AIRBORNE ADVENTURE: DEVELOPMENT OF AN ENGAGING FLIGHT SIMULATOR FOR SCALABILITY AND IMMERSION

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SESI PENGAJIAN: 2022 / 2023

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Alamat tetap:	PROFESOR TS. DR. SAZILAH BINTI SALAM
Tarikh: 26 September 2023	Tarikh: 26 September 2023

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This report is submitted in partial fulfillment of the requirements for the Bachelor of Computer Science (Interactive Media) with Honours.

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2023

DECLARATION

I hereby declare that this project report entitled

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is written by me and is my own effort and that no part has been plagiarized without citations.

STUDENT : _____ Date : 26/09/23
(CHOO XIN LE)

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 (Interactive Media) with Honours.

SUPERVISOR : _____ Date : 26/09/23
(PROFESOR TS. DR. SAZILAH BINTI SALAM)

DEDICATION

This project report is dedicated to all the individuals who have supported and guided me throughout this journey.

To my family, for their unwavering love, encouragement, and understanding during the ups and downs of this project. Your constant support has been my source of strength.

To my supervisor, PROFESOR TS. DR. SAZILAH BINTI SALAM, for their invaluable guidance, expertise, and patience throughout the entire project. Your mentorship and insightful feedback have been instrumental in shaping the success of this endeavour.

To my classmates and friends, for their companionship, motivation, and shared experiences. Your collaboration and discussions have contributed to the development of new ideas and perspectives.

To the participants and stakeholders who generously contributed their time, insights, and expertise. Your contributions have enriched the project and provided valuable data for analysis.

Lastly, I would like to express my heartfelt appreciation to all the researchers, scholars, and practitioners whose work has laid the foundation for this project. Your contributions have inspired and influenced my own research journey.

Thank you all for being an integral part of this project and for your unwavering support. This report is a testament to our collective efforts, and I am grateful to have had the opportunity to work alongside such exceptional individuals.

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I would like to express my heartfelt gratitude and appreciation to the following individuals and organizations who have contributed to the successful completion of this project:

First and foremost, I would like to thank my supervisor, PROFESOR TS. DR. SAZILAH BINTI SALAM, for their guidance, expertise, and unwavering support throughout the project. Their valuable insights and constructive feedback have been instrumental in shaping the direction and quality of this work.

I am deeply grateful to the participants who willingly dedicated their time and provided valuable input for this project. Their contributions have been invaluable in gathering data and gaining insights into the subject matter.

I extend my appreciation to my colleagues and friends who have offered their assistance, shared their expertise, and provided valuable feedback throughout the project. Their input and discussions have helped refine the ideas and strengthen the overall quality of this work.

I am indebted to the academic community and researchers whose work has served as a foundation for this project. Their groundbreaking studies and published materials have provided valuable references and insights.

Lastly, I want to express my heartfelt gratitude to my family for their unwavering support, patience, and encouragement throughout this endeavor. Their love and understanding have been my constant motivation.

Although it is not possible to name everyone who has contributed to this project, please know that your support has been truly appreciated. Thank you all for your invaluable contributions and for being a part of this journey.

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ABSTRACT

The Airborne Adventure VR project aims to provide users with an immersive virtual reality experience that transports them into a thrilling and breathtaking world of aerial exploration. Utilizing the power of virtual reality technology, this project offers users the opportunity to embark on an exhilarating adventure through fantastical landscapes and navigate challenging airborne obstacles. With advanced 3D modelling, realistic physics simulations, and interactive gameplay mechanics, users will be able to experience the sensation of flight as they soar through virtual environments. They will encounter awe-inspiring vistas, encounter obstacles to overcome, and engage in dynamic interactions that enhance their sense of presence and immersion. The project's primary focus lies in creating visually stunning and diverse virtual environments, ranging from majestic mountain ranges to lush tropical forests and other captivating settings. The incorporation of intricate details, such as realistic lighting effects, dynamic weather systems, and interactive elements, further enriches the overall experience. Additionally, the Airborne Adventure VR project places emphasis on user engagement and enjoyment. The implementation of intuitive and responsive controls allows users to navigate the virtual world with ease, ensuring a seamless and enjoyable gameplay experience. Moreover, the inclusion of challenging obstacles, hidden treasures, and exciting objectives provides users with a sense of accomplishment and adventure as they progress through the virtual journey. This project seeks to deliver an immersive and thrilling airborne adventure that pushes the boundaries of virtual reality experiences. By harnessing the capabilities of VR technology, it offers users a unique opportunity to explore captivating landscapes, engage in dynamic interactions, and experience the exhilaration of flight in a virtual realm.

ABSTRAK

Projek Airborne Adventure VR bertujuan untuk memberikan pengguna pengalaman realiti maya yang mendalam yang membawa mereka ke dunia penerokaan udara yang mengasyikkan dan menakjubkan. Dengan menggunakan teknologi realiti maya, projek ini menawarkan peluang kepada pengguna untuk menjalani pengembaraan yang menggembirakan melalui landskap imaginasi dan mengatasi halangan udara yang mencabar. Dengan pemodelan 3D yang canggih, simulasi fizik yang realistik, dan mekanik permainan yang interaktif, pengguna akan dapat merasai sensasi penerbangan ketika mereka melayang melalui persekitaran maya. Mereka akan menjumpai pemandangan yang mengagumkan, menghadapi rintangan yang perlu diatasi, dan terlibat dalam interaksi dinamik yang meningkatkan rasa kewujudan dan penglibatan mereka. Fokus utama projek ini adalah dalam mencipta persekitaran maya yang memukau dan pelbagai, dari rangkaian gunung yang megah hingga hutan tropika yang hijau dan pengaturan lain yang memukau. Penggabungan butiran yang rumit, seperti kesan pencahayaan yang realistik, sistem cuaca yang dinamik, dan elemen-elemen interaktif, lebih memperkayakan pengalaman keseluruhan. Selain itu, projek Airborne Adventure VR menekankan penglibatan dan keseronokan pengguna. Pelaksanaan kawalan yang intuitif dan responsif membolehkan pengguna menavigasi dunia maya dengan mudah, memastikan pengalaman permainan yang lancar dan menyeronokkan. Selain itu, penyertaan rintangan yang mencabar, harta tersembunyi, dan objektif yang mengasyikkan memberikan pengguna rasa pencapaian dan pengembaraan ketika mereka bergerak maju dalam perjalanan maya. Projek ini berusaha untuk menyampaikan pengembaraan udara yang mendalam dan menggembirakan yang mendorong batasan pengalaman realiti maya. Dengan mengambil kelebihan teknologi VR, ia menawarkan peluang unik kepada pengguna untuk meneroka landskap yang memikat, terlibat dalam interaksi yang dinamik, dan mengalami keghairahan penerbangan dalam alam maya.

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LIST OF ABBREVIATIONS

VR	**-**	**Virtual Reality**
UI	**-**	**User Interface**
NPC	**-**	**Non-Player Character**

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CHAPTER 1: INTRODUCTION

1.1 Project Background

Virtual reality technology has opened new possibilities for immersive and engaging experiences, and flight simulators have been a popular use case for this technology. Air travel is a fascinating and exciting activity that many people are interested in, but not everyone has the means or opportunity to experience it in real life. A virtual reality flight simulator can provide a realistic and accessible way to explore the world from the skies, while also allowing users to practice their flying skills and learn about aviation.

1.2 Problem Statement

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A flight accident is an unplanned event that occurs during the operation of an aircraft and results in damage to the aircraft or injury or death to its occupants or people on the ground. Flight accidents can be caused by a variety of factors, including mechanical failure, pilot error, adverse weather conditions, and acts of terrorism. On March 10, 2019, Ethiopian Airlines Flight 302 crashed shortly after take-off from Addis Ababa, Ethiopia, killing all 157 people on board. The accident was caused by a malfunction of the aircraft's automated flight control system.

The Airborne Adventure VR project aims to provide a more cost-effective way and ensure the safety of users. For instance, operating a physical aircraft can be expensive and avoiding the risk of damage to the aircraft or injury to users. The project will leverage the capabilities of virtual reality technology to create a realistic and engaging environment that allows users to experience the thrill of flying and explore different parts of the world. The project will incorporate realistic flight physics, interactive environments, and

customizable flight settings to provide a unique and enjoyable experience for users.

The project will provide a fun and educational experience that can be enjoyed by all ages, while also allowing users to practice their flying skills and explore different parts of the world. The project will work closely with users to gather feedback and improve the project, ensuring that it meets the needs and expectations of the target audience.

1.3 Objective

This project included the following objectives:

- To identify the key features that contribute to an engaging and immersive experience of flight simulator.
- To develop a scalable and expandable flight simulator that can be updated with new features and content in the future.
- To evaluate the project based on user engagement, attraction and immersive experience of the prototype.

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1.4 Scope

The scope will be shown from aspects which are target audience, platform, genre, and theme.

- Target audience: aviation enthusiasts, travellers, families, and youngsters
- Platform: unity

- Genre: simulation

- Theme: around the world. users can explore different parts of the world

1.5 Project Significant

The Airborne Adventure VR project offers several advantages over traditional flight simulators and real-life flying experiences:

- Accessibility: The Airborne Adventure VR project can be accessed by a wide range of users, regardless of their location or physical ability. Users can experience the thrill of flying without leaving their homes and can customize their flight settings to suit their skill level.

- Affordability: Real-life flying experiences can be expensive and inaccessible for many people, but the Airborne Adventure VR project provides an affordable alternative that offers many of the same benefits.

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- Safety: Real-life flying can be dangerous, and flight simulators can be limited in their ability to provide realistic flight experiences. The Airborne Adventure VR project provides a safe and controlled environment for users to practice their flying skills and explore different parts of the world.

- Realism: The Airborne Adventure VR project uses virtual reality technology to create a realistic and immersive environment that closely simulates the experience of real-life flying. This provides users with a unique and engaging experience that can be difficult to replicate in traditional flight simulators.

- Education: The Airborne Adventure VR project can be used as an educational tool, providing users with an opportunity to learn about different parts of the world and practice their flying skills in a fun and interactive way.

1.6 Conclusion

Airborne Adventure is a unique and engaging VR project that provides users with a thrilling and educational experience, while also catering to different interests and skill levels. It has the potential to become a popular and successful product in the VR industry.

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CHAPTER 2: LITERATURE REVIEW AND PROJECT METHODOLOGY

2.1 Introduction

Virtual Reality (VR) is an immersive technology that allows users to experience computer-generated environments as if they were real. It simulates a user's physical presence in a digital world by using a combination of specialized hardware and software. VR systems usually consist of a headset or a pair of goggles with a screen that covers the user's eyes, as well as hand controllers or other devices for interacting with the virtual environment. The experience is designed to be interactive, giving users the ability to explore and manipulate the digital world in a way that feels natural and intuitive. VR has a wide range of applications, from gaming and entertainment to education, training, and therapy. With continued advancements in technology, VR is poised to become an increasingly popular and widespread technology in the coming years.

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2.2 Domain

Nowadays, more and more industry and technology are involved in creating and using virtual reality systems. This includes the development of specialized hardware, such as VR headsets and controllers, as well as the creation of software applications and experiences designed for use with these devices. The VR domain encompasses a wide range of industries, including gaming, entertainment, education, healthcare, engineering, and more. As VR technology continues to advance, it has the potential to transform the way we

interact with digital content and the world around us, opening new possibilities for immersive experiences and applications.

a) Gaming and entertainment

VR gaming is an immersive gaming experience that allows players to enter a virtual world and interact with it using specialized hardware and software. VR gaming involves wearing a VR headset, which tracks the movement of the player's head and body, and hand controllers, which allow the player to interact with objects in the virtual world.

Figure 2.2.1 VR Gaming

b) Healthcare

VR technology is being used in the diagnosis and treatment of various medical conditions. For example, VR can be used to visualize the anatomy of a patient's body, or to provide distraction during medical procedures to reduce pain and anxiety.

Figure 2.2.2 VR Diagnosis and Treatment

c) Education

VR education can be used to personalize learning experiences to meet the needs of individual students. By using VR technology, educators can create customized learning experiences that cater to each student's unique learning style and pace. Meanwhile, students can also experience simulations of real-world situations and practice problem-solving skills in a safe and controlled environment.

Figure 2.2.3 VR Education

d) Design and architecture

VR technology can be used for architectural visualization, allowing architects and designers to create and explore virtual environments in 3D. This can help to visualize and refine architectural designs before construction.

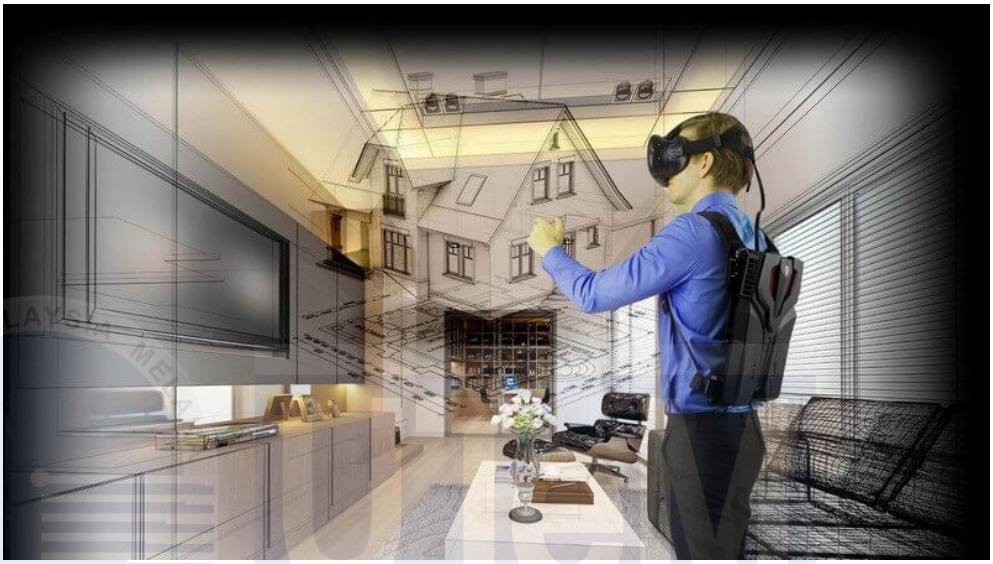

Figure 2.2.4 VR Design and architecture

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2.3 Existing Project

This topic will be list out the similar projects that have the related features with Airborne Adventure VR project.

For example:

2.3.1 Aero fly FS 2 Flight Simulator

This is a VR flight simulator that allows players to pilot a variety of aircraft, from small planes to commercial jets, in a highly realistic virtual environment.

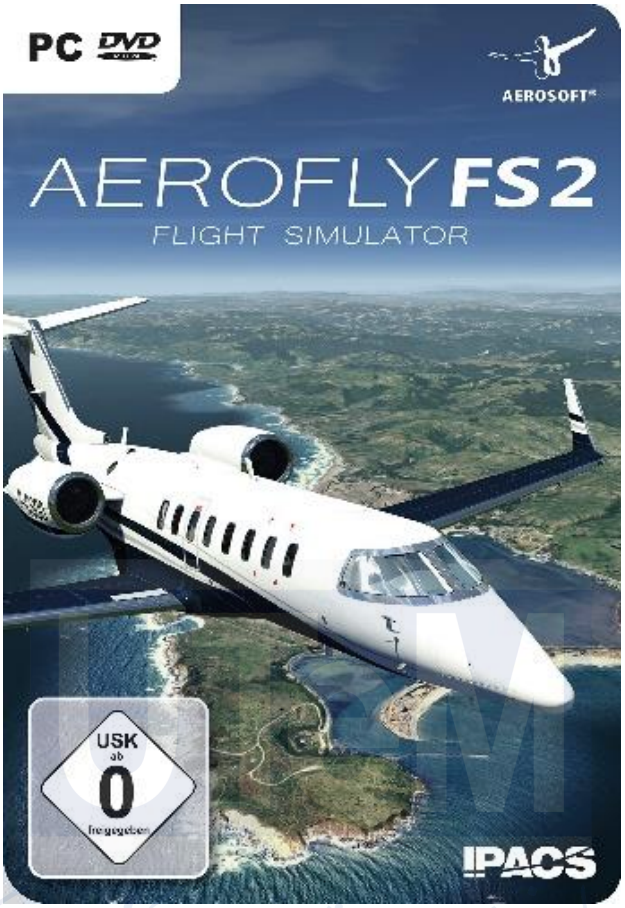

Figure 2.3.1.1 Cover

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Figure 2.3.1.2 Gameplay Scene

2.3.2 Red Bull Air Race – The Game

This is a VR game that allows players to experience the thrill of the Red Bull Air Race, a high-speed competition between stunt pilots.

Figure 2.3.2.1 Gameplay Scene A

Figure 2.3.2.2 Gameplay Scene B

2.3.3 Skydiving VR

This is a VR experience that simulates the thrill of skydiving, allowing users to experience the sensation of freefall and parachute landing.

Figure 2.3.3.1 Skydiving VR

2.4 Project Methodology

Airborne Adventure VR Project began with defining the project goals. For instance, determining the goals of the VR project, such as the type of airborne adventure experience to be created, the target audience, and the desired level of realism. Then, conducting the related research towards the project like the airborne adventure experience to be simulated in VR, such as the physics of flight, the geography and terrain of the area to be flown over or explored, and the safety and regulatory requirements for the experience.

Thirdly, developing the conceptual design for the VR experience, including the virtual environment, the type of aircraft or vehicle to be used, the interactive elements of the experience, and the user interface. After that, create and develop the prototype using VR development tools and software. This could involve building 3D models of the environment, aircraft, and other objects, creating interactive elements, and integrating sound and visual effects. Moreover, the user testing and feedback is required. Gathering the users' feedbacks and identify parts for improvement through surveys, interviews, and focus groups.

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Refining the design with the feedback gathered from user testing to refine the design of the VR experience. This could involve modifying the virtual environment, adjusting the physics of flight, improving the user interface, or enhancing the interactive elements. Once the design has been refined, finalize the development of the VR experience, including creating high-quality graphics, optimizing performance, and testing for bugs and glitches. At last, launching the VR experience and promote it to the target audience and provide ongoing support and maintenance for the VR experience, including bug fixes, updates, and enhancements based on user feedback.

2.5 Project Requirement

2.5.1 Software Requirements

a) Microsoft Word - To create a document that can be stored as an electronic file, printed on paper, or saved as a PDF file. Microsoft Word is being used to create the progress report for this project.

b) Microsoft PowerPoint - A show programming program with worked in proficient looking illustrations and apparatuses that empower you to make outwardly staggering introductions.

c) Unity - A powerful game engine and development platform that is widely used to create 2D and 3D games, as well as interactive experiences and simulations. It allows developers to create games using a visual editor and a programming language called C#.\

d) Visual Studio 2019 - A popular integrated development environment (IDE. It can improve your productivity and workflow by providing a powerful and feature-rich environment for writing and debugging C# code) that can be used to write C# code for Unity projects.

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2.5.2 Hardware Requirements

a) Operating System – Microsoft Windows 10 Home Single Language 21H2, 64- bit Operating system, x64-based processor
b) Computer Processor - AMD Ryzen 7 3750H with Radeon Vega Mobile Gfx 2.30 GHz
c) Installed Memory – 20.00 GB Memory (RAM)
d) Graphics Card - NVIDIA GeForce GTX 1650 with 4GB VRAM

2.6 Conclusion

This chapter stated and explained about Airborne Adventure VR Project with more detailed, but simple way. For instance, the common domains for VR are list out which are included gaming and entertainment, education, diagnosis, and treatment as well as design and architecture. Meanwhile, some of the current similar existing VR project are used to explain and compare. Then, the project methodology is shown to ensure all the steps to develop the project from scratch are stated out clearly. Lastly, the project requirements whether software or hardware are shown.

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CHAPTER 3: ANALYSIS

3.1 Current Scenario Analysis

In recent years, the popularity of flight simulators has increased significantly, with more and more people looking for ways to experience the thrill of flying without leaving the ground. The COVID-19 pandemic has also contributed to the rise in demand for flight simulators, as people are unable or unwilling to travel by air.

The airborne adventure flight simulator industry has responded to this demand by developing more advanced and realistic simulators, with features such as virtual reality headsets, motion platforms, and realistic cockpit replicas. These advancements have made flight simulators even more immersive and realistic, with some simulators even being used for pilot training.

Overall, the airborne adventure flight simulator industry is expected to continue growing in the coming years, as more people look for ways to experience the thrill of flying without leaving the ground. With advancements in technology and increasing demand, it is likely that we will see even more realistic and immersive flight simulators in the future.

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3.2 Requirement Analysis

3.2.1 Project Requirement

Airborne Adventure VR project/ Flight Simulator is classified as genre of simulation game. The storyline will be developed with:

a. The player plays as a skilled pilot who has been hired by a luxury tourism company that specializes in aerial tours of the world's most stunning landscapes. The task is to fly passengers to different destinations, showcasing the natural beauty and cultural wonders of each location.

b. As he soars above mountains, deserts, oceans, and forests, he will encounter challenges like unpredictable weather patterns, mechanical failures, and unexpected obstacles. The passengers will rely on his expertise and quick thinking to ensure a safe and memorable journey.

c. The player will have access to a range of aircraft, each with their own strengths and weaknesses. He can choose from small helicopters for up-close views of landmarks, larger planes for longer distance journeys, and even hot air balloons for a unique and peaceful experience.

d. The passengers will come from all over the world and will have different interests and preferences. The player will need to tailor each trip to their needs, providing informative commentary and making stops at specific sites that appeal to them.

e. As player's progress through the game, he will unlock new destinations and upgrades to the aircraft. He will also encounter challenges that test his skills and knowledge of the area, such as sudden weather changes or navigating through crowded airspaces.

f. The goal is to build a successful and reputable tourism company that offers the ultimate airborne adventure to travellers from all walks of

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life. With each successful tour, the player will earn positive reviews and recommendations, expanding your reach and becoming a top player in the industry.

The comparison among the existing projects which is similar with Airborne Adventure VR project.

Table 3.2.1.1 Comparison among the existing systems and current project

Game	Weakness	Architecture	Background	Texture
Airborne Adventure	Limited gameplay features, control via keyboard	3D game, VR technology	Real world locations, tropical islands	Realistic textures, high-resolution
Microsoft Flight Simulator	Requires high-end PC, limited gameplay features	Proprietary game engine	Real world locations, cities, and airports	High quality textures, realistic
Elite Dangerous	Steep learning curve, repetitive gameplay	Proprietary game engine	Space environments, planets, and stars	High quality textures, realistic
X-Plane 11	Requires high-end PC, limited gameplay features	Proprietary game engine	Real world locations, cities, and airports	High quality textures, realistic

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Airborne Adventure VR project will require the following devices/technologies:

i. VR Headset: The game will be designed for virtual reality headsets, such as Oculus Rift, HTC Vive, or PlayStation VR, which allow players to immerse themselves in a 3D environment.

ii. Gaming PC or Console: The game will require a high-end gaming PC or console to run smoothly and render the VR environment at high frame rates.

iii. Input Devices: Players will need a compatible input device to control their movements and interactions within the game. This could include a gamepad, joystick, or motion controllers.

iv. Audio System: The game will require a high-quality audio system, such as headphones or speakers, to provide an immersive sound experience.

v. Internet Connection: Depending on the features of the game, an internet connection may be required for multiplayer modes or online updates.

3.2.2 Software Requirement

a. Microsoft Word - To create a document that can be stored as an electronic file, printed on paper, or saved as a PDF file. Microsoft Word is being used to create the progress report for this project.
b. Microsoft PowerPoint - A show programming program with worked in proficient looking illustrations and apparatuses that empower you to make outwardly staggering introductions.
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3.2.3 Hardware Requirement

a. Operating System – Microsoft Windows 10 Home Single Language 21H2, 64- bit Operating system, x64-based processor
b. Computer Processor - AMD Ryzen 7 3750H with Radeon Vega Mobile Gfx 2.30 GHz
c. Installed Memory – 20.00 GB Memory (RAM)
d. Graphics Card - NVIDIA GeForce GTX 1650 with 4GB VRAM

3.3 Requirement Analysis

3.3.1 Project Requirement

The project requirements will be examined into the framework that will be developed. It will outline the activities, methods, and other requirements that the project must meet. It will be evaluated based on the requirements acquired as well as the basic technique used in this project. The criteria for this project will include a clear grasp of the activities that must be done.

3.3.2 Requirement Gathering

The most critical phase in the data transfer and organization process is undoubtedly gathering requirements. The two forms of requirements collecting are qualitative and quantitative requirements gathering. Subjective evaluations involve phrases or relative traits to describe risk, expense, and effect. A quality evaluation is the ideal alternative when there isn't enough time, money, or data to do a quantitative review. In most circumstances, a qualitative evaluation is carried out during an interview.

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For the requirement gathering purposes, I choose to use observation method. It can provide valuable insights into user behaviours, preferences, and challenges. At first, I will identify user scenarios through determining the specific scenarios or tasks within the Airborne Adventure VR experience that want to observe. For example, it could be the initial setup process, user interactions during flight, or interactions with virtual objects. Then, I will ask my friends, course mates and supervisor to play my project which consider factors such as age, experience with VR, and familiarity with gaming or adventure experiences. Aim for a mix of individuals who can provide different perspectives. After that, ask them the probing questions to gather additional insights. For example, I will inquire about their overall experience, specific challenges encountered, or suggestions for improvement. Moreover, analysing and interpreting the collected data. Review the observation notes and extract meaningful insights. Look for recurring themes, common challenges, or positive aspects that emerge across multiple participants. Use this analysis to identify potential requirements or areas of improvement. Thus, use the insights gathered through observation to inform and refine the requirements for the Airborne Adventure VR project.

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3.4 Project Schedule and Milestone

This segment will explain the venture's timeline and success. The task is completed in one semester, which lasts fourteen (14) weeks. The task's schedule and completion must be carefully planned to ensure that the task meets its objectives. This project's timetable and milestones are shown in the table below.

Table 3.4 Description of Project Schedule and Milestone

Milestones				
No	Activity Description	Duration (Days)	Start Date (DD/MM/YYYY)	End Date (DD/MM/YYYY)
1	Concept Development	12	1/3/2023	12/3/2023
	1.1 Decide project title	1	1/3/2023	
	1.2 Research on the project related information	4	2/3/2023	5/3/2023
	1.3 Develop the game concept, storyline, and game mechanics	7	6/3/2023	12/3/2023
2	Write Proposal	7	13/3/2023	19/3/2023
3	Prepare Project Fundamentals	32	20/3/2023	20/4/2023
	3.1 Install Unity	1	20/3/2023	
	3.2 Practice to use Unity	21	21/3/2023	10/4/2023
	3.3 Project Analysis	10	11/4/2023	20/4/2023
	3.3.1 State project background	1	11/4/2023	
	3.3.2 Target the right user	1	12/4/2023	
	3.3.3 Idenitfy project significant			
	3.3.4 Define literacture review			
	3.3.5 Define project methodology			
	3.3.6 Identify project requirement	6	13/4/2023	18/4/2023
	3.3.7 Review project plan	2	19/4/2023	20/4/2023
4	Project Development	52	20/4/2023	9/6/2023
	4.1 Select and create the game assets	2	20/4/2023	21/4/2023
	4.2 Design 3D models	15	22/4/2023	5/5/2023
	4.3 Create textures	2	6/5/2023	7/5/2023
	4.4 Develop scene	5	8/5/2023	12/5/2023
	4.5 Design game environments	8	13/5/2023	20/5/2023
	4.6 Select the appropriate sound effects	3	21/5/2023	23/5/2023
	4.7 Develop game coding interactions	10	24/5/2023	1/6/2023
	4.8 Integrate with Atavism server	2	2/6/2023	3/6/2023
	4.9 Develop user interfaces	5	4/6/2023	9/6/2023
5	Testing	5	10/6/2023	14/6/2023
6	Documentation and Presentation	6	15/6/2023	20/6/2023
	6.1 Writing report	5	15/6/2023	19/6/2023
	6.2 Done report and presentation		20/6/2023	

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3.5 Conclusion

Overall, the success of the Airborne Adventure VR project will depend on the ability of the development team to create a high-quality game that appeals to a wide audience of VR enthusiasts and flight simulation fans.

CHAPTER 4: DESIGN

4.1 Introduction

This chapter discusses and illustrates the preliminary design and detailed design and its results. In this chapter includes the system architecture, preliminary design, and user interface design.

4.2 System Architecture

System architecture is a representation of the system that explains about the structure, behavior, and view of the system. In this system architecture of our project, it includes mapping the functionality on software and hardware where A-Frame framework is being used.

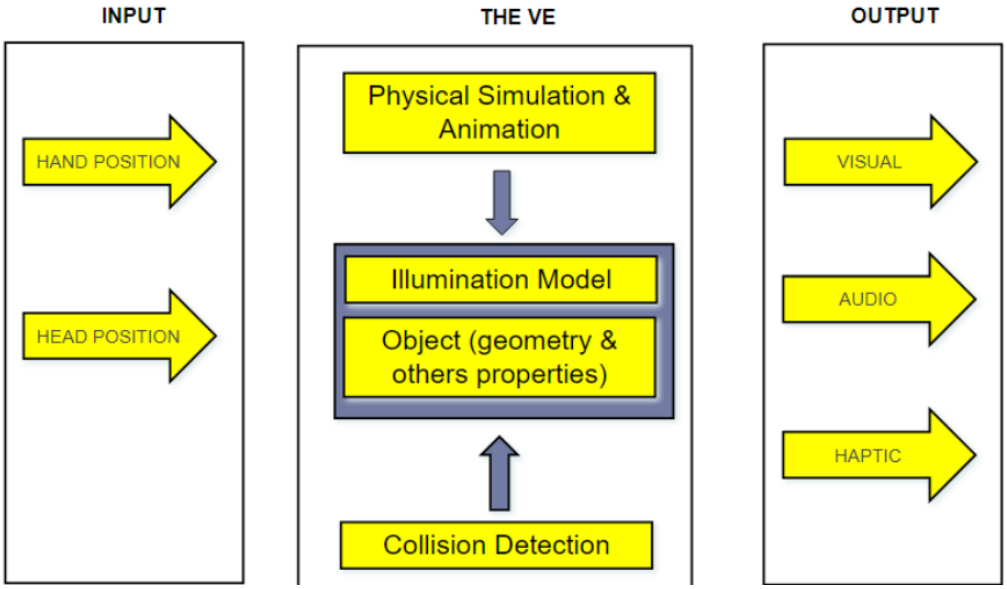

Figure 4.2 VR System Architecture

4.3 Preliminary design

For Airborne Adventure VR project, preliminary design refers to the initial phase of creating a conceptual framework and blueprint for the virtual reality experience. It involves outlining the key elements, structure, interactions, and visual aesthetics of the VR adventure. Here are some aspects to consider in the preliminary design for an Airborne Adventure VR project:

4.3.1 Environmental Design

Create a basic framework for the virtual environments and landscapes that users will explore in the VR experience. Consider the visual aesthetics, level of detail, and immersion factors that will enhance the sense of adventure and excitement.

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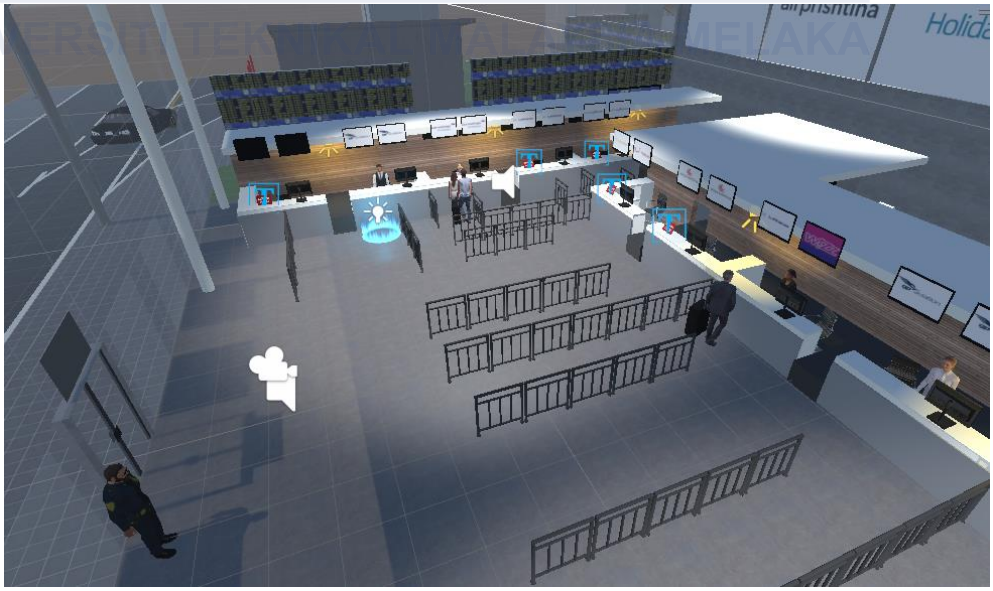

Figure 4.3.1.1 Airport Lobby (Isometric View)

Figure 4.3.1.2 Airport Lobby (First Person View)

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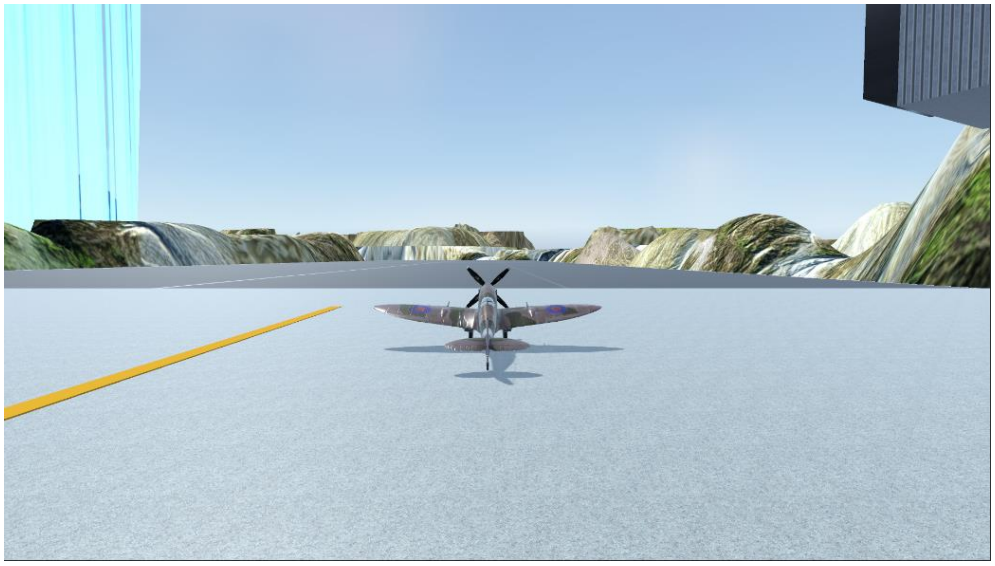

Figure 4.3.1.3 Stating point (Runway)

Figure 4.3.1.4 World Map Islands

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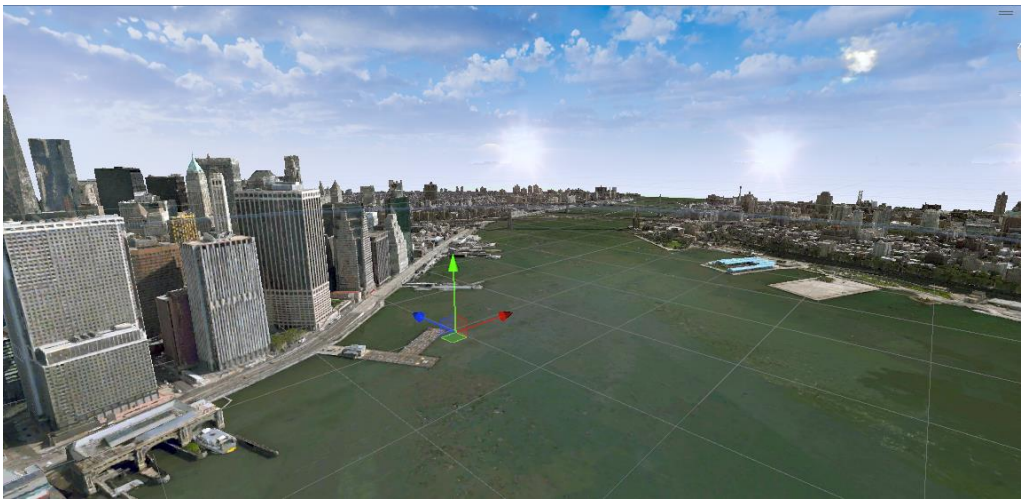

Figure 4.3.1.5 New York City

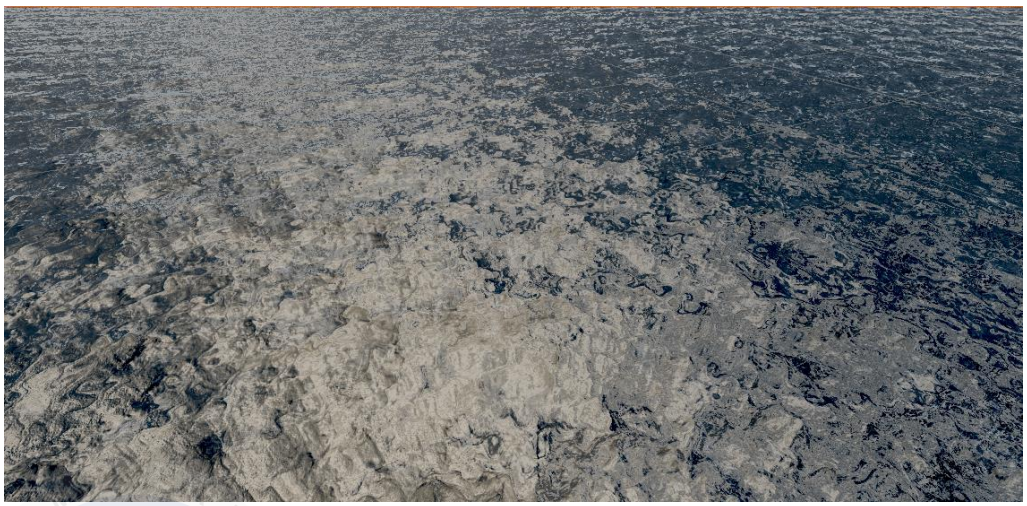

Figure 4.3.1.6 Ocean

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Figure 4.3.1.7 Sky

4.3.2 3D Assets Design

Three-dimensional model design is the process of making three-dimensional (3D) models using a specific software. In current project, the simple 3D models are created with Blender, whereas the complex models are obtained from official 3D models website, Sketchfab.com or packages from Unity Asset Store where the output format is prefabs, models, (.fbx) or (.dae).

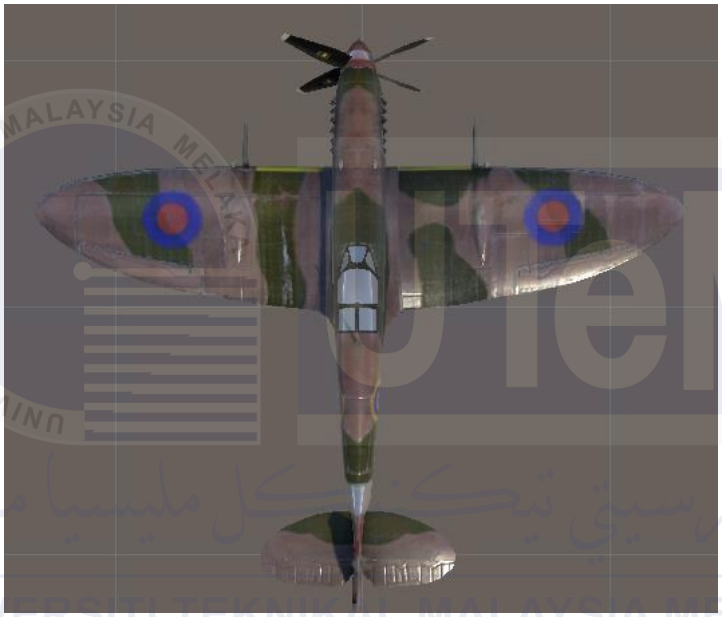

Figure 4.3.2.1 Airplane (Ortho View)

Figure 4.3.2.2 Airplane (Side View)

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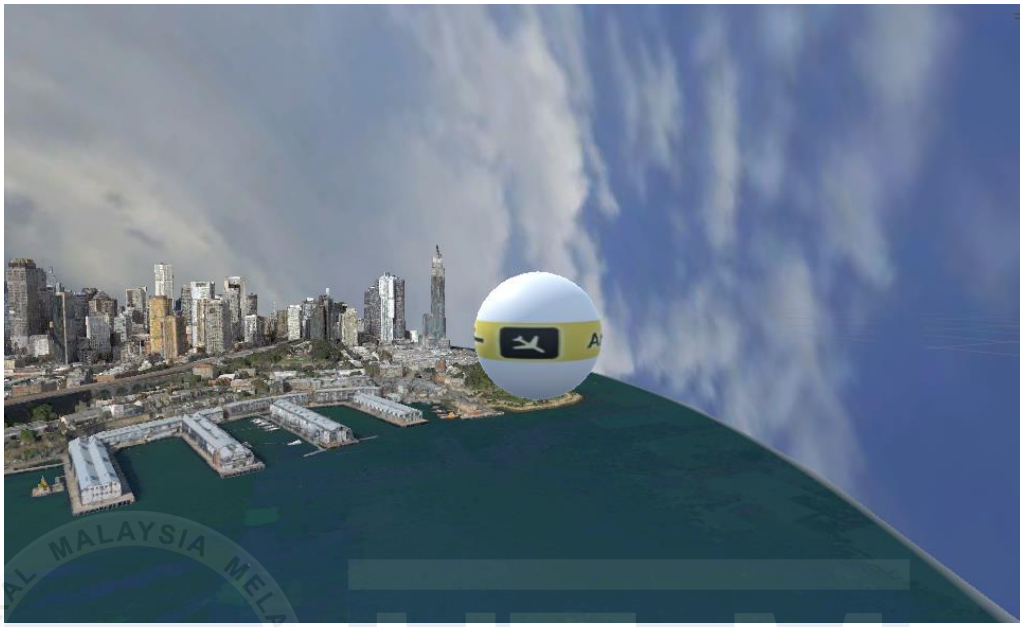

Figure 4.3.2.3 Idling Arrival Ball

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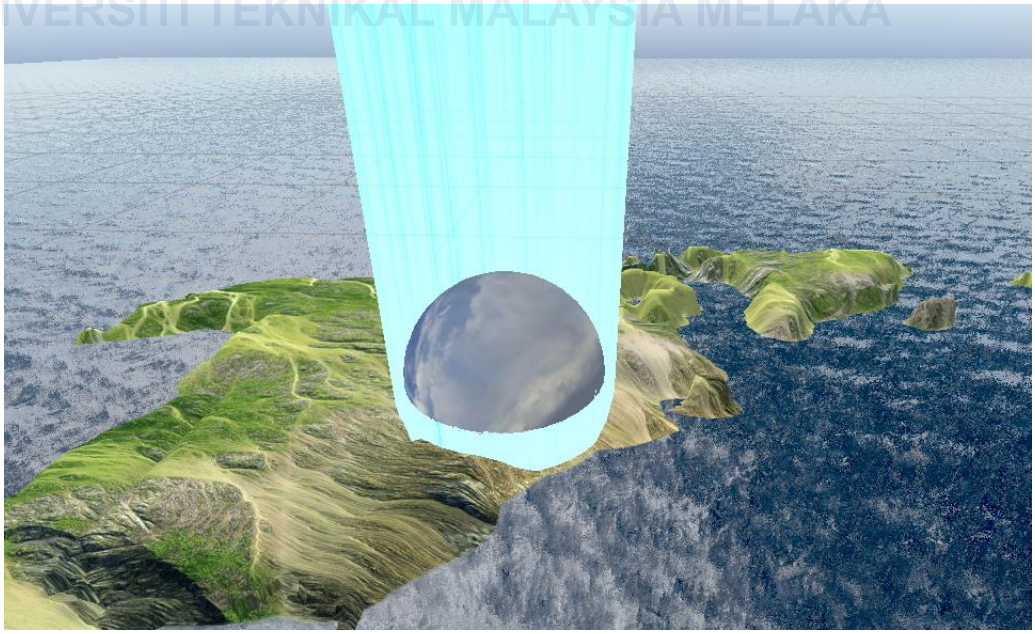

Figure 4.3.2.4 Destination Beam

4.3.3 UI and Navigation

Outline the user interface (UI) elements and navigation systems within the VR experience. Design intuitive and user-friendly controls that allow users to interact with the virtual environment, access menus or options, and navigate through.

Figure 4.3.3.1 Main Menu

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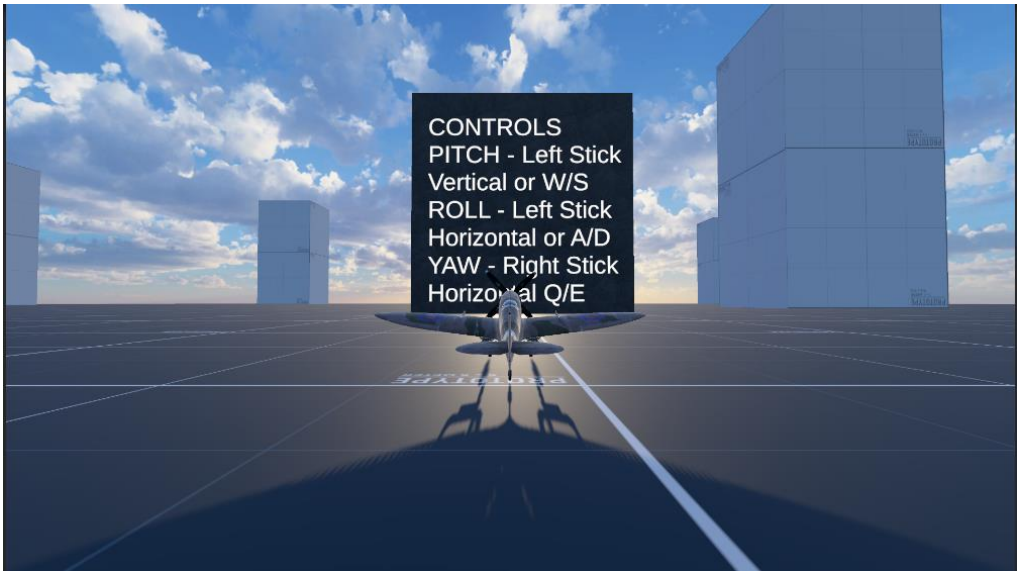

Figure 4.3.3.2 Instruction Panel

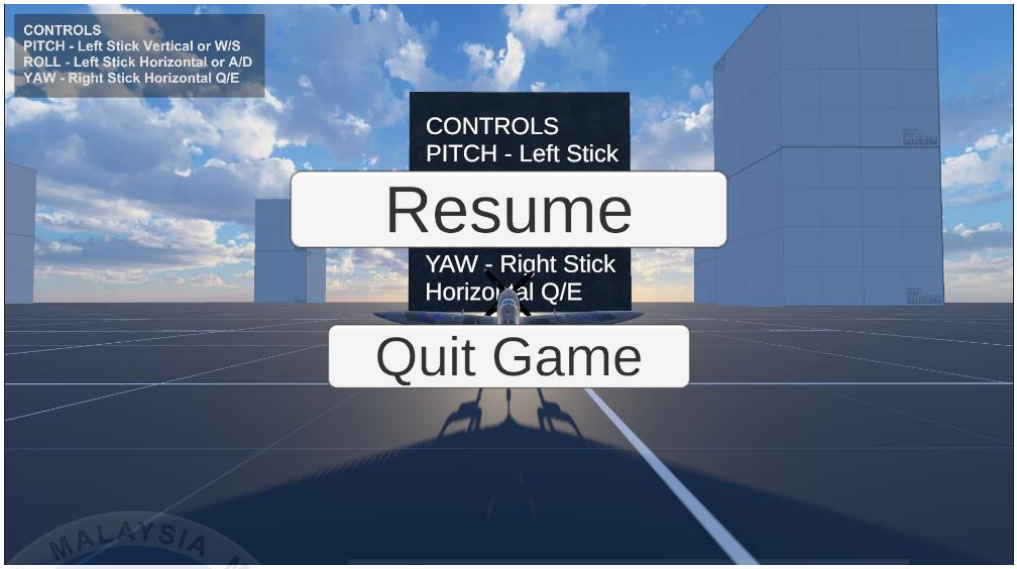

Figure 4.3.3.3 Pause Menu

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Figure 4.3.3.4 World Map Panel

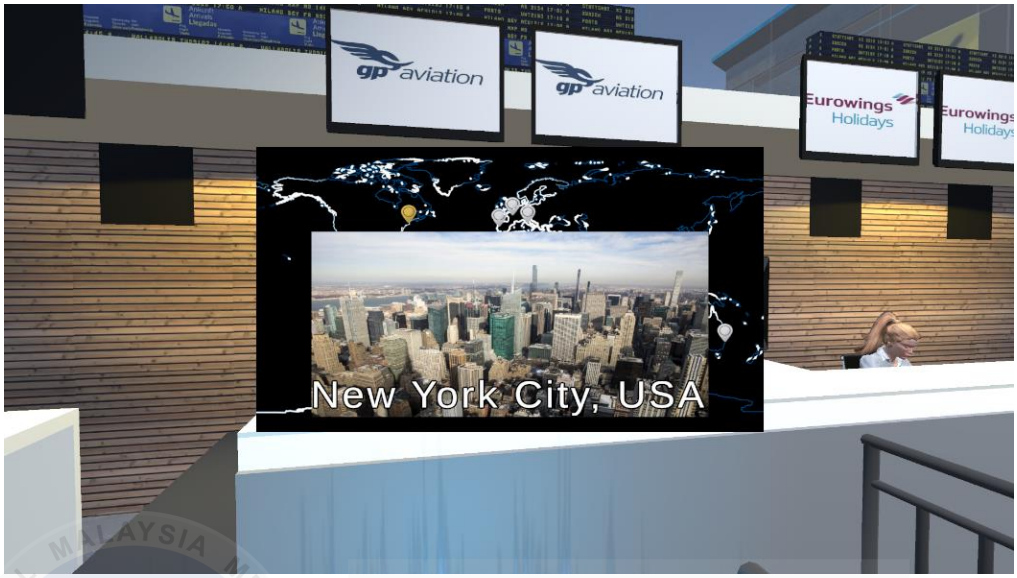

Figure 4.3.3.5 World Map Panel (Hovering)

4.4 Structure Chart

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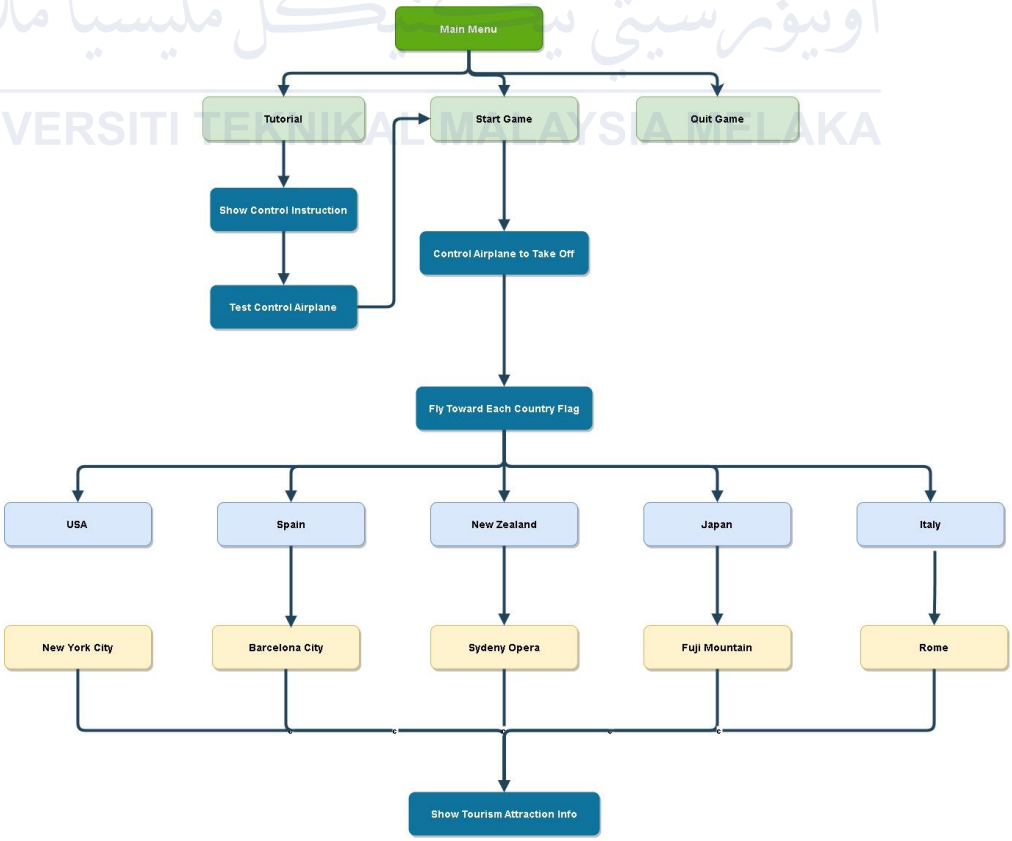

Figure 4.4 Structure Chart

4.5 Flowchart

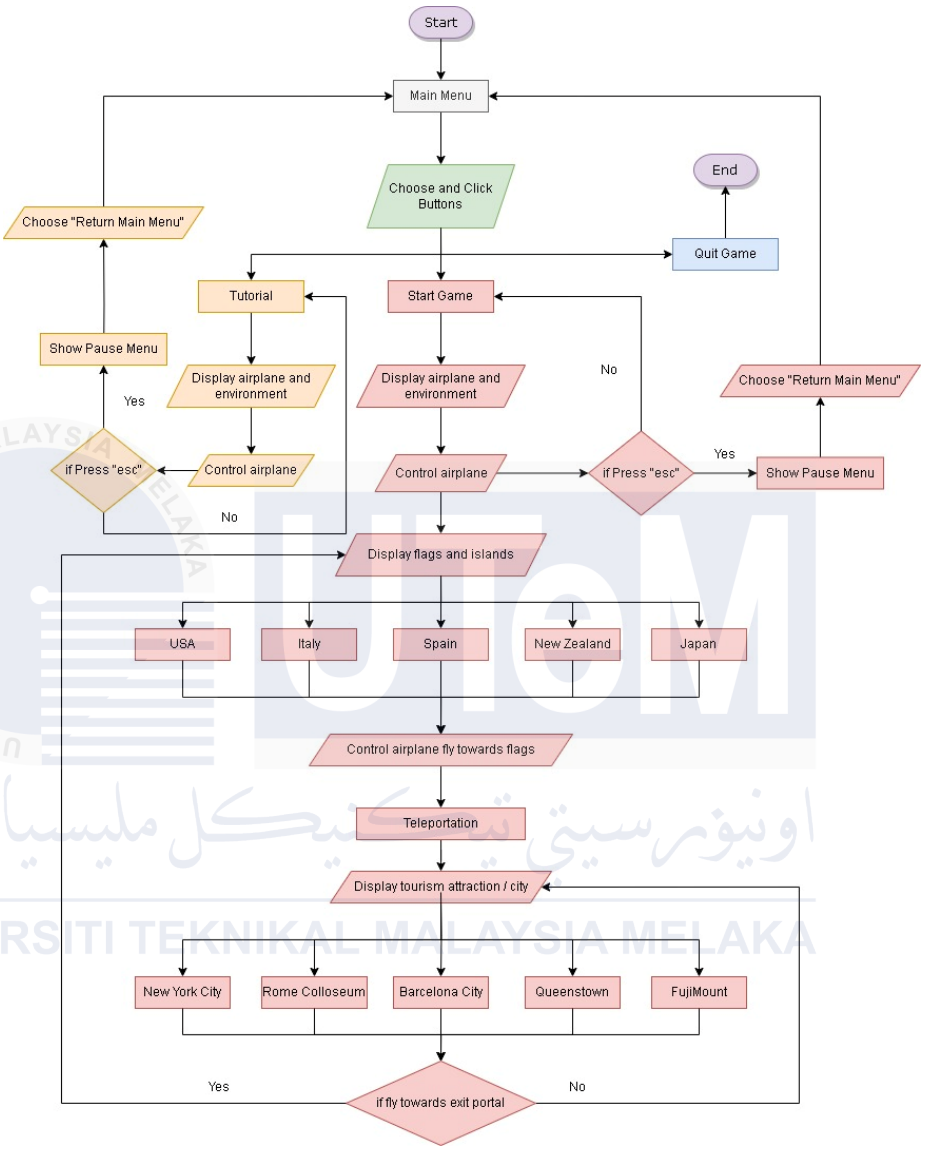

Figure 4.5 Flowchart

4.6 Conclusion

In this chapter, we have sum up the design that is in the system which comprises of the system architecture, preliminary design, and user interface design. System architecture is an outline of the overview, preliminary design is the process of converting ideas into visual design and user interface design is the visual presentation of elements where user can interact. In the next chapter, implementation will be discussed.

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CHAPTER 5: IMPLEMENTATION

5.1 Introduction

In this chapter, we will delve into one of the crucial phases of game development: implementation. This section will offer insights into the technical aspects of implementation from a programmer's perspective, encompassing the production of graphics, audio, video, and animation. Additionally, we will briefly touch upon topics such as integrating core game mechanics, configuration management, and project status tracking.

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5.2 Creation of Game Art

5.2.1 Production of Graphics

I source 3D game assets from official websites like Sketchfab.com and the Unity Asset Store. To enhance realism and efficiency in game development, I find and choose template prototype 3D models, which I then customize to meet my ideal design specifications using Blender. Additionally, I create some simple 3D models from scratch such as generating a terrain in Unity.

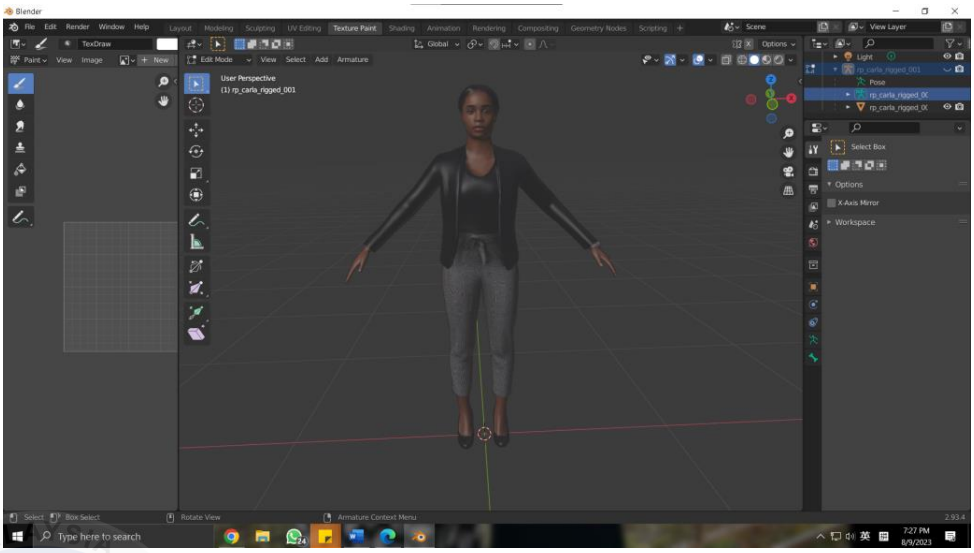

Figure 5.2.1.1 NPC creation and modification

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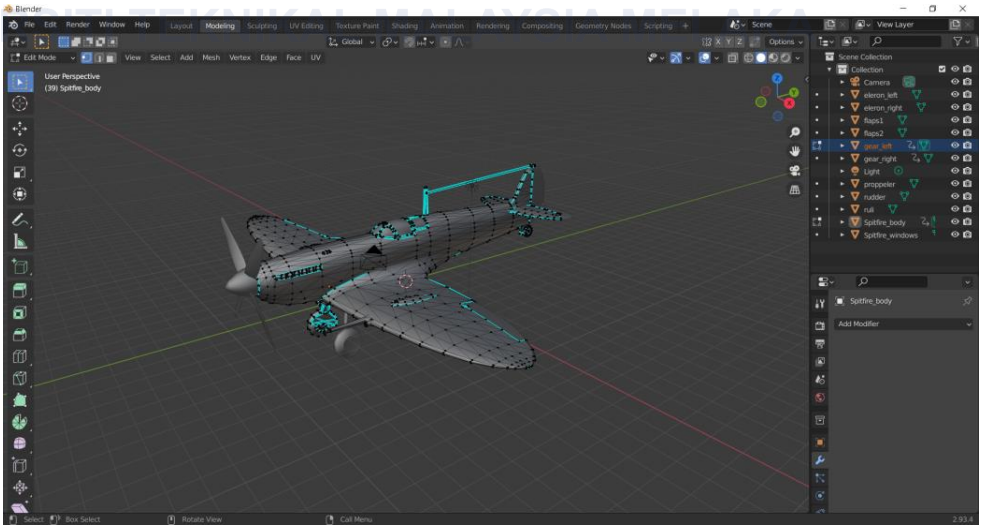

Figure 5.2.1.2 Aircraft creation and modification

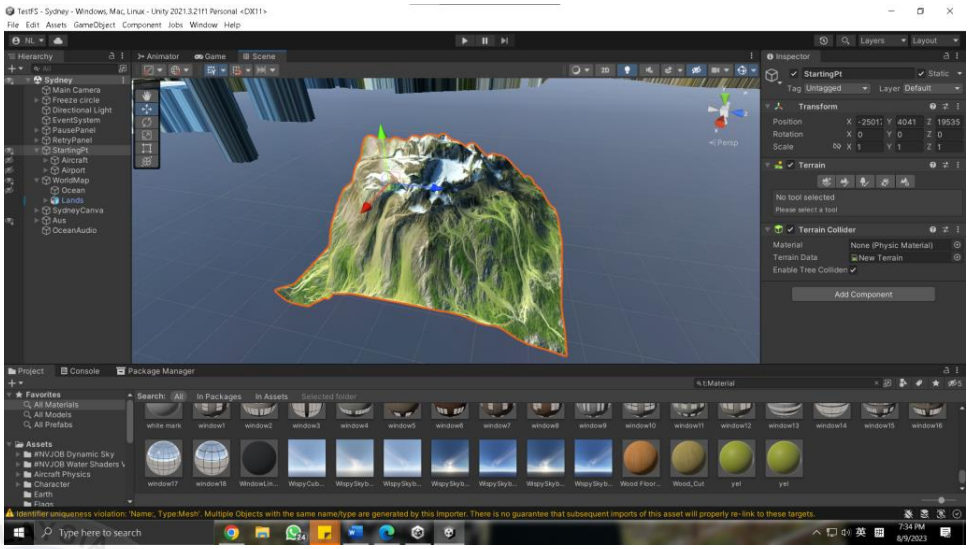

Figure 5.2.1.3 Terrain generation

5.2.2 Production of Audio

Table 5.2.2 Audio Table

Sound	Description
Engine Sounds	In Play Scene, the sound of engines based on throttle settings, RPM, and aircraft type.
Environmental Effects	In Play Scene, the sounds like birds, wind noise, ocean sound or other environmental elements that add to the realism of the virtual world.
Ground Crew and Aircraft Movement sound	In AirPort Lobby Scene, the sounds related to ground operations, such as the noise of baggage handlers loading luggage, the roar of ground service vehicles like baggage tugs and fuel trucks, and the voices of ground crew communicating.
Announcements	In Airport Lobby Scene, the announcements over the public address system, such as boarding calls, gate changes, and safety instructions for passengers.

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5.2.3 Production of Video

There is no video implementation inside the game.

5.2.4 Production of Animation

Figure 5.2.4.1 Guard (NPC) Idling Animation

Figure 5.2.4.2 Staff (NPC) Waving Animation

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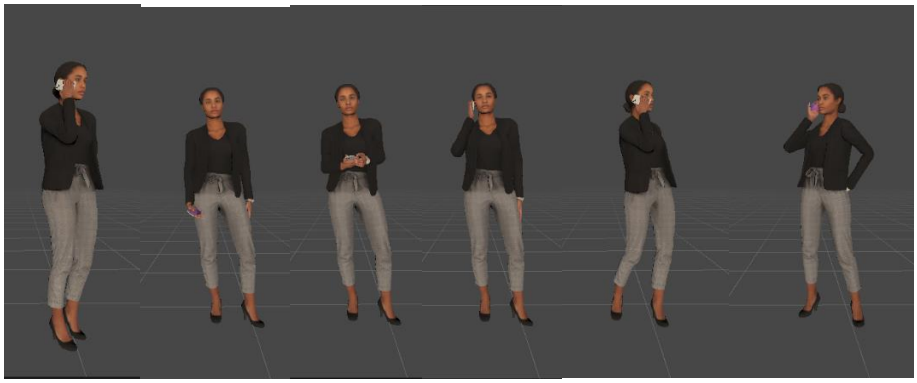

Figure 5.2.4.3 Staff (NPC) Calling Animation

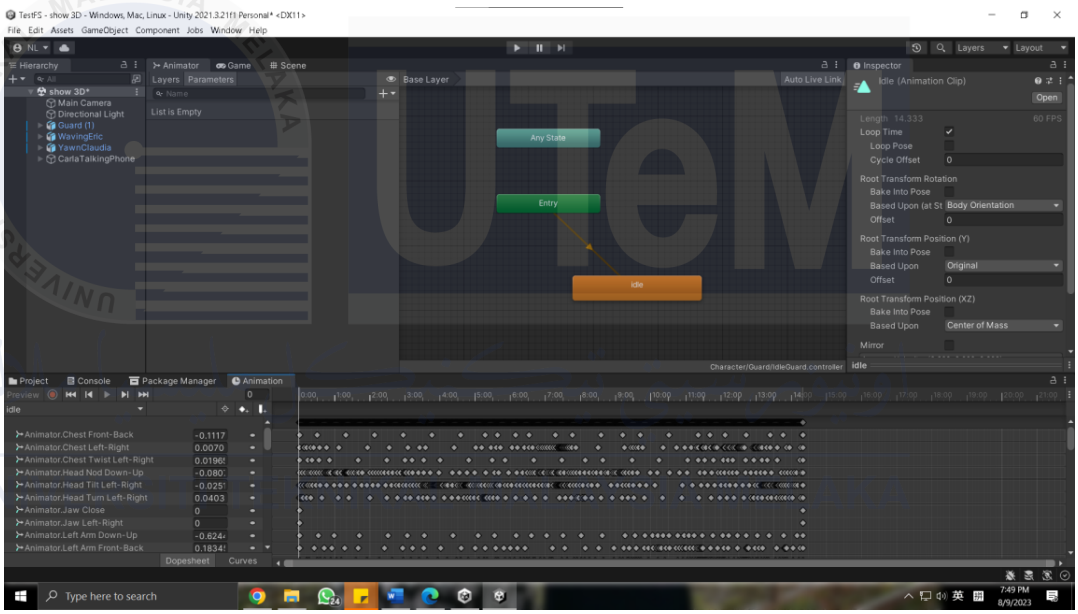

Figure 5.2.4.4 NPC Animator and Animation Transition

5.3 Integration of Game Components

```
pitch = pitchControlSensitivity * Input.GetAxis("Vertical");
roll = rollControlSensitivity * Input.GetAxis("Horizontal");
yaw = yawControlSensitivity * Input.GetAxis("Yaw");
```

```
if (Input.GetKey(KeyCode.Space))
{
    SetThrust(thrustPercent + thrustControlSensitivity);
}
propeller.speed = thrustPercent * 1500f;
```

Figure 5.3.1 Aircraft Movement Control Script

Spacebar is used for the aircraft taking off. W and S are used for rotating the aircraft along pitch axis, A and D are used for rotating along roll axis as well as Q and E used for rotating along yaw axis.

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```
void OnTriggerEnter(Collider other)
{
    float time = 10;
    Panel.SetActive(true);
        Destroy(Panel, time);

}
```

Figure 5.3.2 Aircraft Collide to show Canva Script

```
public void OnPointerEnter(PointerEventData eventData)
{
    hoverImage.SetActive(true);
}

0 references
public void OnPointerExit(PointerEventData eventData)
{
    hoverImage.SetActive(false);
}
```

Figure 5.3.3 Aircraft Movement Control Script

```
void Update()
{
    if (Input.GetKeyDown(KeyCode.Escape))
    {
        if (isPause)
        {
            ResumeGame();
        }
        else
        {
            PauseGame();
        }

        isPause = !isPause;
    }
}
```

Figure 5.3.3 Trigger Pause Panel Script

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```
public void PauseGame()
{
    Panel.SetActive(true);
    Time.timeScale = 0f;
    isPause = true;
}

1 reference
public void ResumeGame()
{
    Panel.SetActive(false);
    Time.timeScale = 1f;
    isPause = false;
}
```

Figure 5.3.4 Pause and Resume Game Script

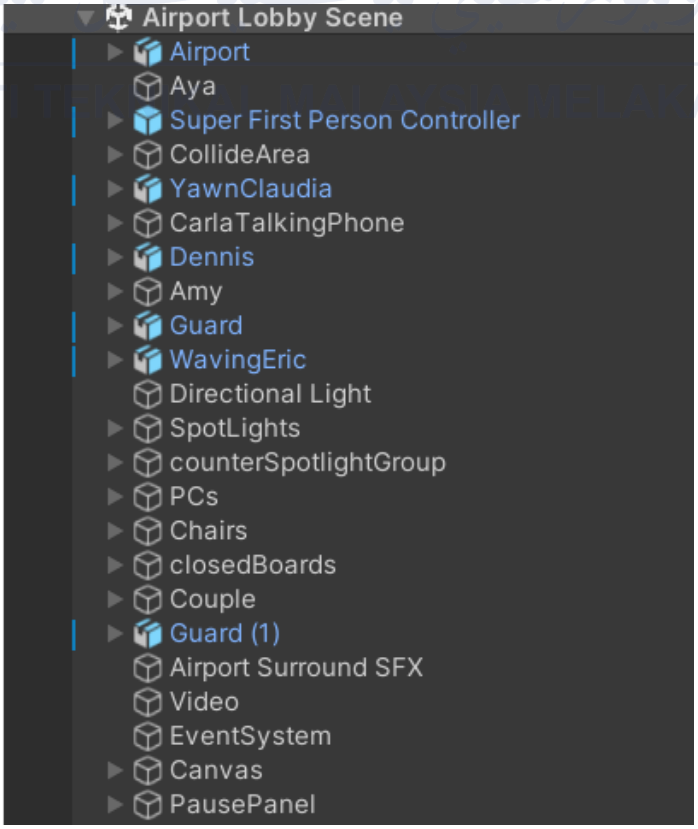

Figure 5.3.5 Prefabs list in Airport Scene

5.4 Game Configuration Management

The game offers two play options: installation, which involves transferring the entire game file, or a more convenient click-and-play option, which requires only a small installation file. Players can enjoy the game using standard input devices such as a mouse and keyboard.

5.4.1 Configuration Setup

This project was developed using Unity 2021.3.21f1 for Windows 64-bit. It requires several configuration steps within the project settings. These include setting up the initial scene for player interaction, adjusting lighting configurations based on quality settings, and configuring essential game information such as the project title and logo.

5.4.2 Version Control Procedure

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Table 5.4.2 Version Control Procedure

Testing phase	**Description**	**Detail**
Alpha	The game will undergo testing to identify what works and what doesn't, with a focus on identifying major bugs that significantly impact the game's core aspects. This testing will be conducted using an early prototype that is, at the very least, playable. Emphasis will primarily	As part of the implementation for Final Year Project 1, we will conduct testing using an early playable prototype, with a primary focus on mechanics and localized content.

	be on mechanics and localized content testing. This process is part of the implementation for Final Year Project 1.	
Beta	We will conduct game testing with a targeted focus group, gathering feedback and questionnaires from their unique perspectives to further enhance and refine the game.	After receiving evaluations from the project evaluator and supervisor during the Final Year Project 1 presentation, the game will progress into a semi-beta phase. During this phase, the focus will be on improving critical aspects of the game, including refining its objectives. The remaining development will continue into Final Year Project 2, where we will gather feedback from the target focus group.
Golden Version	The final version where the game is ready to publish to the market.	After evaluation in Final Year Project 2

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5.5 Implementation Status

Table 5.5 Implementation Status

Component	Description	Duration To Complete	Completed Duration	Status
Game prototype creation	Basic mechanics of the game	2 Weeks	2 Weeks	On time
Game assets creation	Game assets such as 3D sprites and User Interface were created in Blender and Unity.	1 Week	1 Week	On time
Game World Creation	Creation of the world map and city view	1 Week	1 Week	On time
Interface Element and Implementation	Designing game user interfaces and user interfaces in the game engine using 2D/3D elements	2 Weeks	10 days	In time
Game Mechanic Implementation	Implement all the functions and mechanics inside the game from the gameplay element until interface functionality	6 Weeks	6 Weeks	In time
Animation Implementation	The animation for the characters and game objects were implemented using Unity animator.	2 Weeks	2 Weeks	In time

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Polishing the game	Fixing the bugs and make few adjustment before exporting the game.	2 Weeks	2 Weeks	In time

5.6 Conclusion

The implementation phase plays a significant role in ensuring that game mechanics function correctly and that the game is playable. This phase encompasses the creation of game assets, including graphics, audio, video, and animation. In terms of game integration, the project leveraged the C# language within the Unity Engine for game development. In the upcoming chapter, we will conduct testing with the target user group to gather valuable feedback through questionnaires.

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CHAPTER 6: TESTING

6.1 Introduction

The subsequent critical phase following implementation is testing, which we will explore in this chapter. The primary aim of this phase is to assess the game's immersive flight simulator VR experience, gauged by players' experiences with it. It's important to note that the purpose of testing is not solely error and bug identification; rather, it is to ascertain whether the game aligns with the project's objectives. A series of targeted tests will be conducted to evaluate the game's functionality and usability.

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6.2 Test Plan

Before conducting tests for the Airborne Adventure VR game, it is essential to adequately prepare by identifying test users, defining the test environment, establishing a test schedule, formulating a test strategy, designing the tests, and planning for test result analysis to ensure smooth and effective testing.

6.2.1 Test Organization

The personnel involved in this chapter are game developers, the ones who develop the game to do unit testing and while functionality testing with developers who have the experiences in game development. The

next person is the end users to test the usability of the system. The end users are open to the public who are aviation enthusiasts, travelers, families, and youngsters.

There are three types of tests carried out, unit test, functionality test and usability test. Each tester has roles and responsibilities. The test organization is summarized in Table 6.2.1.

Table 6.2.1 Test Organization

Type of Test	Personnel Involved	Roles and Responsibilities
Subject Matter Expert	Expert Game Developers (one person)	To test each software design component shows and works correctly.
Functionality	Game Developers (two persons)	To test each question whether it gets correct answer and functions well.
Usability	End Users (15 candidates)	To test the how players VR experience about playing the game.

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6.2.2 Test Environment

The game will be tested in front of the public from the perspectives of casual and hardcore gamers. The testers will be given the option of either downloading the game or watching a developer-led video game demo to better understand the game's core concept. The testers were then asked to complete a series of questionnaires prepared by the developer.

- Hardware Requirement

The testers must have a personal computer (PC) or a laptop to play the game. Depends on the testers availability to either play the game or just watch the video game demo to have better understanding of the game.

- Software Requirement

The tester needs to have a web browser to download the game files from Google Drive to test the game. As for the video game demo can be watched at YouTube page or YouTube application for mobile devices.

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6.2.3 Test Schedule

Test schedule is made to ensure the tests run as planned within the period given. After that, the results will be analyzed to make improvements. Therefore, tests must be held in schedules so that the results can be presented on time.

6.3 Test Implementation

There are several methods in conducting usability testing. Only one method will be used during the usability testing which is by giving the game file download link, the video game demo link and the link for the online questionnaire that prepared by the developer of the project.

6.4 Test Results and Analysis

An online survey by using Google Forms has been distributed to game testers. Google Forms is an online platform provided by Google to make online custom questionnaires with responses graphs. A total of 15 respondents has been giving feedbacks.

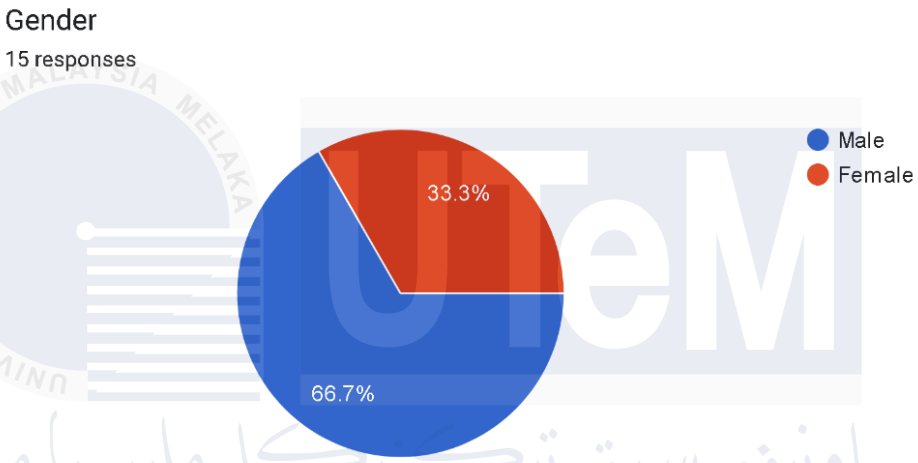

Figure 6.4.1 Gender

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Figure 6.4.1 illustrates the participation of 15 respondents in the end-user test, with 10 males (66.7%) and 5 females (33.3%) taking part.

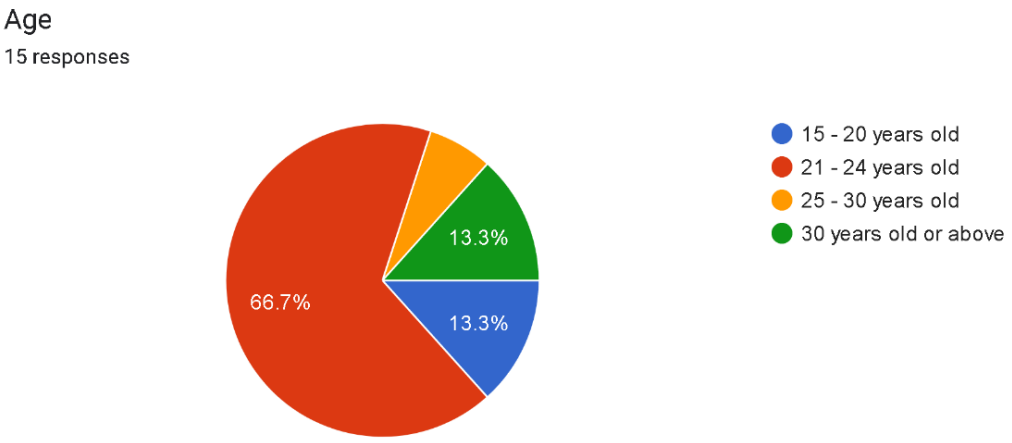

Figure 6.4.2 Age

Figure 6.4.2 illustrates the participation of 15 respondents in the end-user test, with 2 respondents (13.3%) from 15 to 20 years old, 10 respondents (66.7%) from 21 to 24 years old, 2 respondents (13.3%) from 25 to 30 years old and 1 respondent (6.7%) from 30 years old or above taking part.

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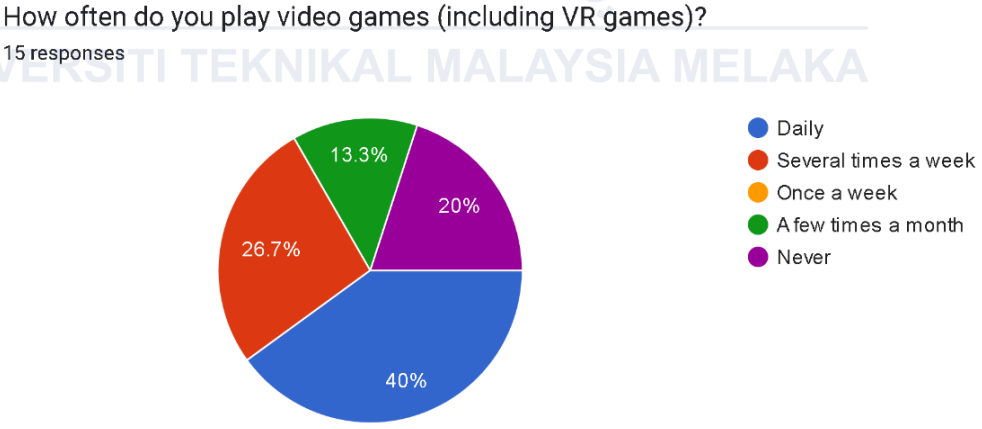

Figure 6.4.3 How often to play video games

Figure 6.4.3 illustrates the participation of 15 respondents in the end-user test, with 6 respondents (40%) play video games daily, 4 respondents (26.7%) play video games several times a week, no respondent (0%) play video games once a week, 2

respondents (13.3%) play video games a few times a month and 3 respondent (20%) never play video games taking part.

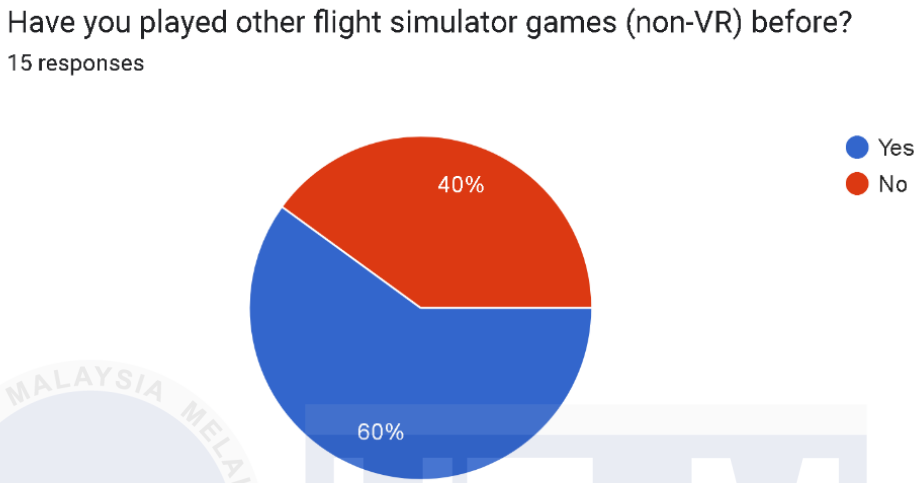

Figure 6.4.4 Flight simulator gaming experience

Figure 6.4.4 illustrates the participation of 15 respondents in the end-user test, with 9 respondents (60%) never played flight simulator games before and 6 respondents (40%) did play flight simulator games before taking part.

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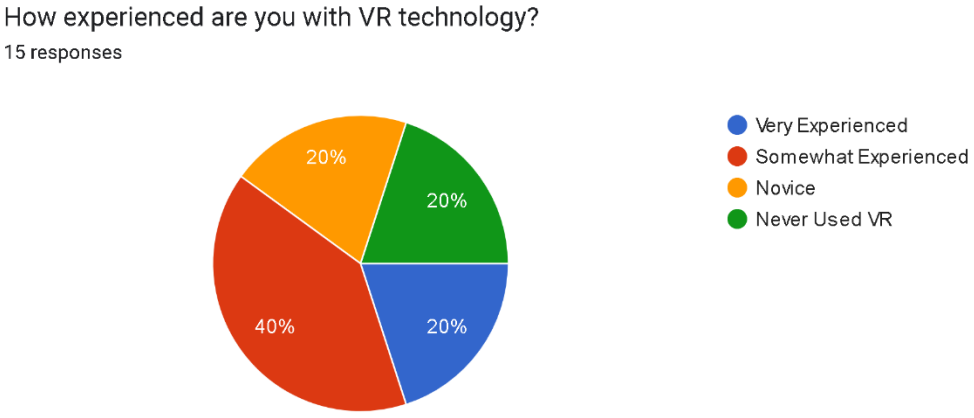

Figure 6.4.5 VR experience level

Figure 6.4.5 illustrates the participation of 15 respondents in the end-user test, with 3 respondents (20%) are very experienced in VR technology, 6 respondents (40%) are somewhat experienced in VR technology, 3 respondents (20%) are novice in VR technology and 3 respondents (20%) are never used VR technology taking part.

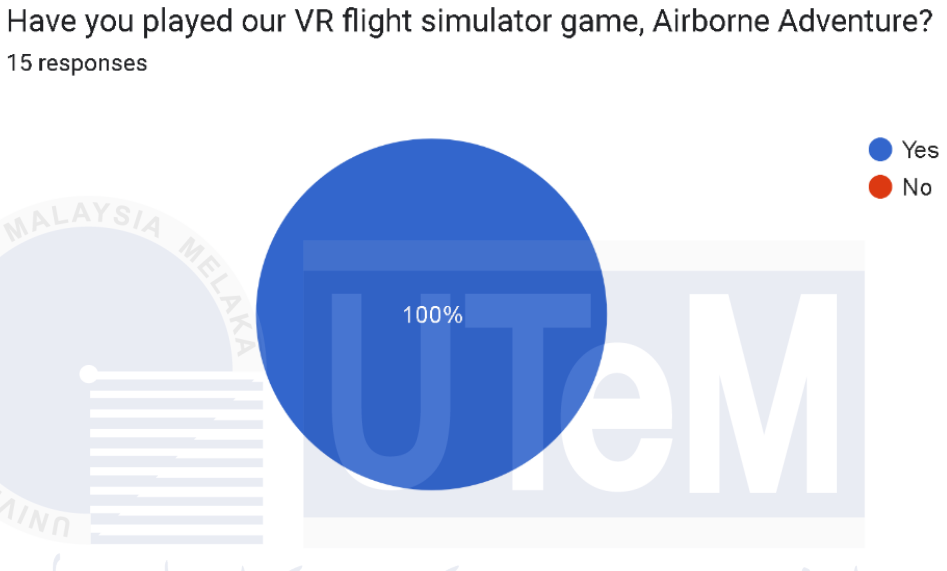

Figure 6.4.6 Airborne Adventure gaming experience

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Figure 6.4.6 illustrates the participation of 15 respondents in the end-user test, with all 15 respondents (100%) playing Airborne Adventure.

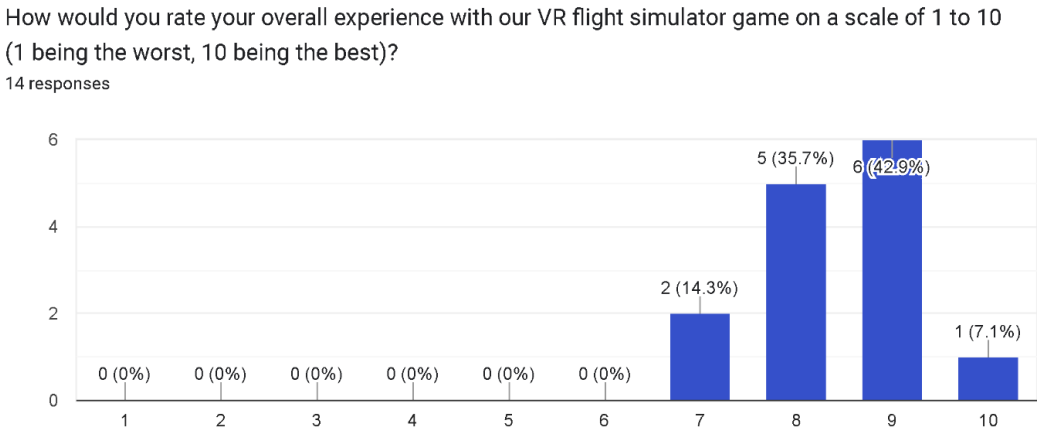

Figure 6.4.7 Rate of Airborne Adventure game experience

Figure 6.4.7 illustrates the participation of 15 respondents in the end-user test, with no respondents (0%) rated Airborne Adventure from scale 1 to 6, 2 respondents (14.3%) rated at scale 7, 5 respondents (35.7%) rated at scale 8, 6 respondents (42.9%) rated at scale 9 and 1 respondent (7.1%) rated at scale 10 taking part.

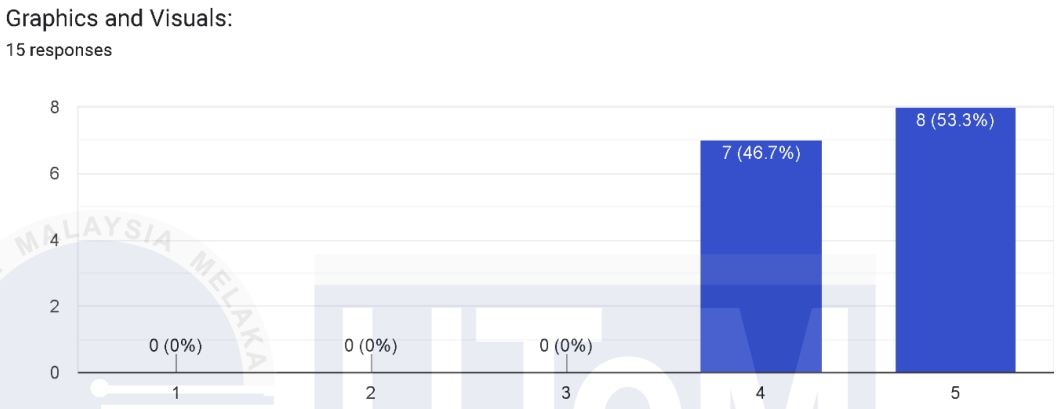

Figure 6.4.8 Graphic and Visuals

Figure 6.4.8 illustrates the participation of 15 respondents in the end-user test, with no respondents (0%) rated the graphic and visuals of Airborne Adventure from scale 1 to 3, 7 respondents (46.7%) rated at scale 4 and 8 respondents (35.7%) rated at scale 5 taking part.

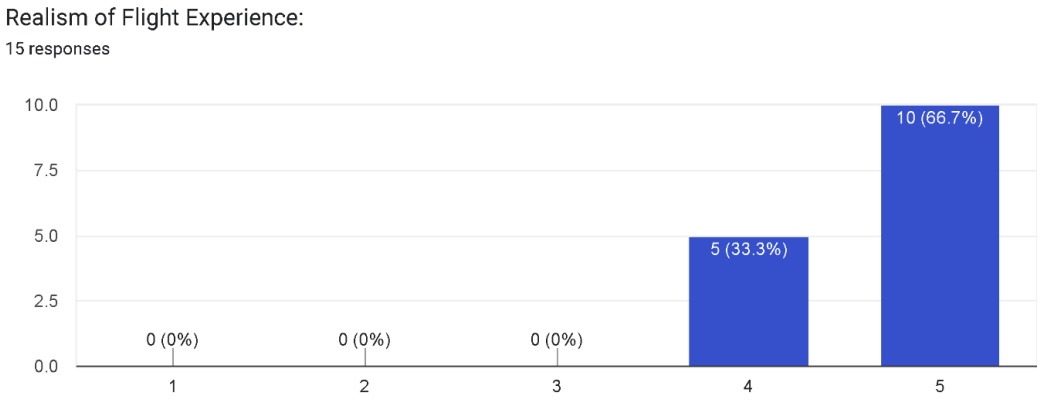

Figure 6.4.9 Realism of Flight Experience

Figure 6.4.9 illustrates the participation of 15 respondents in the end-user test, with no respondents (0%) rated the graphic and visuals of Airborne Adventure from scale 1 to 3, 5 respondents (33.3%) rated at scale 4 and 10 respondents (66.7%) rated at scale 5 taking part.

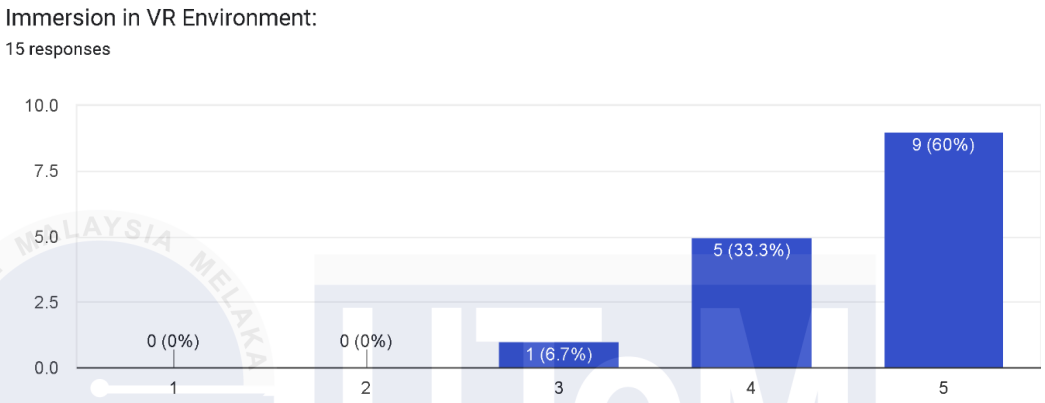

Figure 6.4.10 Immersion in VR Environment

Figure 6.4.10 illustrates the participation of 15 respondents in the end-user test, with no respondents (0%) rated the graphic and visuals of Airborne Adventure from scale 1 to 2, 1 respondent (6.7%) rated at scale 3, 5 respondents (33.3%) rated at scale 4 and 9 respondents (60%) rated at scale 5 taking part.

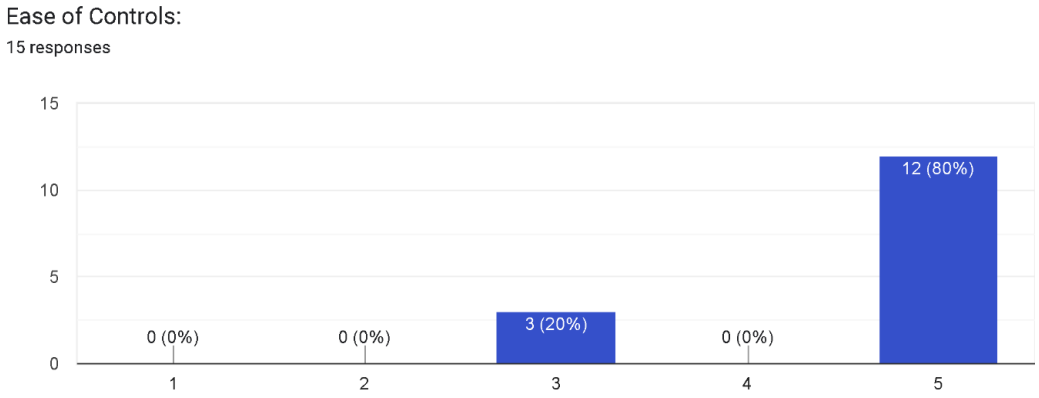

Figure 6.4.11 Ease of Controls

Figure 6.4.11 illustrates the participation of 15 respondents in the end-user test, with no respondents (0%) rated the graphic and visuals of Airborne Adventure from scale 1 to 2 and 4, 3 respondents (20%) rated at scale 3 and 12 respondents (80%) rated at scale 5 taking part.

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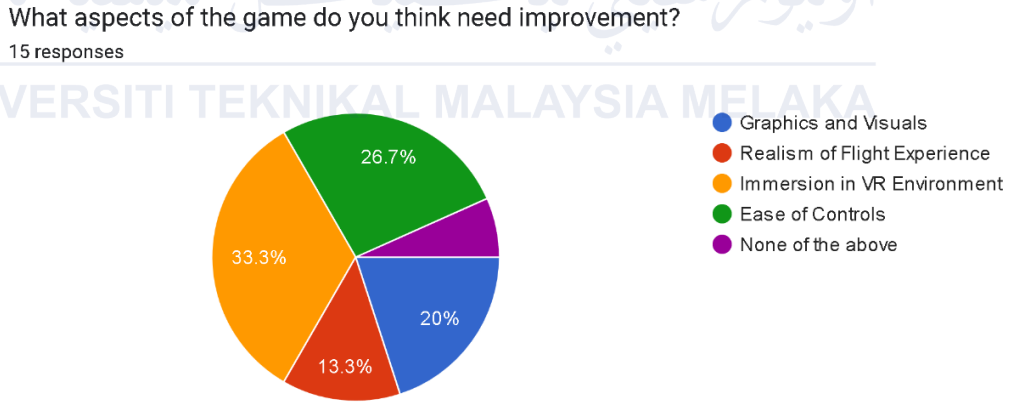

Figure 6.4.12 Aspects of game to improve

Figure 6.4.12 illustrates the participation of 15 respondents in the end-user test, with 3 respondents (20%) choose the graphic and visuals of Airborne Adventure need improvement, 2 respondents (13.3%) choose realism of flight experience, 4 respondents (33.3%) choose immersion in VR environment, 4 respondents (26.7%)

choose ease of controls and 1 respondent (6.7%) choose none of above to improve taking part.

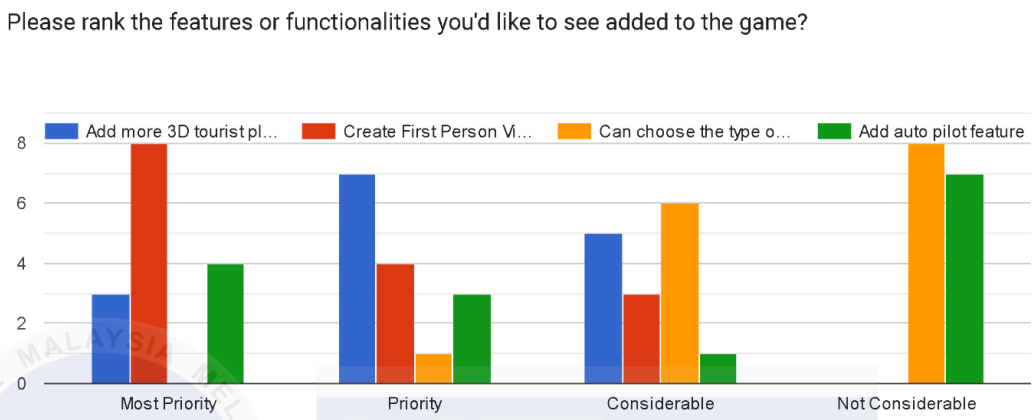

Figure 6.4.13 Ranking of the additional features or functionalities

Figure 6.4.13 illustrates the participation of 15 respondents in the end-user test, with 8 respondents think create First Person View to be added to the game as their most priority choice, which obtained the highest number of votes among other choices like add more 3D tourist places (3 respondents), can choose the type of aircraft (0 respondent) and add auto pilot feature (4 respondents).

For the priority choice, 7 respondents think add more 3D tourist places to be added to the game which obtained the highest number of votes among other choices like create First Person View (4 respondents), can choose the type of aircraft (1 respondent) and add auto pilot feature (3 respondents).

For the considerable choice, 6 respondents think can choose the type of aircraft to be added to the game which obtained the highest number of votes among other choices like create First Person View (3 respondents), add more 3D tourist places (5 respondents) and add auto pilot feature (1 respondent).

For the not considerable choice, 8 respondents think can choose the type of aircraft to be added to the game which obtained the highest number of votes among other choices like create First Person View (0 respondent), add more 3D tourist places (0 respondent) and add auto pilot feature (7 respondent).

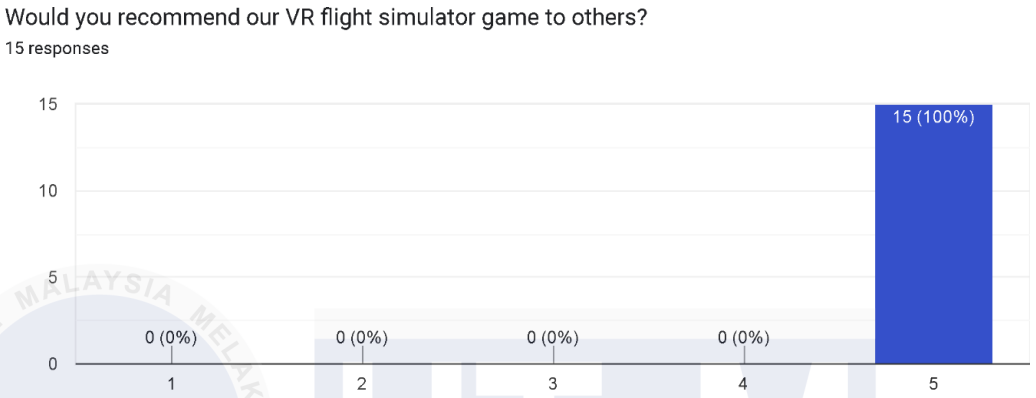

Figure 6.4.14 Scale of recommend Airborne Adventure to others

Figure 6.4.14 illustrates the participation of 15 respondents in the end-user test, with no respondents (0%) rated from scale 1 to 4 to recommend Airborne Adventure to others, all 15 respondents (100%) rated at scale 5 taking part.

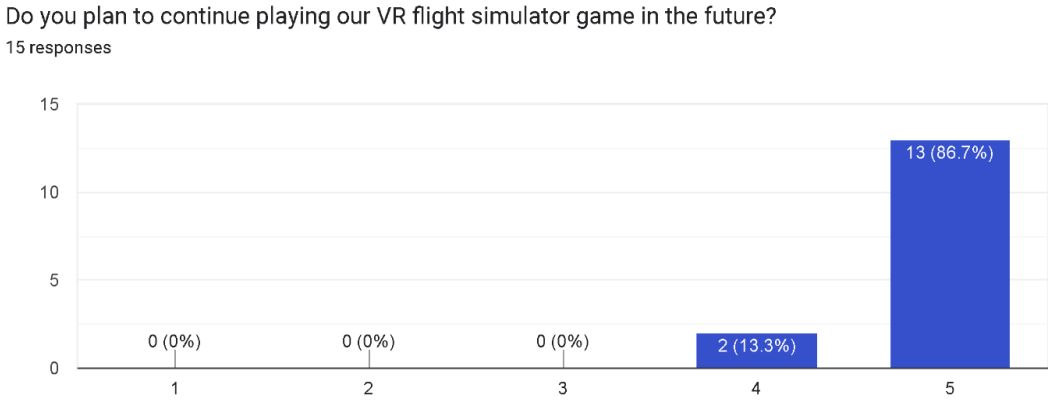

Figure 6.4.15 Scale of continue playing Airborne Adventure in future

Figure 6.4.15 illustrates the participation of 15 respondents in the end-user test, with no respondents (0%) rated from scale 1 to 3 to continue playing Airborne Adventure in future, 2 respondents (13.3%) rated at scale 4, 13 respondents (86.7%) rated at scale 5 taking part.

6.5 Conclusion

In conclusion, this chapter provides an overview of the testing process and presents the results obtained from the questionnaires administered after testing the game. As a summary, this chapter briefly outlines the testing procedure and highlights the feedback gathered from respondents who engaged with the game directly or by watching a walkthrough video prior or experiencing the game to completing the questionnaires. A total of 15 questions were posed to 15 participants, and the results overwhelmingly indicate that the game received positive feedback in various aspects. Respondents strongly agreed on the game's strengths. Furthermore, based on their recommendations, improvements in presentation and aesthetics, such as add more 3D tourist places, add auto pilot feature, can choose the type of aircraft and create First Person View were suggested. In the next chapter, we will delve into a comprehensive examination of the game's strengths and weaknesses, propose strategies for improvement, and discuss the project's overall contribution.

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CHAPTER 7: PROJECT CONCLUSION

7.1 Observation of Strength and Weaknesses

One of the key strengths of my project lies in its realism. For example, it incorporates realistic air physics and gravity effects during aircraft take off and flight. Moreover, the 3D assets used in the game have been meticulously selected and designed to closely resemble real-world objects, enhancing the overall immersive experience. This dedication to realism is pivotal in delivering a unique and enjoyable flight simulator experience for users.

One notable drawback of the project is its simplistic gameplay, potentially leading to rapid player disengagement. The game lacks depth in terms of player interactions and objectives beyond basic aircraft control and destination-seeking. After a few playthroughs, the game's experience becomes boring due to the repetition of the same gameplay, which may diminish long-term player engagement.

Within this project, a significant challenge lies in the generation of a mini map. The mini map's purpose is to display the aircraft's location and the destination site from an orthographic view. Unfortunately, it struggles to accurately track the moving aircraft's transformation and may lose track of the aircraft on the mini map. To address the above scenario, I implemented a blinking beam surrounding the destination site as a solution to the challenge. The beam becomes visible when the aircraft is within a certain proximity to the

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destination, serving as a visual cue to guide the player and indicate the location of the destination.

As for the project's limitations, one notable drawback is the absence of a First-Person View (FPV) in the game. This omission prevents players from experiencing a viewpoint that closely resembles what they would see with their own eyes. Consequently, they miss out on the immersive feeling of being inside the aircraft cabin and observing its interior design.

7.2 Proposition for Improvement

Based on player feedback, the game requires more things that players can discover later. One key enhancement we plan to implement is a First Person View (FPV) feature, which will greatly elevate the realism of the flight experience and immerse players in the virtual reality environment, making them feel like they are inside the aircraft. Additionally, we intend to expand the game's content by incorporating more 3D recreations of real-world tourist destinations, allowing players to explore these iconic places to their heart's content through Airborne Adventure.

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7.3 Contribution

This project’s primary objectives are to contribute a cost-effective alternative while ensuring user safety. Operating physical aircraft can be expensive and carries the risk of damage and user injury. Leveraging the power of virtual reality technology, this project aims to create a highly immersive and realistic environment, enabling users to experience the excitement of flight and explore diverse global locations. The project will integrate authentic flight physics, interactive environments, and customizable flight settings, promising a one-of-a-kind and enjoyable experience for users.

7.4 Conclusion

As a result, this project successfully achieved its objectives of researching, developing, and evaluating the integration of an engaging flight simulator experience into the Airborne Adventure VR game. This endeavor has the potential to significantly enhance the immersive VR experience and overall user satisfaction. Furthermore, the insights gained from this project offer valuable benefits for game developers in future VR game development endeavors.

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APPENDIX A Google Form (Questionnaire)

Analyzing the Engaging Flight Simulator Experience

Hello! Thank you for ypur participation and feedback.

This project centers on the development of a Virtual Reality (VR) game that offers an immersive flight simulator experience, enabling users to enjoy the exhilaration of flying and explore various global destinations from the convenience of their homes. Falling within the simulation genre, the project's ultimate goal is to design and integrate systems and mechanics that elevate the immersive VR levels and enhance the overall user experience.

xinelchoo0718@gmail.com Switch account

Not shared

Demographic Information:

Gender

- ◯ Male
- ◯ Female

Age

- ◯ 15 - 20 years old
- ◯ 21 - 24 years old
- ◯ 25 - 30 years old
- ◯ 30 years old or above

Gaming Habits:

How often do you play video games (including VR games)?

- ◯ Daily
- ◯ Several times a week
- ◯ Once a week
- ◯ A few times a month
- ◯ Never

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Have you played other flight simulator games (non-VR) before?

- ◯ Yes
- ◯ No

VR Experience:

How experienced are you with VR technology?

- ◯ Very Experienced
- ◯ Somewhat Experienced
- ◯ Novice
- ◯ Never Used VR

Game Experience:

Have you played our VR flight simulator game, Airborne Adventure?

- ◯ Yes
- ◯ No

How would you rate your overall experience with our VR flight simulator game on a scale of 1 to 10 (1 being the worst, 10 being the best)?

1	2	3	4	5	6	7	8	9	10
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

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Gameplay and Immersion

Please rate the following aspects of the game on a scale of 1 to 5, with 1 being "Not Satisfactory" and 5 being "Very Satisfactory

Graphics and Visuals:

1	2	3	4	5
◯	◯	◯	◯	◯

Realism of Flight Experience:

1	2	3	4	5
◯	◯	◯	◯	◯

Immersion in VR Environment:

1	2	3	4	5
◯	◯	◯	◯	◯

Ease of Controls:

1	2	3	4	5
○	○	○	○	○

Feedback and Suggestions
Please rate the following aspects of the game on a scale of 1 to 5, with 1 being "Not Satisfactory" and 5 being "Very Satisfactory".

What aspects of the game do you think need improvement?

- ○ Graphics and Visuals
- ○ Realism of Flight Experience
- ○ Immersion in VR Environment
- ○ Ease of Controls
- ○ None of the above

Please rank the features or functionalities you'd like to see added to the game?

	Add more 3D tourist places	Create First Person View (FPV) feature	Can choose the type of airplane	Add auto pilot feature
Most Priority	○	○	○	○
Priority	○	○	○	○
Considerable	○	○	○	○
Not Considerable	○	○	○	○

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Future Use:
Please rate the following aspects of the game on a scale of 1 to 5, with
1: "Strongly Disagree"
2: "Disagree"
3: "Neutral"
4: "Agree"
5: "Strongly Agree"

Would you recommend our VR flight simulator game to others?

1	2	3	4	5
○	○	○	○	○

Do you plan to continue playing our VR flight simulator game in the future?

1	2	3	4	5
○	○	○	○	○

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Google Forms

APPENDIX B Coding Scripts

AircraftPhysics.cs

```
using System.Collections.Generic;
using UnityEditor;
using UnityEngine;

[RequireComponent(typeof(Rigidbody))]
public class AircraftPhysics : MonoBehaviour
{
    const float PREDICTION_TIMESTEP_FRACTION = 0.5f;

    [SerializeField]
    float thrust = 0;
    [SerializeField]
    List<AeroSurface> aerodynamicSurfaces = null;
    [SerializeField]
    List<ControlSurface> controlSurfaces = null;

    Rigidbody rb;
    float thrustPercent;
    BiVector3 currentForceAndTorque;

    public void SetThrustPercent(float percent)
    {
        thrustPercent = percent;
    }

    public void SetControlSurfecesAngles(float pitch, float roll, float
yaw, float flap)
    {
        foreach (var controlSurface in controlSurfaces)
        {
            if (controlSurface.surface == null) return;
            switch (controlSurface.type)
            {
                case ControlSurfaceType.Pitch:
                    controlSurface.surface.SetFlapAngle(pitch          *
controlSurface.flapAngle);
                    break;
                case ControlSurfaceType.Roll:
                    controlSurface.surface.SetFlapAngle(roll           *
controlSurface.flapAngle);
                    break;
                case ControlSurfaceType.Yaw:
                    controlSurface.surface.SetFlapAngle(yaw            *
controlSurface.flapAngle);
                    break;
                case ControlSurfaceType.Flap:
                    controlSurface.surface.SetFlapAngle(flap           *
controlSurface.flapAngle);
                    break;
            }
        }
    }

    private void Awake()
    {
        rb = GetComponent<Rigidbody>();
    }
```

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```
    private void FixedUpdate()
    {
        BiVector3 forceAndTorqueThisFrame =
            CalculateAerodynamicForces(rb.velocity,  rb.angularVelocity,
Vector3.zero, 1.2f, rb.worldCenterOfMass);

        Vector3                  velocityPrediction                  =
PredictVelocity(forceAndTorqueThisFrame.p);
        Vector3               angularVelocityPrediction              =
PredictAngularVelocity(forceAndTorqueThisFrame.q);

        BiVector3 forceAndTorquePrediction =
            CalculateAerodynamicForces(velocityPrediction,
angularVelocityPrediction, Vector3.zero, 1.2f, rb.worldCenterOfMass);

        currentForceAndTorque      =      (forceAndTorqueThisFrame      +
forceAndTorquePrediction) * 0.5f;
        rb.AddForce(currentForceAndTorque.p);
        rb.AddTorque(currentForceAndTorque.q);

        rb.AddForce(transform.forward * thrust * thrustPercent);
    }

    private   BiVector3   CalculateAerodynamicForces(Vector3   velocity,
Vector3  angularVelocity,  Vector3  wind,  float  airDensity,  Vector3
centerOfMass)
    {
        BiVector3 forceAndTorque = new BiVector3();
        foreach (var surface in aerodynamicSurfaces)
        {
            Vector3  relativePosition  =  surface.transform.position  -
centerOfMass;
            forceAndTorque += surface.CalculateForces(-velocity + wind
                -Vector3.Cross(angularVelocity,
                relativePosition),
                airDensity, relativePosition);
        }
        return forceAndTorque;
    }

    private Vector3 PredictVelocity(Vector3 force)
    {
        return      rb.velocity      +      Time.fixedDeltaTime      *
PREDICTION_TIMESTEP_FRACTION * (force / rb.mass + Physics.gravity);
    }

    private Vector3 PredictAngularVelocity(Vector3 torque)
    {
        Quaternion    inertiaTensorWorldRotation    =    rb.rotation    *
rb.inertiaTensorRotation;
        Vector3                 torqueInDiagonalSpace                  =
Quaternion.Inverse(inertiaTensorWorldRotation) * torque;
        Vector3 angularVelocityChangeInDiagonalSpace;
        angularVelocityChangeInDiagonalSpace.x = torqueInDiagonalSpace.x
/ rb.inertiaTensor.x;
        angularVelocityChangeInDiagonalSpace.y = torqueInDiagonalSpace.y
/ rb.inertiaTensor.y;
        angularVelocityChangeInDiagonalSpace.z = torqueInDiagonalSpace.z
/ rb.inertiaTensor.z;

        return     rb.angularVelocity     +     Time.fixedDeltaTime     *
PREDICTION_TIMESTEP_FRACTION
```

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```
            *                (inertiaTensorWorldRotation                *
angularVelocityChangeInDiagonalSpace);
    }

    public void Brake(bool isBraking) //increases drag on wheels
    {
        //add drag on wheels
        SphereCollider[] wheels = FindObjectsOfType<SphereCollider>();

        //change based on isBraking
        float friction;
        if (isBraking)
        {
            friction = 0.5f;
        }
        else
        {
            friction = 0f;
        }

        foreach (SphereCollider wheel in wheels)
        {
            wheel.material.dynamicFriction = friction;
        }
    }
public class ControlSurface
{
    public AeroSurface surface;
    public float flapAngle;
    public ControlSurfaceType type;
}
    public enum ControlSurfaceType { Pitch, Yaw, Roll, Flap }
```

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AircraftController.cs

```
using System.Collections;
using System.Collections.Generic;

using UnityEngine;
using UnityEngine.SceneManagement;

public class AirplaneController : MonoBehaviour
{
    [SerializeField]
    float rollControlSensitivity = 0.2f;
    [SerializeField]
    float pitchControlSensitivity = 0.2f;
    [SerializeField]
    float yawControlSensitivity = 0.2f;
    [SerializeField]
    float thrustControlSensitivity = 0.01f;
    [SerializeField]
    float flapControlSensitivity = 0.15f;


    float pitch;
    float yaw;
    float roll;
    float flap;
```

```
    float thrustPercent;
    bool brake = false;

    AircraftPhysics aircraftPhysics;
    Rotator propeller;

    private void Start()
    {
        aircraftPhysics = GetComponent<AircraftPhysics>();
        propeller = FindObjectOfType<Rotator>();
        SetThrust(0);
    }

    private void Update()
    {
        if (Input.GetKeyDown(KeyCode.R))
        {
            SceneManager.LoadScene(0);
        }

        if (Input.GetKey(KeyCode.Space))
        {
            SetThrust(thrustPercent + thrustControlSensitivity);
        }
        propeller.speed = thrustPercent * 1500f;

        if (Input.GetKeyDown(KeyCode.LeftShift))
        {
            thrustControlSensitivity *= -1;
            flapControlSensitivity *= -1;
        }

        if (Input.GetKeyDown(KeyCode.B))
        {
            brake = !brake;
        }

        if (Input.GetKeyDown(KeyCode.LeftControl))
        {
            flap += flapControlSensitivity;
            //clamp
            flap = Mathf.Clamp(flap, 0f, Mathf.Deg2Rad * 40);
        }

        pitch = pitchControlSensitivity * Input.GetAxis("Vertical");
        roll = rollControlSensitivity * Input.GetAxis("Horizontal");
        yaw = yawControlSensitivity * Input.GetAxis("Yaw");
    }

    private void SetThrust(float percent)
    {
        thrustPercent = Mathf.Clamp01(percent);
    }

    private void FixedUpdate()
    {
        aircraftPhysics.SetControlSurfecesAngles(pitch,    roll,    yaw,
flap);
        aircraftPhysics.SetThrustPercent(thrustPercent);
        aircraftPhysics.Brake(brake);
    }
```

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```
}
```

Rotator.cs

```
using UnityEngine;

public class Rotator : MonoBehaviour
{
    public float speed;

    private void Update()
    {
        transform.localRotation *= Quaternion.AngleAxis(speed * Time.deltaTime , Vector3.up);
    }
    }
```

HoverButton.cs

```
using UnityEngine;
using UnityEngine.UI;
using UnityEngine.EventSystems;

public class HoverButton : MonoBehaviour, IPointerEnterHandler, IPointerExitHandler
{
    public GameObject hoverImage;

    private void Start()
    {
        hoverImage.SetActive(false);
    }
    public void OnPointerEnter(PointerEventData eventData)
    {
        hoverImage.SetActive(true);
    }

    public void OnPointerExit(PointerEventData eventData)
    {
        hoverImage.SetActive(false);
    }
    }
```

CollideShowCanva.cs

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using UnityEngine.SceneManagement;

public class CollideShowCanva : MonoBehaviour
{
    public GameObject Panel;

    void Start()
    {
        Panel.SetActive(false);
    }
```

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```
    // Update is called once per frame
    void OnTriggerEnter(Collider other)
    {
        float time = 10;
        Panel.SetActive(true);
            Destroy(Panel, time);
    }
    }
```

ChangeScene.cs

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using UnityEngine.SceneManagement;

public class ChangeScene : MonoBehaviour
{
    public int buildIndex;
    // Start is called before the first frame update
    void Start()
    {

    }

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

    }

    public void ToMainMenu()
    {
        SceneManager.LoadScene(0);
        Time.timeScale = 1f;
    }

    public void ChgScene()
    {
        SceneManager.LoadScene(2);
        Time.timeScale = 1f;
    }

    public void GoTutorial()
    {
        SceneManager.LoadScene(1);
        Time.timeScale = 1f;
    }

    public void GoNYC()
    {
        SceneManager.LoadScene(3);
        Time.timeScale = 1f;
    }

    public void GoCoimbra()
    {
        SceneManager.LoadScene(4);
        Time.timeScale = 1f;
    }
```

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```
    public void GoSydney()
    {
        SceneManager.LoadScene(7);
        Time.timeScale = 1f;
    }

    public void GoFrance()
    {
        SceneManager.LoadScene(5);
        Time.timeScale = 1f;
    }

    public void GoRome()
    {
        SceneManager.LoadScene(6);
        Time.timeScale = 1f;
    }

    public void QuitGame()
    {
        Application.Quit();
    }

    public void ReloadScene()
    {

SceneManager.LoadScene(SceneManager.GetActiveScene().buildIndex);
        Time.timeScale = 1f;
    }
    }
```

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APPENDIX C Functionality Tests

Functionality Test 1

Game developer: Muhammad Hazmin bin Wardi

No.	ID	Input (Question)	Expected Output	Output (OK/Error/Failed)
1	Aircraft controls	Can aircraft move?	W/S(Pitch) A/D (Roll) Q/E (Yaw) SPACEBAR (Take off)	OK
2	Character controls	Can character move?	W/S (Move Forward/Backward) A/D (Turn Left/Right)	OK
3	Non-Player Character's (NPC) Idle Animation	Do the animation works?	Some of the NPCs have the animation while idling	OK
4	ESC Button	Can player pause the game?	Pause Panel appear	OK
5	Menu.Play button	Is this button function well?	Move to Airport Lobby Scene	OK
6	Menu.Tutorial button	Is this button function well?	Move to Tutorial Scene	OK
7	Menu.Quit button	Is this button function well?	Quit and close game	OK
8	Menu.Resume button	Is this button function well?	Resume game	OK
9	Menu.Back to Main Menu	Is this button function well?	Return to Main Menu Scene	OK
10	Worldmap Canva.LocationPin button	Is this button function well?	Show the tourist place image (Hovering); Move to Game Scene (Clicking)	OK

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11	Collide with Beam in front of counter (interacting with Lobby Staff)	Does a panel appear on the screen?	World map Canva appear	OK
12	Collide with Cloud System	Does a panel appear on the screen?	A canvas which contained a simple description of the tourist place	OK
13	Collide with Arrival Ball	Is it function well?	Return to Airport Lobby Scene	OK
14	Destination Beam	Is it visible within a certain distance	A beam appears as a destination hint	OK
15	Tourist Place	Is it render well?	Each tourist place will be rendered	OK

Functionality Test 2
Virtual Therapy for Anxiety Disorder Game developer: Bryan Kua Li Quan

No.	ID	Input (Question)	Expected Output	Output (OK/Error/Failed)
1	Aircraft controls	Can aircraft move?	W/S(Pitch) A/D (Roll) Q/E (Yaw) SPACEBAR (Take off)	OK
2	Character controls	Can character move?	W/S (Move Forward/Backward) A/D (Turn Left/Right)	OK
3	Non-Player Character's (NPC) Idle Animation	Do the animation works?	Some of the NPCs have the animation while idling	OK
4	ESC Button	Can player pause the game?	Pause Panel appear	OK

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5	Menu.Play button	Is this button function well?	Move to Airport Lobby Scene	OK
6	Menu.Tutorial button	Is this button function well?	Move to Tutorial Scene	OK
7	Menu.Quit button	Is this button function well?	Quit and close game	OK
8	Menu.Resume button	Is this button function well?	Resume game	OK
9	Menu.Back to Main Menu	Is this button function well?	Return to Main Menu Scene	OK
10	Worldmap Canva.LocationPin button	Is this button function well?	Show the tourist place image (Hovering); Move to Game Scene (Clicking)	OK
11	Collide with Beam in front of counter (interacting with Lobby Staff)	Does a panel appear on the screen?	World map Canva appear	OK
12	Collide with Cloud System	Does a panel appear on the screen?	A canvas which contained a simple description of the tourist place	OK
13	Collide with Arrival Ball	Is it function well?	Return to Airport Lobby Scene	OK
14	Destination Beam	Is it visible within a certain distance	A beam appears as a destination hint	OK
15	Tourist Place	Is it render well?	Each tourist place will be rendered	OK

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