

GNG1103
Design Project User and Product Manual

Innovation nation: A Project to Save the Children of Tomorrow

Submitted by:

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List of Acronyms and Glossary

Table 1. Acronyms

Acronym	Definition
BOM	Bill of materials
CPU	Central Processing Unit
RAM	Random Access Memory
SDK	System Development Kit
UPM	User Manual Product
VCE	Virtual Classroom Environment
VR	Virtual Reality
XR	Extended Reality

Table 2. Glossary

Term	Acronym	Definition
Airlink		Connection between the headset and the laptop via the Wi-Fi network.
Bill of Materials	BOM	It is a list of all materials used to create the product
Block Diagrams		It is a drawing that represents the inputs and outputs of a system.

Code		Set of instructions written in a programming language
C Sharp	C#	Programming language used in Unity
Debugging		Process of finding and fixing the cause of problems in a code base.
Filler block		Any block that fills an empty space within another incomplete block
Graphics Card		A computer expansion card that generates graphics output to a display device (such as a monitor).
Hierarchy Window		List containing every game object in order of importance in the current scene. It is found at the top left of the page.
Prefabricated	Prefab	A component that was made beforehand
Sandbox Experience		Environment where one can look at and interact with all elements in it, without being guided.
Script		A list of instructions that is processed by another program.

System Development Kit	SDK	They are tools that help build software on a specific platform and can allow developers to build an app which can integrate with another program.
Unity Plugin		Helps with building applications that can be used with the Oculus Headset.
Universal Serial Bus type C	USB C	It is a standard connection interface for computers the C indicates that it is of type C.

1 Introduction

This User and Product Manual (UPM) provides the information necessary for new users to effectively use the VR Classroom Environment (VCE) and for prototype documentation. First, this document will show in detail how to set up and start the VCE in Unity, using VR. Additionally, it will outline various conditions to consider for the startup process such as access to Wi-Fi and amount of physical space. Then, this document will provide you with instructions on how to use the VCE to its full potential and outline the various features within it. Next, in case any issues arise while starting up and or using the VCE, this document will provide troubleshooting information where common problems are outlined and solutions to these problems are presented. Finally, this document will conclude with a Bill of Materials (BOM) and Equipment list that were used to create the VCE, methods for testing and validation of the VCE and a recommendation of next steps to advance the VCE. Any new user will find this document useful, as well as anyone who is attempting to create a similar work.

2 Overview

The problem that our final prototype is aiming to solve is that it's trying to influence decision makers into pre-emptively banning autonomous weapons, which is crucial since autonomous weapons don't require human input before applying force, even lethal force, which can be extremely dangerous. The robots malfunctioning or being hacked could lead to civilians losing their lives. The fundamental needs of the user were that they required a no more than 60 second

virtual reality experience in which the consequences of not pre-emptively banning autonomous weapons are shown, mainly by showing the changes that humans would make to their environment to protect themselves. The user also stated that they wanted our final prototype to evoke strong emotions like concern to prompt decision makers to act quickly. Another important need that the user had was that they needed a final prototype that could be finished in the time given, they stated multiple times that they didn't want it to be overcomplicated to the point where it wasn't doable. Furthermore, the user declared that gore and elaborate storylines should not be included; the focus should be on the environment and on the way that it was changed by mankind to adapt to autonomous weapons.

The main aspects of our product that differentiates it from others is that it focuses on children, which are the most innocent people in society. Our final prototype consists of a kindergarten classroom which is altered because of the presence of the autonomous weapons. For instance, the windows in the classroom are boarded up and it includes brightly colored posters teaching children to defend themselves from autonomous weapons. This aspect of our design makes it better than others since children are an important part of all societies and cultures, thus the final product focusing on children leads to it being impactful for a wider variety of individuals. Moreover, a lot of decision makers are likely to have children themselves, which will help make our final prototype evoke more emotions. Plus, decision makers tend to be elderly, meaning that they won't be affected by their decisions as much as later generations will be, which is another reason why focusing on children makes our product more impactful. Additionally, our product combines childlike elements and autonomous weapons to show the contrast between the innocence of the children and the dangerous situation caused by the robots. For instance, we

combined bright colours and other childlike elements such as the ABCs and nursery rhymes with instructions teaching the children how they should protect themselves from autonomous weapons in posters that can be found all over the classroom. Plus, we included drawings that seem like they were drawn by children which include autonomous weapons and the destruction caused by them, for example, one of them features a house on fire. We also included masks which can be seen in the classroom as well as in the drawings that ensure that the kids aren't identified by the robots when wearing them. These drawings show that the children are aware of the presence of the robots and imply that they are being affected by them negatively on a psychological level since the drawings are disturbing. Plus, we included missing children's folders in the classroom which strongly implies that the robots are physically harming the children. Thus, all of these components showcase how children would be affected by autonomous weapons, which will most likely evoke a strong emotional response in the decision makers, prompting them to act and to pre-emptively ban these weapons.

Pictures of the final prototype can be seen below.



Figure 2.1.-Screenshot of the final prototype



Figure 2.2.-Screenshot of the final prototype



Figure 2.3.-Screenshot of the final prototype



Figure 2.4.- Screenshot of the final prototype

Our product is a sandbox experience, meaning that there are no interactions and no goals for the user to complete. The viewer is just meant to explore the VR classroom, which allows them to focus on the details included in the design. The key features in our final prototype are the posters, the masks, the drawings made by the children, the missing children's folders on the teacher's desk, and a radio broadcast which explains the situation at hand to the user and which makes them more immersed in the experience by using sound as well as visuals.

As for the architecture and construction of our system, it consists of a virtual reality tour of a classroom made using Unity, a game development software. It includes built in elements such as a plane for the floor and lights as well as elements from Unity's online asset store, like the colourful furniture. Moreover, elements made using other apps are included in the product, such as the posters which were made on slides and Canva and the drawings were made on *Collanote*.

The user can access our product using the Unity application or a VR headset. Using the application, the viewer can control the movement of the camera to better observe the product using the *awsd* keys (w to go forward, s to go backwards, a to go left, and d to go right) and the direction in which the camera is looking using the arrow keys. As for the VR headset, the user controls in which direction they're looking by turning or tilting their head and they control their movement using a controller. Block diagrams illustrating this are included below.

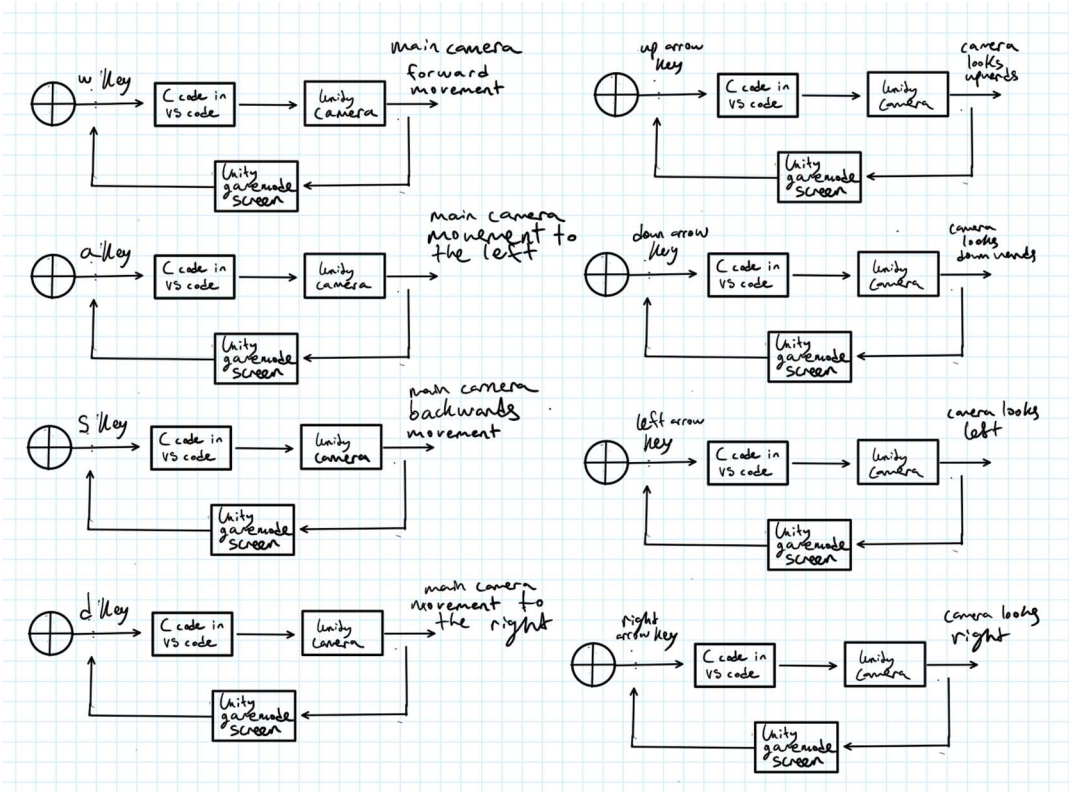


Figure 2.5.-Block diagram showing how camera movement in Unity is controlled

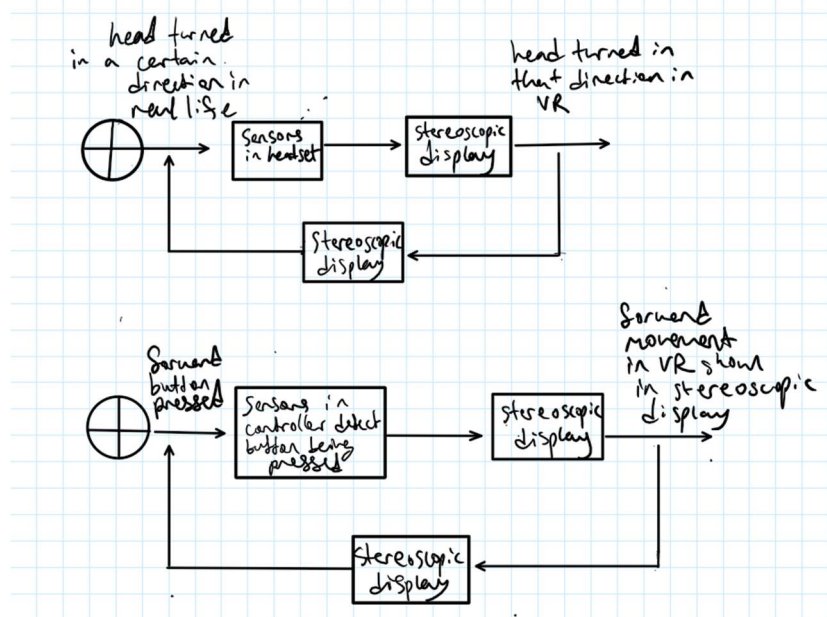


Figure 2.6.-Block diagram illustrating how movement is controlled using the headset.

2.1. Cautions & Warnings

One warning to keep in mind when using our final prototype which was made using Unity is that the user should make sure that their Unity application is up to date, since if it isn't the prototype might be affected. Moreover, the user should ensure that all assets used in the final product are imported properly. Additionally, if the user decides to record the prototype using the recorder built-into Unity, they should be aware that using it affects the speed of the camera's movement: it slows down a considerable amount and becomes choppy. It is suggested that the user uses a recording software other than Unity's built in recording software.

To continue, it is important to consider that using Virtual reality headsets for an extended period can cause nausea and eye strain for the users. Therefore, we advise them to use the product with caution.

Also, we have included very bright assets and pictures to our prototype. Therefore, we also warn users with photosensitive conditions to proceed with caution.

3 Getting started

Part 1: Installation

1. Install Unity <https://unity.com/download>
2. Follow the installation instructions for your operating system.

Part 2: Accessing Unity

3. Open Unity Hub
4. Navigate to the "Installs" tab and click "Add".
5. Select the Unity version you want to install and click "Next". Choose the latest version that is compatible with your device (Mac or Windows). This project in Unity uses the 2022.3.11f1 version. Unity projects are generally forward compatible, so you can open a project in a newer version of Unity than the one it was created in. If there are further issues with accessing the project, contact Unity support <https://support.unity.com/hc/es>

Part 3: Accessing the project

6. Once you have Unity installed, you have to open the project.
7. The project will be sent to you as a zip file.
8. Download the zip file called “prototype 2. zip”
9. Click it twice (double click), that will make a carpet appear called “prototype 2”
10. Click the carpet
11. Go to “assets”
12. Click on the icon “Prototype 2. unity” (it has the unity icon)
13. Now, you have access to the project

14. To be able to use this software prototype, it provides a VR (virtual reality) experience which will make the user immerse into the environment created. This will be explained in the following “configuration considerations” section.

3.13.1. Configuration Considerations

Physical prototype

The VR game is a software prototype, however, there are some physical related steps to take before immersing in the VR experience. To make sure the VR game works correctly, you will need a power source and internet connection, or you can just connect to a strong and safe Wi-Fi. Then, plug in the VR headset into the computer you are using.

Software prototype

For the VR settings in Unity, open Unity and go to project settings. Then, enable VR support and select the best VR SDK option for you, in this case it is Oculus (make sure to have the Oculus Quest app installed).

3.2 User Access Considerations

3.2.1 Administrators

Specification: Have free and full control of prototype. Administrators have the right, as creators, to modify settings and know which users are using the VR game.

3.2.2 Standard users

Specification: Users that access the prototype regularly for their own purposes. They have limited access to settings and don't have permission to modify VR game.

3.2.3 Guests

Specification: They have limited or temporal access to VR game. Guests can be invited by administrators and under their permission, guests can use the VR game, but will have restricted access to settings and are not allowed to modify the game.

3.2.4 Audience

Specification: These users only have view access. Audience can use the VR game but cannot modify any of the settings.

3.2.5 Testing users (team)

Specification: They are responsible for testing the VR game. They can access settings just to make sure everything is in order and working well (testing). However, they are restricted to access production data.

3.3 Accessing/setting up the System

To access the VR game, multiple conditions must be met. Before starting any of the procedures, ensure that the motion controllers and the devices are properly paired and charged. Make sure that both devices used are connected to the same Wi-Fi network. The first of the

conditions would be to turn on the VR game prototype. This is done by starting a laptop or computer with the Oculus Quest app installed. Next ensure that the VR headset is connected to the device via USB C and pair the Oculus via the app in the wired setting. After the devices are connected, launch the Unity app on the laptop and prepare to start the game. Put the VR headset on and adjust for comfort. Once it is adjusted, enable quest link and activate the prompts. At this point, starting the game will be both possible and successful. Once finished, stop the game on the laptop and simply close all the open applications.

3.4 System Organization & Navigation

Main physical components: VR headset and controllers

The VR headset is the central component, allowing a VR experience by providing sound and image. The controllers complement the motion of the user, so they can interact with the virtual environment.

Main software component: Unity

Unity serves as the software where you can build your virtual environment. The home page in Unity is the place where you can create a project, just choose a convenient version and template to start your project.

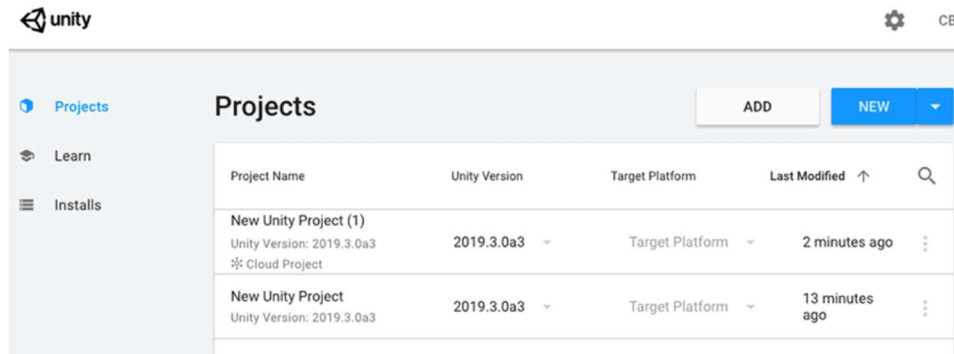


Figure 3.4.- Unity home page

3.5 Exiting the System

VR headset and controllers

Turn off VR headset and controllers, then disconnect the controllers from the device you are using (computer/laptop)

Unity application

Before exiting Unity, save any changes you made. Go to files can click the option of “Save as or Save project”. If you didn’t modify the project, just exit Unity by clicking on the “x” button. If applicable, log out of the system by going to your name initials in Unity.

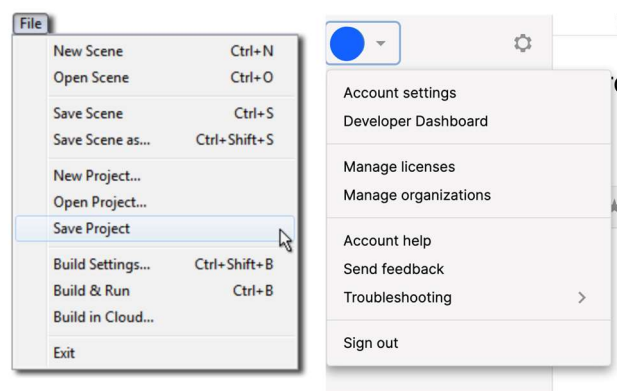


Figure 3.5. - Saving changes and log out

4 Using the System

The following sub-sections provide detailed, step-by-step instructions on how to use the various functions or features of the kindergarten classroom tour VR experience. The prototype doesn't include that many features/functions, since there aren't any interactions in the design, it's a sandbox experience that focuses more on the details present than interactions done by the user.

4.1 Camera movement function

To control the camera's movement, the user must use the a, w, s, and d keys. The w key makes the camera move forward, the s key makes it move backwards, a key makes it move left, and the d key makes it move to the right.

The code in the screenshot below allows us to implement this function:

```
if (Input.GetKey(KeyCode.W))
{
    verticalInput = 1;
}
else if (Input.GetKey(KeyCode.S))
{
    verticalInput = -1;
}

if (Input.GetKey(KeyCode.A))
{
    horizontalInput = -1;
}
else if (Input.GetKey(KeyCode.D))
{
    horizontalInput = 1;
}
```

Figure 4.2.- Screenshot of the Code Allowing Camera Movement using WASD keys

4.2 Function controlling the direction in which the camera is facing

The user should use the arrow keys to control the direction in which the camera is looking. The upwards arrow makes it tilt upwards, the downwards arrow makes the camera tilt downwards, the left arrow key makes it turn left, and the right arrow key makes it turn to the right.

The code in the screenshots below allows us to implement this function:

```
// Rotation speed for horizontal (left and right) camera movement
float turnSpeed = 120.0f;
// Rotation speed for vertical (up and down) camera movement
float verticalLookSpeed = 80.0f;
```



```
void Update()
{
    // Camera looks in the direction of arrow key inputs
    if (Input.GetKey(KeyCode.RightArrow))
    {
        transform.Rotate(Vector3.up, turnSpeed * Time.deltaTime);
        // multiplying by Time.deltaTime ensures that the rotation works consistently,
        // regardless of how fast or slow the game is running
        // Vector3.up specifies rotation around the vertical axis
    }
    else if (Input.GetKey(KeyCode.LeftArrow))
    {
        transform.Rotate(Vector3.up, -turnSpeed * Time.deltaTime);
    }

    // Look up and down
    if (Input.GetKey(KeyCode.UpArrow))
    {
        transform.Rotate(Vector3.left, verticalLookSpeed * Time.deltaTime);
        //Vector3.left specifies rotation around the horizontal axis
    }
    else if (Input.GetKey(KeyCode.DownArrow))
    {
        transform.Rotate(Vector3.left, -verticalLookSpeed * Time.deltaTime);
    }
}
```

Figure 4.2.- Screenshots of the Code Allowing Camera Movement Using Arrow Keys

5 Troubleshooting & Support

5.1 Error Messages or Behaviors

5.1.2 When pressing play another game is loading onto unity

Exit from the previous game by pressing the “pause” button and close the unity program.

Then, restart unity and open the game.

5.1.3 Error message: “No VR device found”

In this case, the possibilities are that the headset is not connected or that the Unity XR settings are missing a few configurations. Many fixes can be done for this. First, check if the Headset is connected to the Oculus application via the computer or another device nearby. If it is not (like

figure 1), try to connect it. If it fails to detect the headset or does not connect, visit section 5.1.4 for connecting the VR headset to the computer. If the headset is properly connected like appearing in figure 5.1, visit the unity store and ensure that the proper oculus assets are downloaded and up to date. This can be done by selecting Window>Package Manager and typing “oculus” in the search bar. If it is downloaded and up to date, it will look like the figure 3.

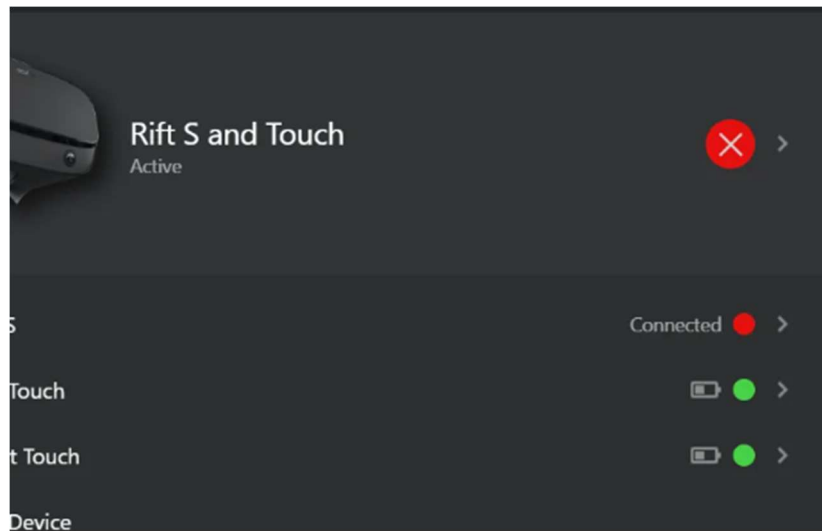


Figure 5.1.- Disconnected VR headset

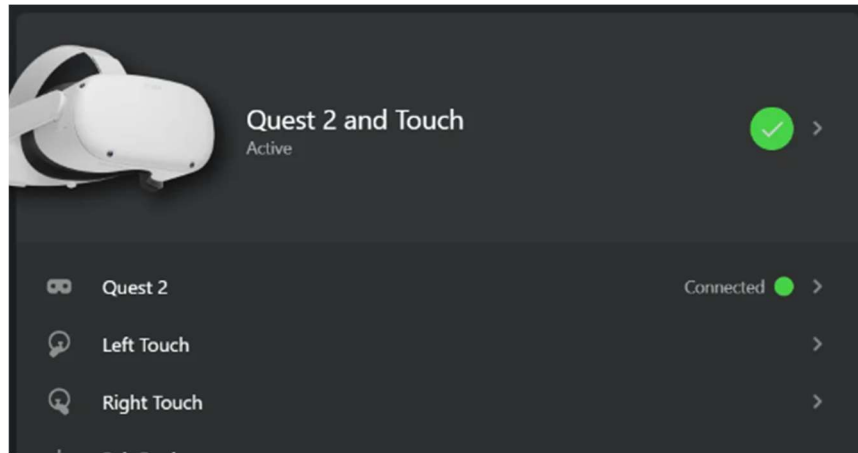


Figure 5.2.- Connected headset

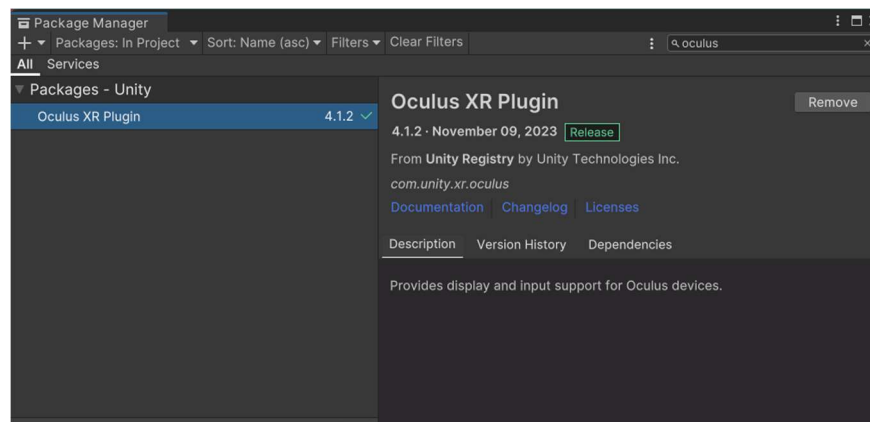


Figure 5.3. Verifying that the Oculus plugin is up to date

5.1.4 No air link connection found for the headset

Try to disconnect and reconnect the headset, ensuring that the headset and the device are connected to the same Wi-Fi. If it remains disconnected or unable to detect the device, use the wire

connect and plug it into the laptop as well as the headset. Then go visit the Oculus application > link and connect the device using the cable.

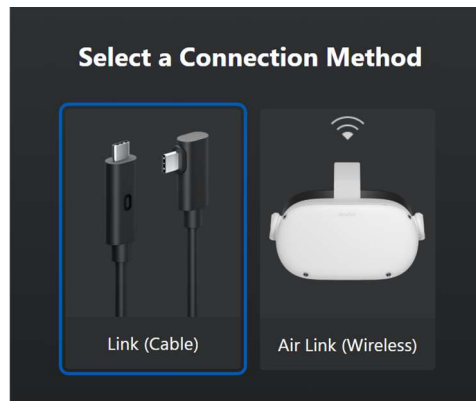


Figure 5.4: link (Cable)

5.1.5 Camera rendering Issues

This error can be shown as a black screen, inaccurate images and spasming images. This is caused by inaccurate camera settings configurations for the VR or incorrect rendering settings. To fix this, ensure that the VR camera is appropriately adjusted by searching in the settings. Ensure that the rendering settings in unity are compatible with the VR's by visiting the settings. Then, search the hierarchy for a Main Camera object, enable it and ensure that the target display is set to Display 1. If the camera is not found, add a camera by selecting Game Object, then Camera (figure 2). Another reason for poor rendering or camera issues could be that the code might be inadequate, especially if it is related to some camera movement. To fix this issue, ensure that there are no compiling issues with the code. If the issue persists, asking a professional would be recommended.

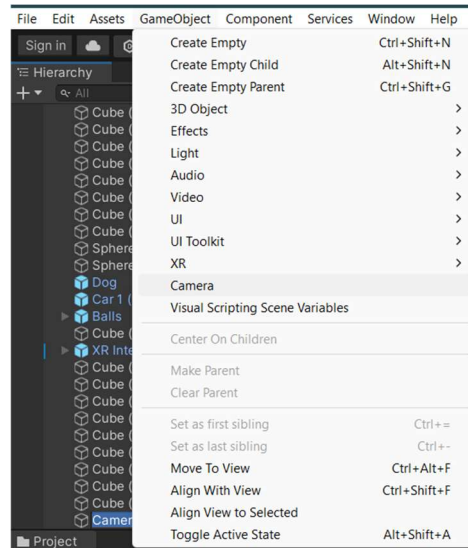


Figure 5.5: The camera settings

5. 1.6 No input from VR controllers.

This can be caused by an incorrectly paired controller or uncharged controller. To fix this, ensure that the controllers are fully charged and connected to the headset. If both are the case, try disconnecting the headset from the device and reconnecting it, ensuring that controllers are paired. If not, visit the unity store, type in “Oculus integration” and download the asset like figure 3. Then open unity. Select assets>import select the Oculus integration and import it.

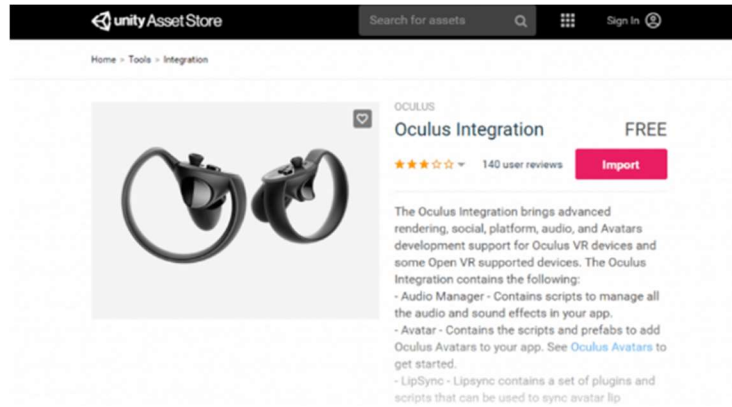


Figure 5.6.- Unity Assets store

5.1.7 Missing Assets in VR

This error can be caused by incorrect build settings or a missing SDK. This can be fixed by opening the files, selecting the assets folders and placing them in the unity folder. Then, opening the game from the unity folder. Once on unity, select the prototype shown at the bottom of the screen.

<input checked="" type="checkbox"/>	Free		2023-11-29 2:56 PM	File folder	
<input checked="" type="checkbox"/>	Horror School Props		2023-11-29 2:58 PM	File folder	
<input checked="" type="checkbox"/>	Scenes		2023-11-29 2:56 PM	File folder	
<input checked="" type="checkbox"/>	Skybox		2023-12-09 9:58 PM	File folder	
<input checked="" type="checkbox"/>	XR		2023-11-29 3:08 PM	File folder	
<input checked="" type="checkbox"/>	XRI		2023-11-29 3:08 PM	File folder	
<input type="checkbox"/>	Free.meta		2023-11-29 3:08 PM	META File	1 KB
<input type="checkbox"/>	Horror School Props.meta		2023-11-29 3:08 PM	META File	1 KB
<input type="checkbox"/>	Scenes.meta		2023-11-29 3:08 PM	META File	1 KB
<input type="checkbox"/>	Skybox.meta		2023-11-29 3:08 PM	META File	1 KB
<input type="checkbox"/>	XR.meta		2023-11-29 3:08 PM	META File	1 KB
<input type="checkbox"/>	XRI.meta		2023-11-29 3:08 PM	META File	1 KB

Figure 5.7.- Selected files from folder

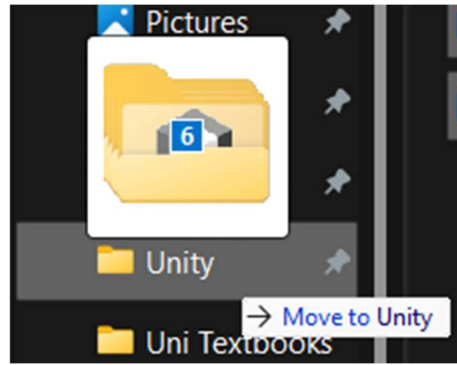


Figure 5.8.- Placing the files into the Unity file



Figure 5.9.-Opening the prototype from the Unity file

5.2 Special Considerations

First, it is important to consider that script errors can be very common, especially if some parts of the code are changed. These errors stem from many sources such as syntax errors (not using the correct template for a code) or logical errors (failing to implement a proper flow to the code resulting in an erroneous implementation). Therefore, if faced with a compiling error, it is favorable to make use of an online debugger, such as sentry.io [1] to detect the errors and correct them.

To continue, it is important to pay special attention to all the imported assets to ensure that they are not corrupted. Corrupted assets can be caused by an array of factors, one of which being if the projects are transferred from one device to another using downloaded files. Therefore, when transferring the product, it is more favorable to download the folders separately, use a stable internet connection and avoid interruptions while downloading. These can help avoid corruption in files. [2]

Another special consideration is to be careful when handling the scene hierarchy in Unity. The scene hierarchy corresponds to the left dropdown menu to the main display. When displacing a scene or an object in that hierarchy, it changes the priority of objects. This can lead to unexpected behavior and errors.

Finally, it is important to either use the same device consistently when building and managing the game or inform oneself of every platform consideration when building the game. This is because many issues can be caused by building from one device to another. In addition, some assets behave differently from one device to another. The team has experienced this with a walking script, which did not work properly on mac, but did on window. In fact, there are several assets who are not imported properly when switched from one device to another. To fix this issue, visit the missing assets in VR section.

5.3 Maintenance

To begin, it is important to complete all unity updates. These include a newer version that could introduce some compatibility issues, therefore after each update, I would be recommended to test the product to ensure that it works as designed. Before updating, it would be important to verify Unity release notes for changes that would affect changes relating to specifics assets used and pairing with headsets. If that is the case, creating a copy of the product would be recommended. Then, proceed with the update with the instructions as shown on the unity page.

Another maintenance to consider performing is updating all plugins and packages. This can be done by opening unity>edit>project settings>package manager then select “all”. By doing so, it

is possible to view all assets and to verify which are up to date and which are not. After doing so, update those who are in need of one.

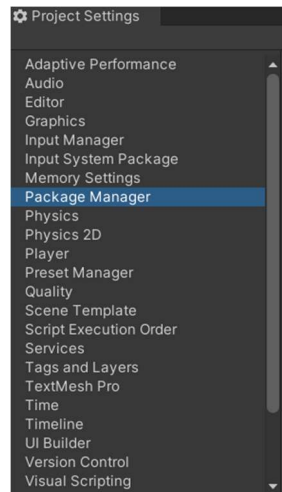


Figure 5.10.-Unity package manager

5.4Support

There are many ways to get access to support when dealing with a VR product. The best way that is accessible to most people is simply googling the problem. This will show either forum people who have had the same issues in the past and show step by step how they went about troubleshooting it. These sites are but not limited to Quora, Reddit, and Unity Forum [3]. If there is a VR specific issue, consulting Meta or Oculus would be the best course of action. If a problem with Unity arises, consult the Unity website and the various Unity Forums.

6 Product Documentation

The following subsection outlines the steps involved in replicating the VR prototype. It highlights specifically the BOM, equipment list, and the instructions on how to build the prototype. Throughout this subsection, emphasis is placed on detailed documentation, high quality visual aids, and alternative solutions to ensure that each aspect of the prototype is well understood and so that it can be easily followed and replicated.

6.1 Prototype creation

6.1.1 BOM (Bill of Materials)

Item Name	Description	Unit Cost	Link	Total Cost
Classroom Props		\$5	https://assetstore.unity.com/packages/3d/props/interior/classroom-props-22141	\$36.04
Wooden Plank	For boarding up windows	\$0	https://www.turbosquid.com/3d-models/free-3ds-mode-woodern-plank/1082125	\$0
Maximo	3-D Animation Software	\$0	https://www.mixamo.com/#/	\$0
Blender	3-D Computer Software	\$0	https://www.blender.org/	\$0

School Assets	School Asset Pack	\$0	https://assetstore.unity.com/packages/3d/environments/school-assets-146253	\$0
Kindergarten Interior	Kindergarten Classroom	\$20	https://assetstore.unity.com/packages/3d/props/interior/kindergarten-interior-111197	\$0
Printed paper	Flyers that we will print in color	\$11.04	https://www.uottawa.ca/library/services/print-copy-scan	\$0
Unity	Game Engine	\$0	Download	\$0

6.1.2 Table 6.2.1.-Bill of materials

6.1.3 Equipment list

Meta Quest 2 VR Headset

PC That Meets Requirements as outlined by Meta

Component	Recommended Specs
Processor	Intel i5-4590 / AMD Ryzen 5 1500x
Graphics Card	See Here
Memory	8 GB + RAM

Operating System	Windows 10, WIndows 11
USB Ports	1x USB Port

Table 6.2.2.-Equipment list

6.1.4 Instructions

Step 1: Opening a New Unity File

The first step to building this immersive VR environment is to create the file necessary for all the data to be stored. This can be done by first opening the Unity Hub application on your desktop and selecting new project in the top right corner.

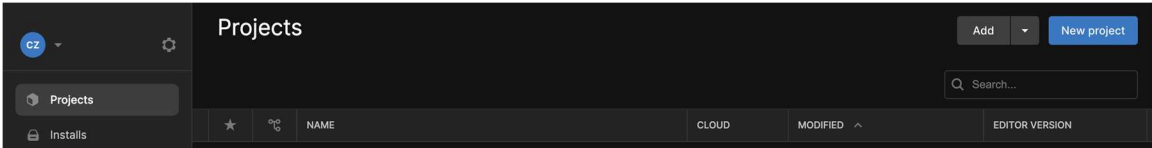


Figure 6.1 - Creating a New Unity Project

Assure that the template is set as 3D and rename the project to whatever you desire. Once all the information is as desired, select create project to create the 3D interactive world.

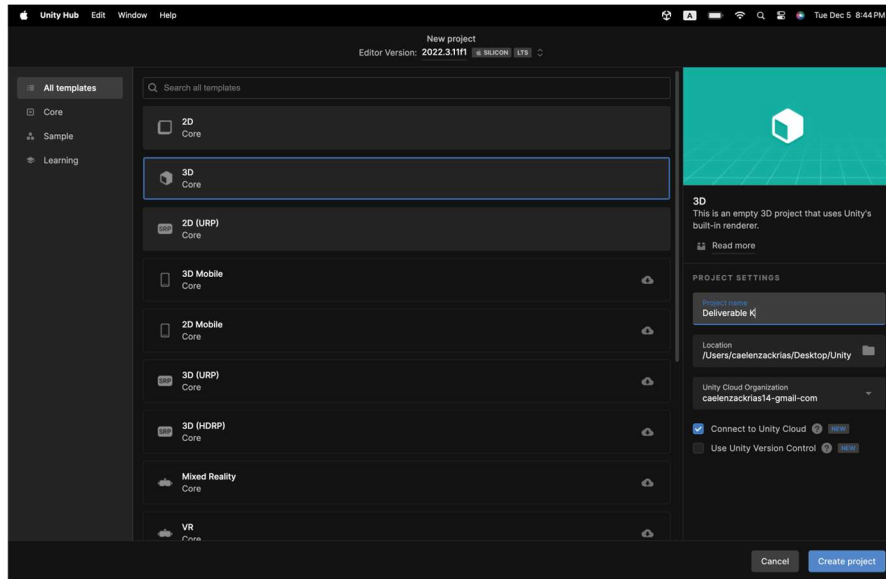


Figure 6.2 - Details and Specifics for Unity Project File

Step 2: Creating a Foundation

The next step would be to use filler blocks to create parameters and to help visualize what the desired end goal will look like. This can be done by going to the top left hierarchy window and selecting the plus icon, 3D objects, the plane. Once selected a 1x1 plane will appear and this will act as the floor for your setting. On the hierarchy section, rename the plane to “Floor”.

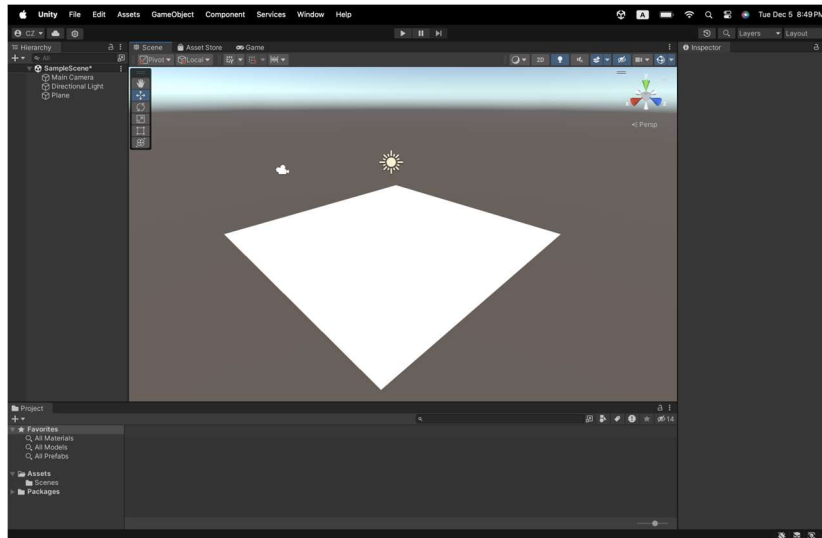


Figure 6.3 - Simple Plane as Floor

Next, add a cube through the 3D object setting and place it on the edge of the floor by selecting and dragging the respective x,y,z axis arrows. Once the cube is in place adjust the scale option in the inspector section to make the cube longer and taller so that it is shaped like a wall.

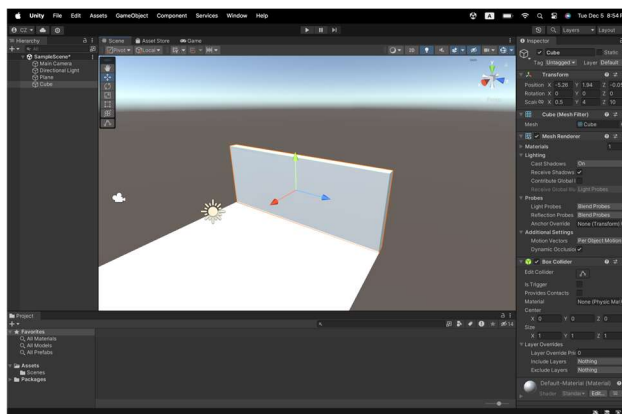


Figure 6.4 - Place Holder Cubes as Walls

Do the same for all sides of the floor plane and the foundation for the scene is complete.

Step 3: Adding Assets/Materials

The next step in the process is to add the details. Download every asset listed in the BOM from 6.1.1 and import them into unity.

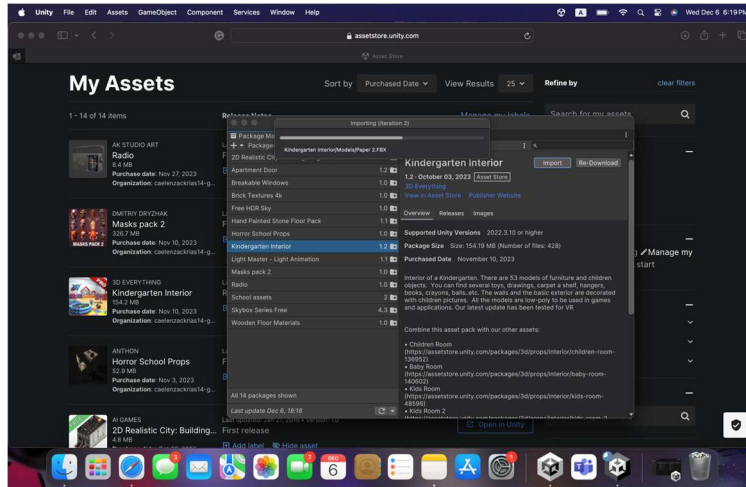


Figure 6.5 - Importing Assets

Once imported, open the “Kindergarten Interior” prefab folder and replace the place holder cubes with the respective walls. Ensure that one of the walls is a door wall and place a door inside too by simply dragging, dropping, and rearranging the prefab as done with the cubes. Enter the materials folder for the asset and drag and drop the “floor” material onto the floor planes. Copy and paste the floor plane and move the copy until it is directly on top of the walls. Enter the materials folder for the asset and drag and drop the ceiling material onto the copy floor plane.

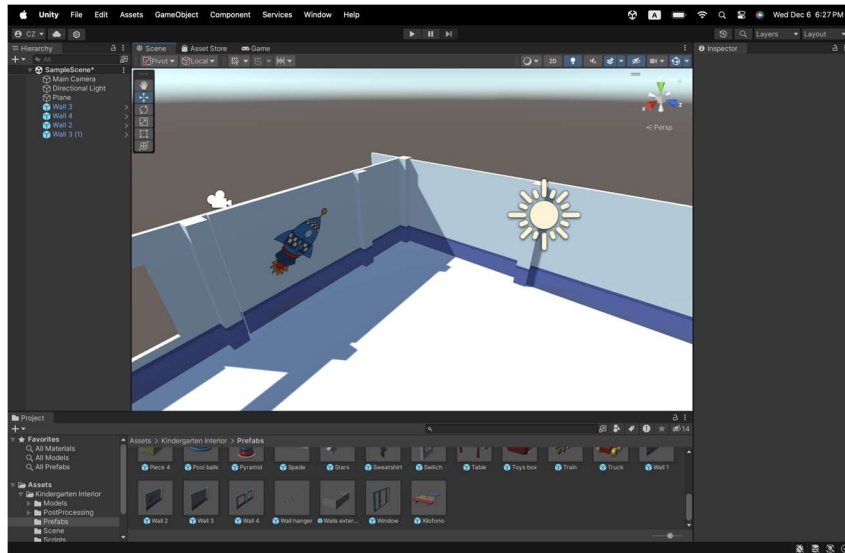


Figure 6.6 - Replacing Placeholders with Detailed Prefabs

After the main structure is complete use the prefabs in the asset to add tables, chairs, roof lights, and toys to the floor.

Step 4: Adding Coding for Movement

Right click on the packages tab and add a blank C# script. Open this script and paste the walking code given:

```
using System.Collections;

using System.Collections.Generic;

using UnityEngine;

public class MoveCamera : MonoBehaviour

{

    float turnSpeed = 120.0f;

    float verticalLookSpeed = 80.0f;
```



```

float moveSpeed = 5.0f;

float walkSpeedMultiplier = 0.5f;

// Variables for bobbing and tilting effect

float bobbingSpeed = 1.5f;

float bobbingAmount = 0.1f;

float tiltAmount = 2.0f;

float timer = 0f;

void Start()

{

    // Initialization code here if needed.

}

void Update()

{

    // Camera looks in the direction of arrow key inputs

    if (Input.GetKey(KeyCode.RightArrow))

    {

        transform.Rotate(Vector3.up, turnSpeed * Time.deltaTime);

    }

    else if (Input.GetKey(KeyCode.LeftArrow))

    {

        transform.Rotate(Vector3.up, -turnSpeed * Time.deltaTime);

    }

    // Look up and down

    if (Input.GetKey(KeyCode.UpArrow))

    {

        transform.Rotate(Vector3.left, verticalLookSpeed * Time.deltaTime);

    }

}

```

```

}

else if (Input.GetKey(KeyCode.DownArrow))

{

    transform.Rotate(Vector3.left, -verticalLookSpeed * Time.deltaTime);

}

// Get the WASD input for movement

float horizontalInput = 0;

float verticalInput = 0;

if (Input.GetKey(KeyCode.W))

{

    verticalInput = 1;

}

else if (Input.GetKey(KeyCode.S))

{

    verticalInput = -1;

}

if (Input.GetKey(KeyCode.A))

{

    horizontalInput = -1;

}

else if (Input.GetKey(KeyCode.D))

{

    horizontalInput = 1;

}

// Calculate the movement direction

Vector3 forward = transform.forward;

```

```

forward.y = 0;

forward.Normalize();

Vector3 right = new Vector3(forward.z, 0, -forward.x).normalized;

Vector3 movement = forward * verticalInput + right * horizontalInput;

// Normalize the movement vector

if (movement.magnitude > 1.0f)

{

    movement.Normalize();

}

// Apply the movement in local space (horizontally)

float currentMoveSpeed = (verticalInput == 1) ? moveSpeed * walkSpeedMultiplier : moveSpeed;

// Check if there is movement input

if (movement != Vector3.zero)

{

    // Bobbing and tilting effect

    // Calculate bobbing, side-to-side tilt, and tilting based on sine function

    float bob = Mathf.Sin(timer) * bobbingAmount;

    float tilt = Mathf.Sin(timer * 3) * tiltAmount; // Increased the multiplier for higher frequency

    // Side-to-side tilt on the vertical plane imitating walking

    float sideTilt = Mathf.Sin(timer * 2) * 1.0f; // Adjust the value for the intensity of the tilt

    // Apply the bobbing, side-to-side tilt, and tilting to the camera position and rotation

    transform.localPosition = new Vector3(transform.localPosition.x, bob + 1.0f, transform.localPosition.z); // Adjusted Y-axis

    transform.localRotation = Quaternion.Euler(tilt, transform.localRotation.eulerAngles.y, sideTilt);

    // Increment the timer based on speed

    timer += bobbingSpeed * Time.deltaTime;

}

```

```

else

{

    // Reset the timer if not moving

    timer = 0f;

}

// Apply the movement in local space (horizontally)

transform.Translate(movement * Time.deltaTime * currentMoveSpeed, Space.World);

}

}

```

Once inputted into the C# unity file save and close the file. Drag and drop the file onto the “Main Camera” in the hierarchy tab.

Step 5: Creating Lighting and 3D Sound

To add lighting, select the object you wish to add animate lighting to. Once selected, press Gam Object, Light, then Point Light. At this stage increase the intensity to whatever lighting desired. Do the same for all the areas and objects for which you wish to give off light.

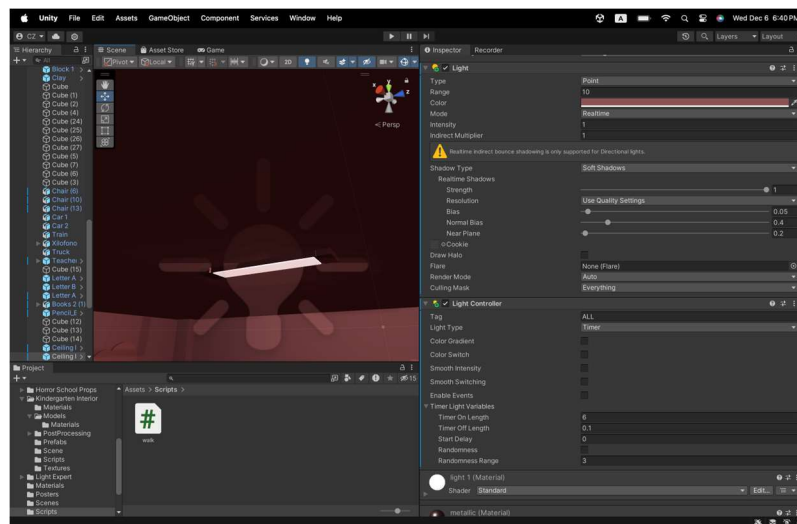


Figure 6.7 - Adding Animate Lighting

To add sound, first download whatever sound desired for the project. For the prototypes, the sound used was a radio broadcast recording. Import this sound into the unity asset section as an mp3 file. Drag and drop the sound onto the object you wish to make noise and the sound will start playing. Adjust the volume of the sound as you see fit.

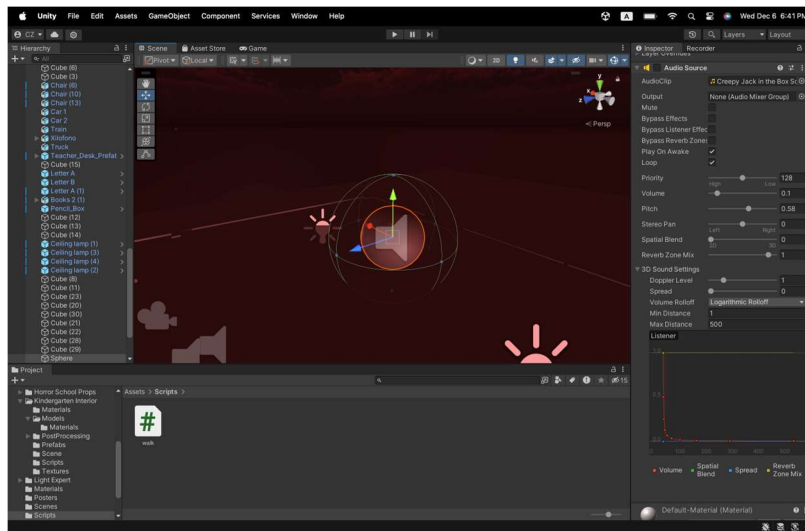


Figure 6.8 - Adding 3D Sound

Step 6: Refining and Details

To finish up the prototype, use the assets provided prefabs to fill in the void and add as many details as desired. This can range from toys, carpets, chairs, windows, and radios. Finally, to add detail and meaning to the prototype create cubes and flush them against the walls so that they look like posters. Then import the desired poster you wish to add into the assets section of unity and simply drag and drop the media file onto the game object.

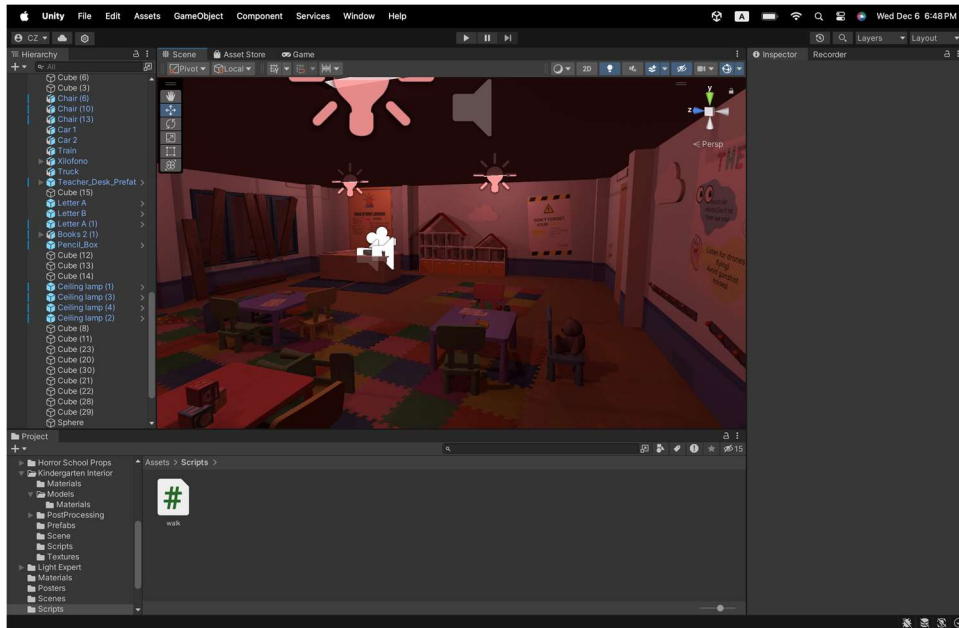


Figure 6.9 - Refining Details and Finished Product

6.2 Testing & Validation

6.2.1 User personas Documentation

We have decided to create a table of user personas to ease the feedback giver finding process and optimize our time by diversifying the feedback givers as much as possible. This was done by selecting 5 main personalities of which we believe most users will fit into and add characteristics to each.

User Personas	Goals	Personality	Activities	Sensibility

Lola (peace)	Helping communities Spreading awareness about suffering	Very involved Leader Concerned for others	Volunteering Spreading awareness about violence Advocating for world peace	High
Edward (decision makers)	Working in the government Managing a country High responsibilities	Fast paced environment Concerned for himself		Low
Regis (regular person)	Earn money Live peacefully	Wants things done fast Not much concern for others Dislikes change in environment	Regular person activities	Moderate

Amy (army)	Learn about new weaponry in the army Help technological advances	Is intrigued by technological advances Is an engineer Concerned about money	Researching tech Developing weaponry	Low
------------	---	---	---	-----

Table 6.2.1: Documentation of all user personas

6.2.2 Prototype 1

Test ID	Test Objective (Why)	Description of Prototype used and of Basic Test Method	Description of Results to be Recorded and how these results will be used (How)	Estimated Test duration and planned start date (When)
		<p>The classroom and some posters on the wall.</p> <ul style="list-style-type: none"> • full classroom (with desks and chairs) • coat hangers on the wall • the posters will be blank • the dimensions will be as high fidelity as possible 		
1	To evaluate its feasibility	We will be testing this by counting the amount of time that is required for us to create this prototype. It should not take more than 3 days.	The result will be recorded in a table that will compare the time required for us to create this prototype and the time for us to create the others. It will then be compared with the other values of the other prototype to determine if it is feasible.	This test starts when we start building the prototype and ends when the prototype is finished.
2	Time duration of product	We will be testing this by roughly timing the time that it takes the camera to move throughout the scenarios. This	We will do 5 trials, which use different combinations of pathways in order to find the most convenient and efficient	The test duration should be about an hour. We will

		should take us between 10 and 30 seconds, since there will be no interactions for this prototype.	one. This will be recorded by using a table, writing down the pathways used for each test and recording the amount of time elapsed.	be satisfied when the time reaches 20 seconds or when 5 trials are done.
3	Ease of use	This will be tested by counting the amount of time elapsed in order to load the VR environment. It should be between 5 to 10 seconds. We will start a timer when the unity icon is clicked and stop it when the environment is fully loaded, and the “play” button is pressed.	We will do 10 trials, to evaluate the consistency and the efficiency of the loading time. The results will be recorded using a table. We will also be recording any special conditions such as the Wi-Fi of the area.	The test duration will be about 1 hour. We will stop testing once we achieve 10 trials.
4	Precision of message/ focus on message: Narrative	This will be tested by showing people that we have identified in different user personas, our prototypes and asking them 3 questions each: How concerned does this make you feel? Do you understand each	We will have at least 10 feedback samples from this test. Each answer to the questions will be recorded using a table. We will make a mean of each column of the table to determine how	The test duration will be when the prototype is finished to when the deliverable is

	effectiveness	of the steps? How much does this motivate you into acting? Their response will be on a scale of 1 to 10. (1 being the lowest and 10 being the highest) And their suggestions will be noted. This can be done by either showing them the prototype or sending them a recording of it.	successful or unsuccessful our product is.	due (time constraint). However, we do want a minimum of 10 feedback samples.
5	Overall Quality: of the video filmed.	This will be tested by using 2 methods to film our product and evaluating the quality of each. The first method will be screen recording with the computer. The second method will be to use teams as a method of screen recording. Then we will evaluate the frames per second of each method.	We will have a table for each method of screen recording. Each of them will be evaluated using 2 criteria and out of 10. The first is the FPS. The second will be the number of times it stops or glitches (for every stop and glitch it will be deducted 1 point).	The test duration will be about 1 hour and will end when both methods have been tried and tested 2 times each for the most accurate results.
6	Immersion of the user	This will be tested by showing people that we have identified	We will have at least 10 feedback samples from this	The test duration will be

	<p>in their environment</p>	<p>in different user personas, our prototypes and asking them 3 questions each: How much do you feel immersed? Is this realistic to you? What could be improved? Their response will be on a scale of 1 to 10. (1 being the lowest and 10 being the highest) And their suggestions will be noted. This can be done by either showing them the prototype or sending them a recording of it.</p>	<p>test. Each answer to the questions will be recorded using a table. We will make a mean of each column of the table to determine how successful or unsuccessful our product is.</p>	<p>when the prototype is finished to when the deliverable is due (time constraint). However, we do want a minimum of 10 feedback samples.</p>
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Table 6.3.2.- Prototyping test plan number 1

6.2.3 Results

Test 1: Evaluate feasibility

It took us 3 days to complete the first prototype. This is very satisfactory, as it was a very comprehensive and medium fidelity prototype. This means that we are not expecting too much, by saying that we can improve on this prototype and deliver a more refined version by the end of the month. The prototype was low effort and did not cost anything. This proves again that it is very feasible within the time limit given.

Test 2: Time duration of product

For this trial, we had decided to use the camera to simulate a person walking around the classroom to all the important parts of the room. After reaching the location, the person is expected to remain there for 5 to 10 seconds. During the test, the walking was stopped for a random amount of time between 5 to 10 seconds. The list is:

- 1 Front of the class (teacher's desk)
- 2 Mask shelf
- 3 ABC wall and Posters
- 4 Windows

From the results received, we are on the right track for the time duration of the product since our product needs to last about 30 seconds. However, it seems that it is sometimes longer than that. We will need to perform more tests later with a higher fidelity prototype to ensure that we do not exceed the time limit.

Trial index	Duration (s)	Combinations of paths taken
1	31.04	1 2 3 4
2	37.55	2 4 3 1
3	39.17	4 3 2 1
4	33.50	2 3 4 1
5	42.43	3 4 2 1

Table 6.2.3.-Test 2 results

Test 3: Ease of use

This test was intended to determine the consistency of the loading time of the software. To keep results as accurate as possible, it was decided to perform this test on 3 different computers. The first one will be in green; the second will be in blue and the third in red. In general, the loading duration is 19.44 seconds. This data will be kept to estimate the amount of time taken to load the prototype on design day.

Trial index	Loading time (s)
1	23.60
2	18.32
3	25.43
4	20.17
5	12.01
6	18.56
7	15.78
8	17.84
9	19.43
10	19.03

Average	19.044
---------	--------

Table 6.2.4.-Test 3 results

Test 4: Precision of message

Questions:

How concerned does this make you feel?

Do you understand each of the steps?

How much does this motivate you into taking action?

Feedback giver number	User persona	Question 1 Grade (/10)	Question 2 Grade (/10)	Question 3 Grade (/10)
1	Regis	4	6	2
2	Regis	5	8	3
3	Lola	5	7	5
4	Lola	4	5	5
5	Regis	5	7	6
6	Regis	8	4	3

Table 6.2.5.-Test 4 results

With this feedback, we can conclude that our prototype is not convincing enough. In fact, most feedback givers mentioned that it did not contain elements of robots. They also mentioned that without our explanation of the goal of our project, they would never be able to determine for themselves what the environment was made to depict. We can fix this issue by adding more detail to our environment and clues that would allude to what is happening in the classroom. We also need to amplify the feeling of fear that is meant to be felt, because most of the feedback givers mentioned that they are not prompted to act after watching the prototype.

Test 5: Overall Quality: of the video filmed.

Both videos were not optimal and glitched at least 4 times each. Now that we are aware of this, we will look for other software that could help us create a more optimal video experience. We are planning to do more research on the topic and test it on the next few deliverables. As for the screen recordings, there is a small difference between the methods used.

Teams recording: 6/10, 30 FPS

Computer recording: 5/10, 32 FPS

Test 6: Immersion of the user in their environment

Questions:

How much do you feel immersed?

Is this realistic to you?

What could be improved?

Feedback giver number	User persona	Question 1 Grade (/10)	Question 2 Grade (/10)	Question 3
1	Regis	6	6	The lighting Making it look like a classroom for kids
2	Regis	5	7	The lighting
3	Lola	7	6	Adding more information about the robots
4	Lola	6	8	

Table 6.2.6.-Test 5 results

The feedback given in this section is generally more positive. In fact, the grades are much higher than in the previous section. This means that our product is very realistic and immersive. However, many mentioned that we should modify the lighting, making it brighter, as it was sometimes difficult for feedback givers to see the details. Also, others mentioned that the classroom did not fit the description of a kindergarten classroom, mostly because of the chairs and the position of the desks. Finally, a feedback giver also mentioned that it would be useful to add more information about the robot or that a robot should appear somehow.

6.2.4 Prototype 2

Test ID	Test Objective (Why)	Description of Prototype used and of Basic Test Method	Description of Results to be Recorded and how these results will be used (How)	Estimated Test duration and planned start date (When)
1	To evaluate its sound quality	<p>We will be testing this by asking people to listen to our sound recordings and state what they hear and how clearly they can hear it.</p> <ul style="list-style-type: none"> • full classroom (with desks and chairs) • Shelves with masks on the wall • the posters will be blank • the dimensions will be as high fidelity as possible • Sound effects (ringing and message from the director) • Posters with drawings on them • ABC's on the walls • Camera that shifts with the arrow keys 	<p>This will be recorded using a table, which will contain the list of feedback givers asked, their ratings of the sounds from 1 to 10 and their understanding of it. We will test this</p>	<p>The test duration should be about 3 days. It will start immediately after the sound effects are</p>

			feature at least 5 times.	implemented in the prototype.
2	Time duration of product	We will be testing this by roughly timing the time that it takes the camera to move throughout the scenarios. This should take us between 30 and 40 seconds, since there will be no interactions for this prototype.	We will do 5 trials, which use different combinations of pathways in order to find the most convenient and efficient one. This will be recorded by using a table, writing down the pathways used for each test and recording the amount of time elapsed.	The test duration should be about an hour. We will be satisfied when the time reaches 20 seconds or when 5 trials are done.
3	Precision of message/ focus on message: Narrative effectiveness for the posters	This will be tested by showing people that we have identified in different user personas, our posters and asking them 3 questions each : How concerned does this make you feel? Do you understand each of the steps? How much does this motivate you into acting? Their response will	We will have at least 10 feedback samples from this test. Each answer to the questions will be recorded using a table. We will make a mean of each column of the	The test duration will be when the prototype is finished to when the deliverable is due (time

		<p>be on a scale of 1 to 10. (1 being the lowest and 10 being the highest)</p> <p>And their suggestions will be noted.</p> <p>This can be done by either showing them the prototype or sending them a recording of it.</p>	<p>table to determine how successful or unsuccessful our product is.</p>	<p>constraint).</p> <p>However, we do want a minimum of 10 feedback samples.</p>
5	<p>Immersion of the user in their environment</p>	<p>This will be tested by showing people that we have identified in different user personas, our prototypes and asking them 3 questions each: How much do you feel immersed? Is this realistic to you? What could be improved?</p> <p>Their response will be on a scale of 1 to 10. (1 being the lowest and 10 being the highest) And their suggestions will be noted. This can be done by either showing them the prototype or sending them a recording of it.</p>	<p>We will have at least 10 feedback samples from this test. Each answer to the questions will be recorded using a table.</p> <p>We will make a mean of each column of the table to determine how successful or unsuccessful our product is.</p>	<p>The test duration will be when the prototype is finished to when the deliverable is due (time constraint).</p> <p>However, we do want a minimum of 10 feedback samples.</p>

Table 6.2.7.-Prototyping Test Plan number 2

6.2.5 Results

Test 1: To evaluate its sound quality:

We will be testing this by asking people to listen to our sound recordings and state what they hear and how clearly, they can hear it

This will be recorded using a table, which will contain the list of feedback givers asked, their ratings of the sounds from 1 to 10 and their understanding of it. We will test this feature at least 5 times.

The test duration should be about 3 days. It will start immediately after the sound effects are implemented in the prototype.

Test 2: Sound quality

Sound index:

Helicopter noise <https://freesoundstock.com/products/flying-drone-sound-effect>

Done noise <https://www.youtube.com/watch?v=UehsfThvwPY>

Music Box <https://www.youtube.com/watch?v=xJewgPuraY>

Tester Number	What is heard	Sound Index and Rating (/10)
1	1: Drone, robot-like engine 2: Same as the first, but with better quality 3: Unsettling sound (like horror movies)	1: 6/10 2: 8/10 3: 7/10

2	1: Helicopter 2: Drone 3: Jack in a box but creepy	1: 9/10 2: 5/10 3: 6/10
3	1: Drone 2: High rpm motor 3: Horror music	1: 7/10 2: 4/10 3: 8/10
4	1: Drone 2: RC Plane 3: Creepy lullaby	1: 9/10 2: 6/10 3: 9/10
5	1: Drone 2: Drone 3: Jack in Box	1: 8/10 2: 7/10 3: 8/10

Table 6.3.8.-Test 2 Results

Test 3: Time duration of product

For this trial, we had decided to use the camera to simulate a person walking around the classroom to all the important parts of the room. After reaching the location, the person is expected to remain there for 5 to 10 seconds. During the test, the walking was stopped for a random amount of time between 5 to 10 seconds. The list is:

Front of the class (teacher's desk)

Mask shelf

ABC wall and Posters

Windows

We had decided to test this feature again, because we were given the opportunity to test it with the VR headset. This meant that we could obtain data that would give us real-time values for how much time it takes to read the posters. Therefore, it was useful to create different paths for the classroom to optimize the path taken and keep the amount of time taken at about 60 seconds. This is different from the previous prototype, because on it, we had used our arrow keys to move around, and the rotation was much faster. We had also evaluated this using people who are not familiar with VR to be more accurate, because the judges will not necessarily have VR experience.

Trial index	Duration (s)	Combinations of paths taken
1	54.88	1 2 3 4

2	1:07.67	2 4 3 1
3	57.26	4 3 2 1
4	59.61	2 3 4 1
5	1:01.25	3 4 2 1

Table 6.3.9.-Test 3 Results

Test 4: Precision of message/ focus on message: Narrative effectiveness for the posters

Questions:

How concerned does this make you feel?

Do you understand each of the steps?

How much does this motivate you into taking action?

Feedback giver number	User persona	Question 1 Grade (/10)	Question 2 Grade (/10)	Question 3 Grade (/10)
1	Edward	6/10	8/10	3/10
2	Regis	8/10	6/10	7/10
3	Lola	9/10	7/10	10/10
4	Amy	3/10	6/10	6/10

5	Lola	8/10	7/10	7/10
---	------	------	------	------

Table 6.3.10.-Test 4 Results

Test 5: Immersion of the user in their environment

Questions:

How much do you feel immersed?

Is this realistic to you?

What could be improved?

Feedback giver number	User persona	Question 1 Grade (/10)	Question 2 Grade (/10)	Question 3
1	Edward	8/10	6/10	Implementation of some sort of objective/task
2	Regis	7/10	5/10	More realistic looking assets
3	Lola	9/10	9/10	Better lighting
4	Amy	6/10	7/10	Maybe more detail?

5	Lola	8/10	9/10	Implementation of audio
---	------	------	------	-------------------------

Table 6.3.11.-Test 5 Results

6.2.6 Other feedback from users and feedback givers

We have also received other feedback from users, the clients and feedback givers. First, many have mentioned that it is difficult to focus on the posters and read them because of how small the letters are. To continue, shorter tester has mentioned that the desk in the VR is too tall for them to read the newspaper. Also, the camera movement in the videos is too fast for them to read the posters properly. They have mentioned that the room is slightly too dark for them to properly see all the colors that we are implementing.

6.2.7 Prototype 3

Test ID	Test Objective (Why)	Description of Prototype used and of Basic Test Method	Description of Results to be Recorded and how these results will be used (How)	Estimated Test duration and planned start date (When)
1	Time duration of product	<p>We will be testing this by roughly timing the time that it takes the camera to move throughout the scenarios. This should take us between 30 and 40 seconds since there will be</p> <p>The classroom and some posters on the wall.</p> <ul style="list-style-type: none"> • full classroom (with desks and chairs • Shelves with masks on the wall • the posters will be blank • the dimensions will be as high fidelity as possible • Sound effects (ringing and message from the director) • Posters with drawings on them • ABC's on the walls • Camera that shifts with the arrow keys 	<p>We will do 5 trials, which use different combinations of pathways in order to find the most convenient and efficient one. This will be recorded by using a table, writing down the</p>	<p>The test duration should be about an hour. We will be satisfied when the time reaches 20</p>

		no interactions for this prototype.	pathways used for each test and recording the amount of time elapsed.	seconds or when 5 trials are done.
2	Precision of message/ focus on message: Narrative effectiveness for the posters	<p>This will be tested by showing people that we have identified in different user personas, our posters and asking them 3 questions each : How concerned does this make you feel? Do you understand each of the steps? How much does this motivate you into acting? Their response will be on a scale of 1 to 10. (1 being the lowest and 10 being the highest) And their suggestions will be noted. This can be done by either showing them the prototype or sending them a recording of it.</p>	<p>We will have at least 10 feedback samples from this test. Each answer to the questions will be recorded using a table. We will make a mean of each column of the table to determine how successful or unsuccessful our product is.</p>	<p>The test duration will be from when the prototype is finished to when the deliverable is due (time constraint). However, we do want a minimum of 10 feedback samples.</p>

3	Immersion of the user in their environment	This will be tested by showing people that we have identified in different user personas, our prototypes and asking them 3 questions each: How much do you feel immersed? Is this realistic to you? What could be improved? Their response will be on a scale of 1 to 10. (1 being the lowest and 10 being the highest) And their suggestions will be noted. This can be done by either showing them the prototype or sending them a recording of it.	We will have at least 10 feedback samples from this test. Each answer to the questions will be recorded using a table. We will make a mean of each column of the table to determine how successful or unsuccessful our product is.	The test duration will be when the prototype is finished to when the deliverable is due (time constraint). However, we do want a minimum of 10 feedback samples.
4	Readability	This will be useful for determining the user experience of reading each poster. Our project is intended for everyone therefore it should take no longer than 30 seconds for one person to read every poster and	This will be tested by asking random feedback givers to read all the posters and not down any comments about the text size, readability and contrast with other colors. We will also time them	The test duration should be about 2 hours. We will ask at least 5 feedback givers for this.

		article that we created for the class.	while they perform this task. All results will be recorded in a table containing the amount of time taken to read the posters and the comments on them.	
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Table 6.3.12.-Prototyping Test Plan number 3

6.3.8 Tests

Test 1: Time duration of product

The reason this test has been repeated is so that we can optimize the time duration in the new environment. This is because even if the dimensions are quasi-similar to the other prototype, there still are elements that make this prototype different and that can make the time duration faster or slower. An example of this could be the placement of the chairs in the environment. It is true to say that the placement is now diversified (not in rows like the previous prototype) to make it look more like a kindergarten classroom.

Trial index	Duration (s)	Combinations of paths taken
1	1:00.36	1 2 3 4
2	59.80	2 4 3 1
3	1:18.98	4 3 2 1

4	1:09:54	2 3 4 1
5	57.92	3 4 2 1

Table 6.3.13.-Test 1 Results

Test 2: Readability

The reading time is a vital element of our prototype. This is because the faster and easier the elements are to read, the more the client and users will understand the concept of our product. We have set a maximum time for our prototype as 1 minute and we want the user to be able to read all posters easily. Therefore, if the reading time of all of our contestants is more than that, it should be apparent the text is not very readable. While testing, we have gotten several elements of feedback. To begin, the ABC poster letters are too small to read. This is something that we can change by making them larger on the poster. To continue, the yellow wording was not legible. Therefore, we will darken the outline of the word. Also, some feedback givers have mentioned that the newspaper was too small to read. This meant that There would also be a feedback column for people who wanted to give more feedback on the subject. Finally, one feedback giver mentioned that the orange poster's letters were too small to read, so we decided to change the side of the poster and the letters to make them bigger.

Trial index	Duration (s)	Readability feedback
1	1:07.16	For the ABCs, the letters are quite small. Making them bigger would be helpful to read better.

		The posters are very child-friendly
2	1:23.09	The yellow wording on one of the posters was not legible in the situation. I love the colours on the ABCs posters
3	1:34:10	The newspaper was too small to read.
4	54:32.32	The words on the MASK poster were very difficult to read.
5	59:51.11	The orange poster's letters were too small.

Table 6.3.14.-Test 2 Results

Test 3: Precision of message/ focus on message: Narrative effectiveness for the posters

Questions

How concerned does this make you feel?

Do you understand each of the steps?

How much does this motivate you to act?

The feedback that we have gotten has helped us prove that our product has improved greatly. This is

because the average in all sections is much higher than that of the first prototype. However, some feedback givers mentioned that they were slightly confused in the first few minutes of the simulations and that they did not know where to start. It is for this reason that we have decided to add an audio recording to our sound to put the users in a situation and explain the environment as they go. This would also ensure that no one would be confused and that they would know exactly what to do. Finally, this decision also helps us add some realism to the environment, by helping shift the atmosphere.

Feedback giver number	User persona	Question 1 Grade (/10)	Question 2 Grade (/10)	Question 3 Grade (/10)
1	Regis	8/10	7/10	6/10
2	Lola	7/10	9/10	6/10
3	Edward	9/10	7/10	8/10
4	Amy	7/10	9/10	4/10
5	Lola	9/10	6/10	9/10

Table 6.3.14.-Test 3 Results

Test 4: User Immersion in the environment

Questions:

How much do you feel immersed?

Is this realistic to you?

What could be improved?

This test also helped us determine if our prototype was becoming more convincing and realistic. This is the case because the average grade for each section was much higher than that of the previous prototype.

Many users mentioned that the posters on the wall were very clear and helped show that it was a kindergarten classroom. The details such as the cubbies, the rocket painted on the wall and the other accessories also helped us display a kindergarten classroom. We had received feedback saying that adding a message describing what events are taking place could help us tell a story.

Feedback giver number	User persona	Question 1 Grade (/10)	Question 2 Grade (/10)	Question 3
1	Regis	9/10	8/10	Adding a message that would guide the person or at least explain what is happening.
2	Lola	7/10	8/10	Some of the posters were tough to read
3	Edward	6/10	6/10	Yellow text is hard to read
4	Amy	8/10	7/10	Not sure if I love the FNAF music

5	Lola	10/10	9/10	More detail couldn't hurt
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Table 6.3.15.-Test 4 Results

6.2.8 Special Requirements

It's also important to test your computer and hardware when one of them is changed. This is because it sometimes takes a few hours for the program to load on Unity. This is because it is required to transfer the product from a USB key to the device. During that process it is often the case that the assets do not load into the game properly, therefore you must ensure that all components are synchronized and up to date. In other circumstances, the hardware and device might not be compatible, therefore some VR programs may not function as expected. This is usually because of some components such as graphics cards that are not compatible with Oculus. To avoid this, you can visit the Oculus website to consult which graphics cards are compatible with Oculus.

- NVIDIA Titan X
- NVIDIA GeForce GTX 970
- Desktop NVIDIA GeForce GTX 1060
- NVIDIA GeForce GTX 1070 (all)
- NVIDIA GeForce GTX 1080 (all)
- NVIDIA GeForce GTX 1650 Super
- NVIDIA GeForce GTX 1660
- NVIDIA GeForce GTX 1660 Ti
- NVIDIA GeForce RTX 20-series (all)
- AMD 400 Series
- AMD 500 Series
- AMD 5000 Series
- AMD Vega Series

Figure 6.10.- All Graphics cards compatible with Oculus

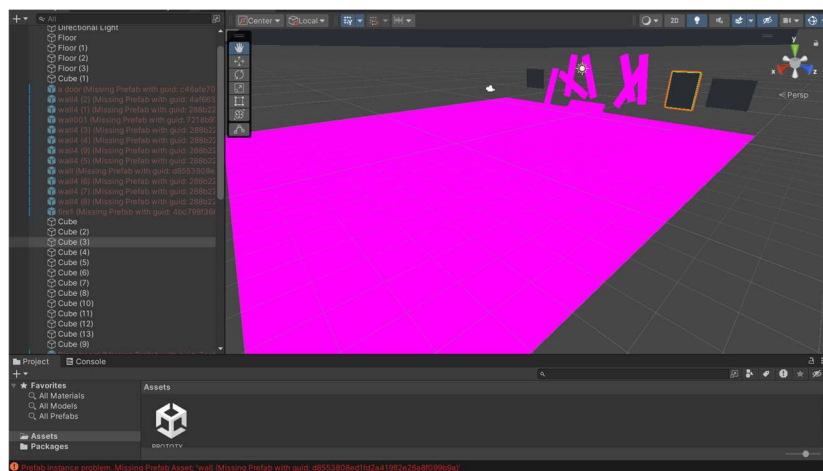
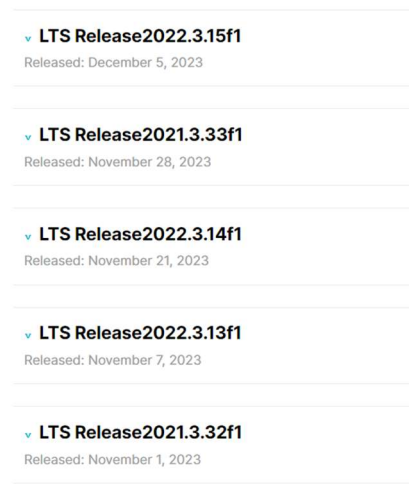


Figure 6.11.- Assets that are not loaded in the Game properly

To continue, it is important to ensure that all components are updated regularly. This can be done in Section 5.4 "Maintenance" or simply by visiting the Unity and Oculus update pages and consulting their notes to ensure that the changes being made do not put the integrity of the project in jeopardy. This is because VR hardware and software can experience technical glitches. Therefore, regular updates can help avoid them.



▼ LTS Release2022.3.15f1 Released: December 5, 2023
▼ LTS Release2021.3.33f1 Released: November 28, 2023
▼ LTS Release2022.3.14f1 Released: November 21, 2023
▼ LTS Release2022.3.13f1 Released: November 7, 2023
▼ LTS Release2021.3.32f1 Released: November 1, 2023

Figure 6.12.- Updates on Unity

Finally, it's important to make sure the connections within the building are working properly. Because without it, many people may encounter the typical problem of the device not recognizing the VR headset



Figure 6.13.- The headset is not detecting the device

7 Conclusions and Recommendations for Future Work

To summarize, making the final prototype involved building the environment using the Unity asset store and built in elements like lights and planes. We used a kindergarten classroom from the asset store to create our main environment, and then added details like brightly coloured furniture and masks (which were both also found in the Unity Asset store). We also included elements that we created in other apps in the final design, for example, the posters found on all four walls were made using Google Slides and Canva and the drawings found on the tables were created with *Collanote*. We then added other elements, like flickering lights and sound which included a radio broadcast. A code written in C that allowed the user to move and look around using their keyboard was included as well.

Many lessons were learned while creating this product, for instance, this project showed us how important it was to keep our design simple and doable. Our initial idea was too complicated and focused on too many elements, which would not have allowed us to have enough time to develop any of these elements and make them detailed. The idea was to first tour a city changed by mankind to adapt to autonomous weapons and then to tour an underground bunker made to protect civilians from the robots. Creating our project in Unity, which consisted of a single classroom, showed us how difficult it would be to create a city and an underground bunker in VR since even the classroom took a while to build. We probably would've run out of time if we went with our initial idea, or at the very least it would not have been as detailed as our final prototype. Moreover, this project showed us that coming up with a memorable idea is one of the most important parts of

creating the design. Our final prototype was not the most detailed one made in our course, nor the one with the most interactions, nor the most complicated to make, but it still won the design day competition since the idea was very noteworthy because it focused on children. Furthermore, another important lesson learned was that prototyping, receiving as much feedback as possible on the prototypes, and using it to adapt and alter them is a crucial step in the design process. Doing this allowed us to improve many elements in our final design such as the lighting, which was too dark at first, and the readability of the posters. Moreover, listening to people's feedback and adapting our design is what led to our final solution which consisted of a kindergarten classroom. During our first pitch to the client, we mentioned that while doing the tour of the city, a destroyed school is going to be briefly shown. The client recommended that we focus only on the school, since showing the effects of autonomous weapons on children would evoke more emotions than just showing a city, and it would also be a lot less complicated. Thus, the first concepts that we came up with were very different from our final solution, but those concepts and the feedback that we got on them is what led us to it. In addition, this project also showed us that seeking help can be extremely beneficial, especially when it comes to working with the VR headsets. Our group had trouble connecting the headsets when testing, but this was quickly resolved when we asked the teaching assistants for help. However, before doing this, we spent a lot of time trying to figure out how to connect the headsets and weren't able to do so. This shows that sometimes, asking experts for help can be very beneficial.

If more time was given to complete the final product, many aspects of it would be developed more and more elements would be added. For instance, some new aspects that would be included

are sounds whose volume changes based on what part of the classroom the viewer is in. If we had more time, we'd make it so that there were drone noises present that get louder when the user comes closer to the boarded-up windows. Another element that we were thinking of including but that we didn't because of a lack of time is posters that light up when they're approached. We'd also add teleportation into our design, which is something that can be done while using the VR headsets. We'd set some points in our classroom that we'd be able to teleport to and from by clicking a button on the VR headset remote. Furthermore, we considered adding interactions, like allowing the user to pick up the missing kids folders and allowing them to wear the masks but ended up not doing this since we decided to focus on other details instead. If we were given more time, we'd try to add these interactions. We'd also add more details into our design if we had a few more months to work on this project. For example, we'd include name tags on the shelf with masks on it to show that each child has a mask that they're supposed to wear, and we'd cross some of them off, to show that children are disappearing. Moreover, if more time was given, we'd make the environment outside the classroom that's seen from the boarded-up window more detailed, possibly by including a destroyed city outside. Another element that we considered adding but that we didn't due to the lack of time was more rooms in the school that the user would be able to explore. These elements can serve as inspiration for identifying the most effective paths for future work, enabling other teams to build upon our product and enhance it.

8 Bibliography

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[system-corruption/](https://www.datanumen.com/fr/blogs/7-effective-tips-prevent-file-system-corruption/)

[3] Technologies, U. (n.d.). Download. Unity. <https://unity.com/download>

APPENDICES

9 APPENDIX I: Design Files

Table 3. Referenced Documents

Document Name	Document Location and/or URL	Issue Date
MakerRepo Link	https://makerepo.com/caelenzackrias/1842.g7innovation-nation	24/09/23
Deliverable A	https://uottawa-makerspace.s3.us-west-2.amazonaws.com/3porzwekx7wqubg8y65tylsxobpb?response-content-disposition=inline%3B%20filename%3D%22GNG1103%20Deliverable%20A.pdf%22%3B%20filename%2A%3DUTF-8%27%27GNG1103%2520Deliverable%2520A.pdf&response-content-type=application%2Fpdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIA34PB766H365QOAG6%2F20231205%2Fus-west-2%2Fs3%2Faws4_request&X-Amz-Date=20231205T173328Z&X-Amz-Expires=300&X-Amz-SignedHeaders=host&X-Amz-Signature=d06cad4e76a14ad93c2cead28685c4a8b1b9985132a2cf78c210281de3a8706d	24/09/23
Deliverable B	https://uottawa-makerspace.s3.us-west-2.amazonaws.com/vmz3c9rexpz6buiocntxhge99hs?response-content-disposition=inline%3B%20filename%3D%22Deliverable%20B.gng%201103.pdf%2	01/10/23

	2%3B%20filename%2A%3DUTF-8%27%27Deliverable%2520B.gng%25201103.pdf&response-content-type=application%2Fpdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIA34PB766H365QOAG6%2F20231205%2Fus-west-2%2Fs3%2Faws4_request&X-Amz-Date=20231205T173320Z&X-Amz-Expires=300&X-Amz-SignedHeaders=host&X-Amz-Signature=d1853f99b2fd7215c12d217a2e7cb34cd0c1ade55a47ad27f2b955f6cb873253	
Deliverable C	https://uottawa-makerspace.s3.us-west-2.amazonaws.com/n66c8drw8zgm6td8vdz76z6l0oip?response-content-disposition=inline%3B%20filename%3D%22deliverable%20C.pdf%22%3B%20filename%2A%3DUTF-8%27%27deliverable%2520C.pdf&response-content-type=application%2Fpdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIA34PB766H365QOAG6%2F20231205%2Fus-west-2%2Fs3%2Faws4_request&X-Amz-Date=20231205T173415Z&X-Amz-Expires=300&X-Amz-SignedHeaders=host&X-Amz-Signature=cea8b8be44e2377717e9550e26c843318c008b23c189d8033842704da948804d	08/10/23
Deliverable D	https://uottawa-makerspace.s3.us-west-2.amazonaws.com/oth2bk0uc7izv2hy2b003qoezs0v?response-content-disposition=inline%3B%20filename%3D%22Final%20Deliverable%20D.pdf%22%3B%20filename%2A%3DUTF-8%27%27Final%2520Deliverable%2520D.pdf&response-content-type=application%2Fpdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIA34PB766H365QOAG6%2F20231205%2Fus-west-2%2Fs3%2Faws4_request&X-Amz-Date=20231205T173539Z&X-Amz-Expires=300&X-Amz-SignedHeaders=host&X-Amz-Signature=9a8b8be44e2377717e9550e26c843318c008b23c189d8033842704da948804d	15/10/23

	Expires=300&X-Amz-SignedHeaders=host&X-Amz-Signature=1e7f03d6d70bf5df0345deba14036a451247c02209e6036427bc979b3d354216	
Deliverable E	https://uottawa-makerspace.s3.us-west-2.amazonaws.com/p93oy600q22rcsvcegf4zs0519o?response-content-disposition=inline%3B%20filename%3D%22Deliverable%20E.pdf%22%3B%20filename%2A%3DUTF-8%27%27Deliverable%2520E.pdf&response-content-type=application%2Fpdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIA34PB766H365QOAG6%2F20231205%2Fus-west-2%2Fs3%2Faws4_request&X-Amz-Date=20231205T173427Z&X-Amz-Expires=300&X-Amz-SignedHeaders=host&X-Amz-Signature=ea107b08bfa3f8595e5664c76c658656fecf994202ebce872f37b238e2534431	29/10/23
Deliverable F	https://uottawa-makerspace.s3.us-west-2.amazonaws.com/t73qsduj0a27w4okefa2lrz27xe?response-content-disposition=inline%3B%20filename%3D%22deliverable%20F.pdf%22%3B%20filename%2A%3DUTF-8%27%27deliverable%2520F.pdf&response-content-type=application%2Fpdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIA34PB766H365QOAG6%2F20231205%2Fus-west-2%2Fs3%2Faws4_request&X-Amz-Date=20231205T173643Z&X-Amz-Expires=300&X-Amz-SignedHeaders=host&X-Amz-Signature=105a62f9886acd152d87fc67d114174cd37e09f0172040a56f5eaac88b43c365	05/11/23
Deliverable G	https://uottawa-makerspace.s3.us-west-2.amazonaws.com/t59txj2tx1wedzh3rlzf3kxjp3kh?response-content-disposition=inline%3B%20filename%3D%22deliverable%20G.pdf%22%3B%20file	12/11/23

	name%2A%3DUTF-8%27%27deliverable%2520G.pdf&response-content-type=application%2Fpdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIA34PB766H365QOAG6%2F20231205%2Fus-west-2%2Fs3%2Faws4_request&X-Amz-Date=20231205T173655Z&X-Amz-Expires=300&X-Amz-SignedHeaders=host&X-Amz-Signature=514396d08c6014aa0448a2ed73b0c7f6cd67d5cfce5da72c732b027551cf25bf	
Deliverable H	https://uottawa-makerspace.s3.us-west-2.amazonaws.com/6n31dywgfdiu39k0r5fze38b1ojf?response-content-disposition=inline%3B%20filename%3D%22deliverable%20H.pdf%22%3B%20filename%2A%3DUTF-8%27%27deliverable%2520H.pdf&response-content-type=application%2Fpdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIA34PB766H365QOAG6%2F20231205%2Fus-west-2%2Fs3%2Faws4_request&X-Amz-Date=20231205T174038Z&X-Amz-Expires=300&X-Amz-SignedHeaders=host&X-Amz-Signature=8590c14125491b17184f04001cff5942971d4ee10e12bf08c121d5e02f14197f	26/11/ 23
Deliverable I	https://makerepo.com/caelenzackrias/1842.g7innovation-nation	29/11/ 23
Deliverable J	https://makerepo.com/caelenzackrias/1842.g7innovation-nation	16/11/ 23

10 APPENDIX II: Other Appendices

[1] Youtube link for the Prototype:

https://www.youtube.com/watch?time_continue=1&v=oYgsmetIMxA&embeds_referring_euri=https%3A%2F%2Fmakerepo.com%2F&source_ve_path=Mjg2NjY&feature=emb_logo