DEPARTMENT OF AIRCRAFT MAINTENANCE

FINAL PROJECT PROPOSAL

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A REPORT SUBMITTED TO DEPARTMENT OF AIRCRAFT MAINTENANCE
IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR DIPLOMA
ENGINEERING IN AIRCRAFT MAINTENANCE

SUPERVISOR

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"We hereby declare that this report is the result of our own work, except excerpts that we have outlined its resource and this project will be the ownership of polytechnic."

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ABSTRACT

The Aircraft Engine Game Explorer (AEGEX) project uses game-based learning to help fill the gap between theoretical knowledge and practical application in aviation studies. This interactive educational application, built on the Roblox platform, educates players on the various components and operations of aircraft engines using realistic 3D simulations, quizzes, and role-playing scenarios. By merging Blender's immersive 3D modeling capabilities with Lua programming, AEGEX provides an engaging environment where users may study engine systems, participate in maintenance duties, and better understand aerodynamics. This innovative method overcomes issues experienced by aviation students, such as difficult accessibility of complicated engine components and the limited options of traditional teaching methods. AEGEX uses gamification to improve information, increase critical thinking, and support various learning styles, making aviation education available to users of all ages and technical backgrounds. Furthermore, the project reduces relying on expensive physical models, making it a cost-effective solution for institutions globally. AEGEX demonstrates the positive impact of combining education and entertainment to provide future aviation professionals with critical skills and knowledge.

Keyword: Game-based Learning, Aviation Learning, Aircraft Engines, 3D Simulation, Gamification, Interactive Learning, Theoretical Knowledge Application, Maintenance Training, Aerodynamics Education, Roblox Platform

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LIST OF ABBREVIATIONS

PBS	Politeknik Banting Selangor
STEM	Science, Technology, Engineering and Mathematics
PC	Personal Computer
GUI	Graphical User Interface
AEGEX	Aircraft Engine Game Explorer
3D	3 Dimensional
FADEC	Full Authority Digital Engine Control
EEC	Electronic Engine Control

LIST OF APPENDICES

A	List Of Task Segregation
B	Appendices

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

It is now an effective educational tool for educating children and teenagers, as well as assisting them in learning and experiencing enriching activities. The majority of Roblox users are in primary and secondary school, and the game is extremely popular among children aged 5 to 16. Roblox Studio allows for real-world learning and game design experiences. This is more than just a traditional online sandbox game; it's also a gaming and education platform where users can have fun while also learning about aviation. They can access it from their mobile phones, laptops, and game consoles. People who want to learn about airplane engines can do so on Roblox, which is more than just a gaming platform. In addition, experienced aircraft technicians, mechanics, and maintenance specialists developed lessons, instructions, and films. This covers engine systems, physics, how engines work, and engine principles.

1.2 PROBLEM STATEMENTS

The complexity and unobservable parts of aircraft engine components hinder the students to gain more thorough understanding in engine components. A lack of understanding of engine components will cause the student confusion for their knowledge also in handling an inspection on real aircraft engines in the future . This can limit the students ability to identify the location of each part for inspection purposes. Therefore, it is important for students to develop better knowledge on aircraft engines. They should give more opportunities to view and interact with engine components to get a better understanding on how they work.

1.3 PROJECT OBJECTIVES

- To help students gain a deeper knowledge and understand how each part of an aircraft engine works.
- To develop a suitable learning tool that is appropriate for all ages.
- To create interactive and enjoyable gameplay with enhanced graphics about various parts of aircraft engines using Roblox platform.
- To demonstrate how the aircraft engine works.
- To prepare students for online learning and reduce the distance between them and lecturers.

1.3.1 SPECIFIC INDIVIDUAL PROJECT OBJECTIVES

1.3.1.1 PRODUCT STRUCTURE

AEGEX Game contained an aircraft engine as well as educational content about gas turbine engines. It includes 3D Models such as turbofans, turboshafts, turboprops, turbojets, and aircraft systems. They can walk around in the game, which combines gaming and education; on the other hand, the player can have fun while learning about the principle, parts, and mechanism of a gas turbine engine. Players can also participate in minigames such as challenges and quizzes to learn more about aircraft engines, which will result in other benefits such as earning credit or other items in the game.

1.3.1.2 PRODUCT MECHANISMS

The product is a fully functional simulator that includes interactive 3D models of the engines; each type of engine has its own set of charts and specifications, as well as detailed parts. Users can also participate in educational challenges by completing quizzes and design tasks and receiving in-game currency or an item in return. The game supports multiplayer, allowing players to collaborate and compete, and they use an online leaderboard to keep track of results. This product was created using Roblox Studio, the Lua programming language, and Blender software. There is also a user-friendly menu and navigation system for manipulating and guiding players, as well as a tutorial on how the engine works and its settings.

1.3.1.3 SOFTWARE /PROGRAMMING

Roblox Studio is the primary tool for game creation, with an interface for developing environments, programming game logic, and controlling resources. Lua is the game logic, controlling the players' actions and providing additional options for engines and parts, such as customisation. Blender is used to generate 3D models for asset enhancement, which are created using upgraded models and textures that improve the game's appearance.

1.3.1.4 ACCESSORIES & FINISHING

For the AEGEX project, we provided clothing accessories, gameplay changes, and training products based on the proposed flight theme. This has been done in such a way that things like technician gear and student uniforms in aviators allow players to capture the aviation experience in a game. Product information, particularly that found in educational learning-based interactive manuals, provides valuable details about various aspects of the engine and mechanics. Use detail and actual gas turbine engine components, such as the turbo propeller, turbo jet, turboshaft, and turbo fan, to improve maintenance functionality.

1.4 SCOPE OF PROJECT

1.4.1.1 GENERAL PROJECT SCOPES

Our proposed concept will have the following limitations:

- Performance and graphics may be influenced by the user's device.
- Additional resources may be required for more in-depth and advanced aviation topics.
- The Roblox library of pre-built assets may not provide a broad range of accurate and detailed engine models.
- The servers may be lagging and unresponsive.

1.4.1.2 GAME STRUCTURE

AEGEX Game will focus on aviation education for teenagers and aviation students, attracting them with all interactive graphics and 3D models and becoming their favorite Roblox game to use for learning about all engine parts. The games allow players to learn about aircraft. AEGEX can use the Blender app to create 3D models that will enhance the game's realistic feel. Other apps include Prisma 3D, Sculpt+, Qubism 3D Modelling, and many more. But AEGEX uses Blender because it is free and simple to use.

About the types of engines, players can find some information and new detailed descriptions about the engine system, as well as 3D models of the engine, one of which is CFM56-3C1 Allison 250B, PT6A each with its own script for explaining with interactivity. The above are kept engaged in their exploration process because the game environment evolves over time through challenges, updates, and events, among other things.

1.4.1.3 GAME MECHANISM

Potential consequences of game-based learning exploration of aircraft engines include a rather limited range of learning opportunities for players. These series may include as much detailed information about various aircraft parts as possible, but this may be limited in order to provide a fun gaming experience while learning.

1.4.1.4 INTERFACE LAYOUT

The Roblox games can be downloaded from Google, Android devices and from Apple iOS devices. Although, to be able to make some additions or use other functions such as updates or collaborative learning, it is possible that the game as a whole may require a fast connection. Users of devices with unstable or slow connection to the network can be in a position not to access some functions or do so very slowly. There may be the need to use an ample amount of space to store used data, updates, and content because this application draws a high storage space. If the users' devices with limited space have to accommodate the application and or if the application has to fit the space available on devices then the ability to download and or save content locally could be limited.

1.5 PROJECT IMPACT

The Aircraft Engine Game Exploration in Roblox project is expected to have a significant positive impact on aviation education and training by modernizing how students engage with complex aircraft engine systems. By offering an interactive simulation, the project enhances practical knowledge, allowing users to visualize and explore engine components beyond traditional diagrams and textbooks, reinforcing theoretical understanding. This immersive approach boosts engagement, making learning more enjoyable and effective, while supporting self-paced study and accommodating various learning styles. Additionally, it serves as an accessible and cost-effective teaching tool for training institutions, reducing the need for physical aircraft or costly equipment and broadening learning opportunities for students. Ultimately, the project improves education quality, enhances knowledge retention, and prepares students more thoroughly for practical work, contributing to the development of skilled aviation professionals.

To accomplish this goal, we selected the Roblox platform. Roblox can be downloaded from a number of websites, including Google, the Play Store, and the App Store. As a result, some online platforms have fewer limitations. This educational game elevates e-learning by presenting an online game of an aircraft engine, as well as a basic explanation of how the engine's physics work. When we create educational games, we want students and educators to be able to use them whenever and wherever they want. Integrating mobile learning into a learner's daily routine improves learning and encourages completion.

CHAPTER 2
LITERATURE REVIEW

2.1 GENERAL LITERATURE REVIEW

2.1.1 Research Of Previous Study

In recent years, the concept of gamification has emerged to reshape traditional teaching and learning methods. Gamification aims to make platform learning more enjoyable and engaging by incorporating game elements into the educational environment for people.

Gamification encourages and motivates students. It encourages critical thinking, making learning more interesting and engaging. This motivation will result in increased participation among eager learners. By incorporating game features such as points, leaderboards, badges, levels, and feedback, students can be motivated and the learning process made more engaging and enjoyable. By incorporating these elements into educational games, students will be able to foster critical thinking, balance opposing viewpoints, and think rationally. This not only improves their critical thinking abilities but also provides them with useful skills in situations in the real world.

Because of its enormous potential, gamification presents challenges in developing and implementing dynamic learning experiences. Educators have to find a balance between incorporating game elements and keeping the content academic. Furthermore, the effectiveness of gamification is determined by how students learn, holding and share knowledge, as well as the need for additional studies.

2.2 Comparison of previous / current study

Educational games are known as an effective method for improving students' learning which has been proven by many researchers. Research showed that educational games for the learning process can improve student involvement and interest. Games can improve the learning experiences and boost creative thinking among students. Games can also have the potential to improve collaboration and problem-solving skills. Plus, educational games can be made to help students understand difficult concepts more easily.

Basic research on educational games repeatedly demonstrates their good effect on student engagement and motivation. In the late 20th and early 21st centuries, research showed that interactive and challenging types of games create excitement and dedicated participation in the learning process. Educational games have the potential to attract students' attention and keep up their interest, thereby creating the way for a more effective learning experience.

Research has moved from examining the impact of educational games on cognitive skills to examining their potential impact on academic performance over the years. Studies have demonstrated that students who play educational games achieve significantly higher learning outcomes, have improved knowledge retention, and demonstrate enhanced application of knowledge than their peers who do not play educational games. The findings suggest that educational games have the potential to develop critical thinking, problem-solving, and other cognitive skills.

2.3 Selection of Idea/Concept/Theory

2.3.1 Product A vs Our Product

Product	**Airline Commander: Flight Game** 	**Aircraft Engine Game Inspection**
Purpose	Learn how to use all airplane controls, and to cope with faults, emergencies and favorable weather conditions.	To create a learning tool suitable for individuals of all ages and backgrounds and to help students gain knowledge and understand how engine physics works.
Target	Kids	Everyone
Platform	Mobile	Roblox platform, accessible on multiple devices such as PCs, consoles, and mobile devices.
Feature	Free to play	Free to play
Genre	A real airplane simulator	Maintenance And inspection

Table 2.3.1: Product A vs Our Product

2.3.2 Product B vs Our Product

Product	**War Thunder** 	**Aircraft Engine Game Inspection**
Purpose	To give the user battle experience in real battleground by using numerous types of aircraft.	To create a learning tool suitable for individuals of all ages and backgrounds and to help students gain knowledge and understand how engine physics works.
Target	Teenager and adult	Everyone
Platform	Steam platform, accessible on multiple devices such as PCs, consoles, and mobile devices.	Roblox platform, accessible on multiple devices such as PCs, consoles, and mobile devices.
Feature	Free to play	Free to play
Genre	Action , combat flight simulator	Maintenance and inspection

Table 2.3.2 : Product B vs Our Product

2.3.3 Product C vs Our Product

Product	**MCAS Simulation** 	**Aircraft Engine Game Inspection**
Purpose	Immersive augmented reality news report in the form of metaverse game that will give you a better understanding of how MCAS works.	To create a learning tool suitable for individuals of all ages and backgrounds and to help students gain knowledge and understand how engine physics works.
Target	Everyone	Everyone
Platform	Mobile	Roblox platform, accessible on multiple devices such as PCs, consoles, and mobile devices.
Feature	Free to play	Free to play
Genre	Simulation and education	Maintenance and inspection

Table 2.3.3 : Product C vs Our Product

2.3.4 Product D vs Our Product

Product	**Plane Mechanic Simulator**  	**Aircraft Engine Game Inspection**
Purpose	Focuses on simulating realistic maintenance procedures, including engine repairs, electrical system checks, hydraulic system maintenance, and more.	To create a learning tool suitable for individuals of all ages and backgrounds and to help students gain knowledge and understand how engine physics works.
Target	Teenager and adult	everyone
Platform	Platforms: Nintendo Switch, PlayStation 4, Microsoft Windows, Xbox One	Roblox platform, accessible on multiple devices such as PCs, consoles, and mobile devices.
Feature	Need to purchase	Free to play
Genre	simulator	Maintenance and inspection

Table 2.3.4 : Product D vs Our Product

CHAPTER 3

RESEARCH METHODOLOGY

3.1 PRODUCT DESCRIPTION AND FEATURES

3.1.1 Product Description

Aircraft Engine Game Explorer (AEGEX) is an educational, game-based activity that uses play to reinforce learning about how aircraft engine components function. These games offer a variety of activities, including virtual tours of aircraft engines and hands-on experiments in which we demonstrate aerodynamic principles and then design an aircraft engine. This is an excellent tool for teaching players about engine construction and functions, as well as engine parts and how the engine works. These games are designed for everyone, so anyone can enjoy them while learning about the physics of gas turbine engines in an interactive manner.

3.1.2 Product Features

The AEGEX Game described several important aircraft engines in a free and animated way using realistic 3D models of the engines, allowing users to have a real game experience by immersing themselves in the engine world. In the game, the user can explore the environment and learn more about the engine. The user can interact with the engine and explore the components and parts of any given item. There are also minigames, such as quizzes with displays, in which the player must test his knowledge in order to win something like game currency. The game also features a role-playing character, the technician or student; the user will understand this aspect, making the game even more interesting.

It will also allow another player join for competing with others, this will boost the community relation through the leaderboards and achievement. This game also offer an information centre for each engine, this will then deliver all aspects of gas turbine engine module technical and operational specification. This can be operated through a very friendly user interface. Players can also earn badges and achievements by completing the missions that appear in the specific challenge, which encourages them to continue playing the game

3.1.3 Product Application

The game is designed to enhance the learning process by providing an interactive platform where users can explore detailed 3D models of aircraft engines. It helps bridge the gap between theoretical classroom learning and real-world application by allowing users to visualize and interact with engine components and understand their functions.

This application is particularly valuable for training institutions looking for cost-effective ways to supplement traditional teaching methods. By incorporating features such as detailed information panels, interactive quizzes, and realistic airport-like environments, the game caters to different learning needs and preferences. It supports both guided learning in a classroom setting and self-paced study, allowing users to review and deepen their understanding as needed. Overall, the game's application makes technical knowledge more accessible and engaging, facilitating a more comprehensive educational experience that prepares students for practical work in aircraft maintenance.

Figure 1.1 Roblox Studio (Google n,d)

3.2 Project Gantt Chart

WEEK / ACTIVITY	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10	W 11	W 12	W 13	W 14	W 15	W 16
Group formation and briefing																
Project idea registration																
Meeting with third party																
Project started																
Analyze any problem of the project on current progress																
Improve the project concept																

Table 3.2 Gantt Chart for Aircraft Engineering Management

PLANNING

EXECUTED

3.3 Design Concept

3.3.1 Morphological Matrix

The Morphological Matrix provides a variety of dimensions and potential combinations, as well as an organized technique for idea production. This simplifies selecting the finest solutions for a successful and engaging Roblox aircraft engine maintenance education experience, while also covering all important topics. Each game mode reflects a distinct trait or option within the game mode.

3.3.1.1 Proposed design concept 1

Criterion	Concept 1
Platform	**Mobile**
Game Mode	**Puzzle**
Place	**Runaway**
Perspective	**First-person**
Interaction	**Multiplayer**

Table 3.3.1.1 Idea design concept 1

3.3.1.2 Proposed design concept 2

Criterion	Concept 1
Platform	**Mobile / PC**
Game Mode	**RPG**
Place	**Hangar**
Perspective	**First-person / third-person**
Interaction	**Multiplayer**

Table 3.3.1.2 Idea design concept 2

3.3.1.3 Proposed design concept 3

Criterion	Concept 1
Platform	**PC**
Game Mode	**Simulation**
Place	**Airport**
Perspective	**First-person / third-person**
Interaction	**Singleplayer**

Table 3.3.1.3 Idea design concept 3

3.3.1.4 Proposed design concept 4

Criterion	Concept 1
Platform	**Console**
Game Mode	**Survival**
Place	**Plains**
Perspective	**Third-person**
Interaction	**Singleplayer**

Table 3.3.1.4 Idea design concept 4

3.3.2 Conceptual design of the Proposed product

The conceptual design of our product phase lays the groundwork for the creation of the Roblox aviation engine repair education product. It is critical to interact with aviation maintenance specialists and potential users throughout the design process to verify that the product fits their needs and corresponds with educational objectives.

CRITERION	CONCEPT 1	CONCEPT 2	CONCEPT 3	CONCEPT 4
PLATFORM	MOBILE	MOBILE / PC	PC	CONSOLE
GAME MODE	PUZZLE	RPG	SIMULATION	SURVIVAL
PLACE	RUNAWAY	HANGAR	AIRPORT	PLAINS
PERSPECTIVE	FIRST PERSON	FIRST-PERSON / THIRD-PERSON	FIRST PERSON/ THIRD PERSON	THIRD PERSON
PLAYER INTERACTION	MULTIPLAYER	MULTIPLAYER	SINGLEPLAYER	SINGLEPLAYER

Figure 1.2 Conceptual design of the proposed product

3.4 Product sketches for interface layout

We ensure that our interface is straightforward, easy to use, and visually appealing. To improve the overall user experience of the Roblox aviation engine maintenance education programme, conduct usability tests and collect user feedback. This allows users to simply explore and identify within the product. Next, we develop a graphical user interface (GUI) known as the menu or navigation bar beneath the header. With obvious labels for product components or modules, such as Lessons, Simulations, Challenges, Assessments, and Resources.

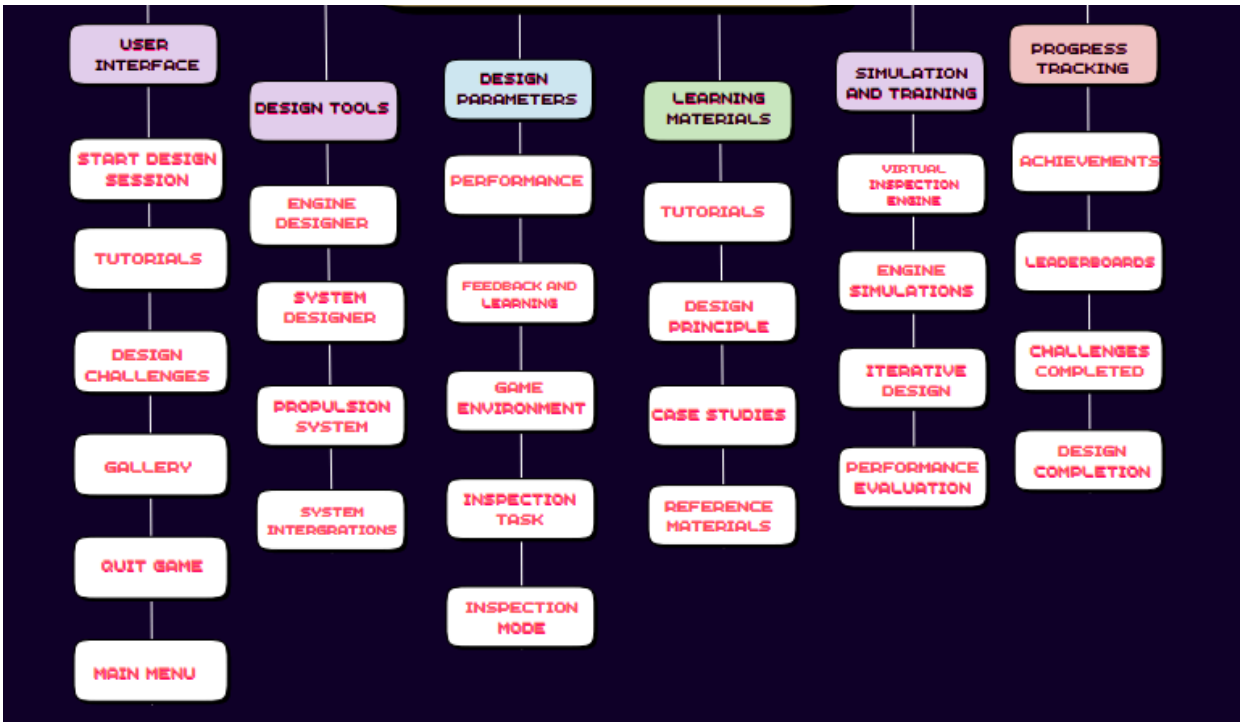

Figure 1.3 Product sketches for interface layout

The Roblox interface is the user's doorway to exploring and engaging with the Roblox platform. We can access the many platform areas that can be explored using the navigation bar, which is normally located in the upper left corner of the interface. The navigation bar allows users to reach numerous pages such as the main menu, home, options, games, avatars, stores, groups, and others. Users can navigate these settings by clicking them.

Figure 1.4 AEGEX in-game homescreen

Furthermore, the navigation bar provides functionality and is often located on the left or right side of the interface. To engage with the chat messages, move the pointer to the upper left corner and press the "/" symbol button. Friends, texts, notifications, and settings are just a few possibilities that remain. Users can also connect with their social interactions, check messages, issue friend requests, receive notifications, and alter account settings by clicking on these options.

CHAPTER 4

RESULT & DISCUSSION

4.1 PRODUCT DESCRIPTION

4.1.1 General Product Features & Functionalities

Aircraft engine game exploration (AEGEX) offers players an engaging and interactive way to learn about aircraft engine components and their functions. These games provide a variety of activities, such as virtual tours of aircraft engines and hands-on experiments that demonstrate aerodynamic and engine design principles. Players can investigate the aircraft engine parts and their functions, learning about engine construction, engine components, and how the engine operates. These games are appropriate for players of all ages and backgrounds, and they provide an enjoyable and engaging way to learn about the science and mechanics of gas turbine engines.

Figure 1.5 Roblox Character

4.1.2 Specific Part Features

4.1.2.1 Game Structures

The game emphasises on the education of gas turbine engines and their components, promoting effective learning as well as realistic maintenance and simulation experiences. Our game is set in a hangar environment with a runway, hangar, and helicopter pad. This type of environment will pique players' interest.

a) Hangar :

In our game, we have several hangars with various types of engines. The game hangar is similar to KLIA, Selangor. This game provides a realistic environment and keeps the user interested. AEGEX has three hangars for the game, and users can explore the aircraft's environment as well as engine assets within the hangar. Each hangar has its own engine model, which makes the learning experience more enjoyable.

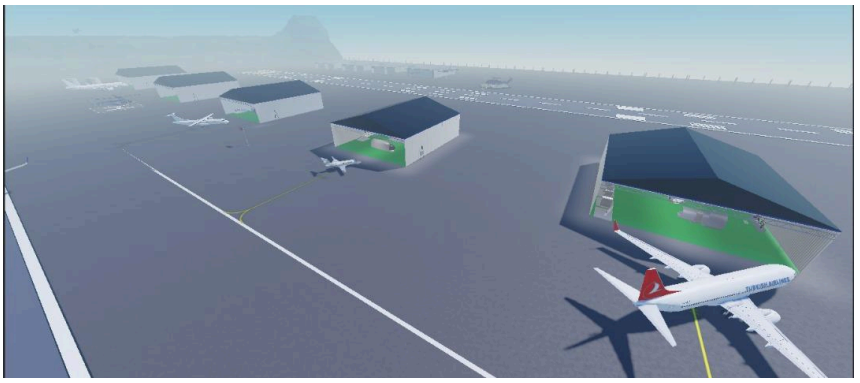

Figure 1.6.1 Engine Hangar with Aircraft Model

Figure 1.6.2 Hangar Sepang Aircraft Engineering at KLIA

b) Asset Engines and Aircraft, CFM56-3C1, General Electric CJ610, Allison 250B, PT6A-20 and The Airbus A330-300 series.

An engine model and sectional cut away is fitted to the hangar for this game. Thus, the engine is merely good for the Roblox characters to have be experience and do the work. Moreover, the plane has an aircraft engine in the hangar which also signifies that belongs to it. The full detail about the engine is where players can access on and explore more.

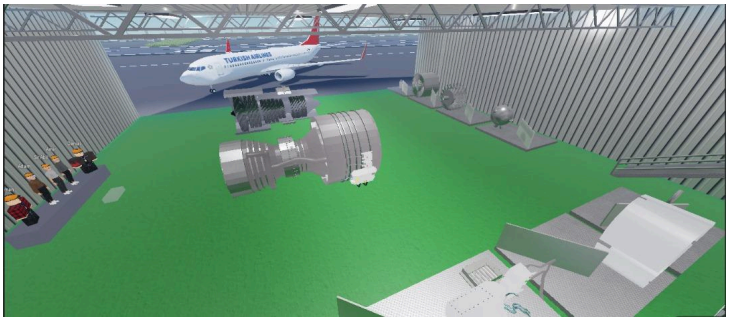

Figure 1.6.3 Asset Model in Roblox Studio CFM 56-3C1

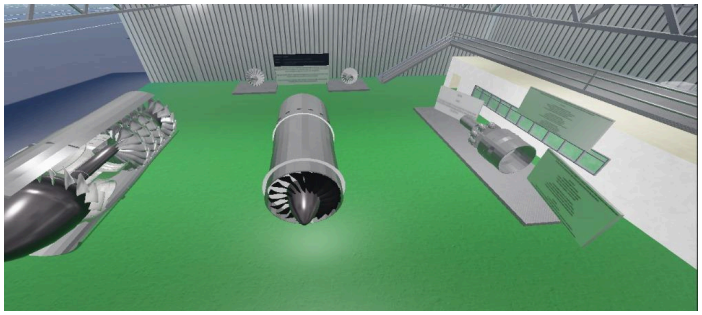

Figure 1.6.4 Asset Model in Roblox Studio General Electric CJ610

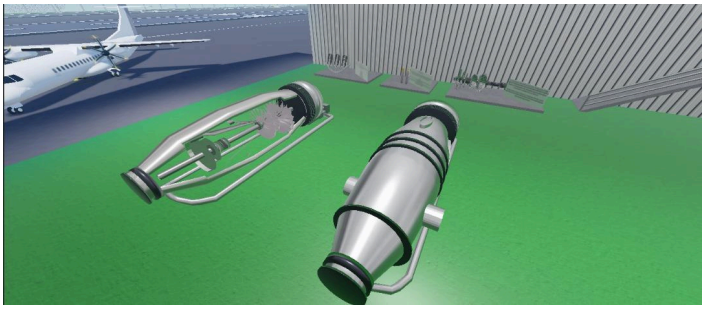

Figure 1.6.5 Asset Model in Roblox Studio PT6A-20

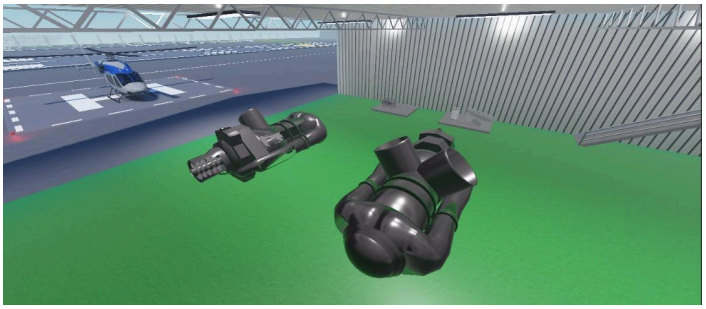

Figure 1.6.6 Asset Model in Roblox Studio Allison 250B

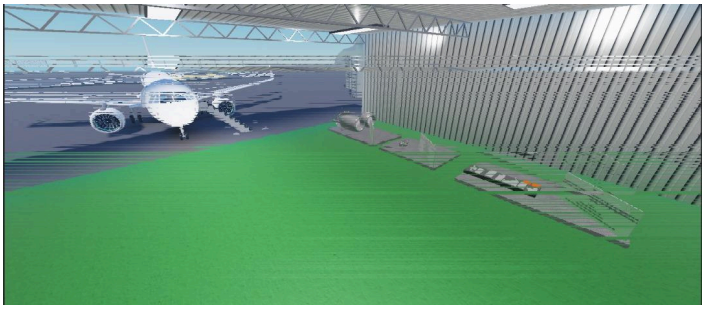

Figure 1.6.7 Asset Model in Roblox Studio A330-300

c) 3D model by Blender Software :

The 3D models were made in Blender apps and imported to hangar and workshop. Each aircraft is built to the specifications of its blueprints, and all of the assemblies and parts on it look identical. The model was hanged on the hangar for instructive purpose. Players can get close to the engine and learn more about parts and componentss.

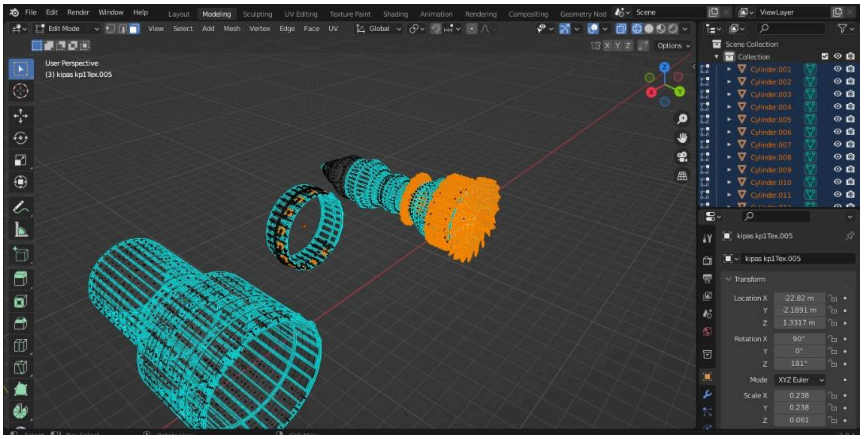

Figure 1.6.8 3D Model Engine CFM56-3C1 using Blender

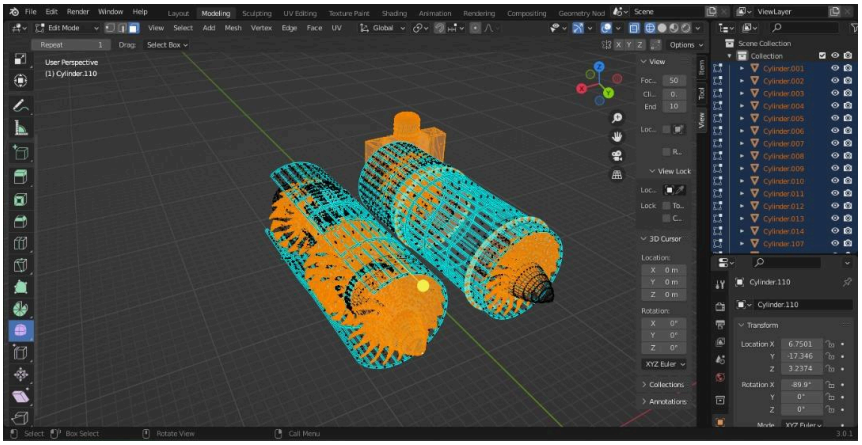

Figure 1.6.9 3D Model Engine General Electric CJ610 using Blender

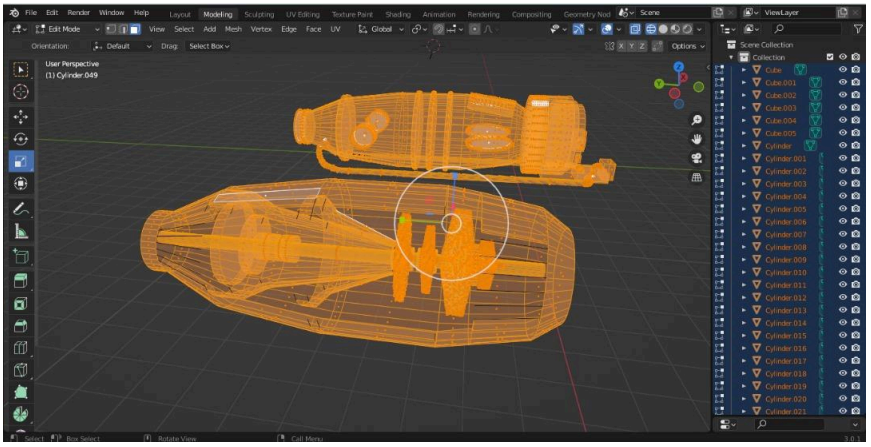

Figure 1.6.10 3D Model Engine PT6A-20 using Blender

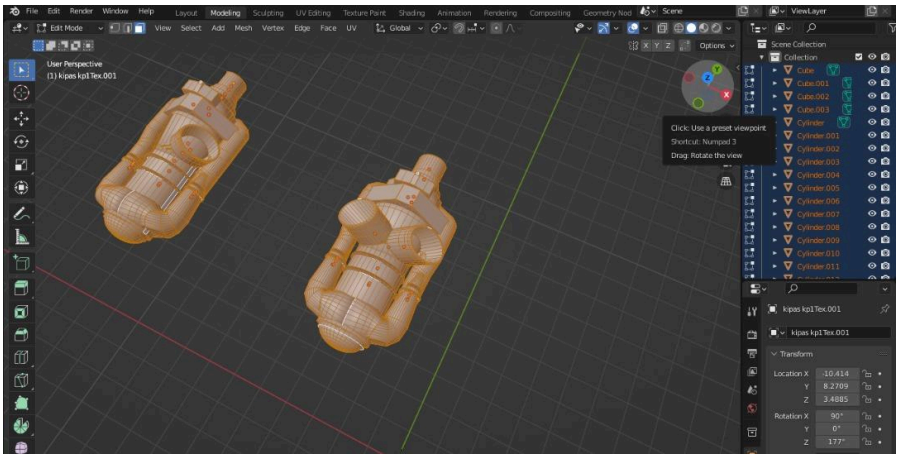

Figure 1.6.11 3D Model Engine Allison 250 using Blender

d) Education baseplate:

Baseplate displayed on top of each one engine, with corresponding parts of engine, air intake, compressor combustor and exhaust. They all have their own invisible wall information and represent the defects, pictures with a brief explanation which can be found on each baseplate. Additionally, there's a teleport at the baseplate to allow players to visit an additional hangar which will be necessary for the storyboard to run accordingly with the sit-in GUI model shown on each hangar.

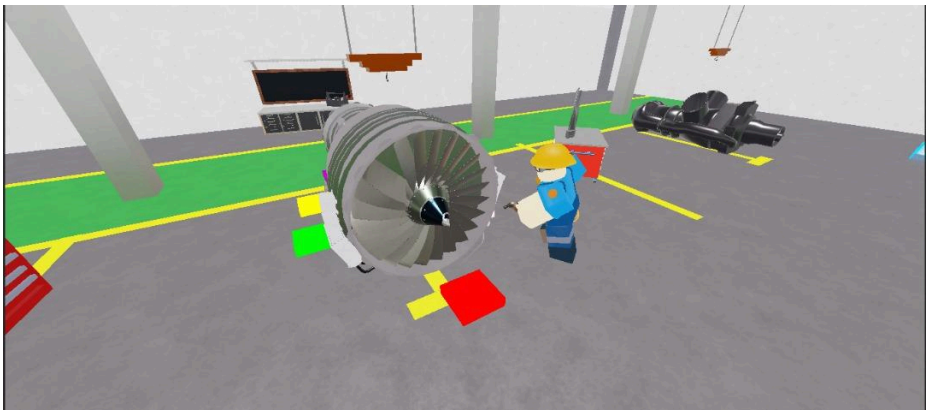

Figure 1.6.12 Education Base Plate each parts on aircraft engine

e) Runway:

Runway was developed to make the game texture and overall Gameplay Better. This runway describe environment of feel hamgar and make the game as realistic, thus this will enhance gaming experience.

Figure 1.6.13 Runway For Aircraft

f) Quiz section:

Mini game is as a way to learn more about it and increase the interest of game among players. And in this case of Roblox, “mini game” is the keyword that brings a little bit more fun with the game experience. This technique was used to create more play on the user online of the game platform called roblox. It will make the game interesting, and interactive.

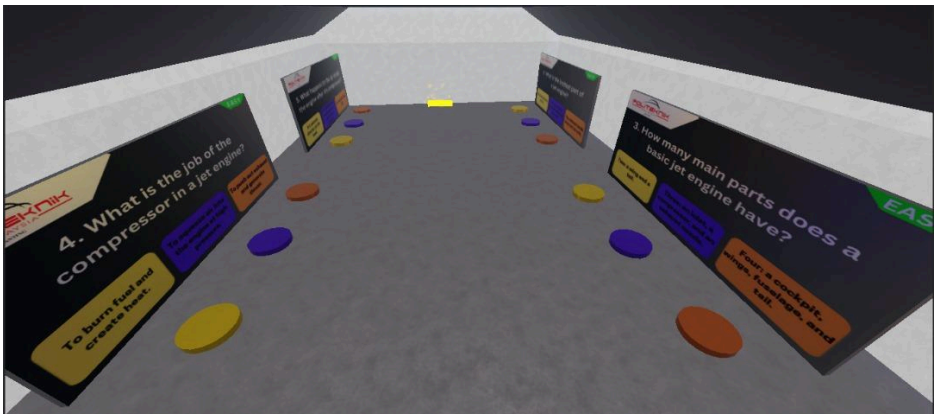

Figure 1.6.14 Quiz Section

4.1.2.2 Game Mechanism

Our game, Aircraft Engine Game Exploration (AEGEX), is about providing an interactive and interesting experience from the point of view of an aircraft technician and students. To achieve this objectives, there are several key mechanism:

a) Detailed Engine Components:

Players are able to navigate through the engine and its various components to actively address defects and engage with parts such, as the oil filter and FADEC system while also interacting with components like the EEC and Acoustic Panels along, with others including the Thrust Reverser and Combustor Type module.This experience offers not an inspection but also provides interactive opportunities to delve deeper into understanding each part of the aircraft.

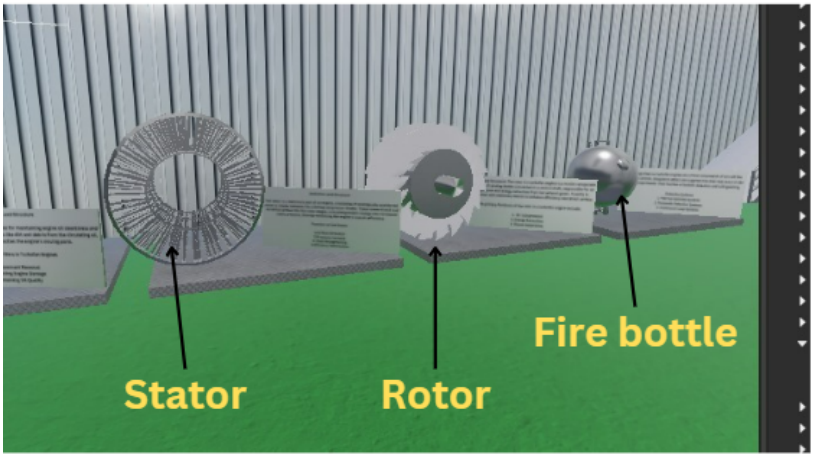

Figure 1.7.1 Detail Engine Components

a) Realistic Simulation:

To enhance the realism of the game experience and provide players with training, in real world situations to ensure their satisfaction, in performing tasks within the game engines environment, players are able to simulate these tasks using the provided tools to gain hands on experience resulting in interactive and seamless learning opportunities.

Figure 1.7.2 Installation of Fan Blade

b) Interactive Learning:

In order to enhance the gaming experience and make it more engaging interactive education is provided on engine components with a focus, on recognizing them.Players are drawn to the challenge of identifying engine defects and parts through hands on activities that encourage learning in areas of the engine.

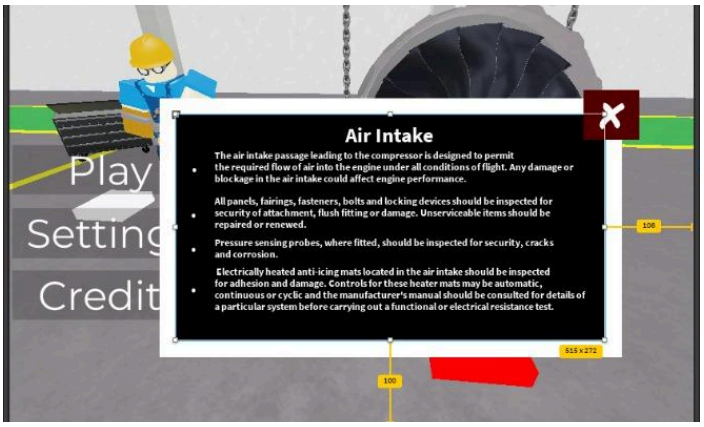

Figure 1.7.3 Defects Information on Air Intake

c) User-Friendly Interface:

The convenient profile enhances the game. For example, the torch is used to inspect engine parts in low-light conditions or in difficult-to-reach locations. A guided information game simplifies the testing with inspection of components. The scoreboard contains the player's name, rewards, achievements, and progress. Here is a chat box where players can communicate. More menu classes include items (inventory), emotes, and characters. The Roblox Menu displays the settings and home screen in-game.

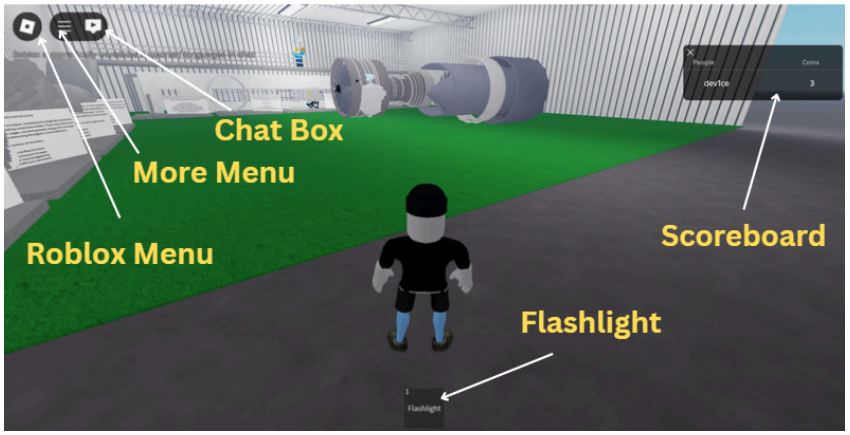

Figure 1.7.4 Features in the AEGEX Game

d) Transportation

This added feature, such as a car, makes it easier for the player to explore the game's environments. The garage provides transportation and cars, making it easier for players to explore and improves gameplay.

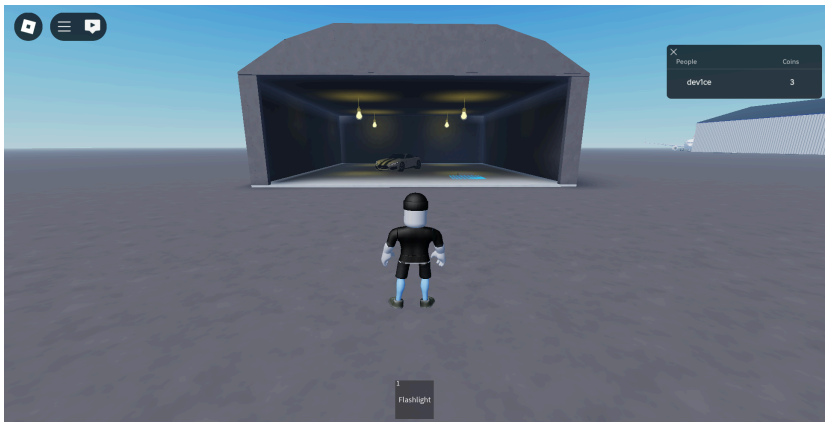

Figure 1.7.5 Garage

4.1.2.3 Interface Layout

To ensure the project "Aircraft Engine Game Exploration"'s success and efficiency on Roblox, a strong software structure must be created. This structure includes tools for creation, frameworks, architecture, and game maintenance.

a) Button Visibility and Placement:

The settings button is located in the main menu interface to allow the game to be customised to the user's preference, providing an easier way to enhance the game. To improve visibility and convenience, the icon settings are displayed and can be clicked. As a result, the goal of this project was to make it easier to identify players quickly and efficiently.

b) Dropdown Menu:

The player can see the menu, which includes settings that allow them to customise their own preferences and access additional menu features. Players can adjust the visual lighting, sound, language, and additional feature options, which are all grouped together for ease of use.

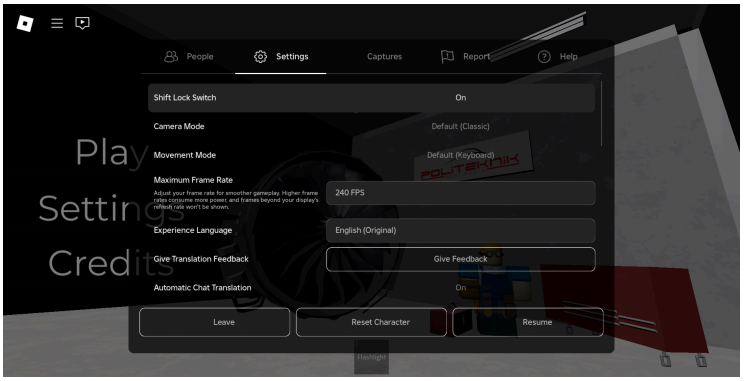

Figure 1.8 Menu Display

4.1.3 General Operation of Product

In essence, the goal of the AEGEX game application is to educate players on how to build a solid foundation while also inspiring confidence in the engine's components. The game's goal is to provide a player with an interactive and engaging experience that satisfies their educational needs while also improving their knowledge of engine parts. And all of this is for sophisticated player utilisation via application processes and interactions.

This game uses an integrating and informative learning gaming model. If players want a more personalised experience and even their own account, they can enter their name in the text box provided in the game. They can track their progress, records, and achievements using a checklist provided by the game. As soon as a player begins a game, he or she gains the ability to use various gaming components, inspect and narratively correct various mechanical components and their parts, and play minigames using the main menu, which is fairly simple and easy to use.

Players are now in an exploration mode, where they can inspect the engines and go into great detail about each one. They can see defects in the engine and inspect its components or parts. This is a game environment where players can interact, explore, and learn about the engine and its components. The game contains interactive elements such as pop-up information about the parts of the engine you are approaching with checkpoints, making it feel more realistic.

By supplementing the educational content with technical context, background information, and media such as images and videos, users gain a thorough understanding of each engine part and component. The gamification element, such as badges, points, and unlocking content throughout the exploration journey, will provide you with prizes and a sense of accomplishment.

4.1.4 Operation of Product Feature

Because of its main component and the way everything is put together, it is the Roblox game Aircraft Engine Game Exploration in its entirety. Here is a breakdown of how each feature functions:

a) Personalization with Uniform Changes:

By altering the player's attire, the user can easily add more touch to the virtual experience, regardless of the game. With the help of this feature, assuming the roles of technician and student will give each player a sense of control over the virtual world and a realistic setting. It had been believed that the choice of clothing contributed to the feeling of realism and total immersion in the AEGEX world.

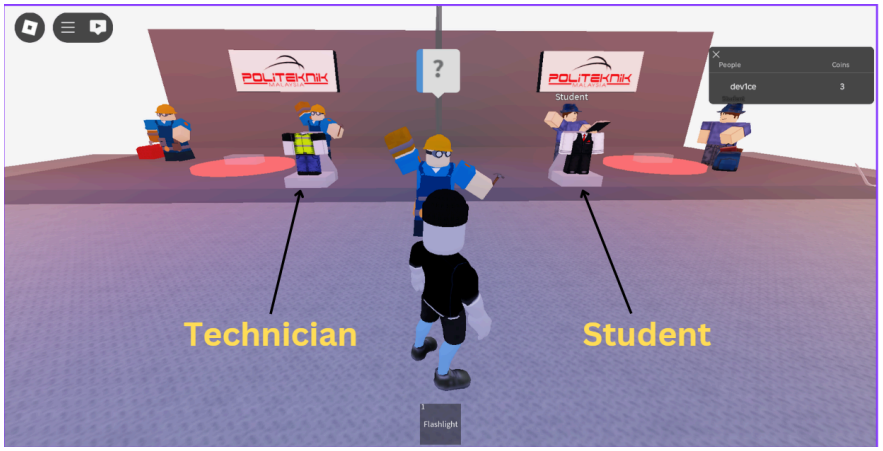

Figure 1.9.1 Uniform Customization

b) Teleportation Style:

Teleportation is meant to allow players to move around the virtual area without having to walk. The teleportation platform's design includes a colourful scheme. On the surface, this appears to be a design choice to lure gamers onto the teleportation platform: it's a useful tool, it'll serve as a quick teleportation, and it'll capture the player's attention. The game's unique gameplay and vibrant design make it a more enjoyable and interactive learning experience because it encourages players to explore in a variety of areas.

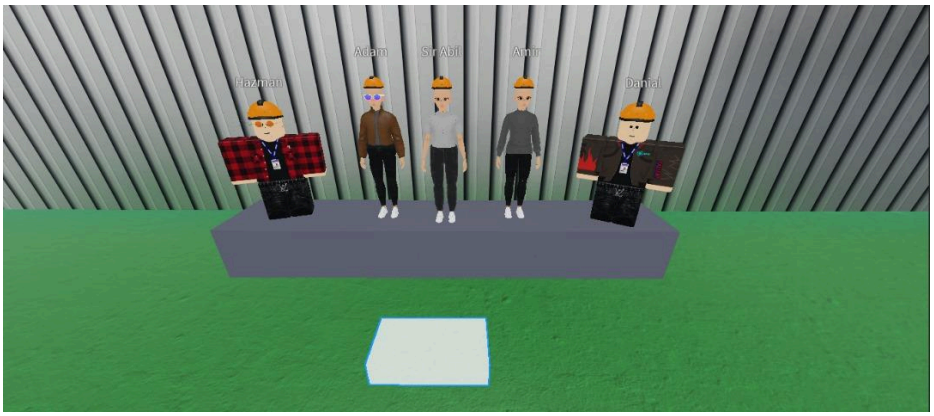

Figure 1.9.2 Base Plate Teleport on hangar

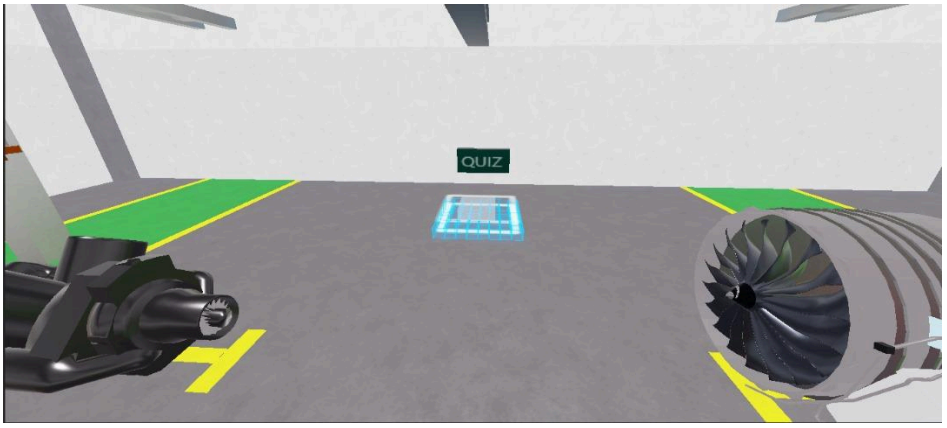

Figure 1.9.3 Base Plate Teleport on Engine Workshop

c) Scoreboards and Rewards:

The scoreboard displays the player's achievements, points, and badges. It also keeps track of their progress and awards them with game prizes. It is a feature that continuously monitors users' activities and accomplishments, and it will provide users with visual proof of their success as well as rewards.

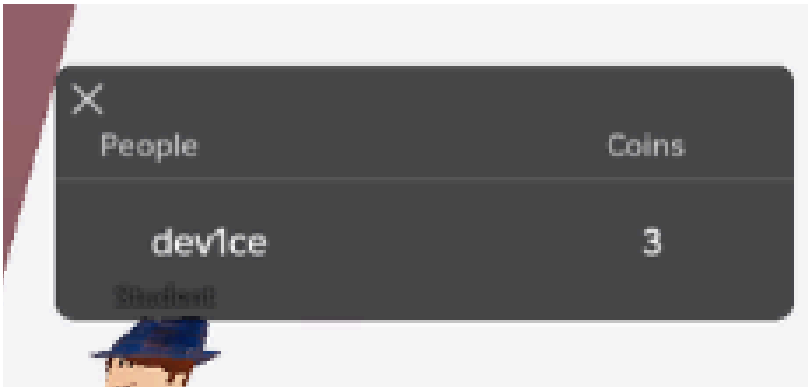

Figure 1.9.4 Scoreboard

d) NPC'S (non-playable characters):

The key mechanics were seamlessly integrated by combining function AEGEX with NPC (non-playable characters) who guided the player through important tasks and served as game checks. NPC scripts can be uploaded directly into Roblox Studio. The game's storyline will unfold in this manner, with players interacting with NPCs.

Figure 1.9.5 NPC Guides

e) Chat Box:

The purpose of this chat box function is to communicate and interact with the virtual learning environment. This feature will enable fast-paced communication by allowing users to whisper, share insight, and build communities while immersed in the game.

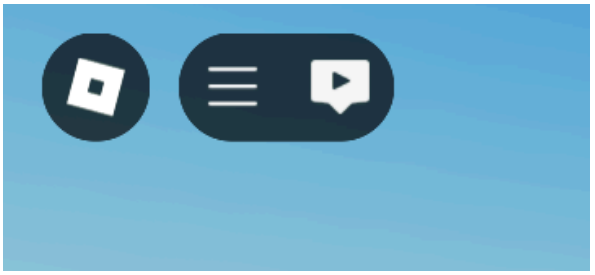

Figure 1.9.6 Chat box

4.2 PROJECT IMPACTS/ PURPOSE OF PRODUCT

AEGEX is an educational game that provides further and deeper exposure about aircraft engines to the younger audience and also to aviation enthusiasts.

a) Educational Purposes

Engine is one of the complex components in an aircraft, therefore our game provides further detail of the aircraft engine and its function. For example, every section such as the combustion section and compressor section has its explanation for the players to gain extra knowledge. Anybody that is interested in learning more about aircraft engines, can use our game as a resource since our game allows every age and any background to play our game. Other than that, AEGEX is the next step in the education world since it teaches virtually and also combines fun and knowledge while studying.

b) Interactive Education

In our game, players can interact with certain in-game models such as the aircraft and the engine itself. Not only that, players can also interact with educational baseplates where they can stand on it and it will pop up information about the components. We also added features where the players can foreplay to become a technician and repair the engines. The goal of creating an interactive learning environment is to provide a fun experience for the players.

c) User Friendly and Responsive Design

In AEGEX, our game provides user friendly and easy going design that can adjust to different variations of devices. For example, in mobile devices such as ios or android and also computers. To allow users from various devices to gain the same experience as players with higher specs of devices, we minimize the scaling of the model so that every player from every device can gain the same experience. The display of menu and in-game information created was also the simplest so that any age can easily play our game without any error.

In conclusion, the AEGEX game is an effective way of blending both learning and entertainment, offering various information and also fun ways of gaining it in different ways. The game accomplishes its goals to create a platform with interactive and enjoyable gameplay while learning the subject of aircraft engines.

4.3 ANALYSIS OF PROBLEM ENCOUNTERED & SOLUTIONS

4.3.1 Product Structures

For the structures part, we faced a few problems in scripting and coding. This is because we don't have any experience in coding or scripting. Mostly the models are generated through blender from scratch and to create the model, we need at least basic coding knowledge. To counter this problem, we hire a third party that acts as our developer. We work together with our developer to achieve the highest detail and quality for our product.

Other than that, we also faced problems during the creation of the quiz section and educational baseplate. The reason that this is a problem is because the application of the information into the GUI format has to undergo various steps to achieve it. This is because putting it into GUI format is considered an advanced feature. Therefore, we minimize the usage of GUI features and apply only on important parts of the engine.

4.3.2 Product Mechanism

In terms of mechanism, we faced problems in lagging and also bugs. Our product, AEGEX, faced lag due to excessive detail parts and models. The engine models have a lot of small components and parts that are very difficult to export into game models. Therefore, by exporting small detail components will make our game experience lagging for the players. Other than that, the bugs we faced, such as tilted structures, disappearing components and much more. This is because our game is placed in a big area where the POV of the characters doesn't load in or the other term is “chunks”. To solve these problems, we minimize the parts where it's not important and focus more on detailing the main structures of the models. This way of solving the problems will allow the players to play our game, AEGEX, without experiencing lag or facing any bugs.

4.3.3 Interface Layout

In Aircraft Engine Game Exploration (AEGEX), a thoughtfully crafted interface design is essential for captivating players, yet various obstacles may emerge. A chaotic interface filled with excessive buttons and panels can confuse players, making it difficult to concentrate, while controls that lack intuitiveness may result in players being puzzled about key functions. To tackle this, implementing a minimalist design featuring collapsible menus and organized control clusters may enhance navigation efficiency. Moreover, adjustable layouts that enable players to modify or reposition components would accommodate individual tastes, while legible fonts guarantee that technical details are readily available. To improve usability, optimizing panel load speeds and minimizing active elements can help eliminate delays, allowing players to effortlessly access tools and information. In total, these modifications establish a user-friendly interface that enhances immersive learning and exploration within AEGEX.

CHAPTER 5

CONCLUSION & RECOMMENDATIONS

5.1 ACHIEVEMENT OF AIM & OBJECTIVES OF THE RESEARCH

5.1.1 General Achievement of the Product

AEGEX managed to achieve its goals by combining a complex learning module which is Gas Turbine Engine with interactive gameplay related to aircraft engines. Focusing on players like aviation students, this game delivers information interactively where players learn about aerodynamics, and its functionality when actively participating in gameplay. The game also provides opportunities for players to troubleshoot and identify problems in the engines. Players can also practice their problem-solving skills and develop their decision-making skills. Thus, this game allows players to gain a better understanding of aviation and its benefits in a fun and engaging manner.

5.1.2 Specific Achievements of Project Objectives

5.1.2.1 Game Structure

The AEGEX initiative is working on creating an interactive game within the Roblox platform to capture the attention of teenagers and students alike. The games primary focus will be on exploring the workings of aircraft engines through realistic 3D simulations and innovative programming methods. Developers are striving to deliver a gaming experience that mirrors real life scenarios involving a variety of aircraft engines. This approach aims to make the learning process about aircraft powerplants more captivating and intriguing, for users of all ages. Using Roblox as a platform for learning about aircraft engines is AEGEXs way of making the learning experience interactive and engaging for users to enjoy while gaining knowledge in a setting.

5.1.2.2 Game Mechanism

AEGEX gaming mechanism that immerses players in an efficient manner using aircraft engine relevant challenges which show education information. Activities that players need to perform are very close to real tasks they would carry out on real-world aircraft engines, like engine assembly and defect identification. The mini game part features you towards the goal of each round, and along the way learn more about aircraft engine parts on a reward system. It also showcases realism by featuring advanced simulation mechanisms, using Roblox's 3D modeling and scripting capabilities to create highly realistic constructs of aircraft engines. This stealth compound realism aids engagement, and ensures players know some actual engineering principles. Realistic physics and operational conditions enhance the educational value of this game.

5.1.2.3 Interface layout

The AEGEX interface design aims to create a user environment to make it easier for players to learn smoothly. It encourages navigation so that players can focus on studying aircraft engine parts without getting overwhelmed by details or too much information. A specific visual layout is used to emphasize game controls and mission goals. Moreover the interface design effectively captures users attention by incorporating a progress tracker that enables them to track their advancement within the module. Furthermore the interface includes features for users to give feedback in time, about their performance and accomplishments which helps foster a sense of achievement and encourages thorough exploration.

5.2 CONTRIBUTION OR IMPACT OF THE PROJECT

The “Aircraft Engine Game Exploration”project significantly enhances education by providing an interactive, hands-on learning experience that improves knowledge retention and understanding of aircraft engines compared to traditional methods. Acting as a practical training tool, it simulates real-world scenarios without the need for physical models, bridging the gap between theory and practice. Leveraging platforms like Roblox, the project showcases the potential of game-based learning and serves as an innovative teaching resource. It also inspires interest in aviation careers, fostering problem-solving and critical thinking skills while being accessible and cost-effective for a global audience. The game accommodates diverse learning styles and promotes teamwork through potential collaborative features, making it a valuable educational asset, especially for institutions seeking affordable training solutions. Overall, it enriches learning experiences, prepares students for aviation careers, and highlights the transformative capabilities of interactive, game-based education.

5.3 IMPROVEMENT AND SUGGESTION FOR FUTURE RESEARCH

5.3.1 Game structure

For future improvements in the *Aircraft Engine Game Exploration* project, several recommendations can enhance the game structure. Focus on improving the game structure by creating a more modular and scalable framework that allows for easy updates and expansion, such as adding new aircraft types, engine components, or maintenance procedures. Implementing a more comprehensive progression system, where players can unlock advanced features or challenges as they advance, would enhance the depth and engagement of the game. Additionally, incorporating a detailed feedback system that tracks player performance and provides personalized recommendations for improvement could boost the educational impact. To make the game more inclusive, adding customizable settings to cater to different learning levels and providing multi-language support could make the game accessible to a wider audience.

5.3.2 Game mechanism

For future improvements in the *Aircraft Engine Game Exploration* project, several recommendations can enhance the game mechanism by integrating more interactive and realistic simulations, such as incorporating real-time engine diagnostics or advanced physics to model the behavior of aircraft engines more accurately. The addition of artificial intelligence (AI) could enable dynamic challenges, such as engine failures or troubleshooting scenarios, to make the gameplay more engaging and educational. Furthermore, improving the user interface (UI) with more intuitive controls and offering multiplayer features could foster collaboration and learning. Expanding the game's environment to include more aircraft models and diverse airport settings would also increase its educational value, providing a more comprehensive exploration of aircraft maintenance in a simulated real-world context.

5.3.3 Interface layout

For future improvements in the *Aircraft Engine Game Exploration* project, several recommendations can enhance the interface layout by ensuring a more user-friendly and intuitive design that simplifies navigation, especially for first-time users. The layout should prioritize clarity, with clearly labeled sections for each engine component and maintenance task, using interactive tutorials or tooltips to guide users through complex features. Incorporating a customizable HUD (Heads-Up Display) that allows users to adjust the level of information displayed according to their preference can improve usability. Additionally, improving the visual hierarchy by using color coding, icons, and 3D representations for different aircraft systems would make the interface more visually engaging and easy to comprehend. Optimizing the layout for mobile devices and VR integration could further expand accessibility, offering users a more immersive experience.

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5.1.2.1	Game structure

APPENDIX B

1.2. Game-Based Learning

Game-based learning (GBL) is thought to be an effective tool for learning (Kebritchi & Hirumi, 2008; Papastergiou, 2009) that can promote enhanced learning experiences (Connolly, Stansfield, and Hainey, 2007) and student motivation (Papastergiou, 2009). According to Connolly, Stansfield, and Hainey (2007), GBL can be defined as "the use of a computer game-based approach to deliver, support, and enhance teaching, learning, assessment, and evaluation". There is also widespread acknowledgement of the advantages that the use of games has in elementary and secondary education (Ebner & Holzinger, 2007). Kebritchi & Hirumi (2008) identified the following five reasons for defining GBL as an effective tool for learning: 1) GBL uses action instead of explanation; 2) GBL creates personal motivation and satisfaction; 3) GBL accommodates multiple learning styles and skills; 4) GBL reinforces mastery of skills; and 5) GBL provides an interactive and decision-making context. Computer games not only integrate knowing and doing, but they also "bring together ways of knowing, ways of doing, ways of being, and ways of caring: the situated understandings, effective social practices, powerful identities, and shared values that make someone an expert" (Shaffer, Squire, Halverson, and Gee, 2004). According to O'Neil,Wainess and Baker (2005), computer games are useful for instructional purposes and they also provide multiple benefits: (a) complex and diverse approaches to learning processes and outcomes; (b) interactivity; (c) ability to address cognitive as well as affective learning issues; and (d) motivation for learning. Robertson & Howells (2008) considered that computer games could develop a number of cognitive skills. Moreover, game-playing activity is linked with the possibility of developing skills in decision-making, design, strategy, cooperation, and problem solving (McFarlane, Sparrowhawk, & Heald, 2002; Ebner & Holzinger, 2007). Students use games to explore, discover, and question. These "learning by doing" and "active learning" concepts are important principles, which underlie GBL (Yang, 2012).

Effects of games on learning components

It is evident that there is ample research conducted on the educational uses of games and its effectiveness in terms of learner achievement and cognitive and affective aspects of learning contributing to achievement. As to the cognitive gains obtained with the use of games in learning environments in the general sense, a significant increase is reported in such salient cognitive qualities of learners as problem-solving skills (Adachi & Willoughby, 2013; Granic et al., 2014; Hwang, Wu, & Chen, 2012; Justice & Ritzhaupt, 2015; Ritzhaupt, Gunter, & Jones, 2010; Spires, Rowe, Mott, & Lester, 2011; Yang, 2012), critical thinking and student creativity (Cicchino, 2015; Hallajian, 2016; Naeini & Masood, 2012), memory (Motabarzadeh & Musavi, 2015; Tavarez, 2012) knowledge retention and recall (Abdullah, Abu Bakar, Ali, Faye, & Hasan, 2012; Alıcı, 2016; Babaandaç, 2013; Bayram, 2015; Selvi & Çoşan, 2018; Shabaneh & Farrah, 2019), cognitive abilities like analogy, processing speed and deductive reasoning (Hisam et al., 2018), perceptual attention and mental rotation skills (Alexiou & Schippers, 2018; Mayer, 2019), and spatial skills which are purported to predict achievement in STEM areas (Granic et al., 2014). In their comprehensive meta-analysis of 248 studies covering the period of 1986-2003, Vogel et al. (2006) concluded that the utilization of interactive games enabled to obtain higher cognitive gains. Furthermore, there are also diverse elements in games which may appeal to different individual learning styles (De Byl & Brand, 2011; Sugar & Sugar, 2002).

There is also a current interest in researching the positive impacts of the GBL on the dimensions of affect in learning like motivation, attitudes, engagement, self-efficacy, self-esteem, social recognition, and anxiety (Aksoy, 2014; Alexiou & Schippers, 2018; Annetta, 2008; Chow, Woodford, & Maes, 2011; Ebrahimzadeh & Alavi, 2017; Hense & Mandl, 2012; Ingram & Cangemi, 2019; Jaffe, 2007; Ke, Xie, & Xie, 2016; Ritzhaupt, Higgins, & Allred, 2011; Şahin, 2016; Tiede & Grafe, 2018; Yazıcıoğlu, 2017), and a more recent trend toward identifying what the GBL provides in terms of the 21st century skills such as innovative thinking, collaboration, information and technology literacy, productivity, etc. (Annetta, 2008; Bakan & Bakan, 2018; Qian & Clark, 2016).

1. The Emergence of Serious Games

1.1. Their Potential

A game is a physical or mental contest played according to specific rules, with the goal of amusing or rewarding the participant. A video game is a mental contest played with a computer according to certain rules for amusement, recreation, or winning a stake, and a serious game is "a mental contest played with a computer in accordance with specific rules that uses entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives" (Zyda, 2005).

The reintroduction of amusement has led to the appearance of the concept of edutainment (Prensky 2001 ;Gee 2007). The idea commonly defended is that the interest of learners in the subject will be increased by the pleasure and the wealth of experience gained during the game.

Generally they are designed in order to balance the subject matter with the game play and the ability of the player to retain and apply said subject matter to the real world. Video games are not the enemy, but the best opportunity we have to engage our kids in real learning process (Prensky 2003).