda ketika bermain VR Smart Science Maze?

   (A) Sangat Menyeronokkan
   B. Menyeronokkan
   C. Kurang Menyeronokkan
   D. Tidak Menyeronokkan

8. Jika VR Smart Science Maze ini Sangat Menyeronokkan/ ~~Menyeronokkan~~/ ~~Kurang Menyeronokkan~~/ ~~Tidak Menyeronokkan~~, berikan sebab kenapa ianya begitu.

   Nampak haiwan, Nampak bunga

9. Apakah yang anda lihat ketika bermain VR Smart Science Maze? Tuliskan jawapan anda dibawah.

   Bunga Raffelia

10. Pada pendapat anda, apakah yang perlu ditambahbaik pada permainan bermain VR Smart Science Maze? Tuliskan jawapan anda dibawah.

    Tiada, Tak tahu

93

Nama: Huzierah   Umur: 12

1. Adakah anda tahu tentang Virtual Reality (VR) ?

   A. Tahu
   B. Tidak Tahu

2. Adakah anda pernah menggunakan VR?

   A. Pernah
   B. Tidak Pernah

3. Adakah anda mempunyai telefon pintar atau tablet?

   A. Ya
   B. Tidak

4. Adakah anda gemar bermain permainan video pada telefon pintar/ tablet atau komputer?

   A. Ya
   B. Tidak
   C. Mungkin

5. Selepas anda mencuba bermain VR Smart Science Maze, adakah anda memperoleh sesuatu yang bermanfaat?

   A. Ya
   B. Tidak
   C. Mungkin

6. Adakah anda faham dengan arahan yang terdapat di dalam VR Smart Science Maze?

   A. Ya
   B. Kurang Faham
   C. Tidak

7. Apakah perasaan anda ketika bermain VR Smart Science Maze?

   A. Sangat Menyeronokkan
   B. Menyeronokkan
   C. Kurang Menyeronokkan
   D. Tidak Menyeronokkan

8. Jika VR Smart Science Maze ini Sangat Menyeronokkan/ Menyeronokkan/ Kurang Menyeronokkan/ Tidak Menyeronokkan, berikan sebab kenapa ianya begitu.

   Tak pernah guna

9. Apakah yang anda lihat ketika bermain VR Smart Science Maze? Tuliskan jawapan anda dibawah.

   Nampak haiwan, ada binasaur, kucing oyen

10. Pada pendapat anda, apakah yang perlu ditambahbaik pada permainan bermain VR Smart Science Maze? Tuliskan jawapan anda dibawah.

    Tak tahu

94

Nama: liam   Umur: 12

1. Adakah anda tahu tentang Virtual Reality (VR) ?

   A. Tahu
   (B.) Tidak Tahu

2. Adakah anda pernah menggunakan VR?

   A. Pernah
   (B.) Tidak Pernah

3. Adakah anda mempunyai telefon pintar atau tablet?

   A. Ya
   (B.) Tidak

4. Adakah anda gemar bermain permainan video pada telefon pintar/ tablet atau komputer?

   (A.) Ya
   B. Tidak
   C. Mungkin

5. Selepas anda mencuba bermain VR Smart Science Maze, adakah anda memperoleh sesuatu yang bermanfaat?

   A. Ya
   B. Tidak
   (C.) Mungkin

6. Adakah anda faham dengan arahan yang terdapat di dalam VR Smart Science Maze?

   A. Ya
   (B.) Kurang Faham
   C. Tidak

7. Apakah perasaan anda ketika bermain VR Smart Science Maze?

   (A.) Sangat Menyeronokkan
   B. Menyeronokkan
   C. Kurang Menyeronokkan
   D. Tidak Menyeronokkan

8. Jika VR Smart Science Maze ini Sangat Menyeronokkan/ Menyeronokkan/ Kurang Menyeronokkan/ Tidak Menyeronokkan, berikan sebab kenapa ianya begitu.

   Tak pernah cuba

9. Apakah yang anda lihat ketika bermain VR Smart Science Maze? Tuliskan jawapan anda dibawah.

   Nampak binatang, duduk dalam hutan .

10. Pada pendapat anda, apakah yang perlu ditambahbaik pada permainan bermain VR Smart Science Maze? Tuliskan jawapan anda dibawah.

   Kena letak bunyi kasi lagi gempak

Nama: Aliya   Umur: 12

1. Adakah anda tahu tentang Virtual Reality (VR) ?

   A. Tahu
   B. Tidak Tahu

2. Adakah anda pernah menggunakan VR?

   A. Pernah
   B. Tidak Pernah

3. Adakah anda mempunyai telefon pintar atau tablet?

   A. Ya
   B. Tidak

4. Adakah anda gemar bermain permainan video pada telefon pintar/ tablet atau komputer?

   A. Ya
   B. Tidak
   C. Mungkin

5. Selepas anda mencuba bermain VR Smart Science Maze, adakah anda memperoleh sesuatu yang bermanfaat?

   A. Ya
   B. Tidak
   C. Mungkin

6. Adakah anda faham dengan arahan yang terdapat di dalam VR Smart Science Maze?

   A. Ya
   B. Kurang Faham
   C. Tidak

7. Apakah perasaan anda ketika bermain VR Smart Science Maze?

   A. Sangat Menyeronokkan
   B. Menyeronokkan
   C. Kurang Menyeronokkan
   D. Tidak Menyeronokkan

8. Jika VR Smart Science Maze ini Sangat Menyeronokkan/ Menyeronokkan/ Kurang Menyeronokkan/ Tidak Menyeronokkan, berikan sebab kenapa ianya begitu.

   Dapat tengok haiwan, berada dekat alam buh

9. Apakah yang anda lihat ketika bermain VR Smart Science Maze? Tuliskan jawapan anda dibawah.

   Nampak haiwan, Nampak Rafflesia

10. Pada pendapat anda, apakah yang perlu ditambahbaik pada permainan bermain VR Smart Science Maze? Tuliskan Jawapan anda dibawah.

    Tak tahu hada