RMIT
UNIVERSITY

VIRTUAL REALITY CANVAS LMS TECHNICAL REPORT

Version 1.0

Start Date: **23/5/2023**

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DOCUMENT CONTROL

Version #	Implemented By	Implementation Date	Reviewed By	Approval Date	Reason
1.0	JH-235-vr-Canvas GROUP	23/5/2023	ZHENG LIU	5/6/2023	First Version

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1. EXECUTUVE SUMMARY

PROJECT OVERVIEW:

The goal of our project is to develop a virtual reality chemistry classroom that enables students to learn chemistry through interactive and hands-on experiences. The project utilizes VR technology to give students an immersive experience that combines theoretical knowledge with hands-on practice to increase their interest and efficiency in learning.

PROBLEM STATEMENT:

Traditional chemistry education often lacks opportunities for hands-on practice with elemental models. Additionally, conducting certain experiments in a laboratory environment can be challenging due to factors such as cost and safety concerns. Our aim is to help students gain a more comprehensive understanding of chemistry by complementing theoretical knowledge with practical experience.

SOLUTION:

We used Unity 3D, C#, Snobal and other tools to create a safe, repeatable VR Lab environment where students can observe chemical elements as well as do some experiments. Through VR technology, students can see detailed chemical models and understand chemical principles. The project is also connected to the RMIT Canvas LMS, so that students can complete quiz as well as discussion in the virtual classroom.

EXPECTED RESULTS:

We hope that the VR chemistry classroom will increase students' interest and understanding of chemistry, while reducing the cost and risk of teaching chemistry.

KEY DETAILS:

To realize this project, we need to use Canvas API to connect to school resources and obtain learning materials. Snobal is mainly used to detect whether students have started and completed related projects and display them in the background. In addition, due to the need for a large amount of analysis on Canvas, it will be tested on an independent Canvas LMS in the early stage, and then migrated to the Sandbox of RMIT Canvas with teacher permissions to complete the remaining tests after improvement.

2. INTRODUCTION

Chemistry is a fundamental science that studies the composition, properties, changes of matter, and the relationship with energy changes. It plays a pivotal role in academia and industry. However, in traditional chemistry education settings, students' understanding of chemistry is often restricted by paper-based textbooks and limited opportunities for lab work. Many complex chemical concepts and processes are challenging to convey fully through 2D images. Large-scale laboratories are not only expensive but also carry certain risks.

To address these issues, our team collaborated with RMIT University to develop a virtual reality (VR) chemistry classroom that provides an immersive, interactive scenario for teaching and learning chemistry. With VR technology, students can observe and explore the microscopic world of chemistry in a way that was not possible before.
In our VR chemistry classroom, students, who are our primary users, can directly observe and manipulate 3D models of chemical elements to understand their structure and properties better. Furthermore, they can compare different chemical elements and witness microscopic reactions and structures as they integrate and decompose elements. This approach significantly enriches the students' learning experience and boosts their interest in chemistry.

Another significant aspect of our VR chemistry classroom is its integration with Canvas. Students can load different element models into the VR classroom by clicking buttons, with these models being uploaded to Canvas by the teachers. This interactive approach to teaching and learning not only increases student engagement but also makes tracking and assessing student progress easier.

To build this VR classroom, we utilized various technologies and tools including C#, Unity3D, SNOBALSDK, and PicoSDK. Our aim is to revolutionize chemistry education by making it more engaging and effective through innovative teaching methods and interactive designs that stimulate students' interest and enhance learning efficiency.
With the continuous development of VR technology, we are optimistic about the vast potential of its application in the field of education, especially in science teaching. We are proud to be part of this revolution, providing innovative solutions to enhance the effectiveness of chemistry education.

3. REQUIREMENTS

USER CASES

User Case 1: Freedom to move around the Classroom

-***Participant:*** Student

-***Description:*** Students can move and observe freely in the VR classroom. This includes forward, backward, left and right movement, as well as rotation of the viewpoint, providing a 360-degree free viewing environment.

User Case 2: Interactable Options

-***Participant:*** Student

-***Description:*** Students can click different buttons in the vr to complete different actions. These actions may include viewing chemical element models, participating in virtual quizzes, asking questions, etc.

User case 3: View chemical element models

-***Participants:*** Students

-***Description:*** Students can view and manipulate 3D models of chemical elements in a VR environment. These models provide an intuitive way to learn by accurately demonstrating the structure and properties of chemical elements.

User Case 4: Participate in a virtual quiz

-***Participant:*** Student

-***Description:*** Students can participate in a virtual quiz created by the instructor in a VR environment and get instant feedback. In a quiz, students are required to answer questions and can receive immediate feedback, which helps them understand their progress and level of understanding.

User Case 5: Create a virtual quiz

-***Participant:*** Teacher

-***Description:*** Teachers can create and manage quizzes through RMIT Canvas LMS, then will show that in a VR environment students can check quiz.

User Case 6: Login

-***Participant:*** Student, teacher

-***Description:*** Students and teachers can access the VR Chemistry classroom by providing credentials (SNOBAL 6 DIGITAL PASSOWRD AND CANVAS ACCESS CODE).

User Case7: Editing and adjusting a 3D model in a VR Canvas

- ***Participant:*** Student

- ***Description:*** Students want to be able to edit and adjust 3D models in the VR canvas, including operations such as scaling, rotating and moving. This will allow them to create more detailed and complex designs and creations.

User Case 8: Putting in chemical element models via Canvas

- ***Participant:*** Teacher

- ***Description:*** A teacher wants to upload a model of a chemical element via Canvas so that students can access and interact with it in a VR chemistry classroom.

FUNCTIONAL REQUIREMENTS SPECIFICATION

Req. ID	Description	Priority	UC covered
1	The system should allow students to move and observe freely within the VR classroom	High	User Case 1
2	The system should provide a series of interactable buttons for students to perform different actions in the VR environment	High	User Case 2
3	The system should provide 3D models of chemical elements for students to view and manipulate in the VR environment	High	User Case 3
8	The system should allow a teacher to upload a model of a chemical element via Canvas.	High	User Case 8
4	The system should allow teachers to create virtual quizzes in a VR environment	Medium	User Case 4

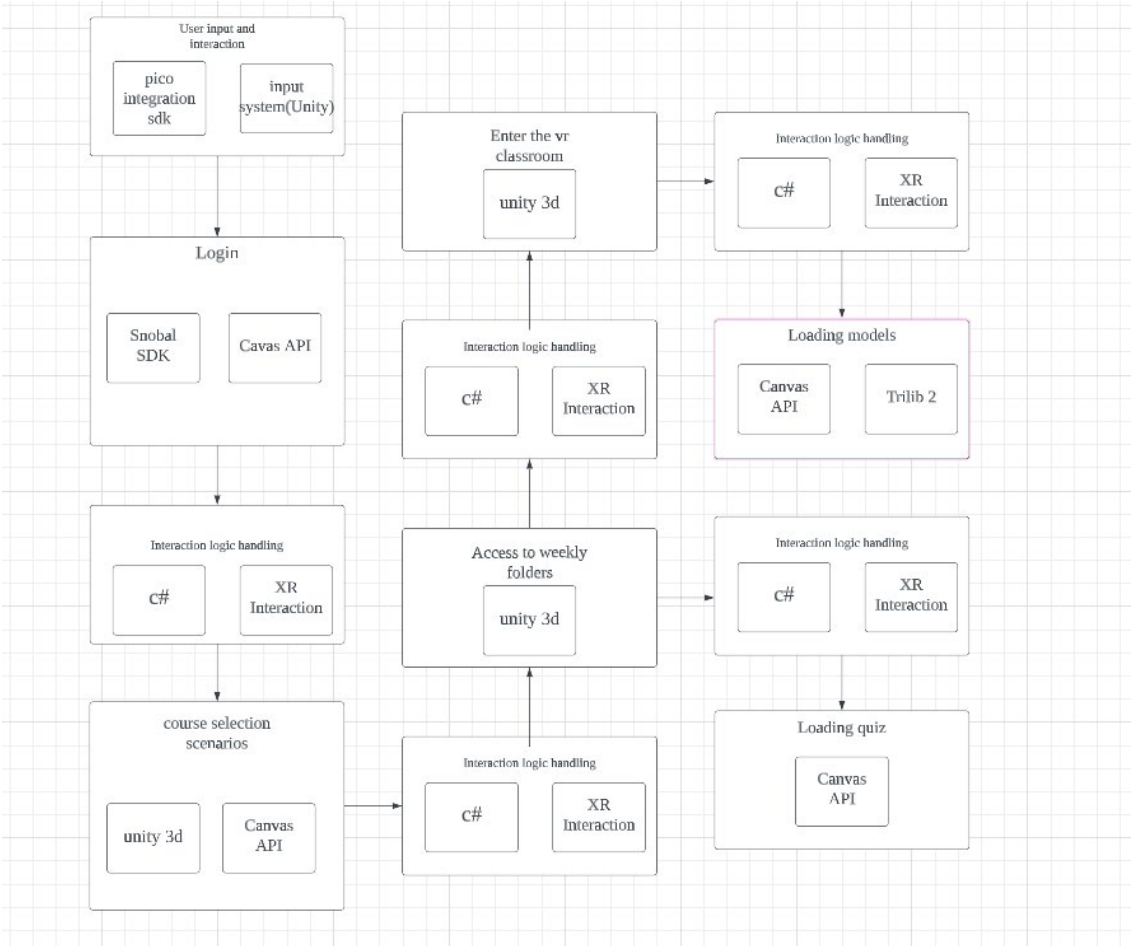
5	The system should allow students to participate in virtual quizzes in a VR environment and receive immediate feedback	Medium	User Case 5
6	The system should allow students and teachers to access the VR Chemistry classroom by providing credentials.	Medium	User Case 6
7	The system should allow students to edit and adjust 3D models in the VR canvas, including operations such as scaling, rotating, and moving.	Low	User Case 7

NON FUNCTIONAL REQUIREMENTS SPECIFICATION

Req. ID	Description	Priority	UC covered
9	The VR environment should remain smooth, and the rendering speed needs to meet the demand for real-time interaction.	High	N/A

4. ARCHITECTURE

Describe here the architecture of the system with detailed diagrams/flowcharts etc.



5. TECHNICAL FRAMEWORK

TECHNOLOGY AND ENVIRONMENT:

1. PICO Integration SDK: We use PicoSDK to realize the interaction between user and VR environment. PicoSDK can complete the interaction between virtual glasses and controller, and provides a set of development tools for developing VR applications, including user input processing, 3D model rendering and other functions.

2. Unity3D: Our application is built based on Unity3D engine. We use Unity3D for modeling. Unity3D is a powerful game development engine that supports the creation of 3D models and environments, and provides a complete set of physics engine and interaction processing tools.

3. Snobal SDK: Snobal is a platform that integrates online classrooms and multi-person chats. In the project, we require you to log in to Snobal before starting connect to Canvas. After students complete the relevant courses, you can see which students have completed and which have not completed in the Snobal background.

4. Canvas API: We use the Canvas API to manage and conduct courses. the Canvas API allows us to create and manage quizzes in the VR environment, select different courses, and download files from Canvas, providing powerful educational tools.

5. TriLib 2: TriLib 2 is an open source model import library for Unity3D that provides the ability to import and manipulate 3D models, allowing us to easily import various model formats (e.g. FBX, OBJ, GLTF, etc.) into Unity.

6. Input System: Input System is a package for Unity3D that provides a more powerful, flexible and customisable user input system. It enables better handling of various input devices such as keyboards, mice, joysticks and touchscreens, and provides more streamlined input handling and event listening capabilities.

7. Test Framework (Unity Package): The Testing Framework is a package for Unity3D that provides a set of tools and features for writing and executing automated tests. This makes it easier for us to perform unit, integration and functional testing of our applications etc.

8. XR Plugin Management: XR Plugin Management is a Unity3D feature that allows us to manage different XR (Extended Reality) platform plugins such as Oculus, SteamVR and Windows Mixed Reality in our applications. it simplifies the process of switching and configuring between different XR platforms.

9. XR Interaction Toolkit: XR Interaction Toolkit is a package for Unity3D that provides a set of tools and components for developing interactive XR applications. It includes features for handling user interaction, grasping and manipulating objects, touch feedback and more to help simplify the development process of XR applications.

10. PICO Unity Live Preview Plugin: PICO Unity Live Preview Plugin is a plugin for Unity3D that provides live preview and debugging with Pico VR devices. It allows us to instantly view and test the performance of our applications on the Pico VR device in the Unity editor.

11. WaveXR_SDK (No longer use in project): WaveXR_SDK is a development kit for Unity3D to develop applications on the Wave XR platform.

PROGRAMMING LANGUAGE:

We mainly use C# programming language for development. In the project, all interactions performed by clicking buttons are done by C#, which is an object-oriented programming language that is very compatible with tools such as Unity3D and PicoSDK, which can facilitate efficient development and debugging. Script in Unity3D run on C# which help manipulate 3D game objects.

6. IMPLEMENTATION

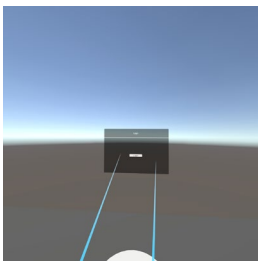
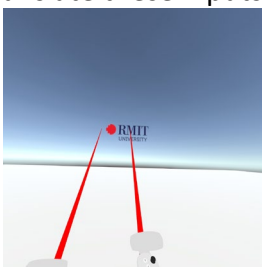
The implementation of our VR chemistry classroom application consists of the following major steps:

MODELING THE CLASSROOM ENVIRONMENT:

We first downloaded the basic classroom scene from "https://www.aigei.com/" along with the basic elements for modeling, such as terrain, furniture and decorations, and then created a basic 3D classroom environment in Unity3D, and then used Unity's lighting and rendering tools to create realistic visual effects.

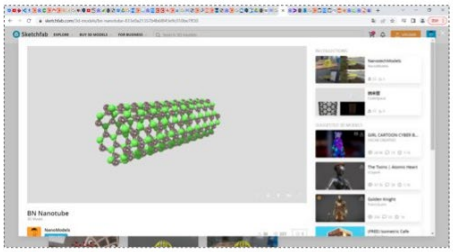
IMPLEMENTATION OF VR INTERACTION:

We used PicoSDK to implement user interaction with the VR environment. We wrote C# scripts to handle user inputs, including moving, viewing, clicking, etc., and then used PicoSDK's tools to translate these inputs into actions in the VR environment.

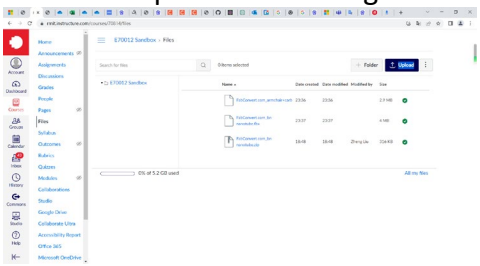
CREATION OF CHEMICAL ELEMENT MODELS:

We downloaded the fbx type from sketchfeb(https://sketchfab.com/3d-models/1t-hfs2-wte2-aap-ce651dd879a64df99d7aebda20772e89) and upload them to canvas as a zip archive, so that when users enter the classroom, they can load the corresponding element models in the canvas by clicking on the file names. Users can view and manipulate these models to better understand the properties and structures of chemical elements. In the screenshots below, on the left is a preview of the model in sketchfeb, and on the right is what the model looks like in the vr classroom.



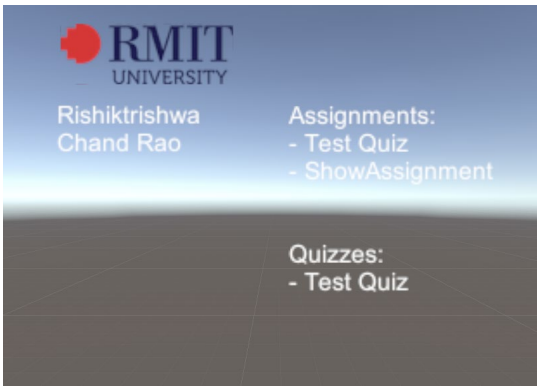
CANVAS INTEGRATION:

We used the Canvas API to integrate the VR classroom with Canvas. Students can log in to their Canvas account directly in the VR classroom and can access and load their course content, including chemistry element models and quizzes. In addition, teachers can use Canvas to upload and manage chemistry models and quizzes.



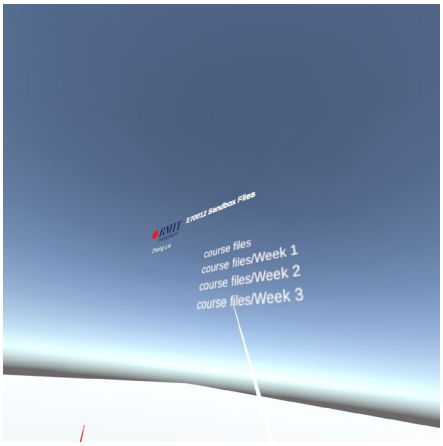
VR CLASSROOM QUIZZES:

We have also developed a feature to take quizzes in a VR environment using the quiz feature of Canvas. Teachers can create and manage quizzes in Canvas, and students can take these quizzes in a VR environment and get real-time feedback. This allows teachers to easily monitor and track student progress, while providing an immersive learning experience for students.



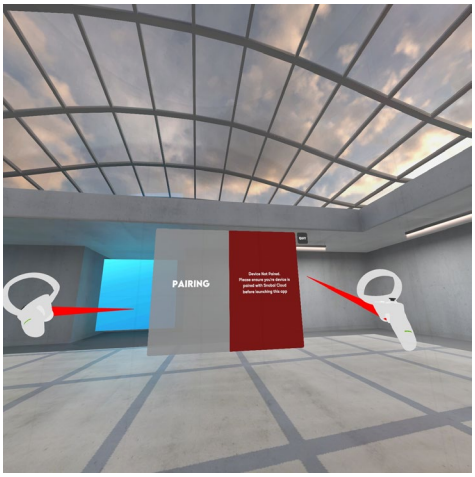
SELECT COURSE SCENARIO:

We created a Select Course Scenario. In the Select Course Scenario, students can choose the chemistry course they want to participate in based on a list of courses provided by the school. By providing an intuitive course selection interface in the VR environment, students can browse the available courses and make their choices. This feature ensures that students are able to select the course that suits them according to the school's requirements for learning and practice in the VR chemistry classroom.

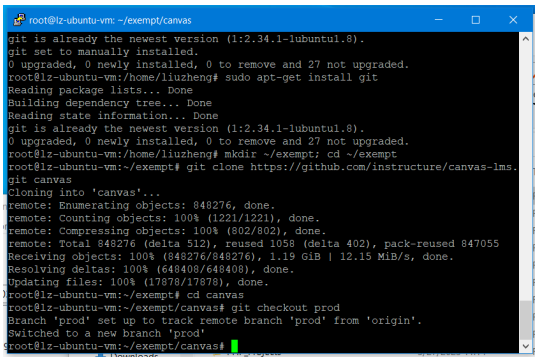


LOGGING IN USING SNOBAL:

In our VR Chemistry Classroom, students can log in using Snobal, which provides a secure and reliable authentication mechanism that allows students to use their Snobal account to log in to the VR Chemistry Classroom, gain access and start learning. On the other hand, teachers can view students' learning and completion in the VR Chemistry classroom in snobal.

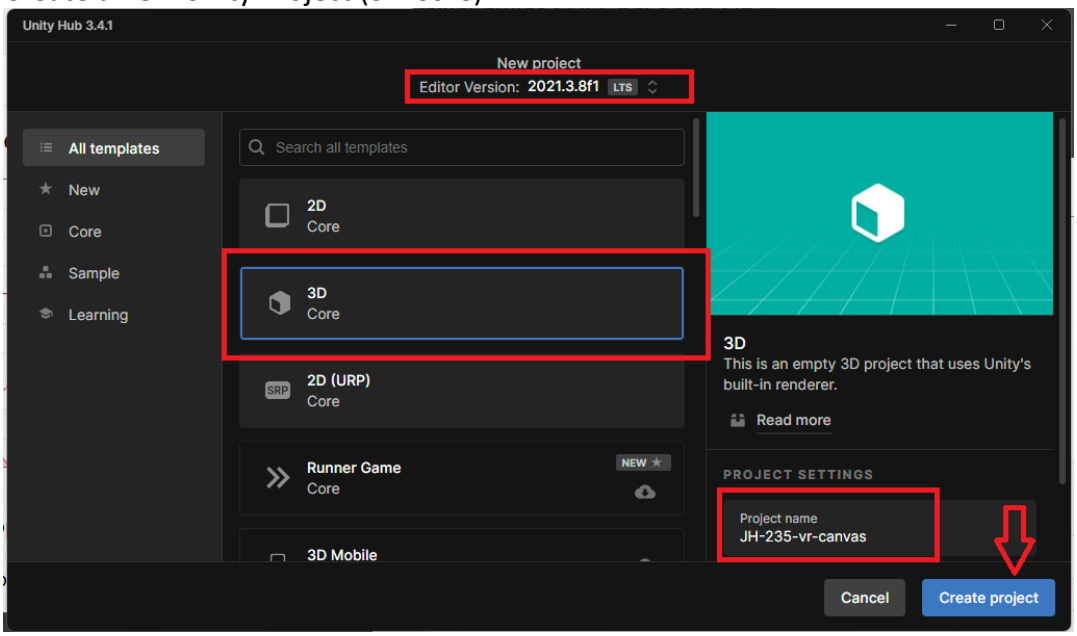


BUILD OUR OWN CANVAS PLATFORM AND CREATE A DEVELOPER ACCOUNT.

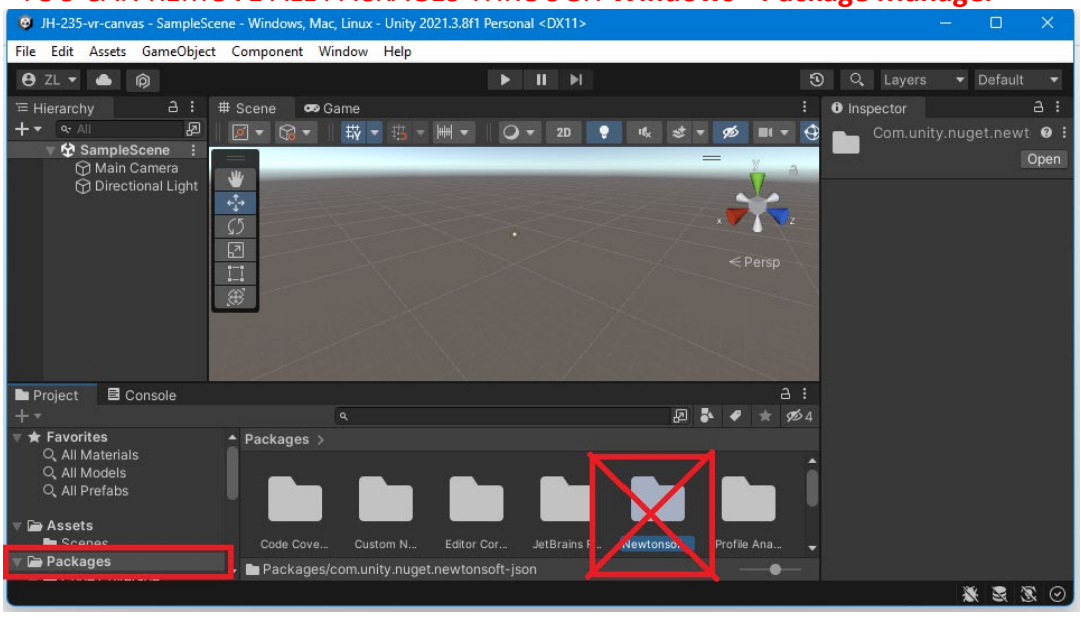


7. DEPLOYMENT INSTRUCTIONS

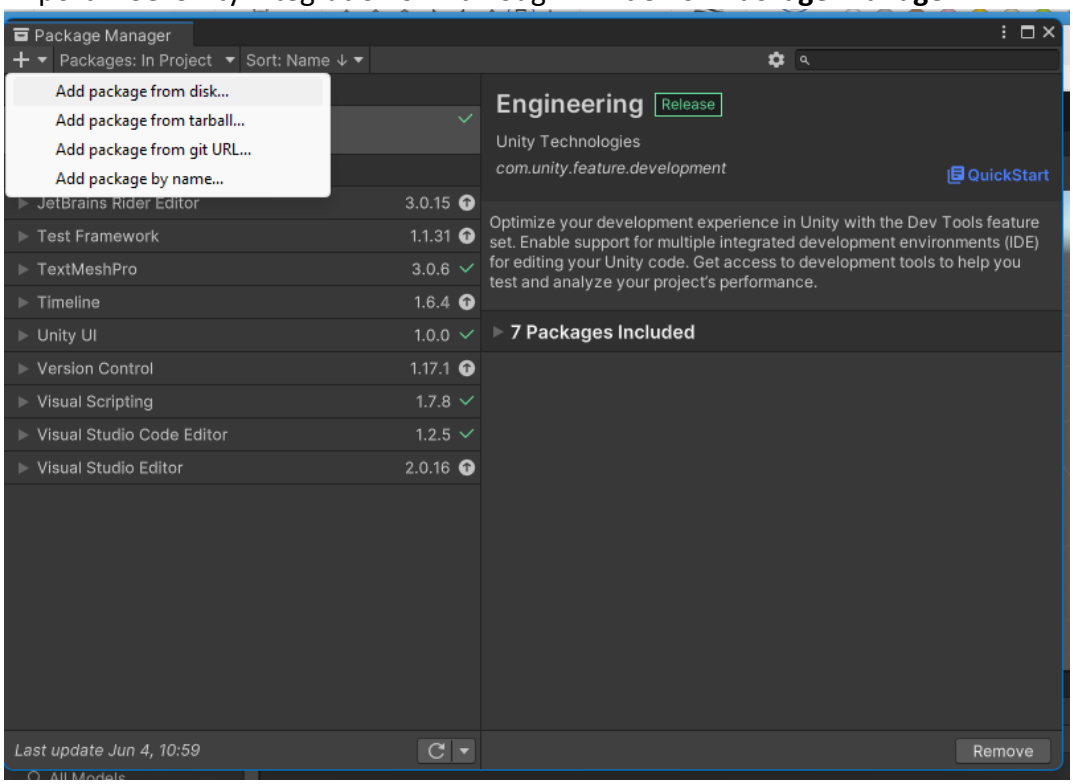
1. Install Unity (Recommend Version 2021.3.8f1 because PICO SDK has a BUG).
2. Create a new Unity Project (3D Core).



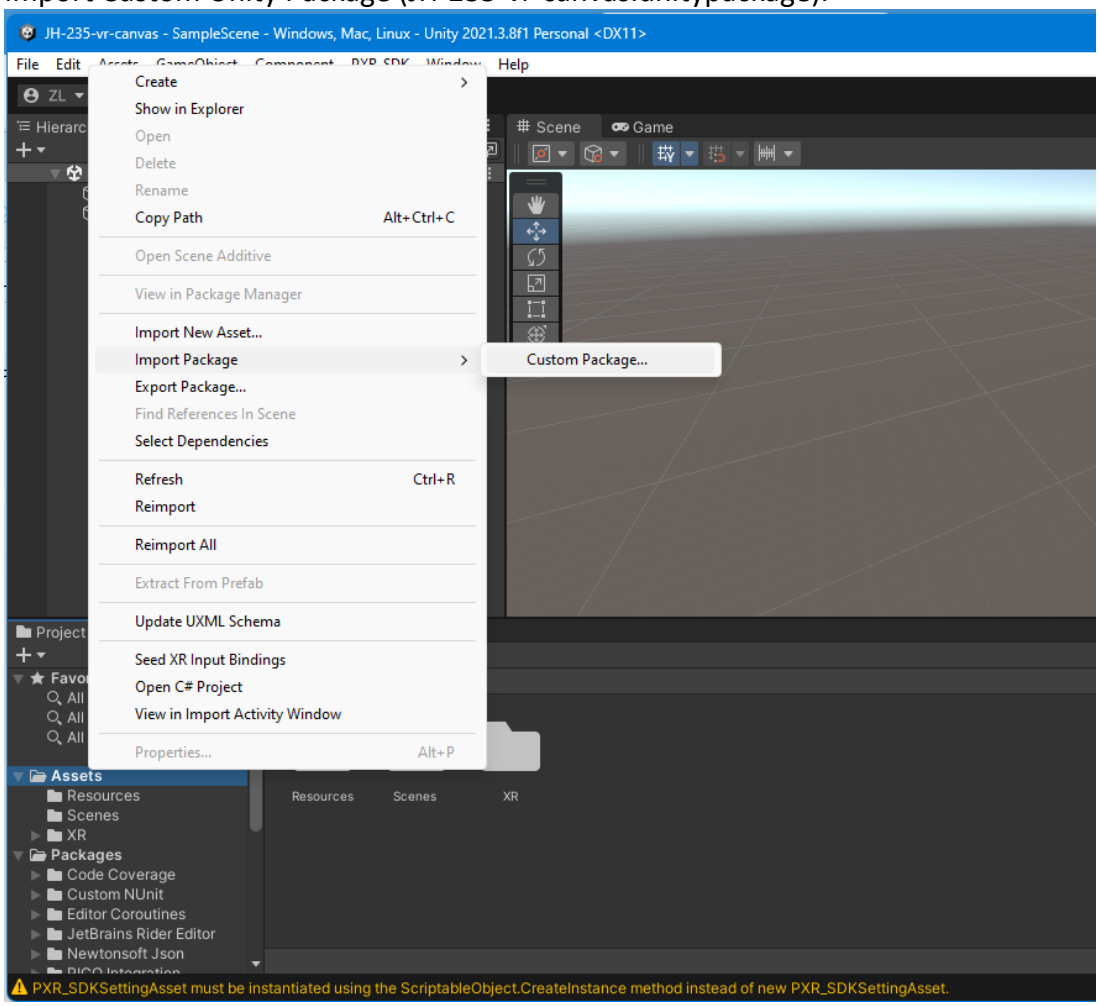
3. Delete the package (com.unity.nuget.newtonsoft-json@??.??.??) from Packages.
   *YOU CAN REMOVE ALL PACKAGES THROUGH **Windows->Package Manager**



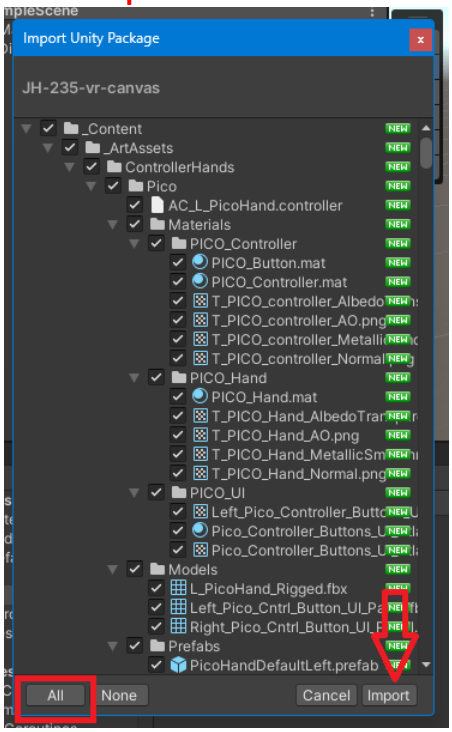
4. Download PICO Unity Integration SDK from PICO DEVELOPER WEB (https://developer-global.pico-interactive.com/sdk?deviceId=1&platformId=1&itemId=12).
5. Import PICO Unity Integration SDK through **Windows->Package Manager**.



6. Import Custom Unity Package (JH-235-vr-canvas.unitypackage).

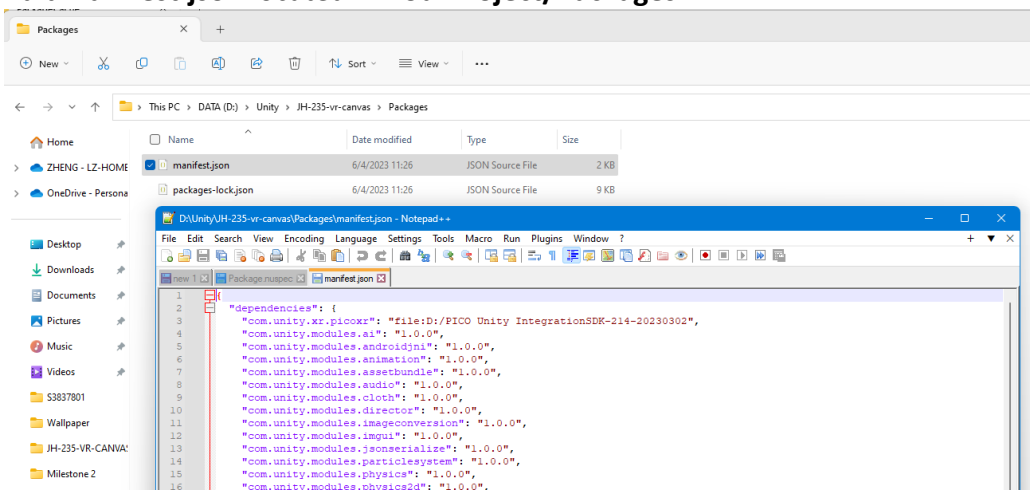


Select import ALL.



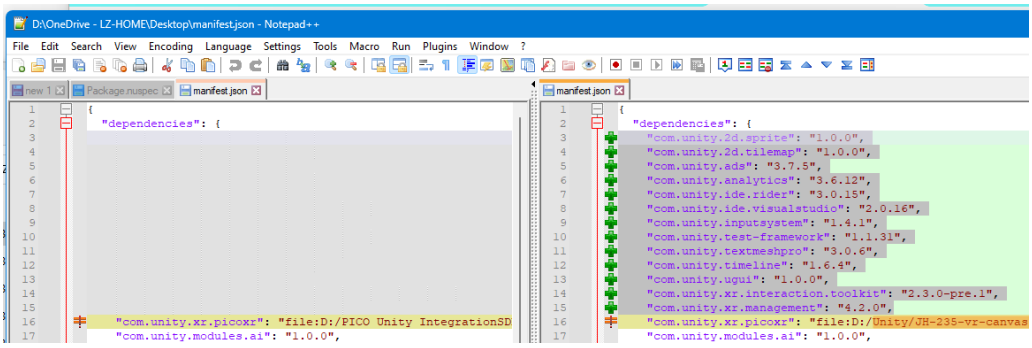
Ignore all error for now, you need import some extra packages later.

7. Edit **manifest.json** located in **YourProject/Packages**

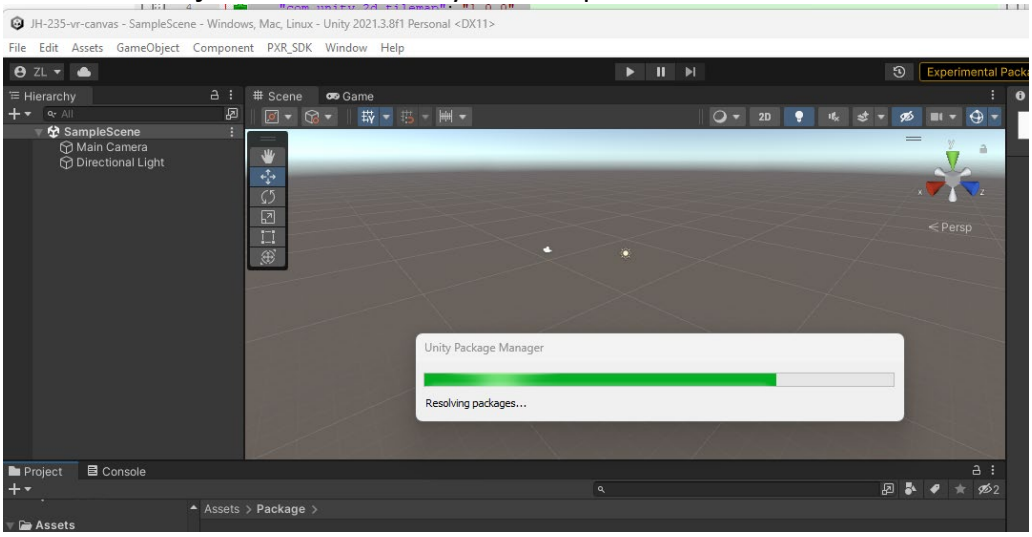


8. Add required packages lists as follow.

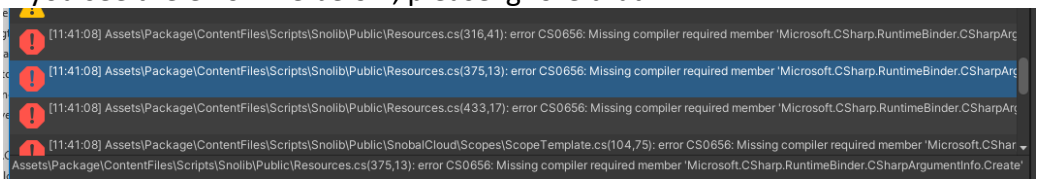
"com.unity.2d.sprite": "1.0.0",
"com.unity.2d.tilemap": "1.0.0",
"com.unity.ads": "3.7.5",
"com.unity.analytics": "3.6.12",
"com.unity.ide.rider": "3.0.15",
"com.unity.ide.visualstudio": "2.0.16",
"com.unity.inputsystem": "1.4.1",
"com.unity.test-framework": "1.1.31",
"com.unity.textmeshpro": "3.0.6",
"com.unity.timeline": "1.6.4",
"com.unity.ugui": "1.0.0",
"com.unity.xr.interaction.toolkit": "2.3.0-pre.1",
"com.unity.xr.management": "4.2.0",



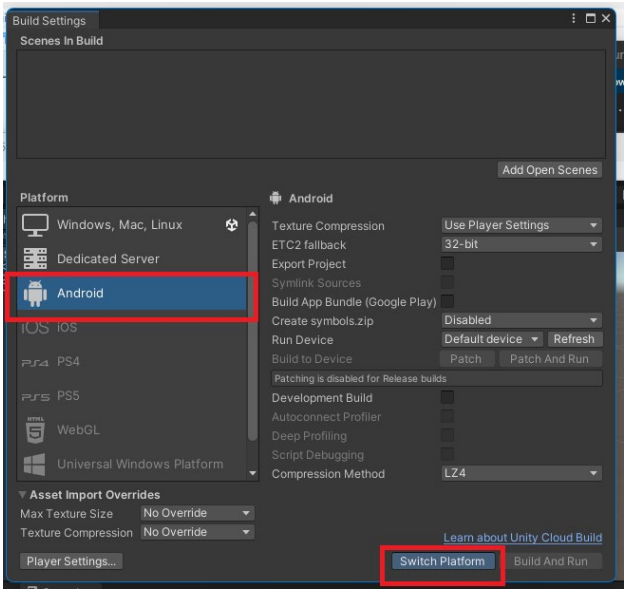
9. Save **manifest.json** then back Unity should update itself.



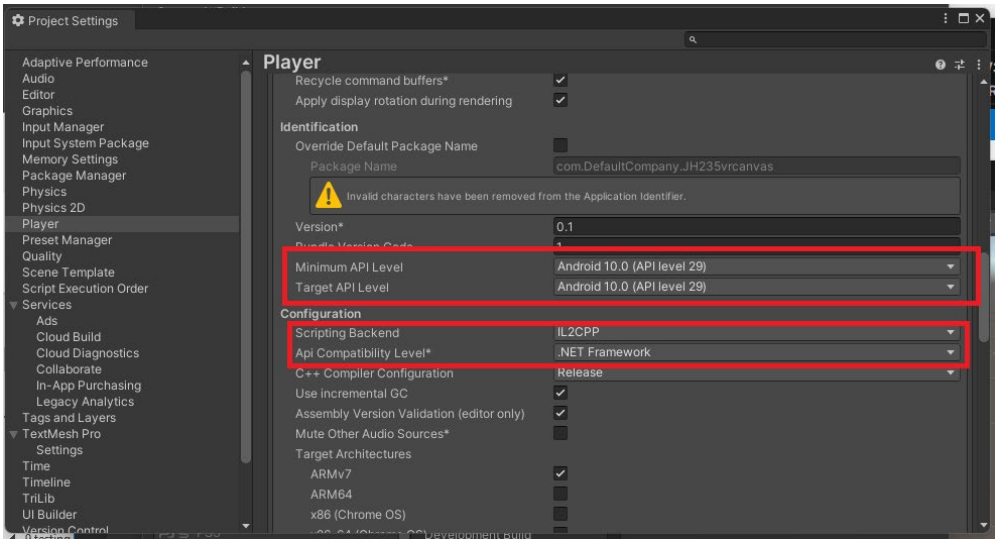
10. If you see the error like below, please ignore that.



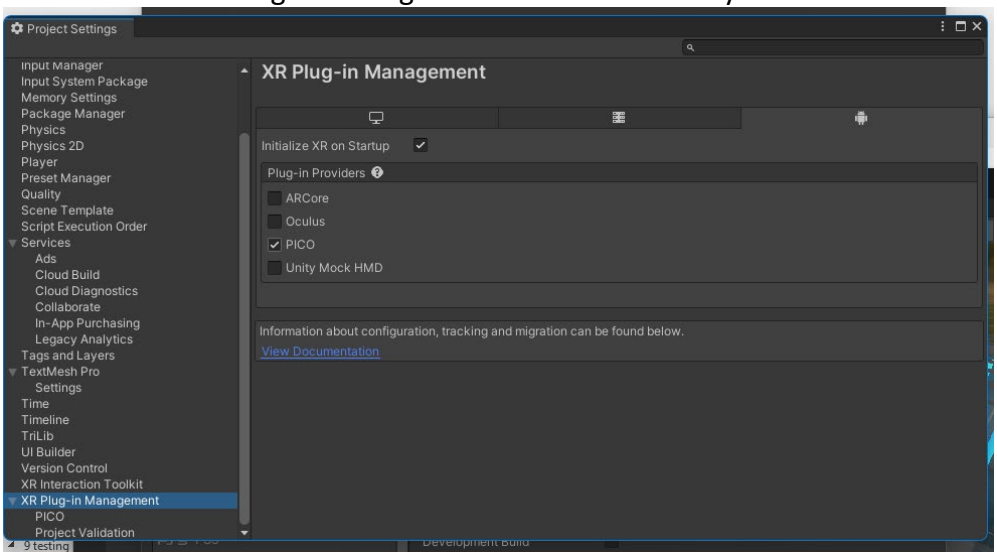
11. Change Build Settings to **Android**.



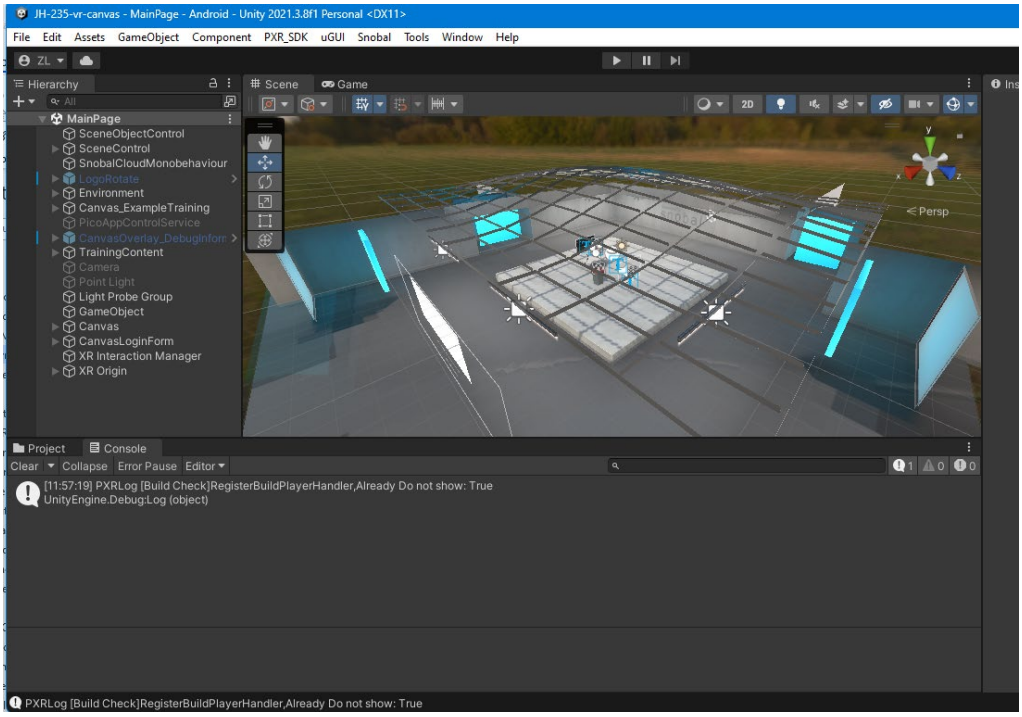
12. Change **4** important settings in Player settings.
    Minimum API Level **Android 10.0 (API level 29)**
    Target API Level **Android 10.0 (API level 29)**
    Scripting Backend **IL2CPP**
    Api Compatibility Level **.NET Framework**



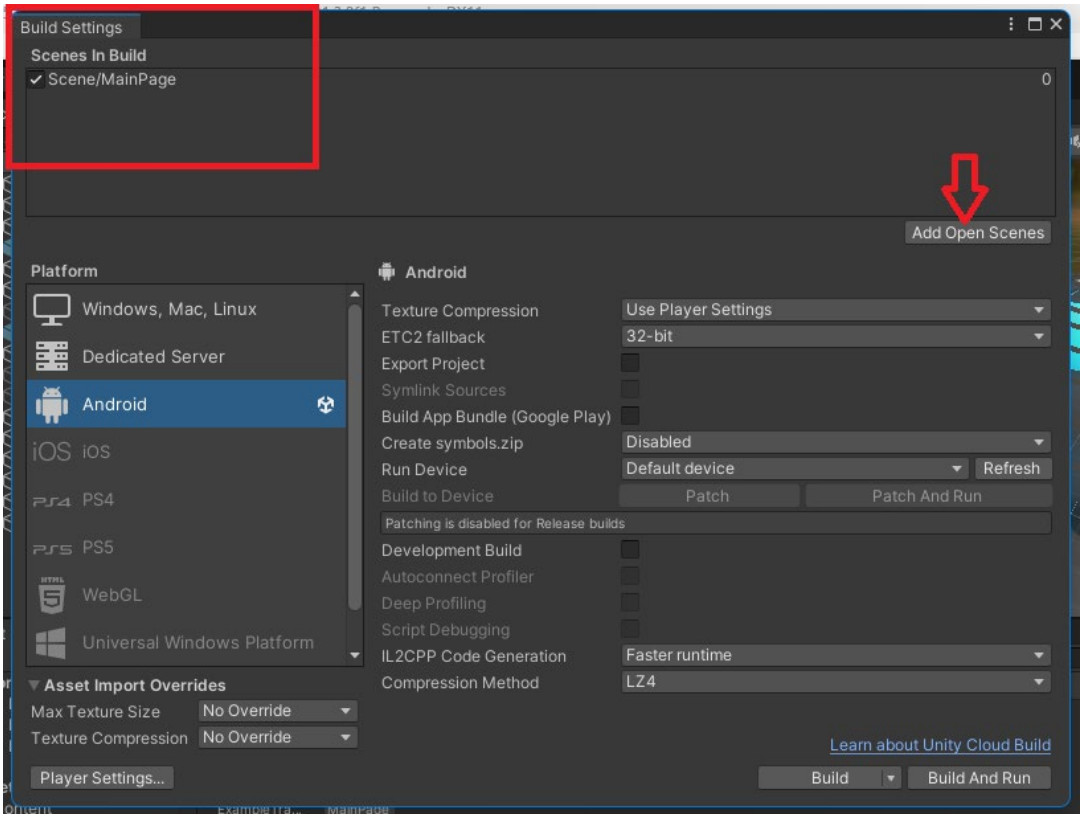
13. Double check XR-Plug in Management tick the **PICO** only.



14. All errors should be solved.



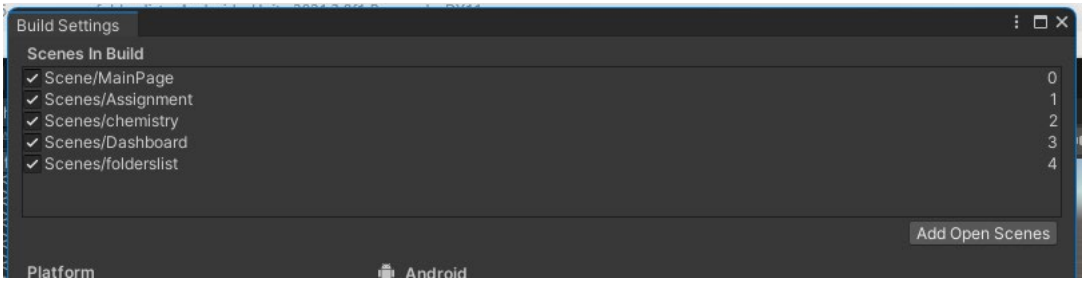
15. Add all Scenes in Build as follows.
    - Double click Open Scene **/Assets/MainPage**
    - Go to **File->Build Settings** Click **Add Open Scene** button.



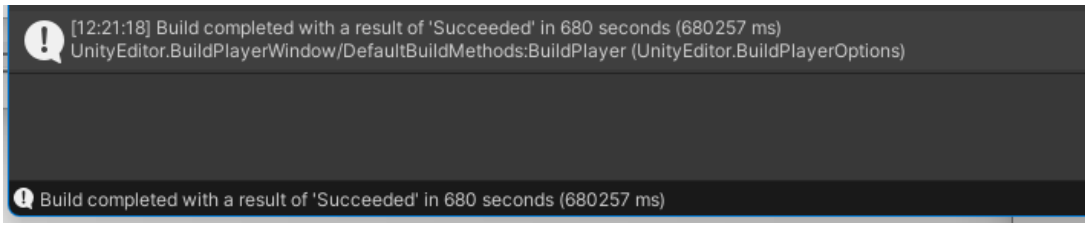
Repeat the above steps to import the remaining scenes in Scenes in Build.

- Scene1 **/Assets/Scenes/Assignment**
- Scene2 **/Assets/Scenes/Chemistry**
- Scene3 **/Assets/Scenes/Dashboard**
- Scene4 **/Assets/Scenes/folderslist**

Scenes in Build should look like as follow.



16. Click Build and give a location check the whole project work properly.
    *FIRST BUILD MAY NEED AT LEAST 10 MINS.



17. Done part of VR PROJECT.
18. Tips.

    Just remind, this project need keep it online and make sure your VR devices has been registered in Snobal Cloud and this APK should be upload in Snobal Cloud and get the APK UUID then could work properly. Otherwise, you will see empty error message.

    For debug purpose you need to change the file **\Assets\ExampleTrainingApp\ Example App Settings** and main scripts in **\Assets\scripts**

8. TEST SPECIFICATIONS

Test Case ID	Req. covered	Test Objective	Preconditions	Steps	Test data	Expected result
1		PC	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Open snobal website Make our project outcome type-acknowledge	Snobal login data, Canvas model and canvas user data	All the files ready
2		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Turn on Pico neo 3 Click Jh-235-vr-canvas in app store	Snobal login data, Canvas model and canvas user data	Able to open the application
3		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Look around the room	Snobal login data	The view can move and have controller displayed

4		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click the passcode to login	Snobal login data	Able to login
5		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Look back	Snobal login data, canvas user data	The view can move and canvas login page displayed
6		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click login button to join the project	Snobal login data, canvas user data	Able to login
7		Pico neo 3	Uploaded project onto Snobal	Look onward	Snobal login data, canvas user data	The view can move and have controller displayed

			Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas			
8		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click E70012 Sandbox	Snobal login data, canvas user data	Able to click and view files
9		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click Assignment button	Snobal login data, canvas user data	Able to click and show assignments and quizzes
10		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click Dashboard	Snobal login data, canvas user data	Able to click and back to dashboard

11		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click Sandbox	Snobal login data, canvas user data	Able to click and show files
12		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click course files/Week 4	Snobal login data, Canvas model and canvas user data	Able to click and load files
13		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click course files/Week 4		Able to show no files in this folder
14		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode	Look around the chemical laboratory	Snobal login data, Canvas model and canvas user data	Able to move view camera and controllers displayed

			Upload all the files needed onto canvas			
15		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click back button		Able to click and back to sandbox files page
16		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click course files/Week 2		Able to show model files in this folder
17		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Look around the chemical laboratory and the model	Snobal login data, Canvas model and canvas user data	Able to move view camera and controllers displayed
18		Pico neo 3	Uploaded project onto Snobal	Click back button	Snobal login data, Canvas model and canvas user data	Able to click and back to sandbox files page

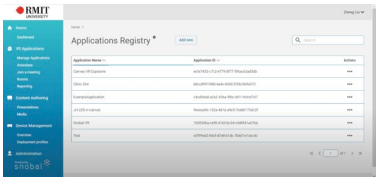
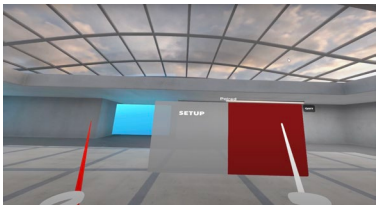
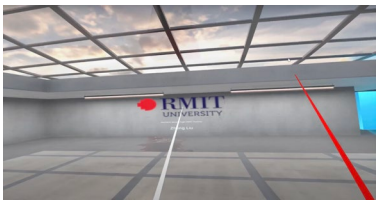
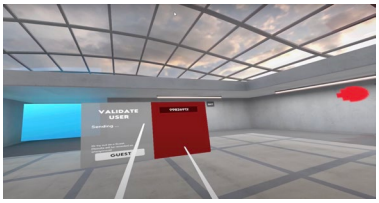
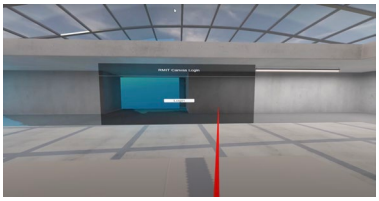
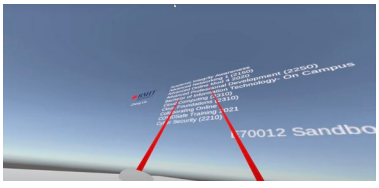
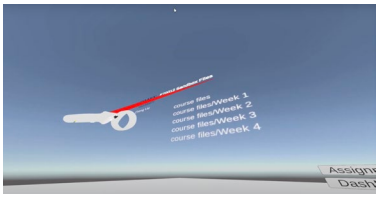
			Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas			
19		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click course files/Week 1	Snobal login data, Canvas model and canvas user data	Able to show model files in this folder
20		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click back button	Snobal login data, Canvas model and canvas user data	Able to click and back to sandbox files page
21		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click course files/Week 3	Snobal login data, Canvas model and canvas user data	Able to show model files in this folder

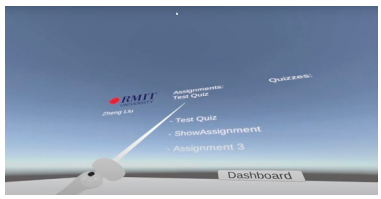
22		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click back button	Snobal login data, Canvas model and canvas user data	Able to click and back to sandbox files page
23		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click Home page button	Snobal login data, Canvas model and canvas user data	Able to click and back to home page
24		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click quit button	Snobal login data and canvas user data	Able to quit
25		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode	Turn on pannel	Snobal login data	Able to show control panel

			Upload all the files needed onto canvas			
26		Pico neo 3	Uploaded project onto Snobal Application outcome type-acknowledge Set the passcode Upload all the files needed onto canvas	Click quit button	Snobal login data	Able to quit the program

9. TESTING RESULTS

DEMO VIDEO URL: https://youtu.be/nfxKR9QjgXE

Test Case ID	Status	Screenshot
1	Pass	
2	Pass	
3	Pass	
4	Pass	
5	Pass	
6	Pass	
7	Pass	
8	Pass	

9	Pass	
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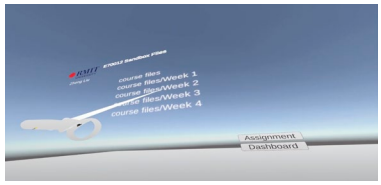
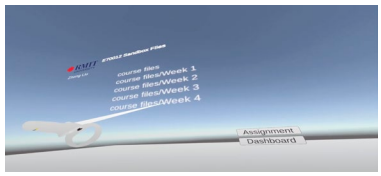
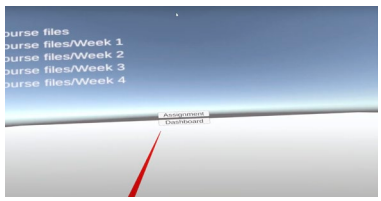
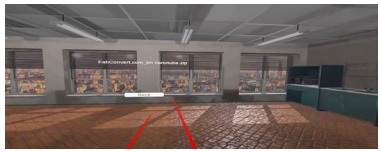
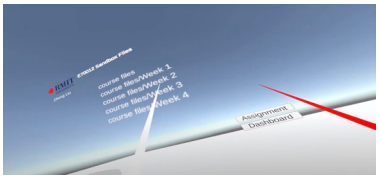
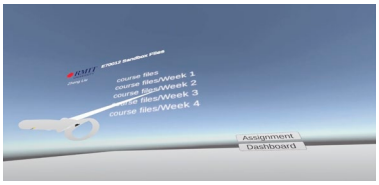
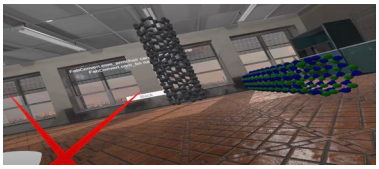
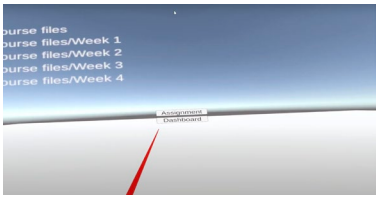
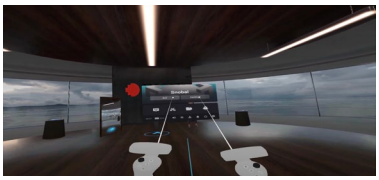
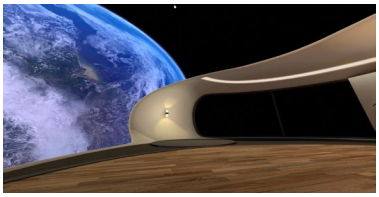
11	Pass	
12	Pass	
13	Pass	
14	Pass	
15	Pass	
16	Pass	
17	Pass	

18	Pass	
19	Pass	
20	Pass	
21	Pass	
22	Pass	
23	Pass	
24	Pass	
25	Pass	
26	Pass	

10. CYBER SECURITY

1. Authentication and Access control: Implement robust authentication and access control mechanisms to ensure that only authorized users can access the VR project and related data (Canvas). Use methods such as passwords, two-factor authentication, and access permission controls to protect the system from unauthorized access.
2. Data Encryption: For sensitive data stored in the Canvas and VR project, employ encryption techniques to safeguard the confidentiality of the data. This can include encrypting the data using encryption algorithms and ensuring proper key management and storage.
3. Secure Data Transmission: When data is transmitted over the network, employ secure transmission protocols (such as SSL/TLS) to protect the confidentiality and integrity of the data. This prevents data from being intercepted, tampered with, or forged.
4. Strengthened Network Defense: Implement enhanced network defense measures within the network architecture of the Canvas and VR project, including firewalls, intrusion detection and prevention systems (IDS/IPS), antivirus software, etc. These measures can detect and prevent malicious network activities, enhancing the security of the system.
5. Regular updates and Vulnerability patching: Timely update the VR project and related software with patches and security updates to address known vulnerabilities and security issues. This helps prevent hackers from exploiting known vulnerabilities to attack the system.
6. Monitoring and Logging: Implement monitoring and logging mechanisms to monitor the activities of the VR project and Canvas, record critical events and security-related information. This helps in early detection and response to potential security threats.
7. Recovery and Backup strategy: Develop appropriate data backup strategies and implement disaster recovery and business continuity plans to ensure quick recovery in the event of security incidents or data loss.

11. IMPACT ON STAKEHOLDERS

STAKEHOLDERS:

1. Students: Students can have a more immersive and interactive learning experience by using this virtual classroom. They can access and interact with learning content in a virtual environment through VR devices, engage in real-time interactions with teachers and peers.
2. Teachers: Teachers can leverage the virtual classroom to provide innovative and engaging teaching methods. They can design virtual scenarios, showcase multimedia content, and engage in real-time communication and guidance with students.
3. School administrators: The virtual classroom offers schools more teaching options and resources, fostering the development of innovative education. It can attract more students and teachers, enhancing the reputation and competitiveness of the school.

USER IMPACT:

1. Student users: Students can enhance their learning experience by using VR devices and the virtual classroom. They can better understand and apply the instructional

content, interact with teachers and classmates, and participate in more engaging and interactive learning activities.

2. Teacher users: Teachers can deliver more creative and interactive teaching methods through the virtual classroom. They can create virtual environments, customize learning activities, and engage in real-time interactions and feedback with students, promoting deeper learning and engagement.
3. School management users: School administrators can utilize the virtual classroom to provide innovative learning resources and environments for students and teachers. This helps improve teaching quality, student satisfaction, and the reputation of the school.

SOCIETAL IMPACT:

1. Advancement of Innovative Education: The virtual classroom project contributes to the advancement of innovative education. By combining virtual reality technology with educational resources, it provides students with more engaging and interactive learning approaches, stimulating their interest and creativity.
2. Accessibility and Inclusivity Enhancement: The virtual classroom can offer learning opportunities to students who cannot physically attend traditional classrooms, such as physically disabled students, remote learners, etc. It breaks down geographical barriers and promotes inclusivity in education.

12. OTHER CONSIDERATIONS

SOFTWARE

Data latency

1. Data transmitting delay: When data is transmitted from source to destination (eg: one laptop to the other, or download source from internet and put it into the project), there is a transmission time delay. Large data files or slower network connections may cause longer transmission delays.
2. Data processing delay: After the data reaches the target location, it may need to go through a series of processing steps (such as decoding, decrypting, formatting, etc)
3. Data storage delay: When data needs to be stored on a disk, database, or memory. This might include the time to write data to disk, the creation of database indexes, especially when there is mixing Windows OS and MAC OS.
4. Data retrieval delay: Similar with Data storage delay, when data needs to be retrieved from the storage medium. This may involve reading data from disk, querying a database, or accessing a distributed storage system.
5. Data sensor latency: For data collection systems, such as Unity, the response time of the data sensor itself also has an impact on the data latency. Sensor sampling frequency, signal processing time, and transmission time to the central processing unit can all cause data delays.

Incomplete data reception

1. Network or connectivity issues: Interruptions or disruptions in the network connection can lead to data packets being lost or not received in their entirety. This can result in missing or incomplete data.
2. Data transmission errors: During data transfer, errors can occur due to interference, or issues with the transmission medium. These errors can corrupt the data, causing some portions to be lost or modified.

3. Data collection limitations: In certain data collection scenarios, such as sensor networks or manual data entry processes, there may be limitations or errors in the data capture mechanism. For example, a sensor may fail to capture data for a specific time interval, or human operators may make mistakes during data entry, leading to missing or erroneous data.
4. Time synchronization issues: When data is collected from multiple sources or distributed systems, synchronization issues can arise. If the timing is not properly aligned, some data may arrive late or be out of sequence, resulting in incomplete information.

PLATFORM

Adaptation to different platforms and devices: VR projects may need to accommodate different VR platforms and devices such as Android OS, IOS/MAC OS, PlayStation VR, etc.

HARDWARE

1. Betteray: The battery must be fully charged to support the various tests and be charged at the end of each test, otherwise the next test will not be guaranteed to run properly.
2. User safety and comfort: Safety and comfort of users will be prioritized when designing a VR project. This includes avoiding motion sickness and discomfort, providing appropriate pauses and rest mechanisms, and avoiding situations or environments that may cause discomfort or risk. And we need to ensure the integrity of the headset, including the handle.

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