

Virtual Lecture Hall and Classroom in UTAR

BY

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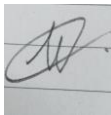
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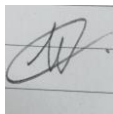
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ABSTRACT

This project is to innovate the virtual reality classroom system to provide a new experience and raise an awareness of virtual reality classroom to users as it is yet a well-known platform in our country. Virtual classroom, a digital learning environment that allows teachers and students to connect via online in real time. Mostly, the virtual classroom that are commonly used among people is to make use of video conferencing, online whiteboards, share screens, etc. These features are performed to replace the physical actions. However, there are also some limitations such as lack of interactivity, lack of information provided, lack of focuses etc. Thus, this project will innovate the virtual reality classroom system by integrating special elements like selection of preferred avatar, tour around buildings, interesting and fun features inside the virtual space, etc into this project. This project is to aim to user interactions and improve their learning through this memorable and immersive experiences. Besides that, this project is designed to play in desktop or laptop platform due to budgets of a student. They might not have sufficient financial supports to buy a VR set. Therefore, this project provides equality to all the users to play and experience the virtual classroom.

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LIST OF ABBREVIATIONS

<i>VR</i>	Virtual Reality
<i>3D</i>	Third Dimension
<i>COVID-19</i>	Coronavirus Disease 2019
<i>UTAR</i>	University Tunku Abdul Rahman
<i>FICT</i>	Faculty of Information and Communication Technology
<i>SDK</i>	Software Development Kit
<i>VAR</i>	Virtual and Augmented Reality
<i>PUN</i>	Photon Unity Network
<i>API</i>	Application Programming Interface

Chapter 1

Introduction

In chapter 1, the report will give presentation about the introduction of virtual reality to education, problem statement for virtual classroom, motivation of the research, objectives, scope, direction, contributions to the fields, and outline of the thesis.

1.0 Background Information

Virtual Reality (VR) is the use of computer technologies that create a simulated environment which enable user to explore in 360 degrees. Unlike tradition graphic interface, VR give users more immense experience in exploring the virtual environment which almost let user to felt they are inside the world. VR are totally popular in gaming purpose. Due to the third dimension (3D) environment, users can have the excitement and experiencing the fun of near to real. Although VR was less introduced to education, but the effects that brings by it give a lot of changes toward education system.

When it comes to education, it gives a big impact in changing the style of study and effectiveness of studies towards students. The main reason for VR to be introduce into education system is not just allow students experiencing the virtual tour of the destination's environment without leaving the current place, but also have the power of engaging and inspiring them in a unique way of learning. Virtual Reality provides a lot of benefits towards education places, for example, study tour. Due to the cases like unable to go overseas or COVID-19 pandemic which make students not able to return to campus, the virtual tour become important role in this situation. Virtual tour come with the benefits of cost effective and help freshman to learn and knowing more about their future education environment without leaving their current place. Next, interaction between people through online is the main of the benefits of virtual classroom. As said, due to the pandemic, people are not able to meet each other. So, virtual classroom come with the opportunities of letting user to have free virtual interaction through online.

Besides, some of the virtual classroom system had been implement the desktop or laptop platform as well due to considering users are not capable to have own VR set. This gives the equality for users to access the virtual system although the experience obtained is not much

expected compared to using a VR set.

1.1 Problem Statement and Motivation

1.1.1. Poor utilization of virtual lecture hall and classroom decrease motivation.

Virtual lecture hall and classroom used as a platform of delivering previous presented materials such recorded or live videos, so students can have reference if they miss the class or for certain study purpose. It is good to have the result of students has strong interest in virtual education, but the impact is not as strong as expected. Students only use their virtual equipment such as virtual headset to access to the classroom and listen to those videos or listening to the recorded PowerPoint slides [4]. Not just that, based on conducted research result, it is shown that it is failed to find relationship between utilization of virtual lecture hall and classroom with improvement on study although majority of students preference with virtual lecture hall and classroom is high [6].

1.1.2 Lack of education content

Although virtual reality gives good impact in helping students obtaining more effective learning experiences, due to the high cost of development and lack of expertise in the area, it is difficult to maximize the use of virtual reality in education as mentioned in previous point that virtual lecture hall and classroom is only used for posting recorded or live videos and not all education institutes or schools has funds to hire an expertise to develop more content for them [1].

1.1.3 Difficulties of accessing and learning technologies for those people who from or cannot go overseas.

In this era, virtual reality technologies and equipment are not very accessible. Although student and educators may use own devices in school or other education places, the library of content inside the virtual equipment is still in initial stage which not suitable enough to be call as “education” for them. If they are looking for higher quality of user experience, they can purchase new equipment but require more time and knowledge on learning. Not just that, for those students who may not be able to go but desire to learn knowledges from overseas are also having difficulties in

learning due have limited interactions with the educators [2].

This project is conducted with a motivation of letting students and lectures having a fun and pleasant learning environment under virtual classroom. Compare to the normal online classes which is only share screen, open camera and mic to talk, online whiteboard, etc that bring feel of bored to users, we create a virtual room which users has the free to have virtual interactions to reach the purpose of having more fun and interest while teaching and learning as well as raise the awareness of other people about virtual classroom system. Additionally, online communication with other user will be one of our main features in virtual classroom to let user have more interactive talk or discussion which is pleasant and easier.

1.2 Research Objectives

Main objective of this project is to develop a virtual lecture hall and classroom that can give values to users as well as fulfil their satisfaction towards the lecture hall and classroom. Before fulfilling the main objective, few sub-objectives need to be achieved as well:

1.2.1 To create a decent and elegant environment that is enable social activities.

A virtual lecture and classroom that enable educators to provide immediate feedback to students when encountering problems as well as students can share their problems with educators and course mates will be developed. Not just that, with high interaction between human in virtual hall and classroom, students will have more motivations and excitement to study instead of just staring on a boring screen.

1.2.2 To maximize the use of virtual lecture halls and classroom by gaming experience

As stated in problem statement, the virtual lecture hall and classroom for education is only for posting education videos. Students may have the user experience but not an effective experience as they expected. To maximize use of virtual lecture hall and classroom, virtual game tour experience is being developed to let them have more fun

by exploring the environment instead of just sitting and walk around in same space.

1.2.3 To establish a discussion platform for students and educators which can enjoy easily.

Instead of letting students and educators to purchased new equipment for virtual learning, mainly focus on develop the virtual lecture hall and classroom in desktop version has more advantages in terms of time and knowledge. This is because most people familiar with usage of computer and laptop to do their daily work which can give all users an equal chance to enjoy the virtual environment.

1.3 Project Scope and Direction

The project is ongoing with the purpose of developing a virtual environment of University Tunku Abdul Rahman (UTAR) lecture hall and classroom. At the end of the project, a virtual hall and classroom will be presented to the society. The development of this project is mainly focus on the environment of lecture hall and classroom in UTAR with purpose of making user familiar with the environment as they can feel like are study in the university. At the final, this project will enrich user's experience by deliver some virtual tour experiences through the virtual environment.

1.4 Contributions

The main goal of this project is to provide all users an interesting and pleasant virtual workspace for their purpose. With this project, they will have the chance on experiencing the virtual classroom and knowing more about UTAR FICT facilities and study environment. Besides that, this project can also have the function of promoting our UTAR FICT to the freshman to let them have a better understanding and knowing about the building and the environment. In addition, this project will be design in desktop / laptop version to share the chance of experiencing the virtual classroom to allusers equally.

1.5 Report Organization

The details of this research are shown in the following chapters. In Chapter 2, literature review regarding existing VR system and related university VR articles will be shown. Then, proposed methodology, requirements, system overview, and flowchart will be presented in Chapter 3. Chapter 4 will continue by describes the system design such as use case diagram, activity diagram, block diagram, and storyboard while Chapter 5 is giving brief on system implementation such as hardware setup, software setup, plugins and SDK's setup, and system operations. Chapter 6 brings a talk on system evaluation and discussion which is the test result, project challenges, objectives evaluation, and concluding remark. Chapter 7 will be reporting the conclusion for this project and givesome future recommendations.

Chapter 2

Literature Review

2.1 Existing System Review

2.1.1 Altspace VR



Figure 2.1.1- Altspace VR

Altspace VR is one of the popular social platforms that enable individuals to gather, talk, collaborate, having work discussion, etc with other users (refer Figure 2.1). Currently, this system is the only social platforms that allow large groups of users to co-present in a single workspace. The environment inside the virtual chatroom comes with the used of high quality of buildings and images which can increase the user’s excitement of exploring the virtual space (refer Figure 2.1.2).



Figure 2.1.2- Altspace VR Chatroom- Camp

Altspace VR also had come with their own special features for example, as seen in Figure 2.1.3, user can create various types of chat room to play with friends or other online people. Each room come with its useful purpose which not just helping on user's work but also increase their experience of using this virtual chat system. By referring to Figure 2.1.4, in Altspace VR watch party room, it enables users to connect their accounts with the link or QR-code to have an extra benefit of linking the videos and other audio materials inside the screen in the virtual monitor to be play. In addition, the software also provides tutorial training for new users to use the system effectively.

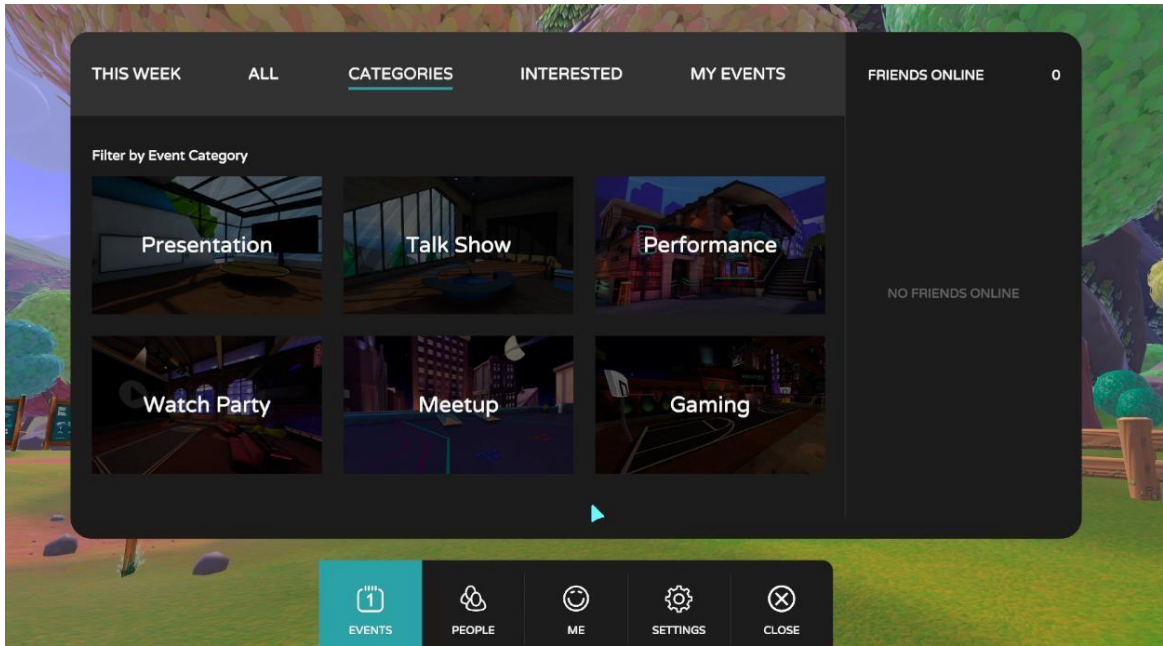


Figure 2.1.3- Altspace VR menu- Types of chatrooms

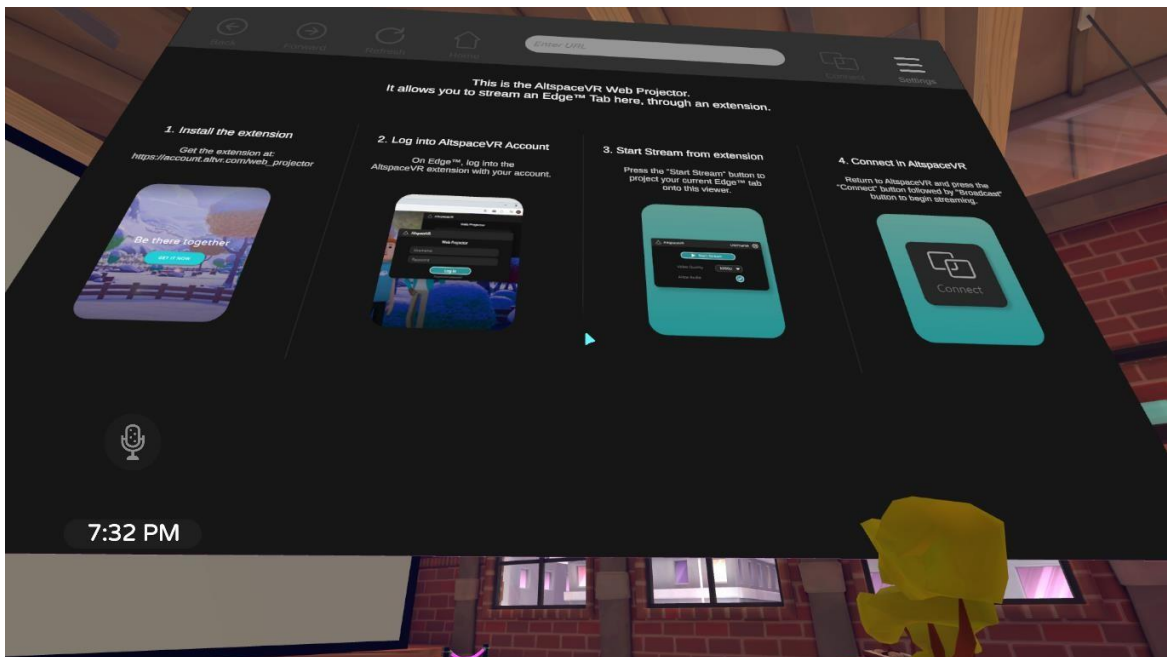


Figure 2.1.4- Altspace VR Cinema- Movie Player Instructions

2.1.2 Strengths of Altspace VR

Different types of mini games are provided in each of the chatroom to let users having fun when trying the software to prevent dissatisfaction of boring due to only chat and discussion. Next, the software is also available for desktop / laptop version. This gives equality for users who did not have the VR set to experiencing the chatroom.

2.1.3 Weakness of Altspace VR

Although this virtual system is good but still has its negative point. Altspace VR will be very laggy due to the high quality of virtual environment. Not just that, although the system had provided desktop version, but the experience obtained is not satisfied as VR version. For example, desktop user cannot control the virtual hand of their avatar. They only allow clicking and rotate the mouse only. Most of the mini games inside the chat room should be using VR control hand to play easily and efficiently. Besides, when other users are having conversation with user, the user not just cannot wave back by virtual actions, but also cannot use the pop out box to message them back. The conversation for desktop version is only open mic and talk to them.

2.2.1 Virbela

Virbela is a virtual world that brings users, individuals, or an organization to work, learn, and have discussion in an immerse environment at any time. Virbela mainly develop in desktop version, and it is free to be used by anyone. As same as previous system, Virbela also having a good quality of background environment which increase the satisfaction for user when exploring it. The background for the system is mainly on a big area of campus. User can discover and having a tour toward the virtual campus (refer Figure 2.2.1).



Figure 2.2.1- Virbela Campus- Beach Party

Comparing to individuals, Virbela is more suitable for an organization using. The purpose of Virbela being develop is to help the organization to have benefits of cost effective and maintain the relationships with their member through real-time socialization and familiar surrounds. Virbela also is a friendly use virtual chatroom which does not required too complicated control for user's avatar. Interesting and excited features like mini games is also prepared for users to experience to let them have fun while chatting with each other for example mind gym can let user to test their thinking (refer Figure 2.2.2).



Figure 2.2.2- Virbela Campus- Mind Gym

2.2.2 Strengths of Virbela



Figure 2.2.3- Virbela Campus- Campus



Figure 2.2.4- Virbela Campus- Auditorium Room

Special features which is the computer or monitor inside the virtual environment can be used. User can click anything on the screen directly just like they using their computer click on screen for example, by refer to Figure 2.2.3, when user step into the blue circle in front of “Host an Event”, they can use the monitor by clicking it and book and event (refer red box) as well as when user want to present or displaying some information while having discussion, they can connect the browser inside the virtual room to their documents or folders and present it. Also, the notice board inside the buildings will bring related to the actual website in own browser when user click it (refer Figure 2.2.4).

2.2.3 Weakness of Virbela

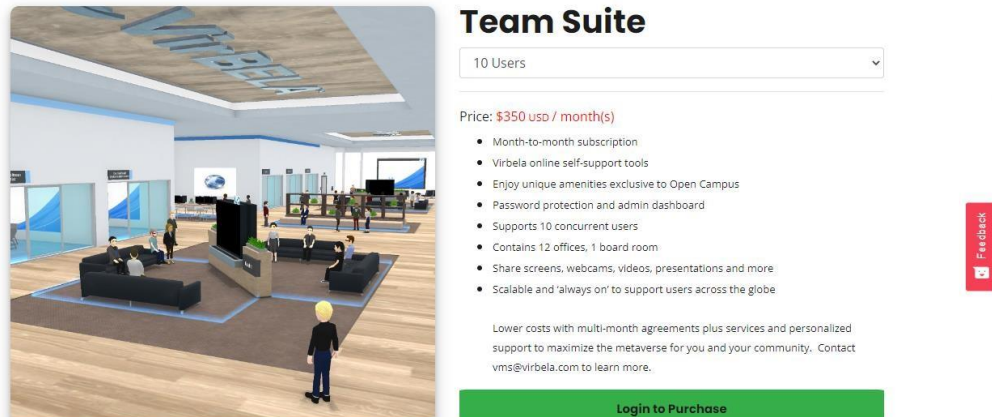


Figure 2.2.5- Virbela Campus- One month plan

Not all system is perfectly reaching user satisfaction, it also has some negative points that reduce their experiences. For example, the connection between actual internet and virtual computer is slow. It consumes a lot of time to have a proper connection as 2 different types of connection is occurred. Sometimes, user may also fail to have the connections to the virtual system.

Next, user may have disappointment with the avatar due user cannot use mouse to move the direction but only adjust using keyboard's key W, A, S, D. When user control the avatar to move from, the camera then will adjust itself to front, when user want to look around the environment while running or walking, they need to press either A or D key to look but it also will affect the avatar not running straight but in weird direction.

In addition, not all features are free use to users for example, if user want to have private chat discussion, he/she may need to subscribe for a month in amount of USD 350\$, else the chat will become public which everyone can join and listen (refer Figure 2.2.5).

2.3.1 IMVU



Figure 2.3.1- IMVU

IMVU is a virtual social mobile game. Players can create own avatar, meet new people, and play together in world largest social experiences. In this game, players can find fun and opportunity for example, host a party, go on virtual date, knowing different people around the world, etc in a 3D metaverse experience of making own day (refer Figure 2.3.1).

2.3.2 Strength of IMVU



Figure 2.3.2- IMVU- Night Bar

IMVU has a beautiful and relaxing virtual environment which not just help player feel relax, but also joyful when chatting with others. Refer to Figure 2.3.2, there are lots of pointer shown. The useful of the pointer is when user click on the it, certain action will be done by the avatar for example, if player click on the pointer on sofa, then the avatar will show the action of sitting on the sofa. This pointer helps player feel the simplicity and friendly use of this game. Beside chatroom, IMVU also has live room which is the room that enable all players to chat by mic. In addition, IMVU also can help players in real life in terms of monetary.

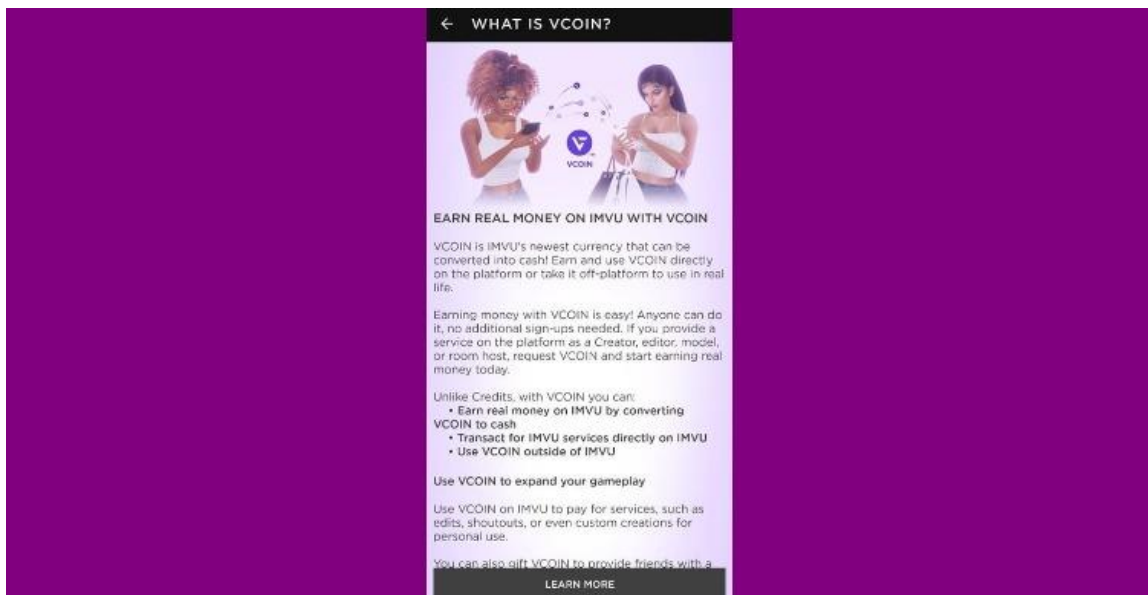


Figure 2.3.3- IMVU- VCOIN Instruction

According to the news shown in Figure 2.3.3, it is known that players can earn real cash by transact the game coin.

2.3.3

Weakness of IMVU

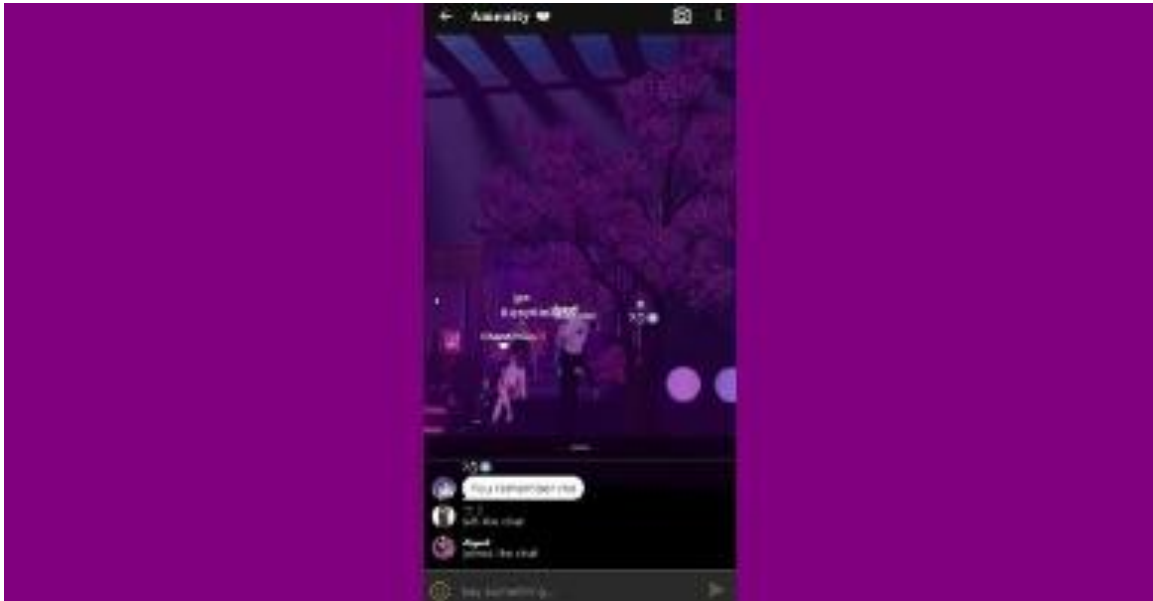


Figure 2.3.4.- IMVU-Camera View

The view of the whole environment is only concentrated on the avatar itself. Player can only rotate the view around the avatar and cannot go to further place for example, when player try to zoom inside the room to see another player, it cannot. Not just that, IMVU also not giving player a good experience of “gaming” although is a game such as player cannot move freely their avatar nor playing mini games as this game does not create such features in their room (refer Figure 2.3.4).

2.4 University Article

Virtual and Augmented Reality (VAR) is one of the most innovative technologies in this era which is very good and suitable to be adopt as teaching tools. Most of reasons mentioned that virtual reality system is good for education is due to the technologies has the abilities of letting students to experiencing the virtual environment like the actual location that are physically restricted [4]. Not just that, it also allows them to have interactions with the 3D models, boost up their interest, and help to have competencies among them in education which including problem solving, critical thinking, empathy, and etc [3].

2.5 Virtual System Comparison

Table 2.1- Comparison Result

	Altspace VR	Virbela	IMVU	Proposed Solution
User friendly	No (for desktop version)	Yes	Yes	Yes
Free to use	Yes	Yes	Yes	Yes
Avatar	Yes	Yes	Yes	Yes
Avatar movement	Easy	Easy	Cannot move (move based on point marked by player)	Easy
Map Exploration	Yes	Yes	No	Yes
Devices support	Desktop / Laptop	Desktop / Laptop	Mobile phone	Desktop / Laptop
Effective Interaction	No (for desktop version)	Yes	Yes	Yes
Education content	Little	Many	None	Many
Strength	<ul style="list-style-type: none"> • Mini games in chatroom • Support desktop platform 	<ul style="list-style-type: none"> • Browser service available • Able to connect with actual device 	<ul style="list-style-type: none"> • Simplicity and friendly used • Actual monetary support 	<ul style="list-style-type: none"> • Friendly used • Interesting features such chatting and writing. • Online interaction with others • Virtual tour gameplay

Weakness	<ul style="list-style-type: none"> • Laggy • Bad experiences for desktop version • Difficult to speak as only can pop messages 	<ul style="list-style-type: none"> • Slow or even fail connection made. • Direction to look surrounding is based on avatar movement 	<ul style="list-style-type: none"> • Cannot have exploration due only concentrate on self. • No gaming experiences 	<ul style="list-style-type: none"> • Not pleasant eye environment • Only one map
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Chapter 3

System Methodology/Approach

3.1 Methodology used.

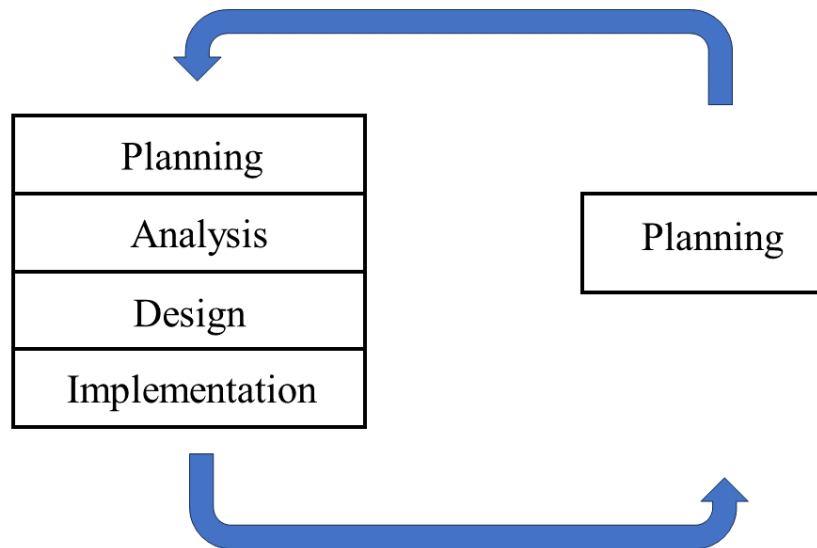


Figure 3.1 – Agile methodology

As for the proposed system, agile methodology is applied as shown in the figure above. Agile methodology is a project management approach that involves breaking project into phases and emphasizes continuous collaboration and elaboration. Agile methodology offers numerous advantages including improved product quality, heightened customer satisfaction, greater project control, and decreased risks.

During planning phases, overall flow and features for the project will be planned and the related plugin and SDK that needed for the feature will be selected as well.

During analysis phase, a lot of study has been conducted to decide those features that can be included into the project based on objectives. Then, continue with the comparison of plugins and SDKs with other similar plugins to be used for the features of the project due to some of the features are not able to be implemented due paid plugins and none supported anymore SDKs or plugins for example content of library is updated and the component is no more useful.

During design and implementation phase, game scene UTAR lecture hall and classroom is

designed and implemented with the features that had been decided during previous phase, next is continue with the user interface such as login page, register page, lobby, avatar selection page, etc and the finalized design are implemented. Moreover, trial and error for each feature are performed in these phases as well. These two phases are repeated until reaching the satisfied results.

These four phases are repeated when implementing each of the feature into the system until become the finalized system.

3.2 System Requirement

3.2.1 Hardware

The hardware involved in this project is laptop. Purpose of the laptop is issued for the process of import assets, 3D objects building and modelling, and some coding for making certain event for the objects.

Table 3.1 Specifications of laptop

Description	Specifications
Model	HP Laptop 14s-dq2509TU
Processor	Intel® Core™ i3-1115G4 (up to 4.1 GHz with Intel® Turbo Boost Technology, 6 MB L3 cache, 2 cores)
Operating System	Windows 10
Graphic	Intel® UHD Graphics
Memory	8 GB DDR4-2666 MHz RAM (1 x 8 GB)
Storage	512 GB PCIe® NVMe™ M.2 SSD

3.2.2 Software

1. Unity



Figure 3.2.2.1 – Unity

Unity3D is a powerful cross-platform 3D engine and a user-friendly development software. The software is easy to use, and it is a good tutorial for the beginner and powerful enough for the expert. Unity is popular among user's choices due to easy to create and develop a 3D games and applications for mobile, desktop, web, and consoles. Unity become one of the best choices among developer's due ease of use and multiple support platforms. Unity is mainly focuses on using C# programming languages. Furthermore, this software is also suitable for projects that required a lot of customization, iterative development, and prototyping.

2. Microsoft Visual Studio 2019



Figure 3.2.2.2 – Visual Studio 2019

Visual Studio 2019 is a basic platform for users to program their functions or handle event occurrences for the module they created in Unity. In this project, all the custom C# script in Unity Editor can be easily edited via Visual Studio after importing the Visual Studio Editor SDK in the package manager as shown in the Figure 3.2.2.3.

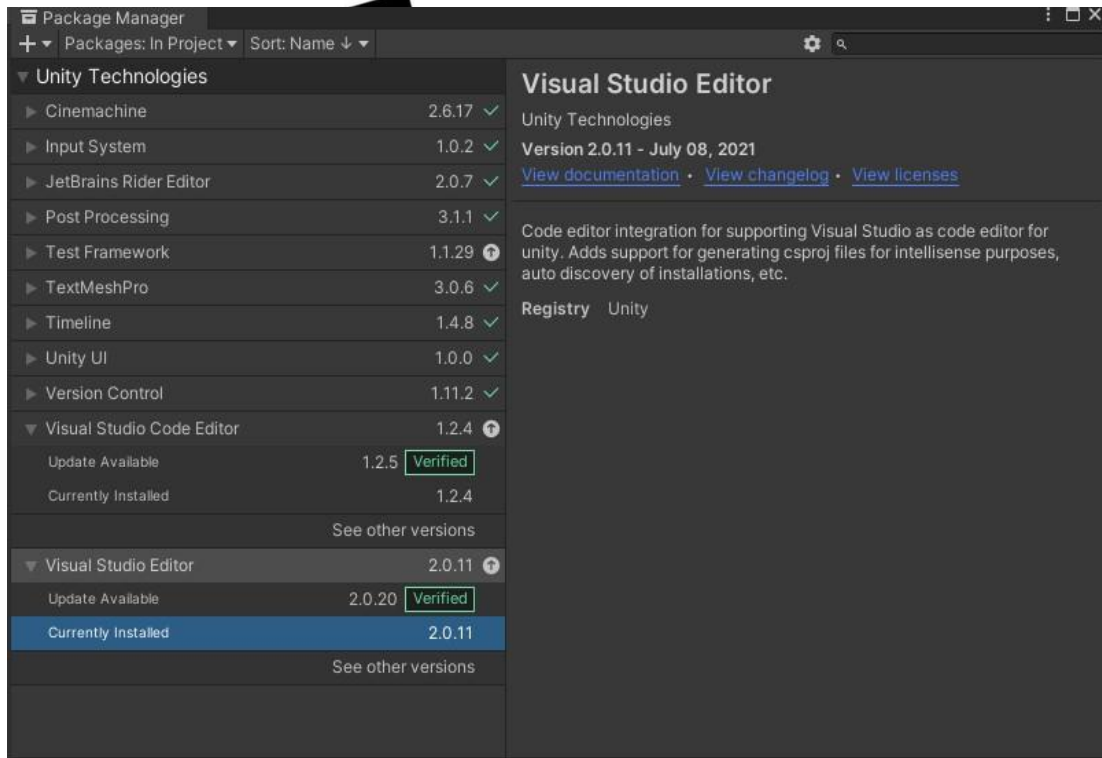


Figure 3.2.2.3 – Visual Studio Editor

3. **Plugins/ SDKs used:**

Table 3.2- Plugins / SDK's in project

PlayFab	PUN2	Photon Voice 2
User Authentication (Login, Register, and Forgot Email)	Act as multiplayer server	Support PUN2 by voice chat server

1. **PlayFab Authentication**



Figure 3.2.2.4 – PlayFab

PlayFab is a complete backend platform for live games with the features of managed game services, time analytics, and LiveOps which can help developers boost their revenue and increase player engagement while cut cost. PlayFab backend services not just reduce barriers for game developers, but also offering them cost effective development solutions that scale with t heir games and help engage, retain, and monetize players [7]. The purpose of using PlayFab for this project is to manage the user authentication, which is login, register and forgot password.

2. Photon Server



Figure 3.2.2.5 – Photon PUN 2

Photon Unity Network 2 (PUN 2) is one of the most popular Unity packages for performing multiplayer games. The package provides flexible matchmaking feature where players can be synch over the network that allow them to create or join room hosted by server which enable to have interaction between users over the network. The server can connect maximum to 20 users simultaneously.

3. Photon Voice 2



Figure 3.2.2.6 – Photon Voice 2

Photon Voice 2 is SDK that make easy to have a high-quality low latency voice chat to Unity project / application. It is built on top of Photon Realtime and inherits all features including matchmaking and interest groups. When clients join the room, it creates an outgoing stream (local voice) which is all other clients in the room will receive the voice message [8].

3.3 System Overview

3.3.1 System Architecture Diagram

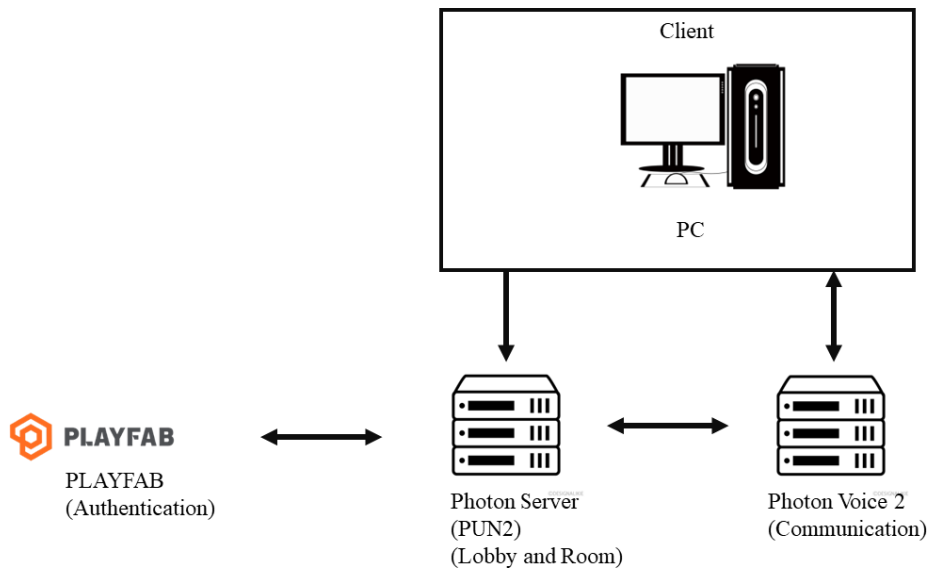


Figure 3.3.1.1 – System Architecture Diagram

This project consists of authentication (PlayFab), lobby and room server (PUN2), and communication server (Photon Voice 2). Before users (clients) connect to the Photon server, they are required to sign in or register to gain the access to the hosted room server. After joining the room, Photon Voice 2 server will then connect to provide voice communication to users within the room. By this connection, users will not just able to talk out, but will also receive feedback from others.

3.3.2 System Flowchart

1. Main Menu System Flowchart

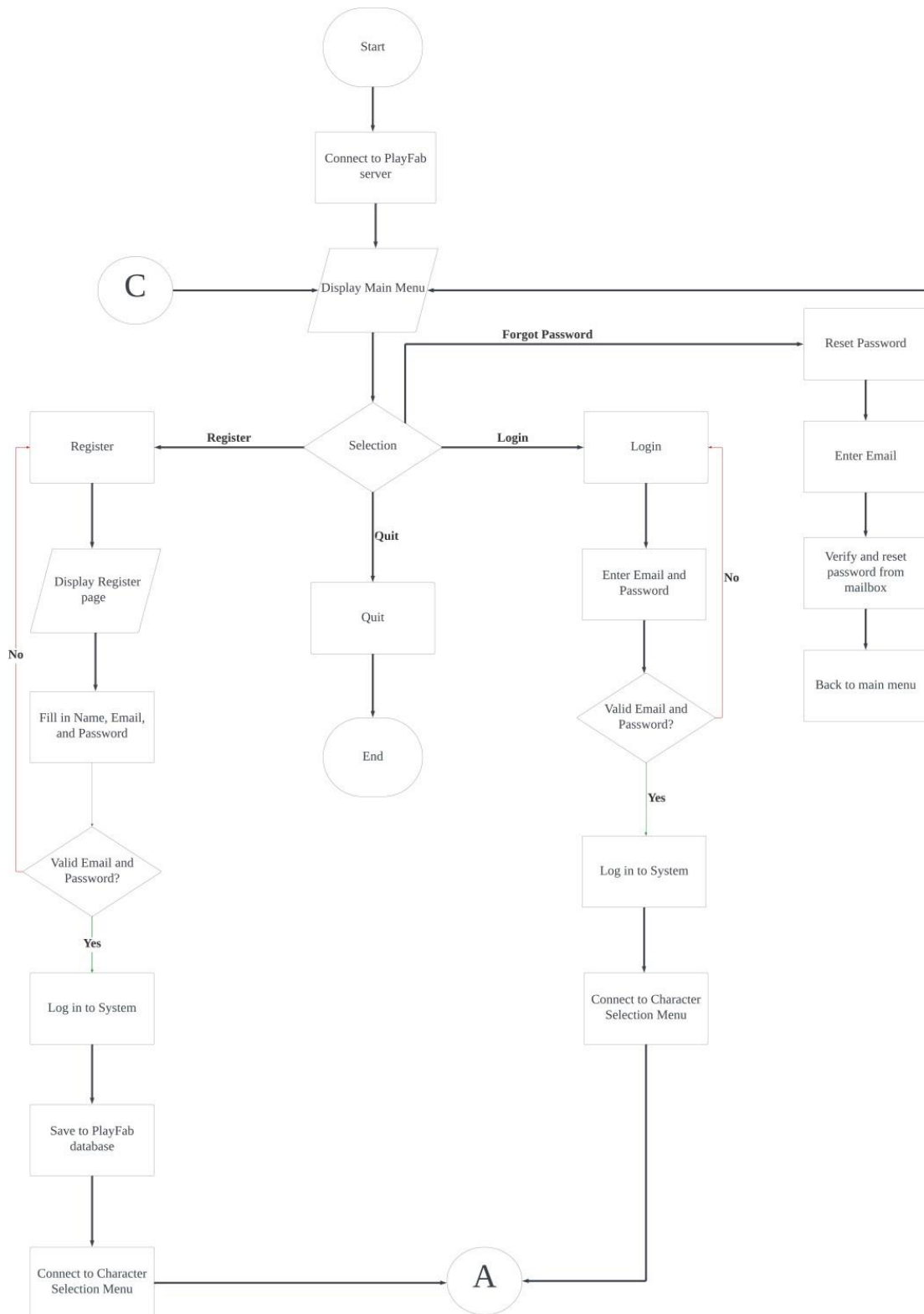


Figure 3.3.2.1 – Main Menu System Flowchart

As can see in Figure 3.3.2.1 is the flowchart for main menu system for the virtual lecture hall and classroom system. At the initial part is showing when user(s) start the game, at the same time, the PlayFab database will be connected as to receive user's data from registration or retrieve data for user's login. If user is a new user, they could go to register by clicking on the button "Register". Information needed to complete the registration is their username, email address, and password. Error will be occurred, and warning will be given if there are some mistakes in the email or password. After checking no more errors, user(s) will be directly log into next page which is character selection page; If user already done registration, they can also just have direct login by only enter their email address and password. Same as previously, error will be given if the format is wrong or wrong password and email. Moreover, if user(s) had forgot their password, they can click on button "Forgot Password" to go to the page. The page will require user to key in their email address. After clicking on button send, notification on checking own mailbox will be given and user(s) will need to check their mailbox to reset the password. After done reset the new password, user can continue to log into the game. If user want to quit the game, they can just press the quit button to quit.

2. Character Selection System Flowchart

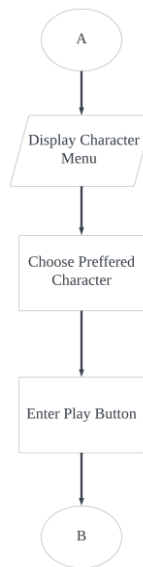


Figure 3.3.2.2 – Character Selection System Flowchart

Continue with previous process, after user(s) done log in or registration, they will continue by this character selection page. User(s) can choose their preferred character to represent themselves when in the game. After done the chosen character selection, click on the play button, and they will be connected to the lobby.

3. Game System Flowchart

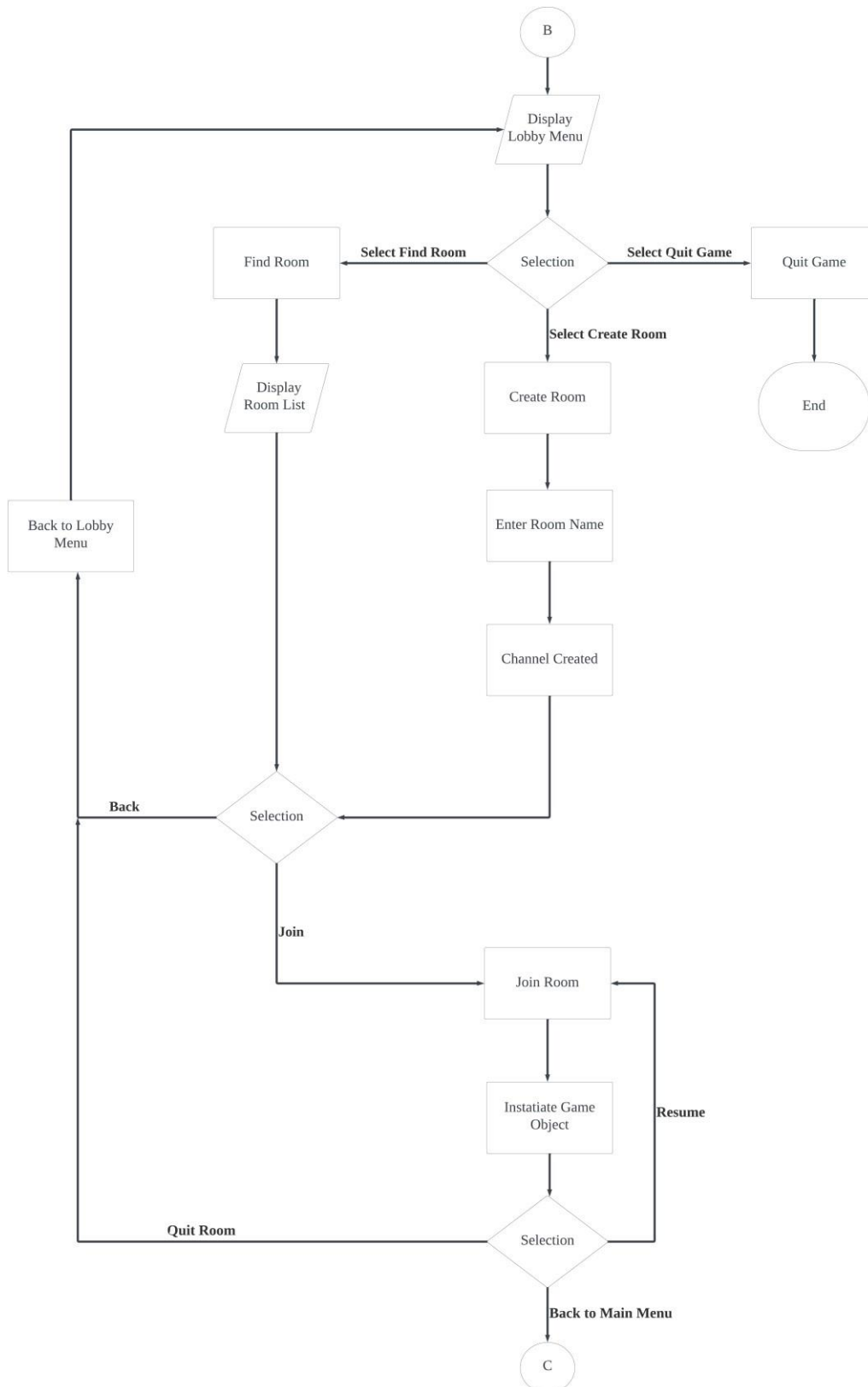


Figure 3.3.2.3 – Game System Flowchart

After done with character selection, user(s) will continue by get connected to the lobby. In the lobby menu, user(s) can either choose to find room, create own room, or quit game. As a user want create room, the person can just enter the room name / title and press create button; As for other users who want to find exist room, they can just click on find room and list of room available will show out. Additionally, only the room owner (host) who create the room has the only to start the room while others (clients) will have to wait for the owner to start the room. If the user (host) leaves the room, the second user (first client) will be the next owner (host) of the room. After everyone was ready or the owner already start the room, users will be connected to the game scene. Users are free to do anything they like once they are connected. By press “Escp” button, pause menu will show and users can either choose to resume the game, quit the room, or back to main menu. Once user(s) quit the room, they will return to the lobby, and the quit button inside lobby is give users to quit the game if they do not wish to continue anymore.

Chapter 4

System Design

4.1 Use Case Diagram and Descriptions

4.1.1 Use Case Diagram

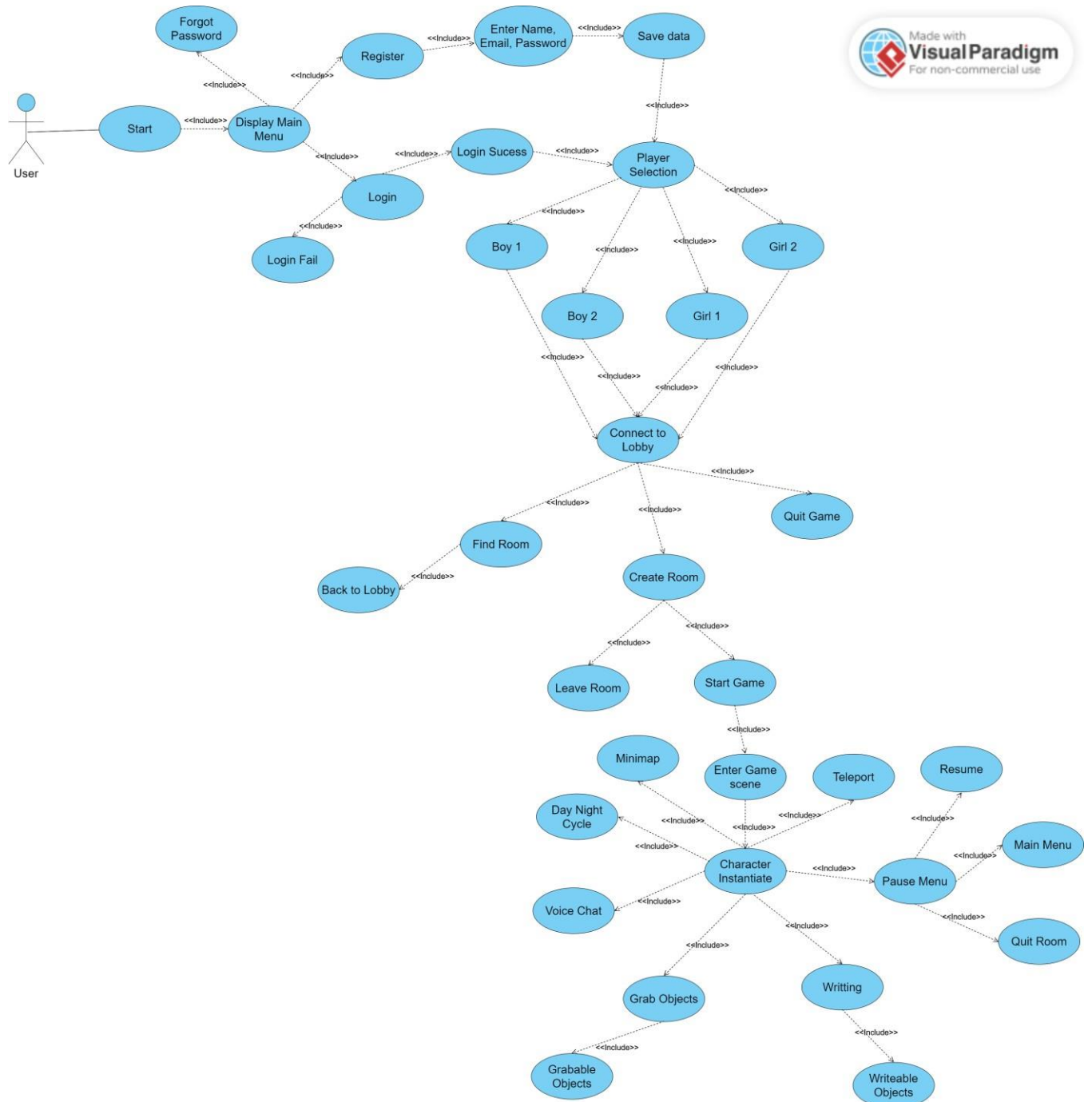


Figure 4.1.1.1 – Use Case Diagram

4.1.2 Use Case Description

Table 4.1 – Use Case Description

Use Case Name: Virtual Reality for Lecture Hall and Classroom in UTAR	ID: 1	Importance Level: 1
Primary Actor: User	Use Case Type: Essential	
Stakeholders and Interests: User – Wants to interact with other users in the virtual environment. - Able to have the experience of using the virtual space.		
Brief Description: The use case describe how user join the virtual scene and interact with other users.		
Trigger: User wants to interact with other user Type: External		
Relationships: Association: User Include: Login, Login Failed, Login Successful, Create Room, Join Room, Show Joined Player List, Leave Room, Enter Scene, Character Instantiate, Join Voice Chat, Draw Whiteboard, Register, Enter Details, Information Saved into Database, Character Selection Extend: Generalization:		
Normal Flow of Events: 1. User starts the program. 2. User key in email and password to login. 3. User successfully login and joins character selection lobby. 4. User select preferred character then start to play. 5. User join to lobby. 6. User can create own room. 7. User enters the game scene. 8. User's avatar created. 9. User joins the voice chat and have conversation with other users or can do whatever the user like to do.		
SubFlows: Not applicable		
Alternate/Exceptional Flows: 2a. User register a new account in the system. 3a. User fills in registration information. 3b. User submits the information, and the data will be saved in database for log in purpose. 3c. User failed to login due to wrong email or wrong password or invalid account. 6b. User can find existing room or quit the game. 6c. User can leave the room (before entering the game scene). 8a User can grab objects and writing. 8b. User draws on whiteboard.		

4.2 Activity Diagram

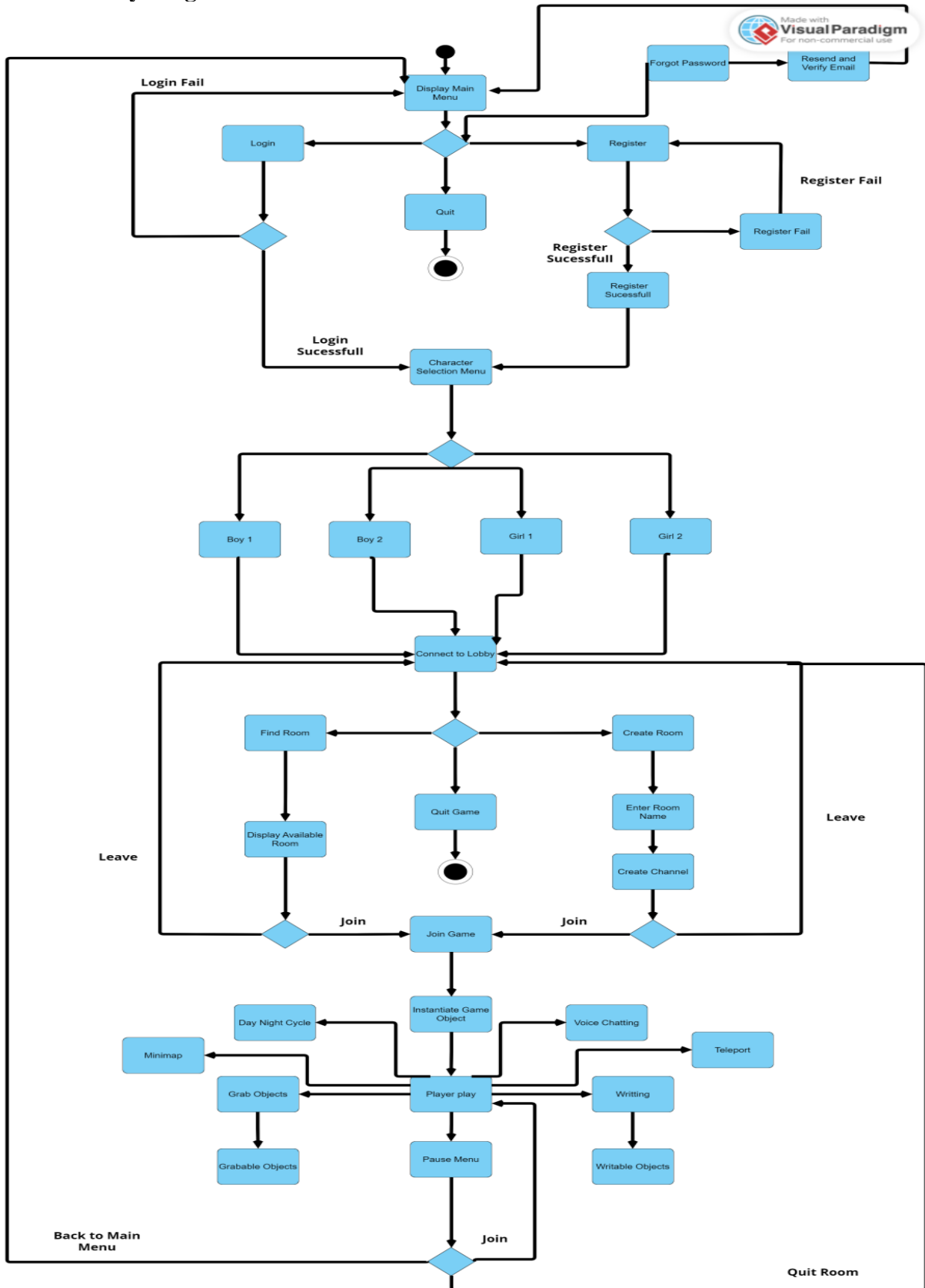


Figure 4.2.1 – Activity Diagram

The above figure shows the activity diagram of the virtual game system. After user(s) reaching to the main menu, they will have choices as either to log in or register or quit game. If a user is a new user, the person is required to have a registration for the system by providing name, email, and password. Error will be given if the detected invalid email or password. Once the registration is completed, user will directly be log to next page which is character selection page; If user is already an existing user, the person could just key in their email and password is enough to continue the process. Same as the registration, error will be given if invalid input is detected, or unknown account is founded. After preferred character selected, user(s) will be connected to the lobby which they can find existing room, create own room, or directly quit game. If user want to create own room, they can just give the name of the room then click the button to create; If user try to join an existing room, they can search by see the listing of available rooms after clicking the button “Find Room”. Additionally, after user(s) join a room, they will also have options to leave room as if the leave room user is the host of the room, the next person who inside the room will become the host for the room. After host start the game and all users get connected to the game, they are free to do whatever they would like to do with the prepared features; grab those grabbable objects to see closely it, writing on whiteboards, voice chatting, map exploration, enjoy day night cycle scene, and lastly teleportation. By pressing “Escp” key button, pause menu will appear and give user choices either to resume, back to main menu, or quit the current room.

4.3 System Block Diagram

4.3.1 Block Diagram (Part 1)

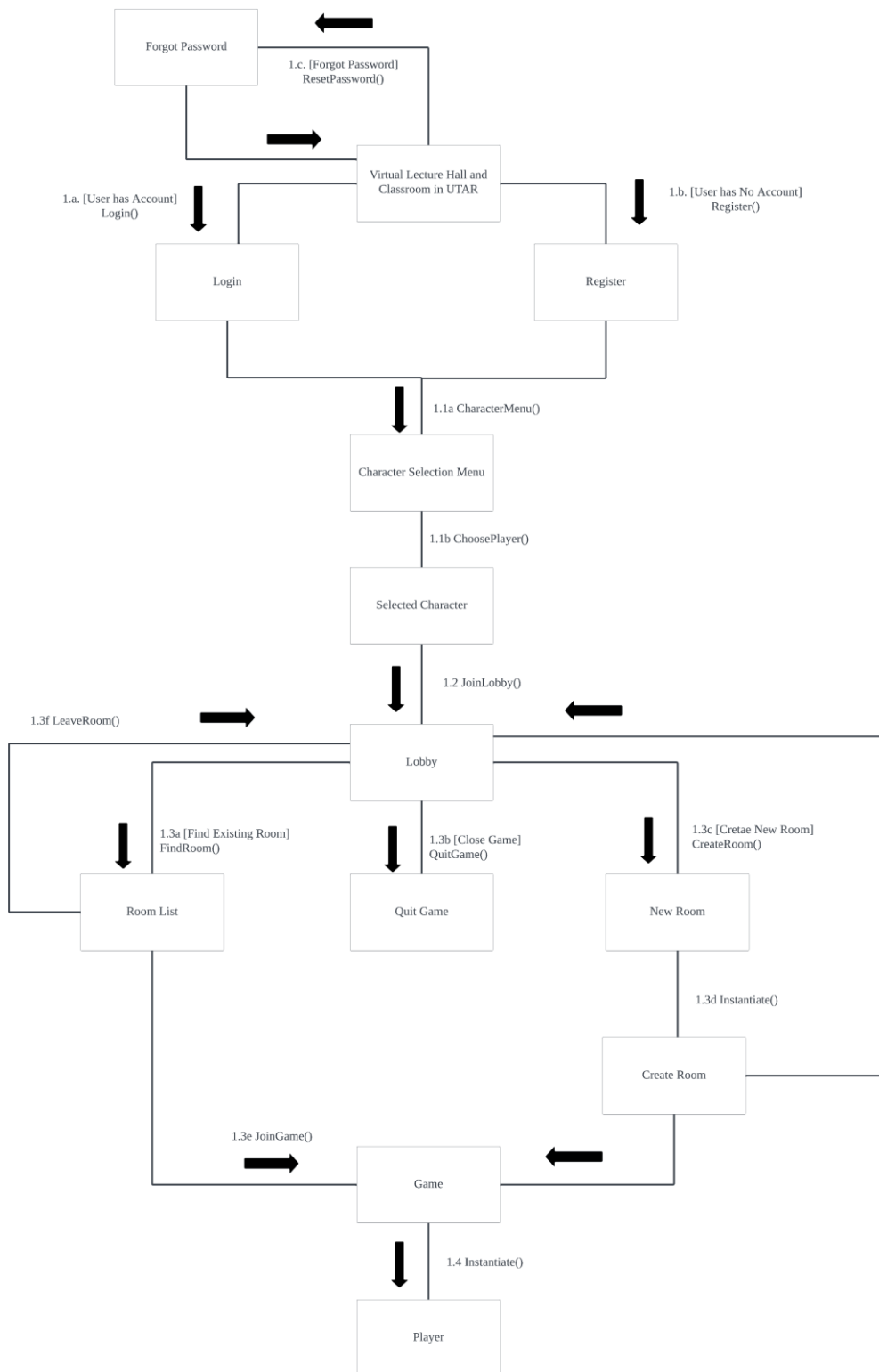


Figure 4.3.1.1 – Block Diagram (Part 1)

4.3.2 Block Diagram (Part 2)

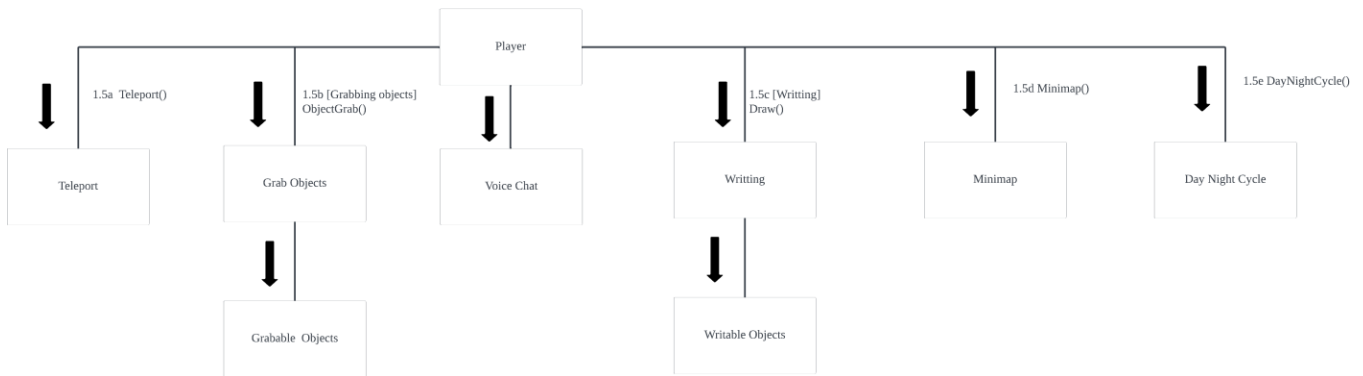


Figure 4.3.1.2 – Block Diagram (Part 2)

Figure 4.3.1.1 and Figure 4.3.1.2 is the block diagram represent the flow of process for the virtual lecture hall and classroom system. At the initial, method `Login ()` and `Register ()` is called for user(s) to have login or registration. Method `ResetPassword ()` is used for giving users(s) to reset the password by their email if they had forgotten old password. After done the initial part, then method `CharacterMenu()` will be called for connecting user(s) to the character selection page for choosing their preferred character to play. After the picking, Photon will now start by connecting them to the lobby by method `JoinLobby()` with code `PhotonNetwork.ConnectToMaster()`. Inside the lobby, user(s) can either find existing room (`FindRoom()`), create own room (`CreateRoom()`), or quit game (`QuitGame()`). After the room is ready, host can start the game, at the same time, the character that has been selected in the previous stage, will now be instantiate to the game:

`PhotonNetwork.Instantiate(players[saveManager.instance.currentPlayer].name, transform.position, Quaternion.identity)`, the first part of the element is the chosen player, next is the spawn position, and last is the rotation. Inside the game, user(s) are free to do anything they like with the prepared features; they can grab those grabbable objects (`ObjectGrabables()`), write or draw (`Draw()`), mini-map viewing (`Minimap()`), teleportation (`Teleport()`), day-nightcycle (`DayNightCycle()`), and have voice chat.

4.4 Storyboard

4.4.1 Storyboard (1)

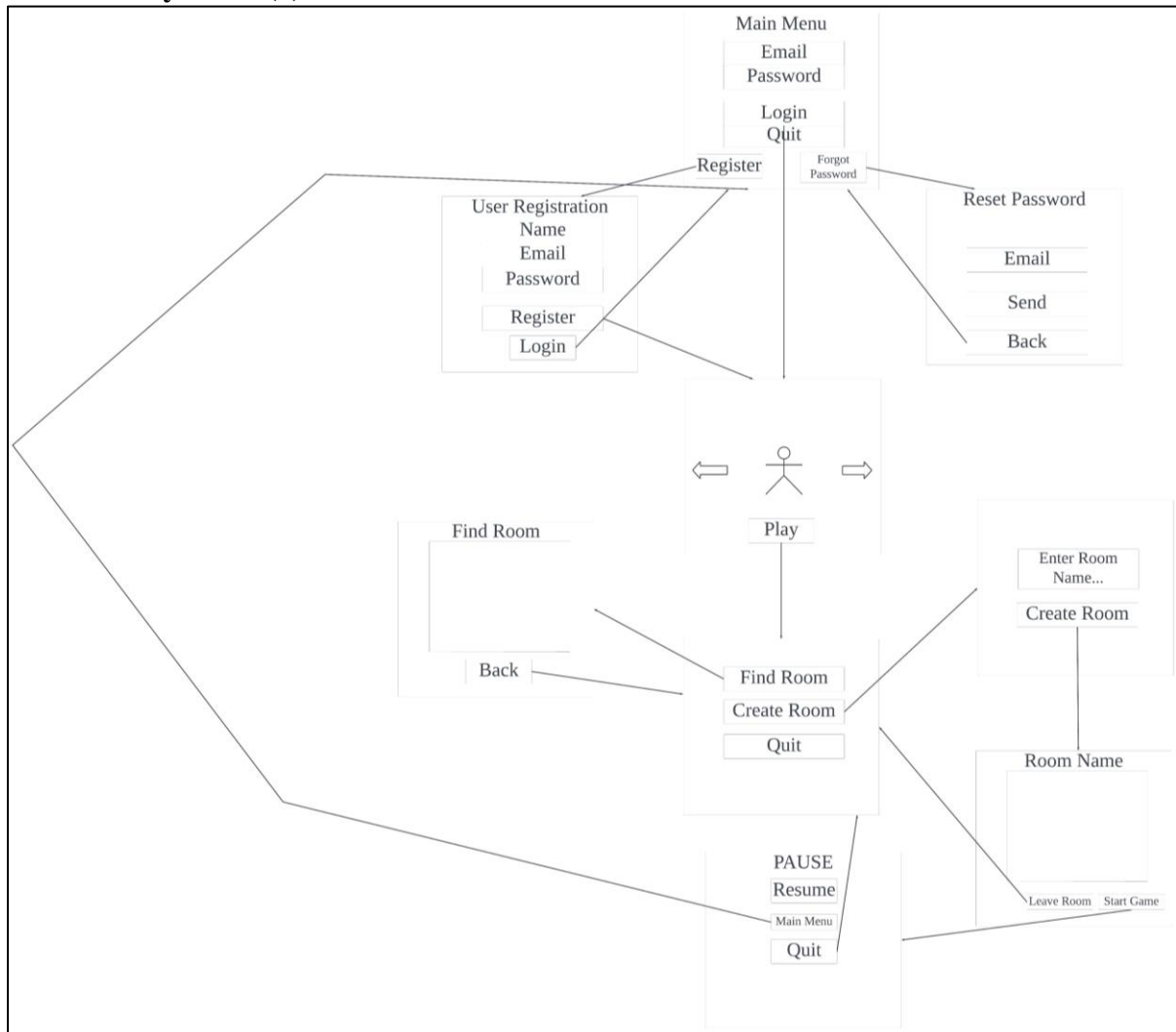


Figure 4.4.1.1 – Storyboard 1

4.4.2 Storyboard (2)

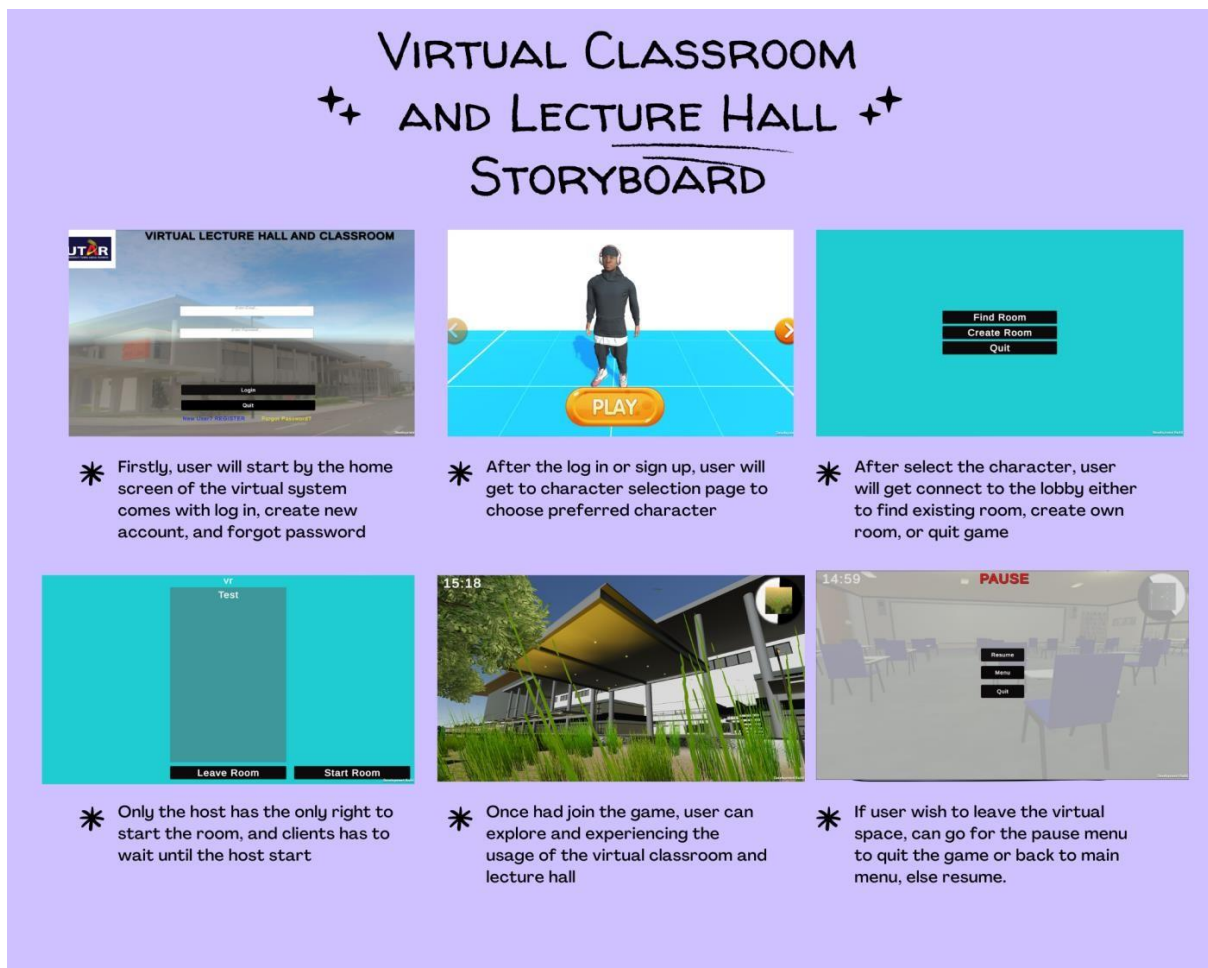


Figure 4.4.1.2 – Storyboard 2

Both figure 4.4.1.1 and 4.4.1.2 is the storyboard of showing the operation of the whole virtual lecture hall and classroom system. At the very first scene is the main menu of the game system. User can either log in or have registration before start to play it. By continue to the next scene, is the scene of character selection menu. There is total of 4 characters to be the choices for user to pick up. After clicking the button play, user will be connected to the lobby scene as shown in third scene which can let user to find existing room or create own room. Once the room create, only the user who create the room (host) can start the game, if other users (clients) join the room, they can only wait the host to start the game, unless the host leave the room then the host right will be send to the second player. Once all users join the game, they can do whatever they like to do by using the prepared features in this system such as voice chat, writing, grab objects, etc. If the user had tired with the gameplay, they could press button “Escp” to call the pause menu to have the button of quit room or back to main menu.

Chapter 5

System Implementation

5.1 Hardware Setup



Figure 5.1.1 – Laptop and Desktop

As mentioned in the objectives, to let all the users to have equality on enjoy using the virtual lecture hall and classrooms, the system will be developed in the desktop platform. Thus, users will only need a desktop or laptop to have the use of the system.

5.2 Software Setup

5.2.1 Unity

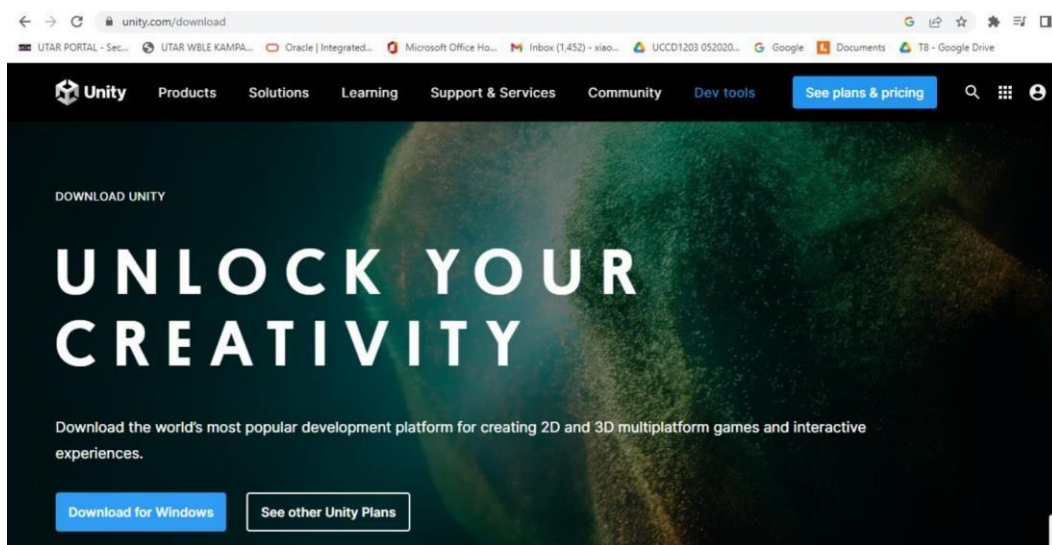


Figure 5.2.1.1 – Unity Website

Firstly, type unity.com or unity.com/download shown in figure above and click on the blue button “Download for Windows” at the left side of the page.



Figure 5.2.1.2 – Unity set-up

Once the download is finished, go to Downloads in your PC, and find the UnityHubSetup as shown as above.

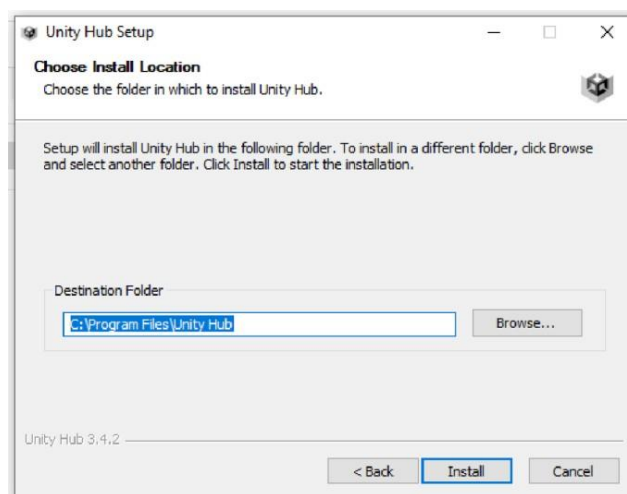


Figure 5.2.1.3 – Install Unity-Hub

After clicking the button “I Agree”, user can just select the destination to keep the software and click on “Install” button to start the installation.

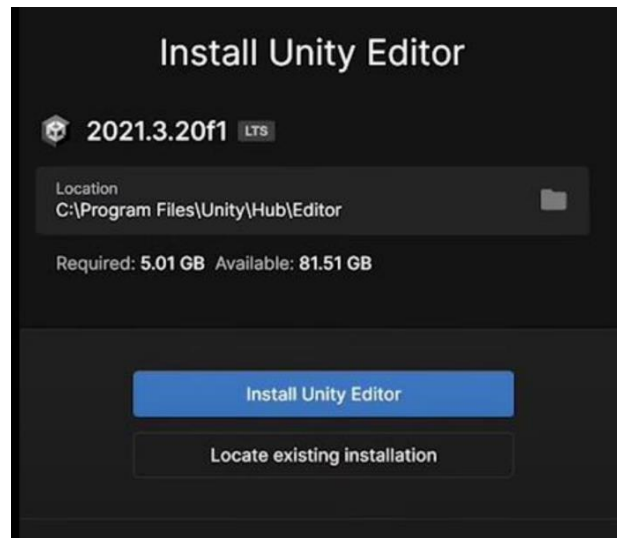


Figure 5.2.1.4 – Install Unity-Editor

After done the installation for the Unity Hub, next is the installation for Unity Editor. Once installation for Unity Hub is done, Unity Hub Application will appear on screen and will see button “Install Unity Editor” shown as figure above.

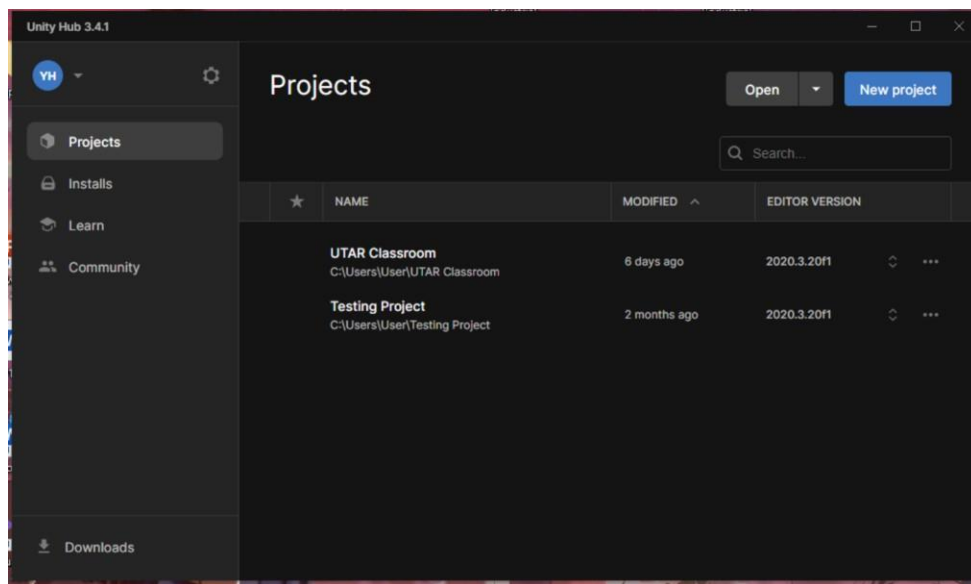


Figure 5.2.1.5 – Unity-Hub

Once all the installation had done, user can now open the software by clicking the icon of Unity with title of “Unity Hub”. User can have login with own Unity account as this is recommended to do so due in future work, we need to access to Unity Asset Store and the access is requiring an actual account. For next step user can click on the button “New Project”,

and it will show several templates for user to choose such as 2D, 3D, VR, AR, etc templates.

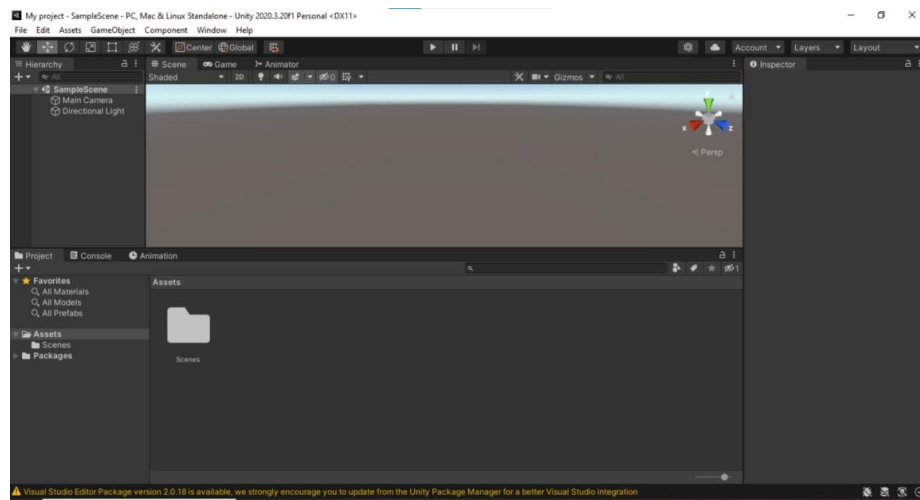


Figure 5.2.1.6 – New Project

Once template had chosen and giving the title of the project, user can click on button “Create Project” and the project will be load and wait to launch. Once the loading had done, the project has been launched and user can start on making the games.

5.2.2 Visual Studio

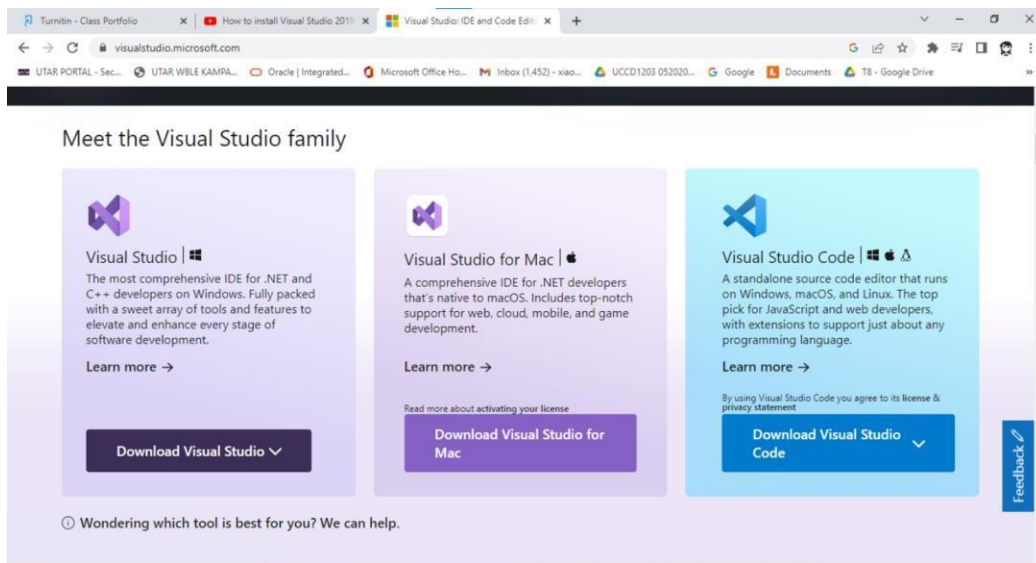


Figure 5.2.2.1 – Microsoft Visual Studio Homepage

Firstly, go to browser and type “visual studio”. Once the result had shown, click on the first which is visualstudio.microsoft.com. Go into the page and scroll down, user will need to click on button “Download Visual Studio” as shown in the figure above which is at the left side of the pages. Before click, there is a scroll down besides the button which will show 3 versions of Visual Studio: Community, Professional, and Enterprise. For this case, choose Community to download.



Figure 5.2.2.2 – Visual Studio set-up

Once the download had done, go find the “VisualStudioSetup” as shown in the figure above in Downloads.

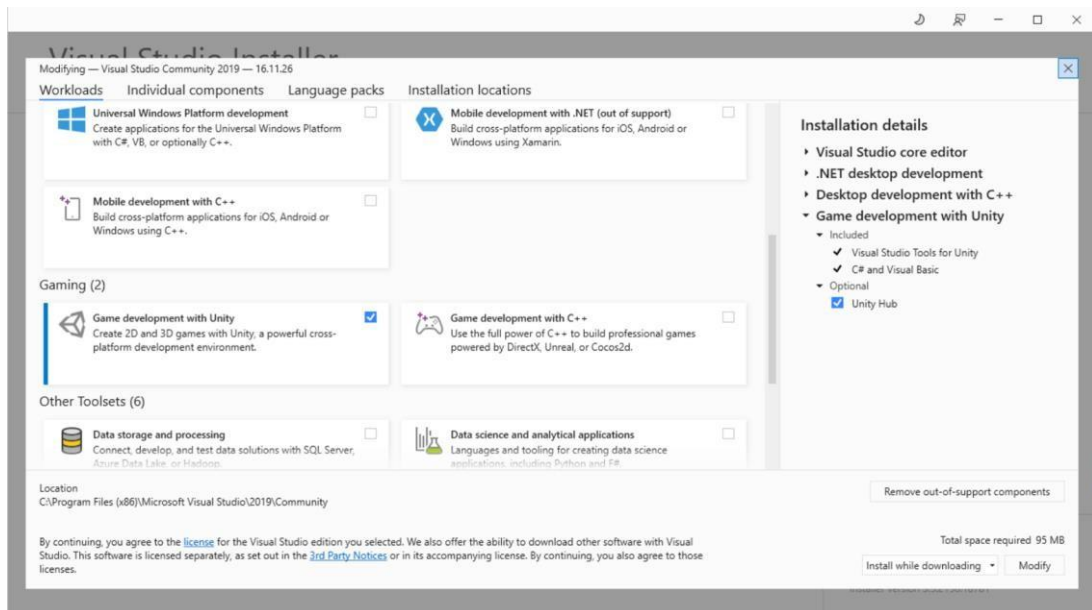


Figure 5.2.2.3 – Visual Studio Tools Installation

After the loading was done, choose the workloads that is needed for the work. For this situation, user is recommended to choose “.NET desktop development”, “Desktop development with C++”, and “Game development with Unity” as this last workload is a must if user want to have coding tools work with Unity.

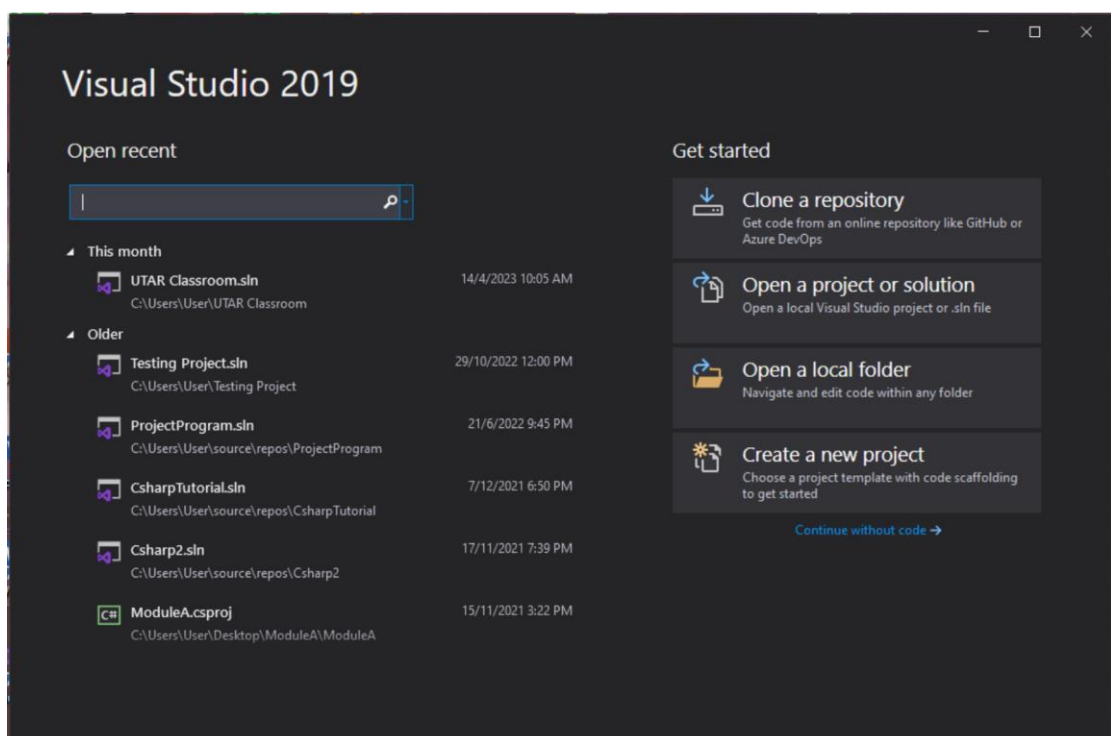


Figure 5.2.2.4 – Visual Studio Menu

Once user had done with selection and installation, user can open the Visual Studio and the menu will be shown same as the figure above.

5.2.3 Plugins / SDKs

5.2.3.1 Visual Studio Plugins

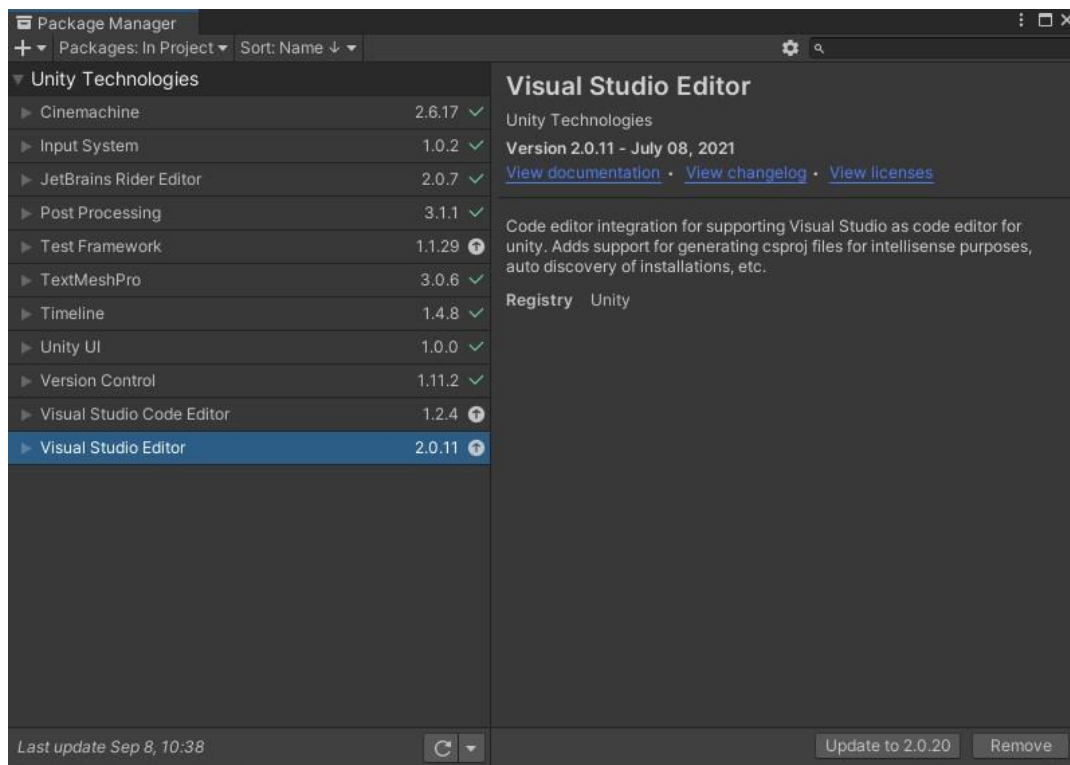


Figure 5.2.3.1.1 – Visual Studio Plugins

User must import and download the Visual Studio plugins show as the figure above to have the Visual Studio to be work with Unity. The plugins are obtainable if user has checked the box of unity engine during installation and implementation of Visual Studio (refer Figure 5.2.2.3).

5.2.3.2 PlayFab SDK

3. Installing or Upgrading the PlayFab UnitySdk

Editor Extensions UI Installation

1. Download the [Editor Extensions package](#)
2. Open and run your Unity project
3. From the Unity editor, go to **Assets > Import Package > Custom Package** and then select the downloaded PlayFabEditorExtensions package. For latest instructions on how to add a custom package, go to Unity documentation site.
4. A new window pops up displaying all the files that would be imported into your project. Select **Import** to add all of the files. After a successful installation, you will see the PlayFab panel with the Create account or login UI in the Unity editor.

Editor Extensions SDK Installation/Update

1. Log in using the Editor Extensions panel
2. If your SDK is missing or out-of-date, you'll see an orange install/update button

Figure 5.2.3.2.1 – Git-hub

PlayFab is implemented within the system for fulfilling user authentication purpose. Once had fully downloaded the Unity SDK from the GitHub as shown as figure above(<https://github.com/PlayFab/UnitySDK>), after extracting it continue by dragging the package file into the unity project.

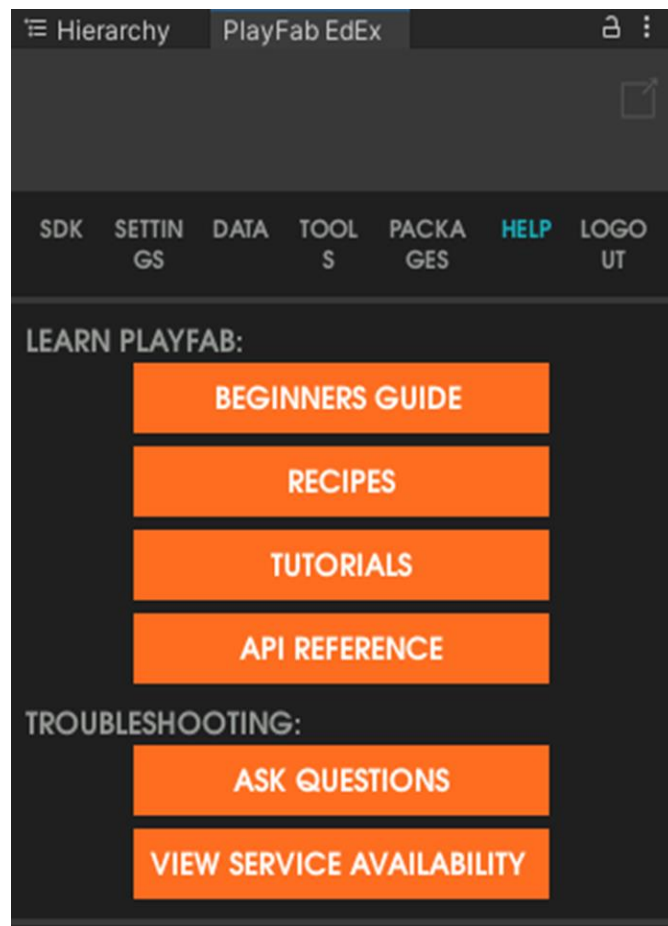
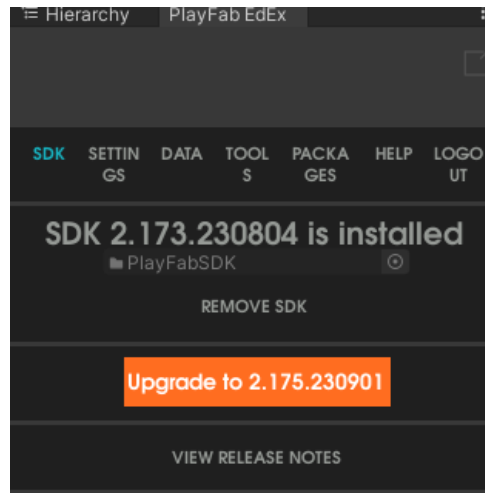


Figure 5.2.3.2.2 – PlayFab EdEx

Once the file had finished the download, at the hierarchy side of Unity will pop out a new tab shown as result of Figure 5.2.3.2.2, but this haven't done yet. Clicking on the SDK to download it to have full useful of this plugin for next process.



Manual Installation

You can install the SDK directly by downloading the latest [SDK Asset Package](#) directly.

Detailed Manual Instructions:

- Download [UnitySDK.unitypackage](#) to a safe location.
- [Only When updating]: Delete your {ProjectLocation}/assets/PlayFab*/ directories.
- (Very old SDKs) You may also need to delete PlayFab specific files in your {ProjectLocation}/assets/Plugins/ directory.
- Failing to do this step may cause compiler errors and/or unexpected runtime errors
- Unpack the .unitypackage file into your project.

Advanced users can copy the contents of

Figure 5.2.3.2.3 – PlayFab SDK

For downloading the SDK, user can just simply click on Download inside the PlayFab tab in unity to start the download, but for some users they may not work proper on this due the issues of version not allowed or not suitable. Thus, users can may manual download shown as the figure above. Same as previous part, once download and extract complete, just drag the package into unity project is fine.

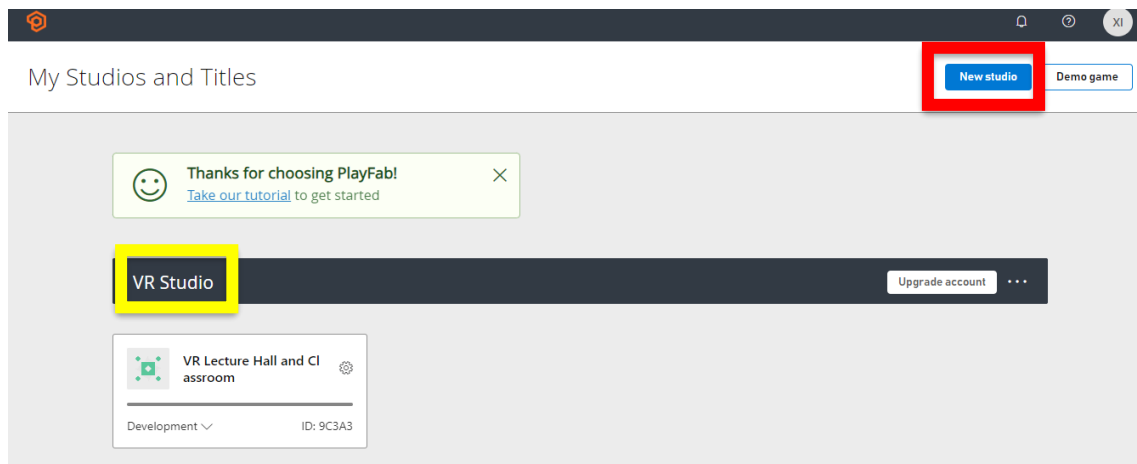


Figure 5.2.3.2.4 – PlayFab Studio

Once it is done from Unity, continue by go to the website (<https://playfab.com/>) to build up a studio which is the database for installing user’s information. Set the title of the studio first (refer yellow box) due it is important then create a new studio and name the studio (refer red box).

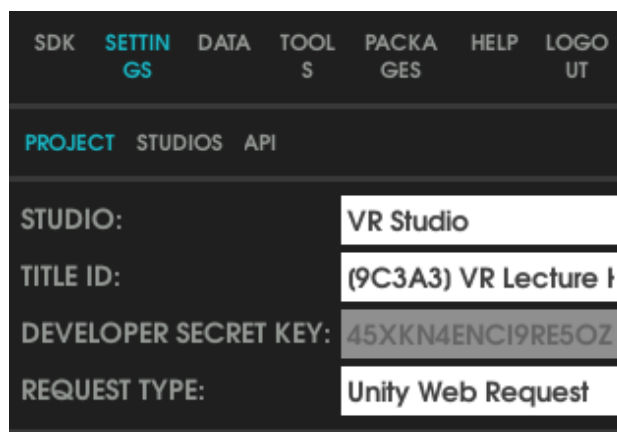


Figure 5.2.3.2.5 – PlayFab Settings

Come back to Unity, select the studio that has been created just now. Title ID is auto fill in once the studio selected. Request type chose to Unity Web Request and now the PlayFab is ready to get new users.

5.2.3.3 Photon PUN2 SDK



Figure 5.2.3.3.1 – Photon PUN 2

PUN2 plays an important role in this project as the function of this SDK is multiplayer gaming. Start the process by go to Unity Assets Store -> type PUN2 -> filter by price (low to high), then user can find it easily due this SDK is free to use.

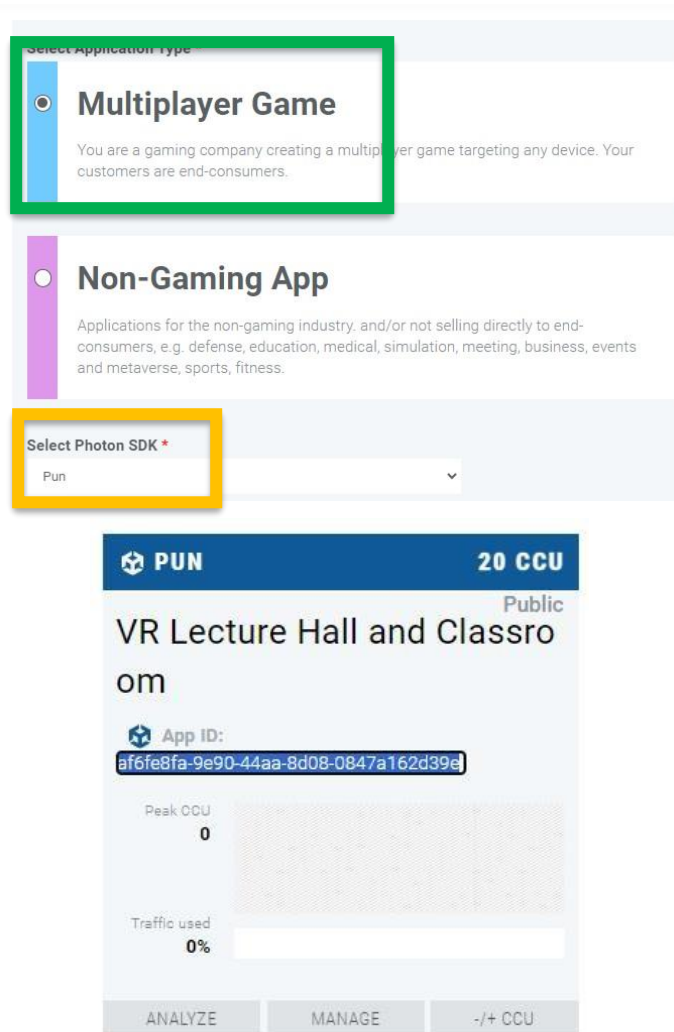


Figure 5.2.3.3.2 – Create New App

Once had added into assets, access from unity package manager, import and download it, go to photon website (<https://www.photonengine.com/>) and create a new app shown as figure above. It is important to know that when create the app, it is a must to ensure that gaming type is selected to multiplayer game (refer green box) and select photon SDK to PUN (refer orange box), other may ignore it. Once had done the app creation, copy the app ID as it is important for next step.

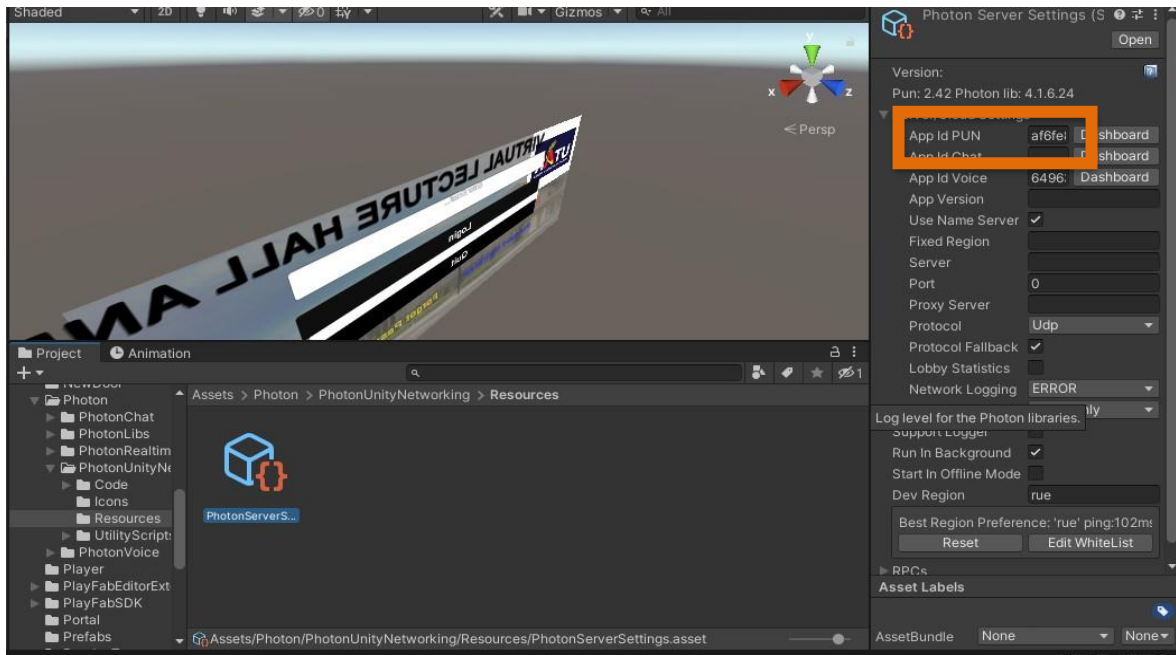


Figure 5.2.3.3.3 – Photon Server set-up

After copied the app ID from previous step, continue by find the photon server that save in the assets file of Unity project. Pasted the ID to the App ID PUN in the server (refer brown box). After users join the lobby hosted by the server, the room creation and connection will be handled by room manager by utilizing the network APIs.

5.2.3.4 Photon Voice 2 SDK

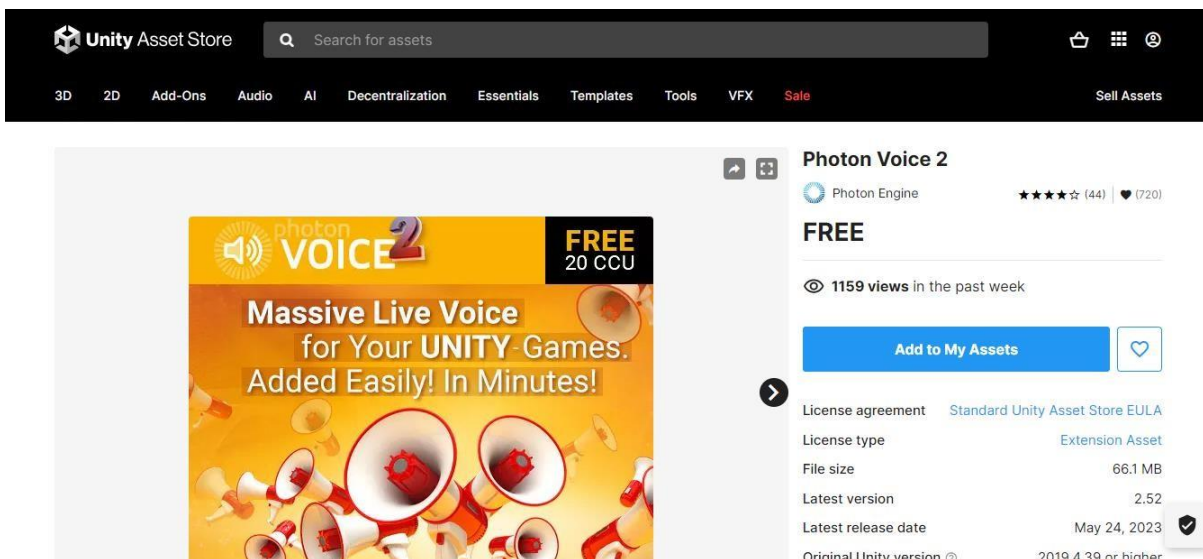


Figure 5.2.3.4.1 – Photon Voice 2

Voice 2 plays the role of voice chatting features in this project. The installation starts by the process of go to Unity Assets Store -> type voice2 -> filter by price (low to high), then user

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can find it easily due this SDK is free to use as well. All the installation steps are almost same as previous PUN2, just select the photon SDK types to Voice.

5.3 System Operation

5.3.1 Multiplayer and Voice Chat

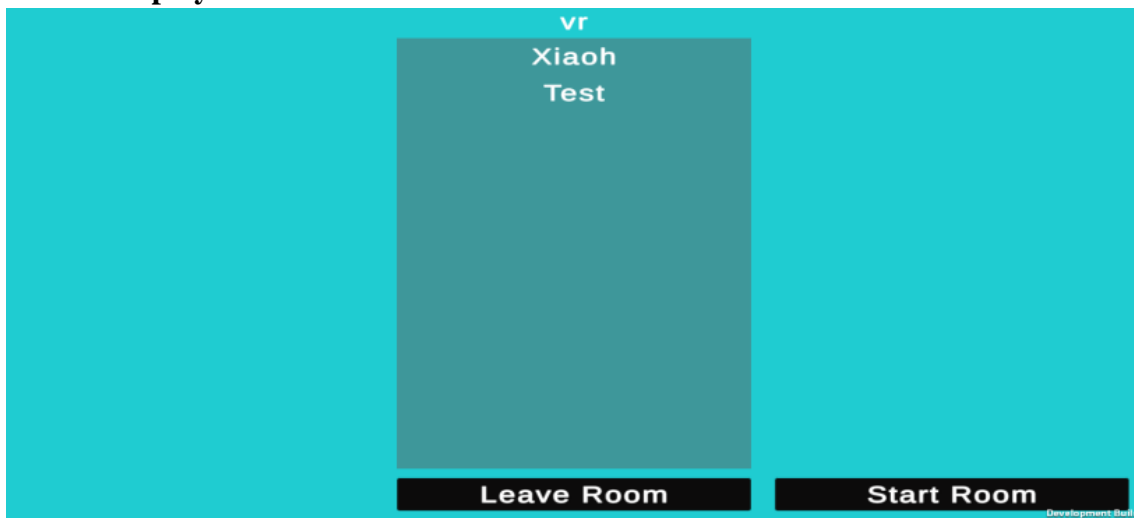


Figure 5.3.1.1– Inside Room named VR (Host view)

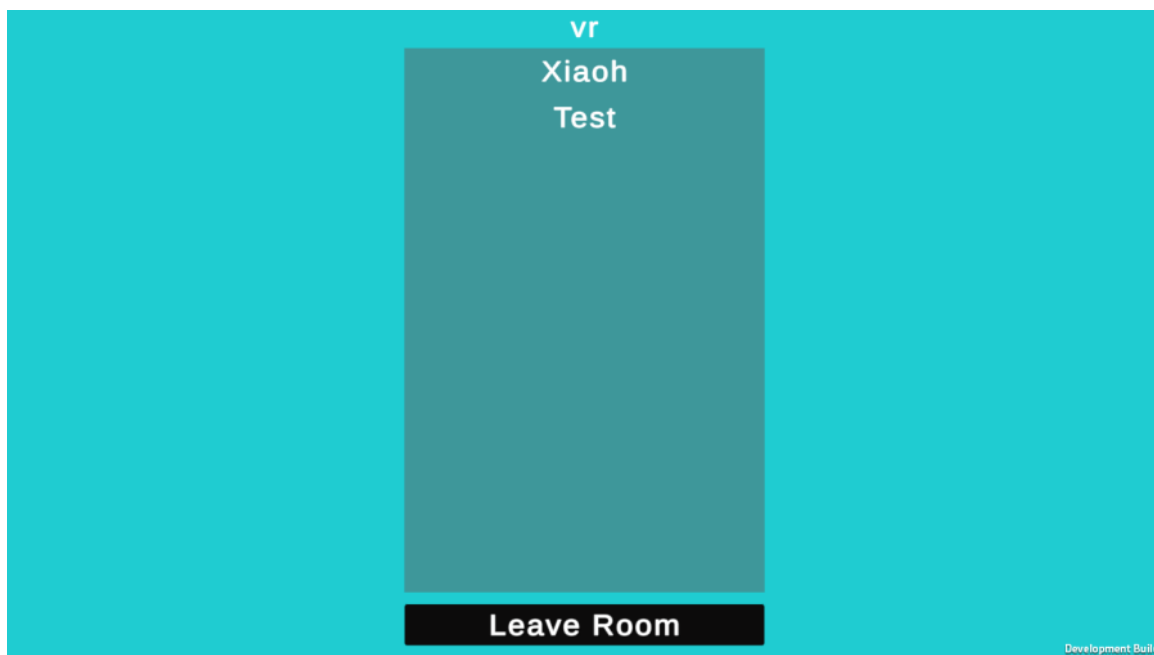


Figure 5.3.1.2– Inside Room named VR (Client view)



Figure 5.3.1.3– Multiplayer and Voice Chat (Client view)

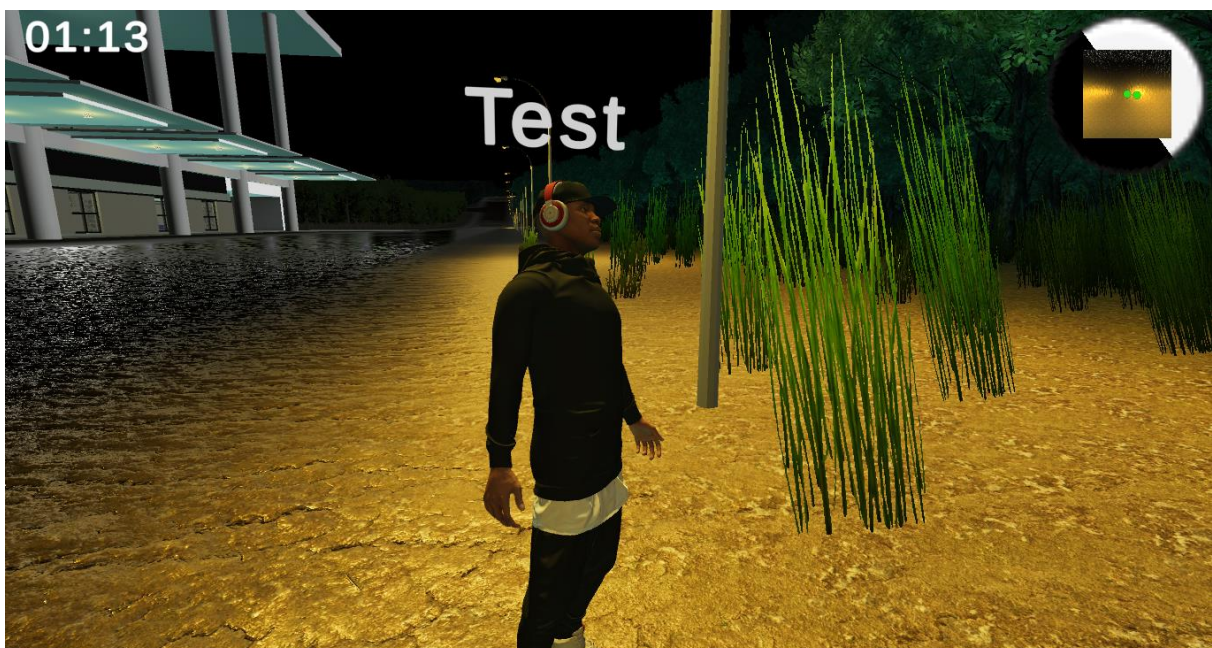


Figure 5.3.1.4– Multiplayer and Voice Chat (Host view)

Virtual lecture hall and classroom system is a multiplayer game powered by Photon Network which enable users to interact with each other in same lobby. Once a user (client) enters the room, the username will be display in the list as shown in the figure above. Based on the Figure 5.3.1.1 and Figure 5.3.1.2, only the user who create the room (host) has the only right to start the room while others (clients) will have to wait for the user to start the room. After room owner start the game, the game object which is the selected character will start being instantiate

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and connected so users can have interactions with each other using it during the game. Not just that, once users have connected, their speaker is also being on so they can have a direct voice chat. Moreover, their username will be display on head above of the avatar to represent who they are.

5.3.2 Scenes

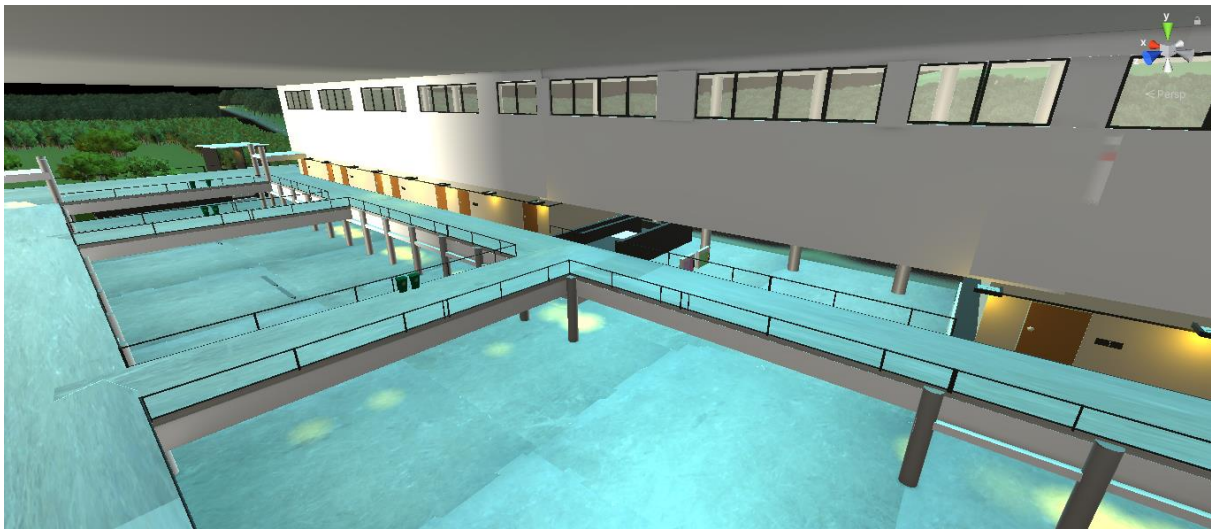


Figure 5.3.2.1– Block N Lobby

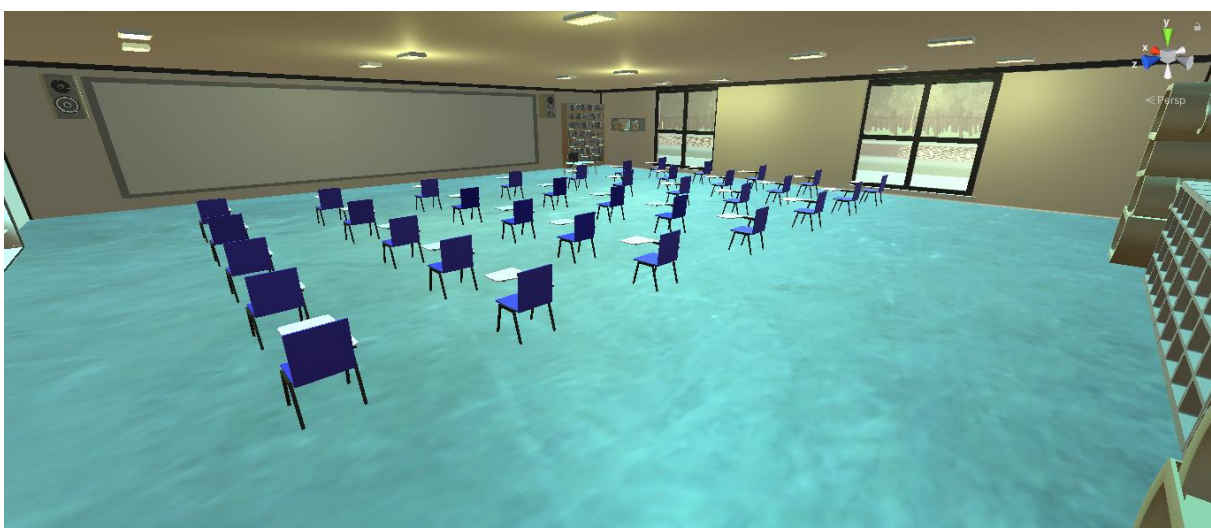


Figure 5.3.2.2– Classroom



Figure 5.3.2.3– Block N

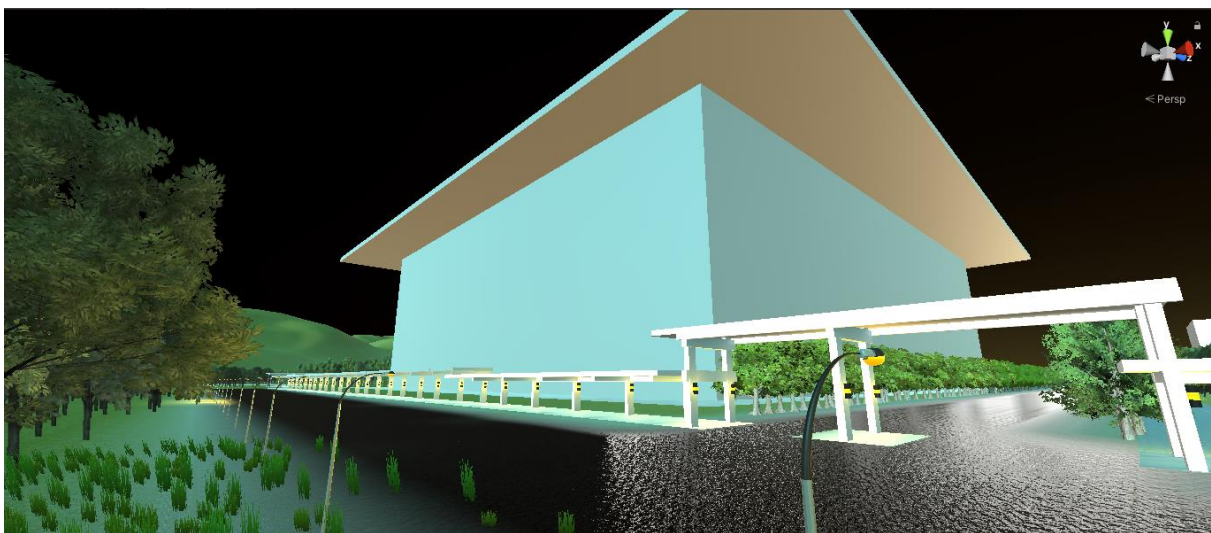


Figure 5.3.2.4– Dewan Dr. Ling Liong Sik

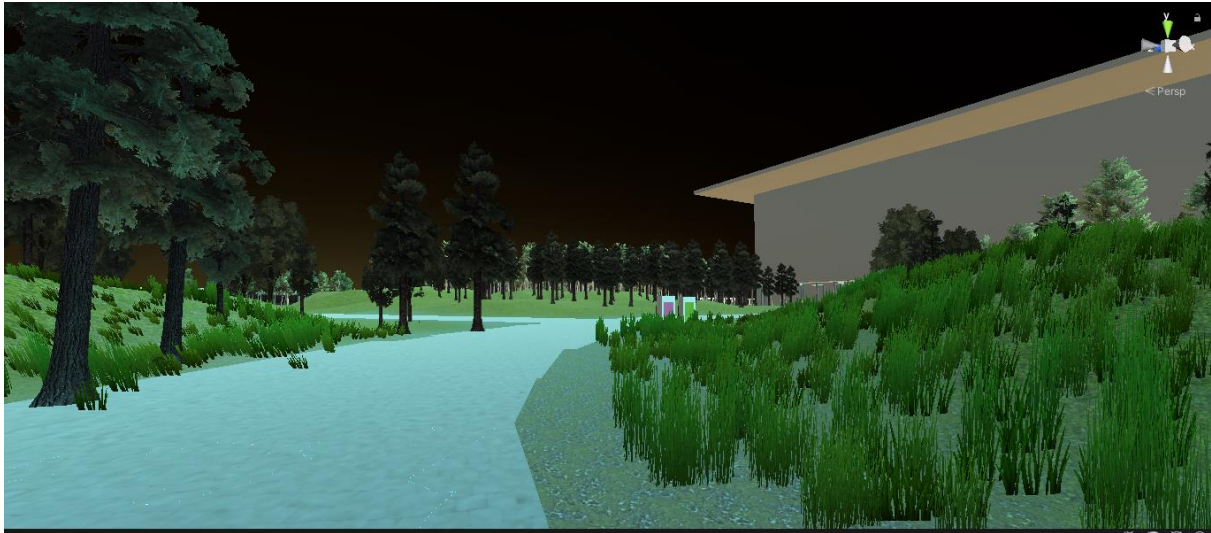


Figure 5.3.2.5– Garden

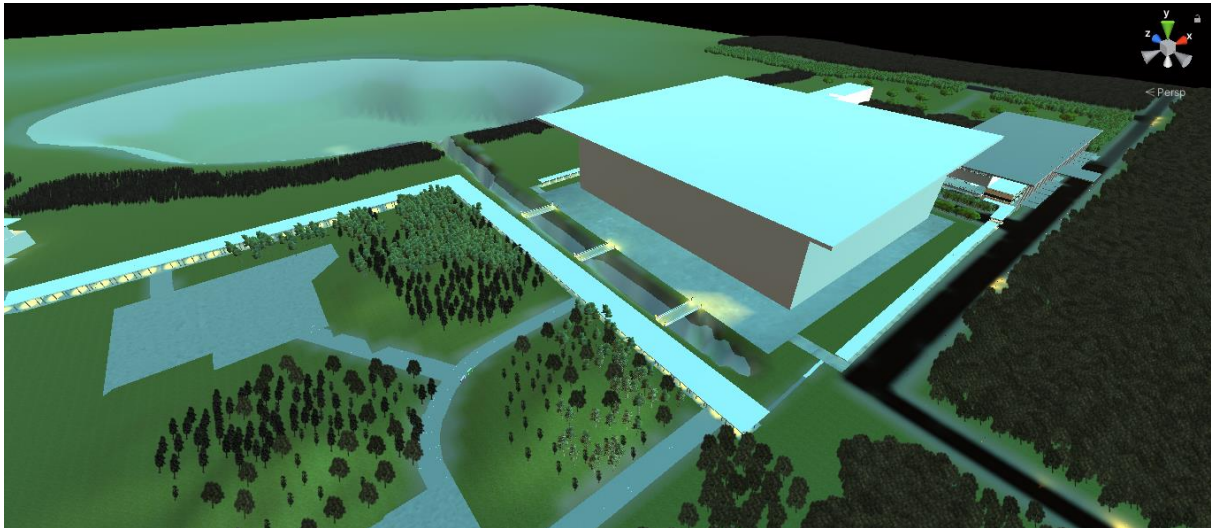


Figure 5.3.2.6– Whole Garden

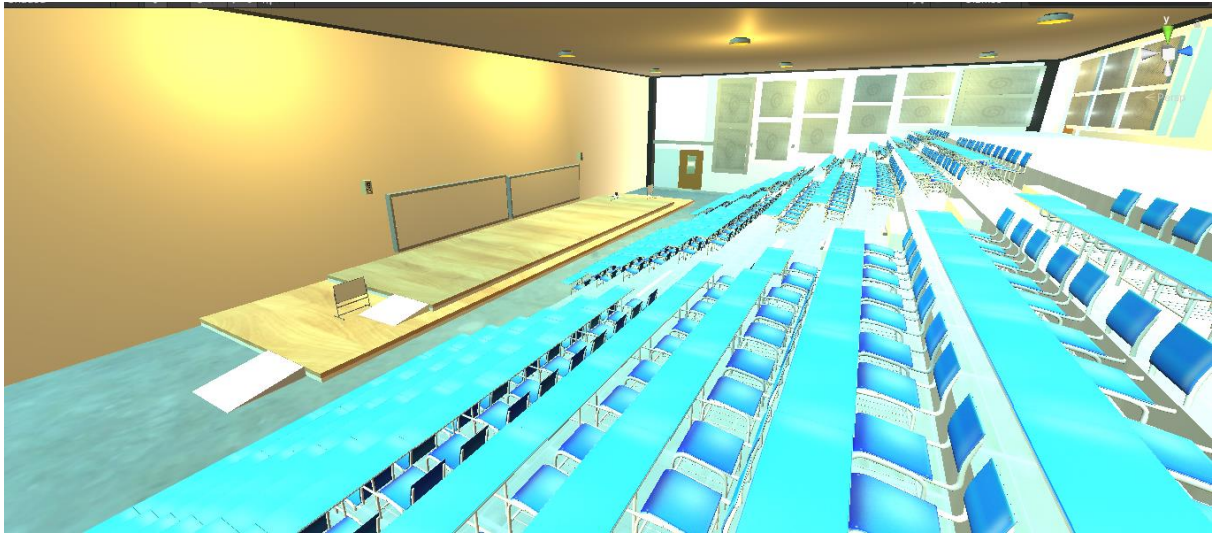


Figure 5.3.2.7– Inside Lecture Hall

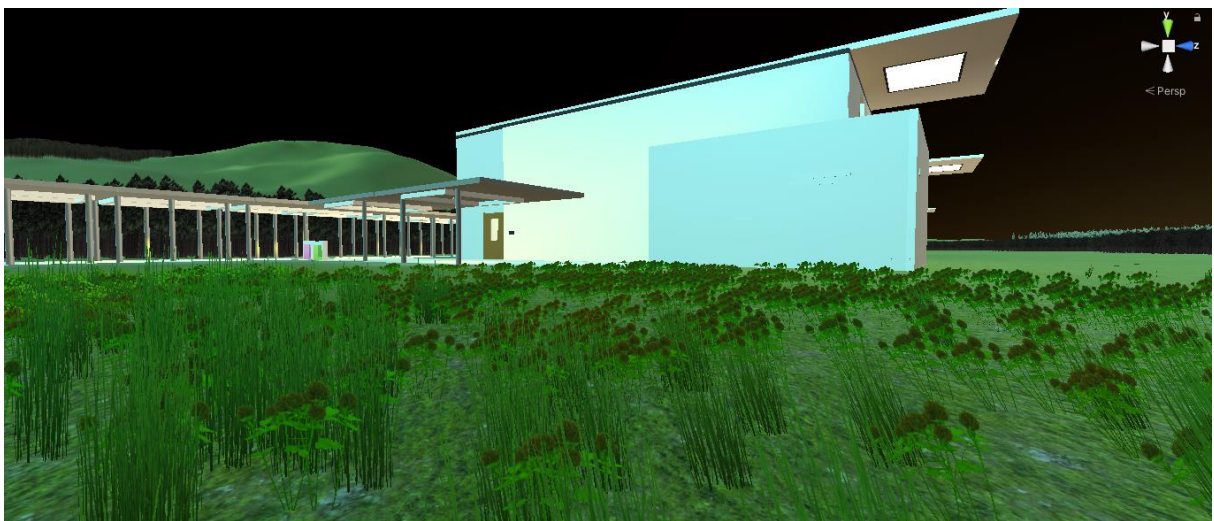


Figure 5.3.2.8- Outside Lecture Hall



Figure 5.3.2.9 – Block L

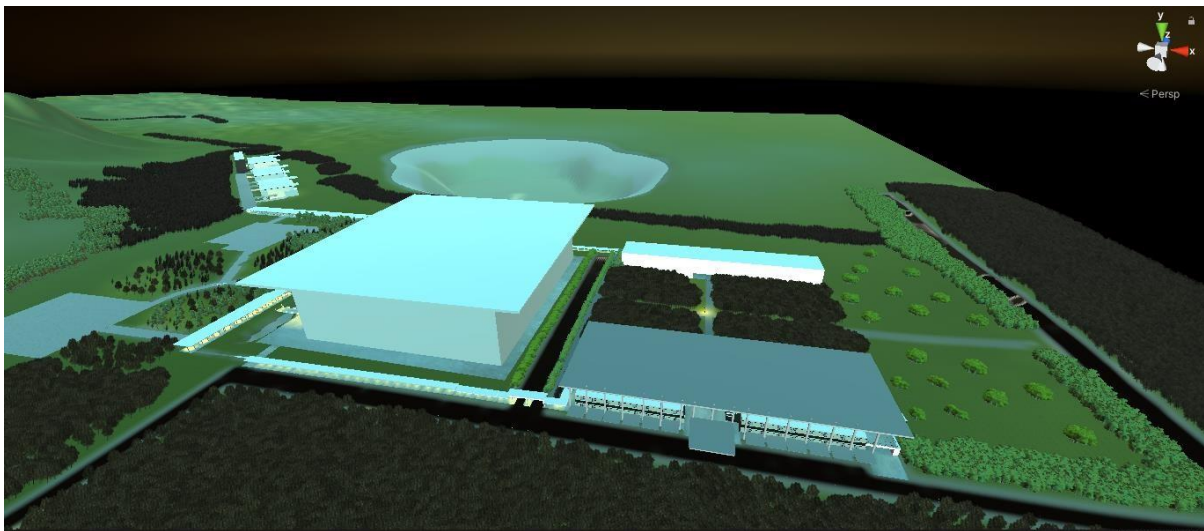


Figure 5.3.2.10– Overall Scene

Figures above shows the virtual environment scenes that users can interact each other and exploration. It is one big map that have reference of actual scenery from FICT of University Tunku Abdul Rahman (UTAR). The first figure shows the scene of faculty block (Block N) which the faculty for IA, IB, CS, CN students to have tutorials and lectures. Follow by next figure is the scene of garden near the Block L which is a place for users to have full space to explore and investigate the environment. Last figure is the Block L which the lecture hall block for students to attending lecture courses.

5.3.3 Features- Grab Object



Figure 5.3.3.1– Grab an Object

As the figure above shown is user grabbing a chair. The purpose of this grab function is to let users to have a realistic experience of playing and studying in this game as students or teachers can have fun together. Besides chair, there is still a lot of objects inside the game is grabbable for example whiteboard in lecture hall, the whiteboard not just can have user write on it but also can be grab as to let others see clearly and easily by just take the whole whiteboard to the front of the person.

5.3.4 Features - Writing / Drawing



Figure 5.3.4.1– Write.

Figure 5.3.4.1 shows user are writing a word “Hi” on the whiteboard. The purpose of this feature is to let users to have easier explanation in written form as words have better understanding than oral speaking. Besides write, users are free to do with the features such as express their ideas and creativity by drawing.

5.3.5 Features- Day Night Cycle



Figure 5.3.5.1– Day Night Cycle

Figures above shows the result of day night cycle changes in the game as this feature is to change the environment scene by using time calculation to prevent users being bored with non-active scenery. The time change to morning is set at 7:00 (refer purple box) and night falls in 20:05 (refer red box).

5.3.6 Teleport

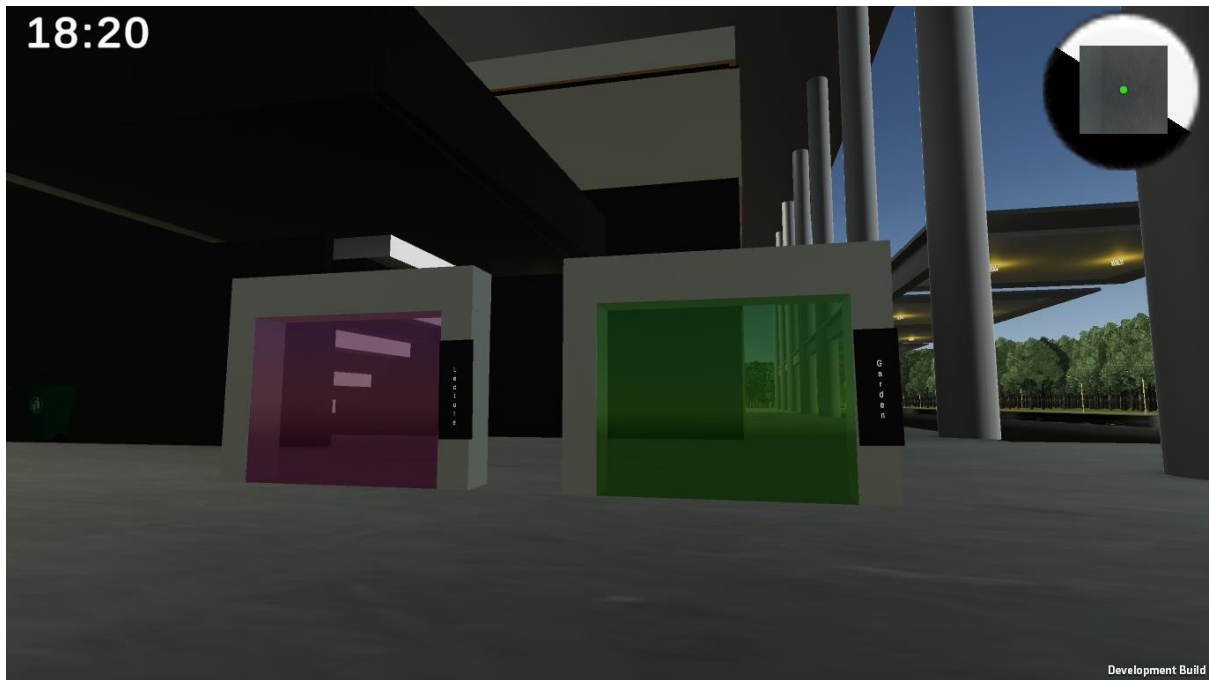


Figure 5.3.6.1– Teleport

As this virtual lecture hall and classroom is a one big map system, it may cause uncomfortable to certain users as they may not interest in exploring the whole map or they are tired by just walking from classroom to lecture, lecture to garden, or somewhere else. Thus, this feature has the purpose of erasing those negative points. The teleports will teleport users to the places that shown in the plate for example, the teleport in the figure above, left purple teleport will teleport users to the lecture halls area while the right green teleport will teleport users to the garden area.

5.3.7 Features- Mini-map

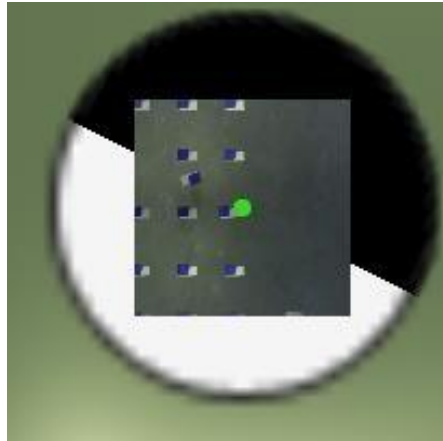


Figure 5.3.7.1– Mini map (User in Classroom)

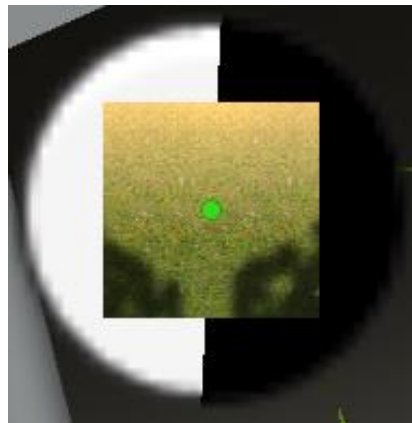


Figure 5.3.7.2 – Mini map (User at outfield)

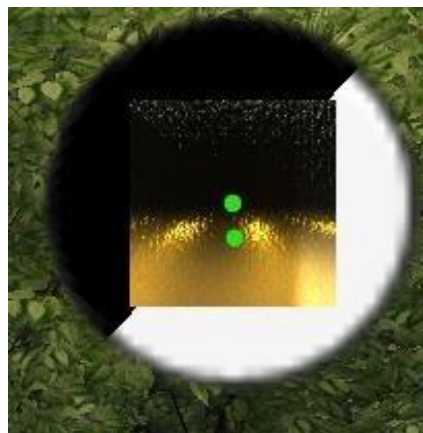


Figure 5.3.7.3 – Players Detection in Mini map

As the last features that have by this virtual lecture hall and classroom system is the feature shown as the figure above. Mini map has the implementation purpose of letting user to know what their current place in the game are. Referring to the Figure 5.3.7.1 and Figure 5.3.7.2, the position of the user change from inside in the classroom become go to outside field shown

in the map to let user see their places. Not just that, the mini map also can detect other players if they are presented around the user as shown in Figure 5.3.7.3.

5.3.8 Features- Avatar



Figure 5.3.8.1 - Boy1- James



Figure 5.3.8.2 - Boy2- David

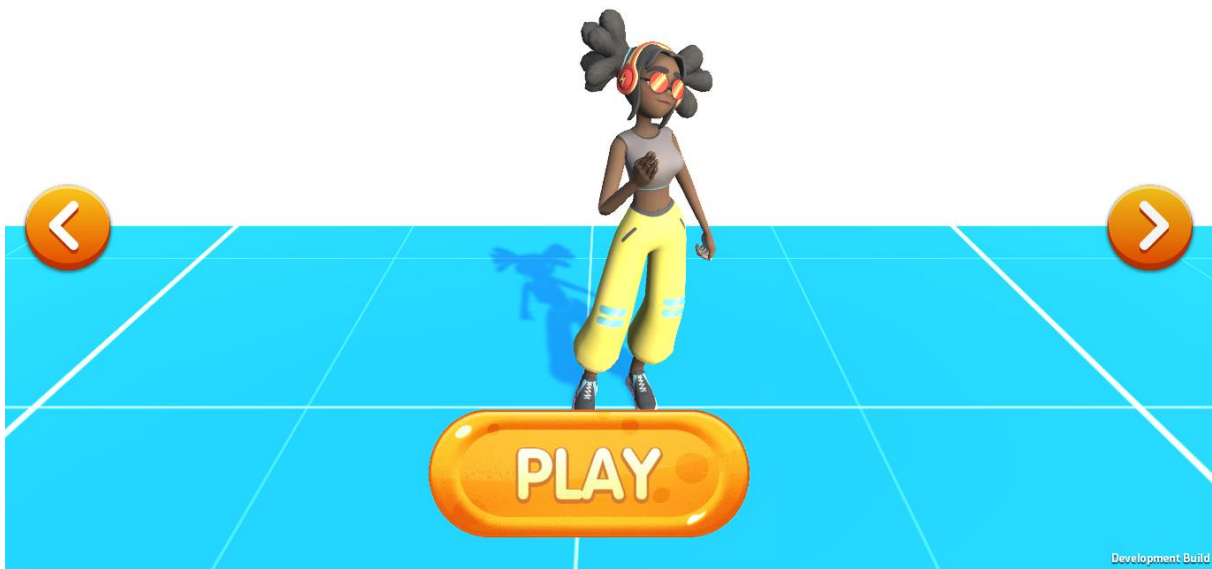


Figure 5.3.8.3 - Girl1- Michelle

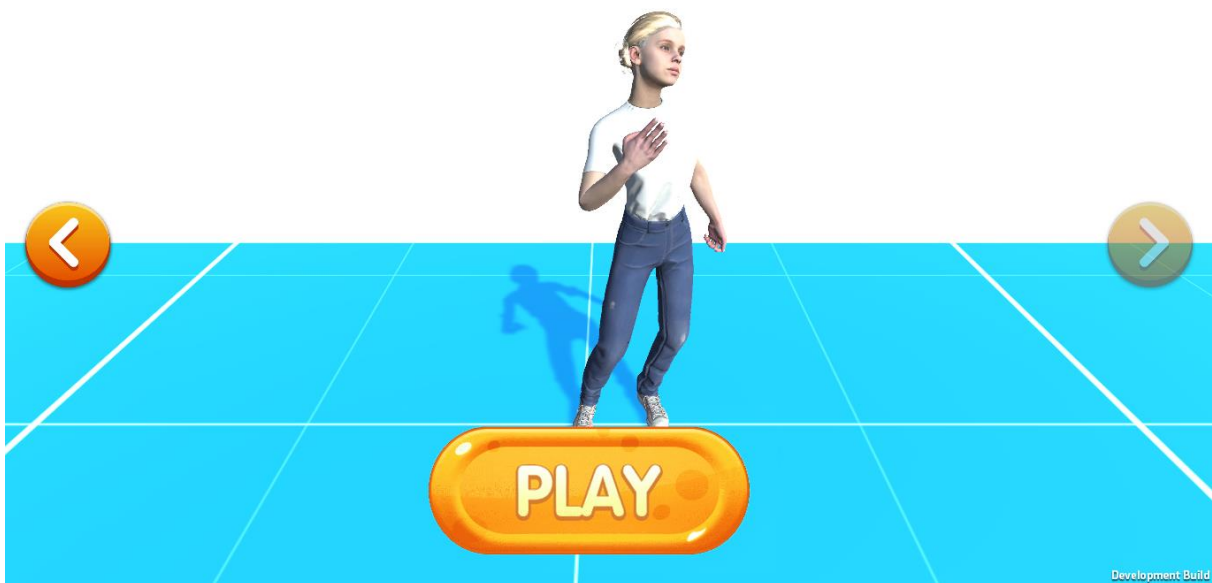


Figure 5.3.8.4 – Girl2- Megan

There are total of 4 avatars being implemented to this virtual game: James, David, Michelle,
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and Megan. After the log in or registration, user(s) can continue to this selection page. Button left right shown in figures above are the button to let user(s) change the selection. If the avatar is the very first avatar, the left button will be deactivated shown as Figure 5.3.8.1; If the avatar was the last avatar, the right button will be deactivated as well shown as Figure 5.3.8.4.

5.4 Implementation Issues and Challenges

First issues that occur is during character building. As it was first time doing the character, it is such as difficult time due the animation of the character won't work as expected. The bug that happened is no issues when user walk front, back, left, and right but when walk while turn the camera, the character will become very laggy and being teleport out of the map range. The problem is solved by redoing the animator by changing into simple direction animations.

Second issue is the character selection. After done the selection, supposedly the only selected character should be appeared in the game, but the reality is all the character are being inside the game. Not just that, due to all character share the same control by user, all the character are having the same actions as the character controlled by users. The issue is solved by applying save and load method.

Third issue is the day night cycle. The features supposedly should have cycle in day and night but the result being done is when reach the nighttime, the sun won't disappear from the sky which making the night scene become as noon seen. The issues were solved by applying the sun rotation method to the moon as well but in opposite direction.

Forth issues as well as the biggest challenge for this project is the multiplayer settings. Due to the first time of getting touch with multiplayer system, it is hard to learn in short time as the duration for complete the project is closer, plus the difficulties for using multiplayer system with 3D characters making the level become harder; instantiation do not run due compiler giving error of `ThrowNoException()` which is an error of the snippet code is not debug while running yet the code does not have any error by the debugger as well. Not just that, first user's

character and second user's character will have an issue of first user's camera view but control the second player character, the problem also applied to the second player as well. The issues have struggle for 3 weeks and finally, it has been solved by:

```
PhotonNetwork.Instantiate(players[saveManager.instance.currentPlayer].name,....)
```

originally is:

```
PhotonNetwork.Instantiate(players [saveManager.instance.currentPlayer], ....))
```

for character instantiation to the game:

```
if (photonView.isMine)
```

is to ensure that if the photon network character is the user him/herself.

```
if(cam!isMine){Destroy(GameObject<Camera>())}
```

is for destroying the camera object that is not user. Although this issue has been solved, but it also creates new issues to the feature draw which is due to destroying the Camera game object. This issue is also being solved by applying if lese for checking if the camera is being destroyed or null, if yes will return else continue to have drawn feature.

Fifth issues are the voice chat. Originally the plan for applying voice chat is by using Agora. Due to the latest update, the original library:

```
using agora_gaming_rtc
```

is no more usable. Thus, this issue is solved by substitute the Agora with similar system, Photon Voice 2 as this system is much easier than Agora.

Chapter 6

System Evaluation and Discussion

6.1 System Test Case

After the development of the project, it is a crucial on confirming that the virtual system is functioning according to its intended purpose and design as there might have some occurrences where users might not be able to do so.

Thus, verifications are required to be fulfil as below:

1. PUN 2 Server

Table 6.1.1– Connection to PUN2 Server Test Result

No.	Test Case	Expected Outcome	Result
1	Verify the connection to server after user done character selection	Users can get connected to the server	Pass

2. PlayFab (Authentication)

Table 6.1.2– PlayFab Authentication Test Result

No.	Test Case	Expected Outcome	Result
1	Verify user fill in NULL values of input (name, email, password)	Login: users will not be able to log in and will show error message of “Wrong email or Password” Register: users will not be able to create account due wrong format of email or password	Pass
2	Verify user fill in wrong value of input (name, email, password)	Login: users will not be able to log in and will show error message of “Wrong email or Password” Register: users will not be able to create account due	Pass

		wrong format of email or password	
3	Verify user fill in email that does not exist	Users will not be able to log in and will show error message of “Wrong email or Password”.	Pass
4	Verify user fill in NULL email for reset password	Users will not be able to get the reset verification	Pass
5	Verify user fill in wrong email for reset password	Users will not be able to get the reset verification	Pass
6	Verify user fill in correct information of account (email and password)	Users can get inside the game	Pass
7	Verify user fill in correct email for reset password	Users will be able to get notice of “Please verify from mailbox to reset password” and manage to reset the password.	Pass

3. Character Selection System

Table 6.1.3– Character Selection Test Result

No.	Test Case	Expected Outcome	Result
1	Verify user can choose preferred avatar by pressing left right button	Users can get to the next avatar to see if the avatar is his/her preference.	Pass
2	Verify user can get to lobby with the chosen avatar after hit “Play” button	Users can get connect to lobby with their avatar	Pass

4. Lobby System

Table 6.1.4– Lobby System Test Result

No.	Test Case	Expected Outcome	Result
1	Verify user can see three buttons: Find Room, Create Room, Quit, after getting connected	Users can get the three buttons after the connection done.	Pass
2	Verify user can see list of available room after clicking “Find Room” button	Users manage to see list of available room after clicking the button	Pass
3	Verify user able to enter the available room by clicking on it	User can get connect to the game room	Pass
4	Verify user can create own room by enter room name and click the button “Create Room”	User can create the room server and become the host for the server	Pass
5	Verify only the host user can start the game while other clients are unable	Only the host has the start button for the room server while clients do not have the start button during the game	Pass
6	Verify first client who enter the room can become host after the initial host leave the room	User become the new host for the room server	Pass
7	Verify user can leave the room by clicking “Leave Room” button	Users get disconnected and back to lobby	Pass

5. Avatar

Table 6.1.5– Avatar Test Result

No.	Test Case	Expected Outcome	Result
1	Verify the avatar can play the animation of its action	The avatar can play the expected animation according to its action such as walk will have walk animation	Pass
2	Verify the avatar can rotate 360 degrees to let user investigate surrounding	Users can get to investigate by looking surroundings	Pass
3	Verify user able to move the avatar	Avatar move as user press the related key for example press “W” will walk front	Pass
4	Verify user can see other users nickname of their avatar head	Users can see each other’s nickname	Pass

6. Voice Chat System

Table 6.1.6– Voice Chat System Test Result

No.	Test Case	Expected Outcome	Result
1	Verify sounds coming from other users	User can get the sound messages from other users same as others can get message from user him/herself.	Pass
2	Verify sound applicable distance	User able to receive the sound from other users in certain range, near will louder, far will lower	Pass

7. Grab Object System

Table 6.1.7– Grab Object System Test Result

No.	Test Case	Expected Outcome	Result
1	Verify user able to grab the objects	Users can grab those grabbable objects and bring it to whatever places by press “E” key button.	Pass
2	Verify user to put down the grabbable objects	Users can put down the grabbable objects by press again “E” key button	Pass

8. Writing System

Table 6.1.8– Writing System Test Result

No.	Test Case	Expected Outcome	Result
1	Verify user able to write or draw on whiteboard	Users can write or draw on whiteboards by pointing the mouse to the whiteboard	Pass
2	Verify user able to clean the draw on whiteboard	Users can delete the words or draws on whiteboard by pressing “R” key button	Pass

9. Day Night Cycle System

Table 6.1.9– Day Night Cycle System Test Result

No.	Test Case	Expected Outcome	Result
1	Verify the scenery will change from day to night, night to morning according to the time	After reach 20:05, scenery will change to night, after reach 7:00, scenery will change back to morning	Pass

10. Teleport System

Table 6.1.10– Teleport System Test Result

No.	Test Case	Expected Outcome	Result
1	Verify user can teleport to the places that had been set by the portal	Purple portal will bring user to lecture hall while green portal will bring user to garden. Walk again into the portal will bring back to classroom	Pass

11. Mini-map System

Table 6.1.11– Mini map System Test Result

No.	Test Case	Expected Outcome	Result
1	Verify user current position and places	Mini map will show the scene of user’s current place with a small green point as representation	Pass
2	Verify other user’s presences	Mini map will show other users as well if detected in users surrounding	Pass

6.2 Project Challenge

The most challenging part of doing this project is to create an immersive and like real life virtual environment and social experience. The project tries to have similar scenery as the actual scenery of UTAR FICT environment. The objects such as lecture halls and classrooms are built from scratch. It is not an easy work due have to ensure that the buildings those not seem weird in the shape and thus, need to have a lot of adjustment to reach the satisfied result.

After done the buildings, next challenge is come to the character. Character animation is not a simple work of clicking but also need a lot of adjustment such as the position to play the

related animation, change the animation become smoother, add sound to the animation by the trigger in animation, etc. During first time of doing the animation, it is really struggle as the animation do not work as expected and very laggy.

Next challenge is the most challenging part, multiplayer. Due to this project has the features of enable students to have social interaction in virtual, thus it is a must for the game to have online mode. At the initial, the multiplayer system does not work well as the error pop out continuously once hit the play button. There are so many errors for this multiplayer system: character movement are overlapping, scenery lost due camera not detected, laggy, etc.

Moreover, certain features are being discarded due it was too complicated to implement and some of API sources are already out date or paid which unable to use.

6.3 Objectives Evaluation

As mentioned in Chapter 1, the main objective for this virtual lecture hall and classroom system is to develop a virtual lecture hall and classroom that can give values to users as well as fulfil their satisfaction towards the lecture hall and classroom.

For the first objective, the objective has been accomplished by implementing voice chat and multiplayer system to the game: multiplayer system allows to have more users to join in and have activities together while voice chat system is enabling those users to have an oral presentation with each other. Not just that, decent and elegant environment is referring to the developed virtual environment which is the entire area of FICT to Block L as this is an achievement for objective 2.

Second objective is accomplished by the creation of the whole map of area of FICT to Block L as mentioned in previous point. Due to this large map, users can have the gaming experience of

virtual tour which allow them to investigate the virtual area. The experience is getting more bigger by the implemented features such as grab objects, writing, mini-map, teleports, and day night cycle which will not let them feel bored instead of just walking around without do nothing.

Third objective is accomplished by the implementation of the game in desktop platform. As said, the purpose of this game system is to allow all users have the equality of opportunity on enjoying the system.

6.4 Concluding Remark

According to the result from this project, it shows that the result had managed to promising all the objectives. Users are now able to join the game over the network and interact with others. The communication functionalities which is voice chat had implemented successfully and allowing users to convey their messages in verbal communication through the internet.

Not just that, with the implemented features such as grab objects, writing, day night cycle, mini-map, and teleports, had given a boost to the gaming experience for users while enjoying this virtual reality game.

By developing the virtual game system in desktop platform, not just the students and lecturers from UTAR, all the users around world are able to enjoy this system freely as this project also have a purpose of supporting low budget.

Chapter 7

Conclusion and Recommendations

7.1 Conclusion

In conclusion, virtual learning system is very effective in bringing impact to educations no matter in which level. Virtual learning system biggest benefit is helping students to grow their imaginations and inspiring them in learning new knowledges.

Not just in Malaysia, for other countries may also have the same issues which is virtual learning is not a very popular option. This learning has not much effective in learning although it is very popular among students. As mentioned, virtual learning that applied is only a virtual class that is open from meeting platforms for example Microsoft Teams (Ms Teams) that is just a simple discussion platform which only able to open camera and mic, share screen, pop some messages and emojis, and share recorded videos. Students behind the devices may not concentrating or even not attending the class as they are not getting attract due no interest. Not just that, due high-cost development, and lack of expertise, successful for virtual learning in educations become smaller and smaller.

Thus, the main objective of this project is to develop a virtual lecture hall and classroom system which gives values to users as well as fulfil their satisfaction towards the system. For the goal to be accomplished, tons of efforts have been put in to build it. It is designed in desktop platform which is free for all user to use it. This virtual system also enhances the experience of tour by providing the gameplay which can give impression to the users so they can have interest in visiting UTAR in real life as this system also act as a promote to our university to the society.

7.2 Recommendation

This project still can have more improvements in many aspects: character movement, environment, browser system, and notification system. As the character movement animation now is only simple direction movement, which is running front, back, left, right, front left, front right, back left, and back right as users may prefer to have run instead of walk. In the future, all these movement can be change to the movement like walking, jumping, crouching, which can give even more realistic feeling on controlling an avatar like the figure shown below.



Figure 7.2.1 – Jumping Animation



Figure 7.2.2 – Crouching Animation

Next is the environment. The environment for this virtual lecture hall and classroom now is just simple area referring to the actual area of UTAR. Due it just a single area, users may get bored in future. For this improvement, a whole map of UTAR area is a future recommendation. Not just the FICT area, but also develop other areas as well such as FBF, FAS, etc shown in figures below which will make one big whole map of UTAR environment.



Figure 7.2.3 – FBF (Faculty of Business and Finance)



Figure 7.2.4 – FAS (Faculty of Arts and Social Science)



Figure 7.2.5 – Whole UTAR Kampar

Besides, it is also a must for baking the environment as baking can help in beauty the environment which make it become more realistic as the result from figure below. The reason for baking is not done in current project is due the process requires extra- large RAM for the baking. It not just causes the desktop to become laggy but also giving pressure to the processor which need it to run for a long time depending on the size of the project.



Figure 7.2.6 – Baking Result 1



Figure 7.2.7 – Baking Result 2

Browser and notification system is originally one of the features that should be implemented to this project. Due to this API's which need to be purchased in high cost and complicated level in developing it, the features have been discard from the current project. In the future, these features will return as one of main features with substitution of low-cost API's if manage to get it from somewhere or someone.

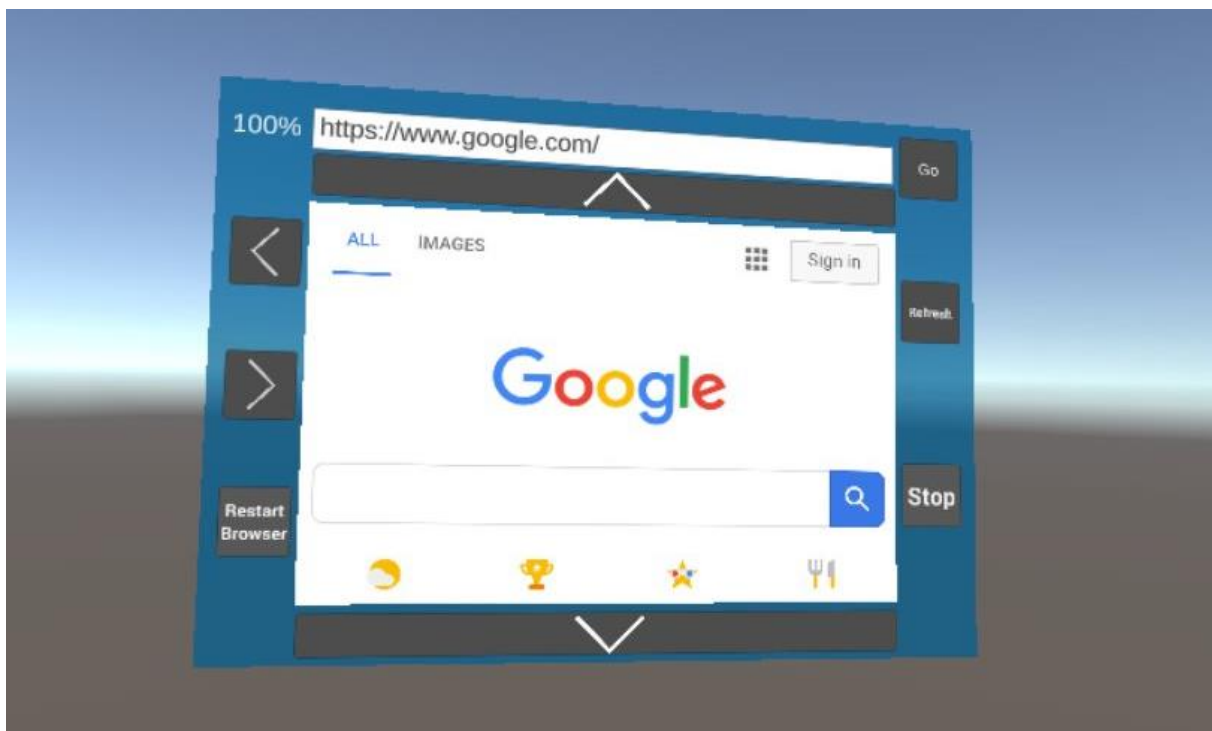


Figure 7.2.8 – Browser

Additionally, the maximum number of users to access to the network is 20 by current implemented Photon Network. In future, a similar multiplayer system, Nakama will be the choices for multiplayer feature due this system has large set of services for users, storage, and real-time communication; as well as specialized API's such as real-time multiplayer, groups/guilds, and chat.

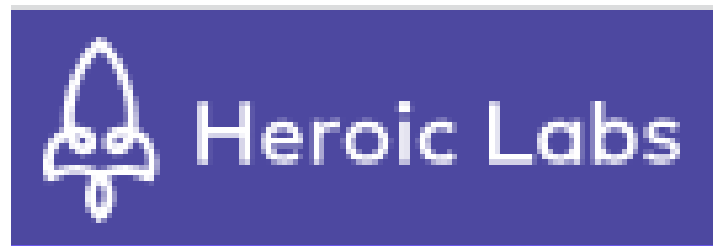


Figure 7.2.9 – Heroic Labs: Nakama

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 1, Year 4	Study week no.: 2
Student Name & ID: YU KAR HING 19ACB04008	
Supervisor: MS. SAW SEOW HUI	
Project Title: Virtual Reality for Lecture Hall and Classroom in UTAR	

1. WORK DONE

Consulting regarding the workflow to be done such as character menu and character creation.

2. WORK TO BE DONE

Character creation and character menu

3. PROBLEMS ENCOUNTERED

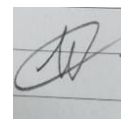
No problem

4. SELF EVALUATION OF THE PROGRESS

Good progress



Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 1, Year 4	Study week no.: 4
Student Name & ID: YU KAR HING 19ACB04008	
Supervisor: MS. SAW SEOW HUI	
Project Title: Virtual Reality for Lecture Hall and Classroom in UTAR	

1. WORK DONE

Done creating the character with animation movement.

2. WORK TO BE DONE

Character selection menu

3. PROBLEMS ENCOUNTERED

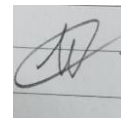
Character animation is not work as expected with laggy problems and animation problems. Had to redo the work from scratch again.

4. SELF EVALUATION OF THE PROGRESS

Bad progress, a bit slow



Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 1, Year 4	Study week no.: 6
Student Name & ID: YU KAR HING 19ACB04008	
Supervisor: MS. SAW SEOW HUI	
Project Title: Virtual Reality for Lecture Hall and Classroom in UTAR	

1. WORK DONE

Character improvement and character menu. After the progress, continue with other features.

2. WORK TO BE DONE

Finish the simple features such as day night cycle, writing, grab objects, mini map, and teleports.

3. PROBLEMS ENCOUNTERED

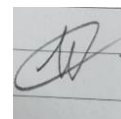
No problem

4. SELF EVALUATION OF THE PROGRESS

Good progress but a bit out of time as planned.



Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 1, Year 4	Study week no.: 8
Student Name & ID: YU KAR HING 19ACB04008	
Supervisor: MS. SAW SEOW HUI	
Project Title: Virtual Reality for Lecture Hall and Classroom in UTAR	

1. WORK DONE

Promising features with an update to the character menu: save and load.

2. WORK TO BE DONE

Multiplayer feature, Photon Network, User Authentication: PlayFab, and Voice Chat: Photon Voice2

3. PROBLEMS ENCOUNTERED

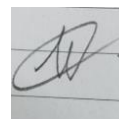
No problem

4. SELF EVALUATION OF THE PROGRESS

Good progress



Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 1, Year 4	Study week no.: 10
Student Name & ID: YU KAR HING 19ACB04008	
Supervisor: MS. SAW SEOW HUI	
Project Title: Virtual Reality for Lecture Hall and Classroom in UTAR	

1. WORK DONE

Done authentication implementation, now start implementing Photon Network to the virtual game.

2. WORK TO BE DONE

Applying voice chat to the game

3. PROBLEMS ENCOUNTERED

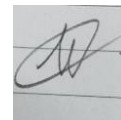
Character not able to be instantiated to the game as the console always show the error of not instantiating the character as no error shown in debugger

4. SELF EVALUATION OF THE PROGRESS

Very bad due had struggle for one week



Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Trimester 1, Year 4	Study week no.:12
Student Name & ID: YU KAR HING 19ACB04008	
Supervisor: MS. SAW SEOW HUI	
Project Title: Virtual Reality for Lecture Hall and Classroom in UTAR	

1. WORK DONE

Final consultation with supervisor and had manage to complete the multiplayer system and voice chat system.

2. WORK TO BE DONE

Final checking on the project

3. PROBLEMS ENCOUNTERED

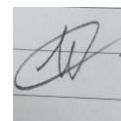
Initially is using Agora for voice chat, due to latest update, the library using `agra_gaming_rtc` is no more usable. Thus, had to change to Photon Voice.

4. SELF EVALUATION OF THE PROGRESS

Not very good due the deletion had given a tight in report time.



Supervisor's signature



Student's signature

POSTER



VIRTUAL REALITY LECTURE HALL AND CLASSROOM

By : Yu Kar Hing

Supervised by : Ms Saw Seow Hui

Introduction

A virtual lecture hall and classroom system is introduced with purpose of making learning to be more fun rather than feel bored. This system not only giving user a tour experience, but also letting them to get know with UTAR FICT.



Objectives

- Create a decent and elegant environment
- Virtual tour game
- Free for all

Methodologies

- Photon-Multiplayer
- Photon Voice-Voice Chat
- Playfab - Authentication



"FUN IN LEARNING WORKS BETTER THAN DULL LEARNING"



Result



PLAGIARISM CHECK RESULT

Virtual Lecture Hall and Classroom in UTAR

ORIGINALITY REPORT

1 %	%	1 %	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	"Chapter 5 Topological and Monotonicity Methods", Springer Science and Business Media LLC, 2007 Publication	<1 %
2	N M Nuttall, G Bradnock, D White, J Morris, J Nunn. "Dental attendance in 1998 and implications for the future", British Dental Journal, 2001 Publication	<1 %
3	S.B. Akintoye, L. Han, H. Lloyd, X. Zhang, D. Dancey, H. Chen, D. Zhang. "Layer-wise partitioning and merging for efficient and scalable deep learning", Future Generation Computer Systems, 2023 Publication	<1 %
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10 Sedra, Adel S.. "Solved Problems to Accompany Microelectronic Circuits", Oxford University Press $<1\%$
Publication

11 V. R. Kaufman, N. Garti. "Analysis of Sucrose Fatty Acid Esters Composition by HPLC", Journal of Liquid Chromatography, 2006 $<1\%$
Publication

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Universiti Tunku Abdul Rahman			
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Form Number: FM-IAD-005	Rev No.: 0	Effective Date: 01/10/2013	Page No.: 1 of 1



FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

Full Name(s) of Candidate(s)	YU KAR HING
ID Number(s)	1904008
Programme / Course	IA
Title of Final Year Project	Virtual Lecture Hall and Classroom in UTAR

Similarity	Supervisor's Comments (Compulsory if parameters of originality exceeds the limits approved by UTAR)
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Number of individual sources listed of more than 3% similarity: <u> 0 </u>	Plagiarism word based on the word "Figure 5.2.1, Figure 5.2...., Table 4.1, Use Case description" in table of content as well as report content.
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Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.



Signature of Supervisor

Name: Ts Saw Seow Hui

Date: 13 Sep 2023

Signature of Co-Supervisor

Name: _____

Date: _____



UNIVERSITI TUNKU ABDUL RAHMAN

**FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY
(KAMPAR CAMPUS)**

CHECKLIST FOR FYP2 THESIS SUBMISSION

Student Id	19ACB04008
Student Name	YU KAR HING
Supervisor Name	MS. SAW SEOW HUI

TICK (√)	DOCUMENT ITEMS
	Your report must include all the items below. Put a tick on the left column after you have checked your report with respect to the corresponding item.
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√	Signed FYP Thesis Submission Form
√	Signed form of the Declaration of Originality
√	Acknowledgement
√	Abstract
√	Table of Contents
√	List of Figures (if applicable)
√	List of Tables (if applicable)
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	List of Abbreviations (if applicable)
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√	Appendices (if applicable)
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I, the author, have checked and confirmed all the items listed in the table are included in my report.

(Signature of Student)

Date: 11/9/2023