GNG1103E

Design Project User and Product Manual

The Room – A Virtual Reality Experience about Autonomous Weapons

Submitted by:

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2024-04-10

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List of Acronyms and Glossary

Table 1. Acronyms

Acronym	Definition
AW	Autonomous Weapon(s)
CC	Closed captions

Table 2. Glossary

Term	Acronym	Definition
Asset	N/A	Any kind of item used in the project, digital.
Parent	N/A	Instances in the hierarchy containing children.
Child	N/A	Subordinate instances in the hierarchy of a parent. Can be a parent and have children itself.

1 Introduction

This User and Product Manual (UPM) provides the information necessary for VR users to effectively use “*The Room – A Virtual Reality Experience about Autonomous Weapons”*.
Within this virtual environment, users are taken to a living room that has been affected by these autonomous weapons. They will see visible signs of destruction, such as damaged walls and bullet holes, providing insight into the impact of this technology on everyday life.

However, "The Room" provides more than just observations. Users can actively interact with elements such as light switch, animated distressed dog and a shattered wine glass. These interactive features enhanced the depth and engagement of the user experience.

Furthermore, the TV in "The Room" broadcasts news updates about these new weapons, adding context to the larger implications. Our goal with this immerses storytelling is to prompt reflection on the moral complexities of technology advancements.

In this report, we will look at the creation of "The Room," including design choices, assets, cautions and warnings, system setup, troubleshooting support, product development, and thematic considerations. By encouraging dialogue and reflection, we aim to enhance users' understanding of the ethical issues surrounding autonomous weapons.

2 Overview

This product is a virtual reality (VR) experience that involves users in a simulated environment where they witness the effects of autonomous weapons on a fictional family to raise awareness about the dangers associated with these weapons. The VR room is filled with objects that evoke the sense of chaos and dangers brought on autonomous weapons, including bullets holes, a crying dog, a broken wine glass, Fan, light switch, Television, toy truck, Posters and barricaded windows.

To ensure a smooth and enjoyable VR experience for users, we prioritize:

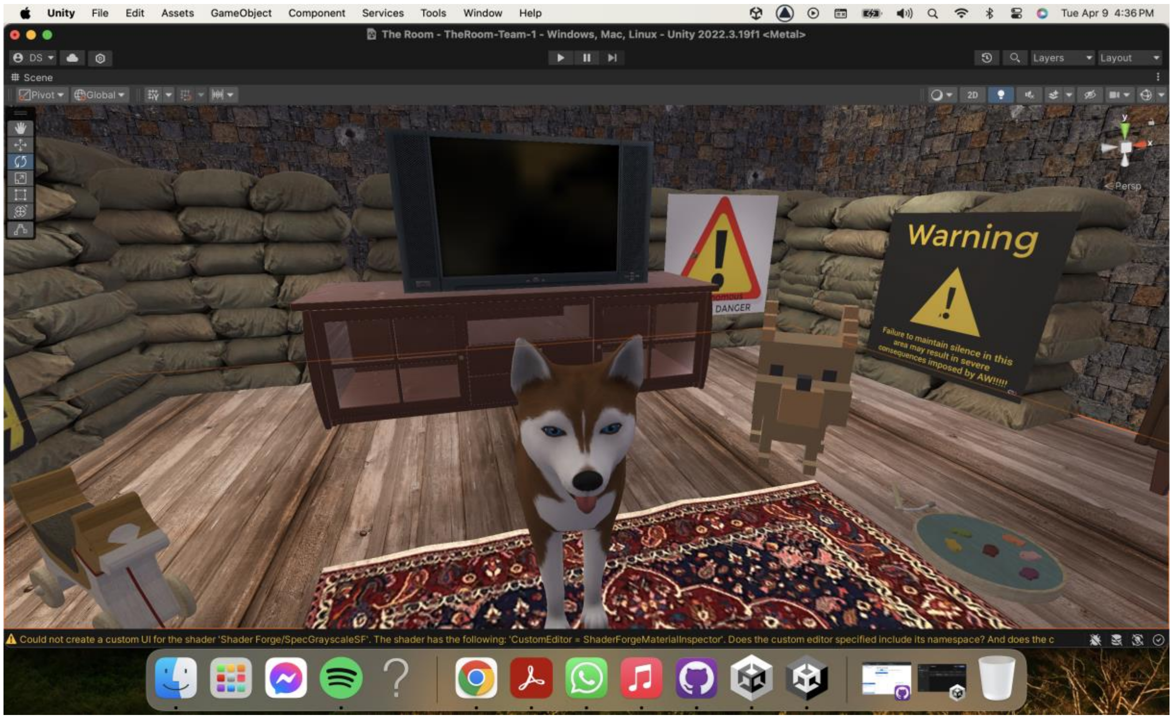
- **User comfort**: We have designed an immersive interface, carefully curated music that respects users' ethical and moral concerns, detailed modeling, interactive engagement, intuitive movement controls, and rigorous testing, including three prototypes, extensive testing, and feedback, before producing the final product that guarantees user comfort.
- **Interface**: The interface was crafted within a VR environment to enhance usability.
- **Sounds and music**: Music was thoughtfully integrated to maintain engagement and coherence within the environment.
- **Movement**: To ensure user-friendly and efficient movement controls, we tested various mechanics tailored for VR experiences. We incorporated user feedback and considered device capabilities, adapting movement controls to accommodate a variety of VR devices and input methods for gameplay.
- **Interaction**: We adapt interaction mechanics to enhance immersion and usability, considering device compatibility and user feedback, users can interact with different object in the room like the dog, glass of wine to deepen their engagement.
- **Model detail**: We enhance immersion and usability by adjusting interaction mechanics based on device compatibility, feedback, and providing users with a realistic simulation.
- **Testing**: Throughout the project, we conducted extensive user testing to identify and resolve any issues related to comfort, usability, or immersion. We designed the environment with clear visual and spatial cues to aid users and prevent disorientation. Our goal is to make the VR experience as smooth and enjoyable as possible for all users and seeking feedback from end users.

The differences of this product from others are:

Realistic Simulation: By simulating the effects of autonomous weapons on a family in a highly realistic way, our virtual reality experience fosters empathy and understanding.

Interactive Elements: To increase their level of engagement and emotional response, users can interact with a variety of objects in the virtual reality room, such as the sobbing dog and shattered wine glass.

Educational Focus: Our product is specially made to teach users about the moral ramifications of autonomous weapons, in contrast to other virtual reality experiences that might put more emphasis on entertainment.


Unity
File
Edit
Assets
GameObject
Component
Services
Tools
Window
Help
Tue Apr 9 4:36 PM
The Room - TheRoom-Team-1 - Windows, Mac, Linux - Unity 2022.3.19f1 <Metal>
DS
Layers
Layout
Scene
Pivot
Global
2D
Persp
DANGER
Warning
Failure to maintain silence in this area may result in severe consequences imposed by AW!!!!!

```
Could not create a custom UI for the shader 'Shader Forge/SpecGrayscaleSF'. The shader has the following: 'CustomEditor = ShaderForgeMaterialInspector'. Does the custom editor specified include its namespace? And does the c
```

The VR system is built using Unity platform, which is well-known for producing engaging games. For the virtual world to come to life, it incorporates assets, scripts, and interactions. UI system for Unity, scripts for object behavior, VR headsets and controllers for user interaction, asset integration for realism, web-based deployment for cross-platform accessibility, and the Unity Engine for rendering are some of the components.

The user access mode:

Using a VR headset and a compatible gaming PC or VR console, users can access the virtual reality experience. Users are presented with a menu interface in the virtual environment when they launch the VR application. From there, they can customize the settings, begin the experience, and explore various scenes. Motion controllers are commonly used for object interaction; they track hand gestures and movements within the virtual environment.

Special condition:

It is advised to use a VR-ready computer or gaming console with adequate processing and graphics power for the best possible performance and user experience. For room-scale virtual reality experiences, users should also have enough room to move around and interact with the virtual world without being restricted.

2.1 Conventions

2.1.1 Asset hierarchy locations

In unity there are dependencies between assets. That means, there are “parent” assets and “children” of those. To describe these dependencies within the hierarchy the following convention is used:

Parent > Child > Sub Child

All assets used in this project and discussed in this document are children of the singular scene *The Room*, so assume all instances to be child of *The Room*.

2.1.2 Hyperlinks within the document

There will be references within this document to other sections to avoid unnecessary repetitions. They are clickable and made visible by an underline.

2.1.3 Cautions & Warnings

- **Motion sickness:** Virtual reality experience can sometimes cause motion sickness and discomfort due to quick motions or perspective changes, which is extremely risky. Therefore, you are encouraged to take breaks if you begin to feel uncomfortable.
- **Emotion impact:** Certain components of the Virtual reality environment, like the distress of an animated dog, are intended to stir up emotions for users. Therefore, Users who are sensitive to themes of distress or violence are advised to proceed with caution and warned about the possible emotional impact of such scenes.
- **Audio sensitivity:** sounds and animations are incorporated into the scene, such as the dog whining, glass breaking, and background rumbling. Therefore, you should be aware of the existence of audio cues and try to adjust the volume settings according to your comfort level.
- **Realism of damage:** The virtual reality setting displays bullet holes and cracked walls from autonomous weapons. Users are reminded that these elements may be distressing or triggering due to their realistic portrayal.
- **Interactive elements:** Some elements in the environment like the light switch, need interaction from the user. Users are reminded to avoid any actions that could cause discomfort or unintended consequences and are recommended to interact with these elements safely.
- **Civilian’s adaptability:** The environment depicts civilians adjusting to life in the presence of autonomous weapons, such as using sandbags for protection and hiding behind metal blinds. Users are cautioned about the depiction of survival strategies and reminded that real-life situations may require different approaches.
- **Ethical and moral concerns:** The Virtual reality environment addresses moral and ethical concerns about the use of autonomous weapons through posters and news channel content.

Users are made aware of the thematic content and encouraged to think about the implications of these technologies.

- **Physical environment Awareness:** Users are reminded to have enough physical space to safely navigate the Virtual reality environment without hitting other objects or tripping over stuff in the real world.
- **Technical consideration:** While the prototype aims to create an immersive experience, users are informed about potential technical issues such as system requirements, compatibility and possible glitches or bugs.

Users are reminded to use Virtual Reality technology responsibly and respectfully, considering the impact on themselves and others. You are also encouraged to seek help if you have any difficulties or distressing experiences while using the Virtual reality environment.

3 Getting started

Section 3 of the User and Product Manual for "The Room - A Virtual Reality Experience about Autonomous Weapons”. This section will guide you through the initial steps of setting up and accessing the VR system and navigating within the virtual environment. Whether you're new to VR or not, this guide will ensure a smooth and immersive experience from start to finish.

Let's explore how to get started with "The Room". The system primarily consists of the Unity application running on a VR-compatible device.

3.1 Requirements

Before setting up the VR experience, ensure that you have the following.

3.1.1 Input Devices:

- VR Headset (e.g., Oculus Rift, HTC Vive)
- VR-compatible controllers

Follow the instructions on the VR headset that you are using to connect it to the system.

Figure1: VR headset.

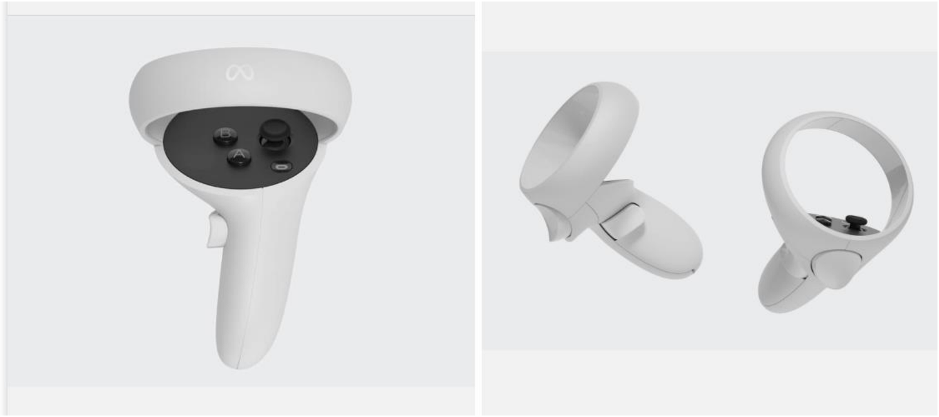


Figure 2: VR controllers

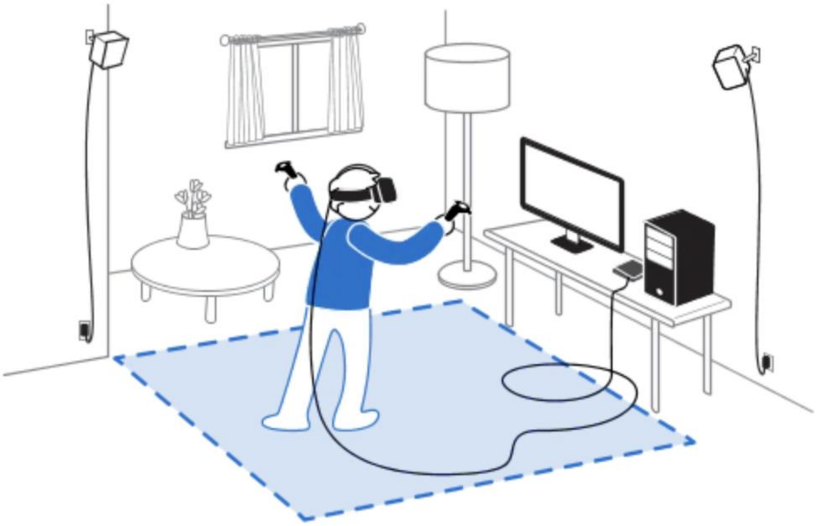


Figure 3: A user with a VR headset.

3.1.2 Output Devices

- Display monitor
- Or a PC

Figure 4: Monitor

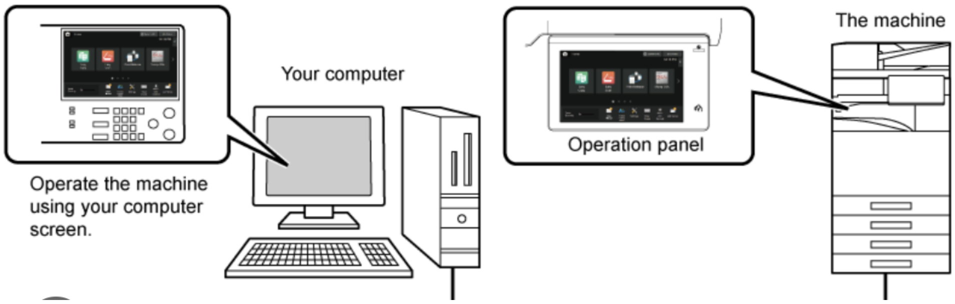


Figure 5: PC and a monitor screen.

3.1.3 Applications needed

- Unity: follow the instructions on Unity when installed foe Setup. Thin Link is a direct access to Unity website: https://unity.com/download

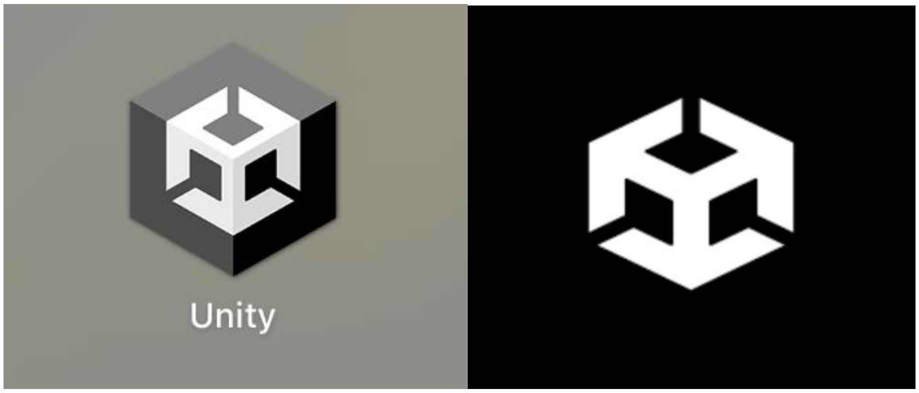


Figure 6: Unity LOGO and application.

3.2 User Access Considerations

No special user access considerations are needed. The system is designed to be accessible to all users without any specific permissions or credentials.

3.3 Accessing/setting up the System

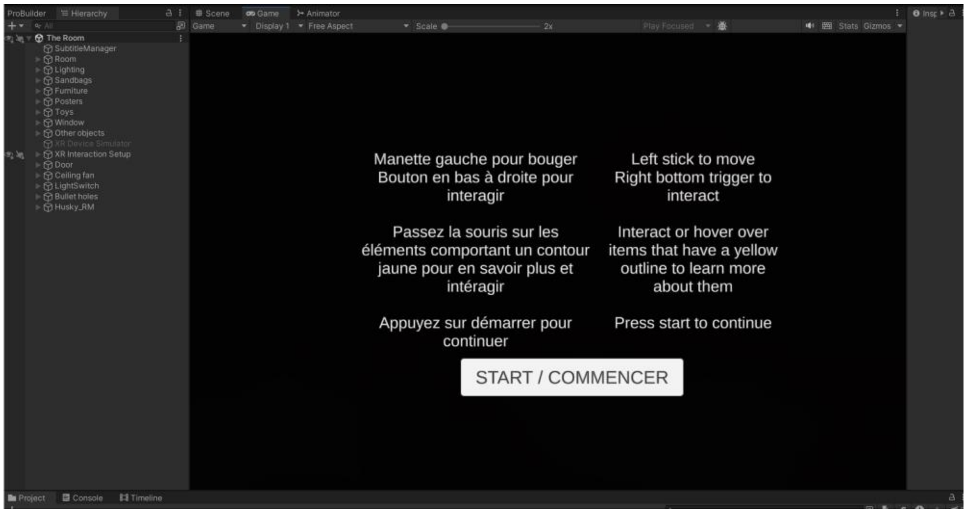
- Connect the VR headset to your computer.
- Ensure that all necessary drivers and software are installed.
- Launch the VR application.
- Put on the VR headset and adjust it for comfort.
- Hold the VR controllers in your hands and ensure they are paired with the headset.
- Follow the on-screen instructions to calibrate your VR setup.
- Once calibrated, you will be transported into "The Room" virtual environment.

3.4 System Organization & Navigation

Upon entering "The Room" virtual environment, you will find a black Panel that will guide you through the VR experience, the instructions are provided in English and French.

3.4.1 Navigation

Use the thumb sticks or trackpads on your VR controllers to press on the **"Start/ Commencer"** bottom.
Use the thumb sticks or trackpads on your VR controllers to move around.
Point the controller in the direction you want to go and press the appropriate button to move.



Manette gauche pour bouger
Bouton en bas à droite pour interagir

Left stick to move
Right bottom trigger to interact

Passez la souris sur les éléments comportant un contour jaune pour en savoir plus et intéragir

Interact or hover over items that have a yellow outline to learn more about them

Appuyez sur démarrer pour continuer

Press start to continue

Figure 7: a picture of the start panel when accessing Unity, the VR headset is required to start navigating.

- Once you press on **"Start/ Commencer"** using the headset you will be inside the room.

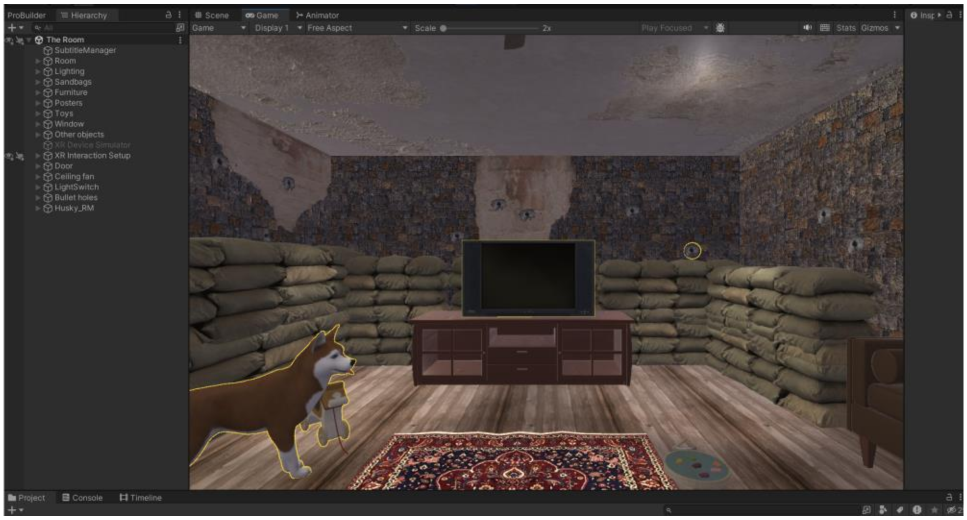


Figure 8: a picture of the "The room" you will be transported into once you press on **"Strat/ Commencer"**.

3.4.2 Interactions

- Direct your gaze towards interactive objects to highlight them.
- Use the trigger button on your controller to interact with highlighted objects.
- TV interactions: Approach the TV. Use the trigger button to view news updates about autonomous weapons.
- Sandbags: Approach the sandbags. Use the trigger button to select the sandbags and view the description box provided.
- Use the same approach for the elements in the room, so you can discover area.

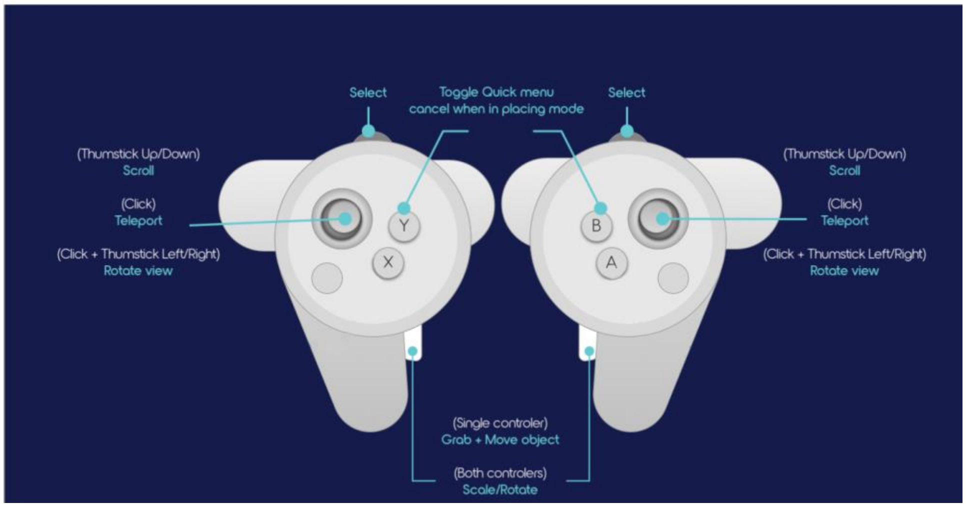


Figure 9: a picture showing an example of VR controllers' elements and how to use the. Check your VR controllers for better instructions.

3.5 Exiting the System

To exit "The Room" virtual environment and return to the main menu:

- Press the designated exit button on your VR controller.
- Confirm your choice to exit when prompted.
- Remove the VR headset and power it off.
- Close the VR application on your computer.
- Close the Unity application on your computer.

4 Using the System

The following sub-sections provide detailed, step-by-step instructions on how to use and modify the various functions or features of The Room.

4.1 XR Interaction Setup

The XR Interaction Setup is responsible for the integration of a VIRTUAL REALITY headset and enable the functionality thereof. It contains the main camera for the game and is parent of the initial UI screen, the CC panel, the black final screen, as well as sounds like the background music and the rumbling,

4.1.1 Initial UI Screen

The initial UI screen provides the user with adequate information about how to interact with the virtual environment of The Room. It is enabled at the beginning and disabled upon button click. It consists of a canvas containing the intro panel, which contains the two text boxes for French and English, as well as the start button and the background plane. It can be found in

> *XR Interaction Setup > XR Origin (XR Rig) > Camera Offset > Main Camera > Canvas (1) > IntroPanel*

The background plane is responsible for hiding the outlines of various assets from the player while being on the UI screen.

4.1.1.1 Text boxes

To modify the text, one can navigate through the hierarchy to the text boxes:

> *> IntroPanel > Text EN* or
>
> *> IntroPanel > Text FR*

and modify the text in the inspector under the component *TextMeshPro – Text (UI)*. To adjust the sizing and the position of the textboxes after changing their content one can change the values of *Pos X* and *Pos Y,* as well as *Width* and *Height* in the *Rect Transform* component of the textboxes.

4.1.1.2 Start button

The start button can be found in:

> *> IntroPanel > Button*

It contains the text on it under

> *IntroPanel > Button > Text (TMP)*

The text can be modified in the inspector under the component *TextMeshPro – Text (UI)*. To adjust the sizing and the position of the textbox after changing the content one can change the values of *Width* and *Height* in the *Rect Transform* component of the textbox.

The button will toggle the entire IntroPanel. The asset to be toggled is referenced as “On Click ()" in the *Button* script in the inspector of the *Button*.

4.1.2 CC Panel

The CC Panel serves as a background for the subtitles and CCs displayed throughout the experience. It is disabled by default, but will be enabled once CCs or subtitles are needed. It can be found in

> *XR Interaction Setup > XR Origin (XR Rig) > Camera Offset > Main Camera > Canvas (1) > CC Panel*

The text contained in

> *> CC Panel > Text (TMP)*

is automatically updated by the *SubtitleManager* (*The Room > SubtitleManager*) and should not be modified.

The sizing of the CC Panel and the textbox can be changed in the respective *Rect Transform* component in the editor.

4.1.3 Black final screen

The black final screen is a simple black plane obstructing the view of the player. It can be found under

> *XR Interaction Setup > XR Origin (XR Rig) > Camera Offset > Main Camera > Canvas (1) > Final black screen*

It is disabled by default and will not be made visible at any point during the game, unless this is enabled in the light switch. It can be used for cinematographic purposed, for example, so that when one turns off the light switch it goes dark (the plane is displayed). For how to enable this functionality consult section 4.2.4.2 Enable black screen.

4.1.4 Background music

The background music is managed through an Audio Source in

> *XR Interaction Setup > Background music*

To change the background music, a new sound file can be dragged form the file explorer into the Project Workspace with the Folders in Unity (Sound files are currently stored under Assets\Assets\Sounds). Then the audio file can be added to the Audio Source on the right in the inspector under *AudioClip*. Through *Priority* and *Volume,* the presence of the music can be adjusted.

4.1.5 Rumbling sound effect

The rumbling sound effect is managed through an Audio Source in

XR Interaction Setup >Rumbling

To change the rumbling sound effect, a new sound file can be dragged form the file explorer into the Project Workspace with the Folders in Unity (Sound files are currently stored under Assets\Assets\Sounds). Then the audio file can be added to the Audio Source on the right in the inspector under *AudioClip*. Through *Priority* and *Volume,* the presence of the music can be adjusted.

4.2 Other objects and assets

4.2.1 Bullet holes

The bullet holes are children of an empty *Bullet hole* parent container.

Bullet holes > Bullet hole (x)

The bullet holes consist of a plane, to which a texture (image) has been applied, see 6.1.3.6 PNG Images.

4.2.1.1 Hover description

One of these objects (has an outline, *bullet hole (2) canvas*) has descriptive boxes that appear when hovering over it. See section 4.4 Hover messages for further information.

4.2.1.2 Outline

One of these objects has an outline (*bullet hole (2) canvas*). The outline stays activated after clicking on it. See section 4.3 Outlines for further information. The outline of the bullet hole is applied to a sphere that surrounds the bullet hole, since the outline around the plane of the image was hard to see.

4.2.2 Dog

The dog is one of the more complex objects in *The Room*. It is a multilayered object with sound effects, interactions, animations, and description. It can be found in the main hierarchy.

The Room > Husky_RM

It has the armature > *Arm_Dog* that is used for animation purposes, as well as the object itself, > *Husky*, and a canvas for descriptive purposes, as explained in section 4.4 Hover messages.

4.2.2.1 Animation

The overall animation is managed through built-in sub-animations of the asset. They are applied to the *Animator* of *Husky_RM*. The animation controller can be accessed under *Assets/Assets/Husky_dog/FBX/Dog animation.controller*.
The animation controller shows transitions between different sub-animations that can be rearranged and connected easily.

4.2.2.2 Closed caption

After clicking on the dog, the whining sounds are accompanied by closed captions. They can be changed on *Husky_RM* in *One Shot Subtitle Data (Script)*.

4.2.2.3 Hover description

This object has descriptive boxes that appear when hovering over it. See section 4.4 Hover messages for further information.

4.2.2.4 Outline

This object has an outline. The outline gets disabled after clicking on it. See section 4.3 Outlines for further information.

4.2.2.5 Sound effects

After clicking on the dog, a whining sound will play. That is managed through the *Audio Source* of *Husky_RM*. To change the audio file, choose a new one in the *Inspector*.

4.2.3 Glass

The glass is one of the more complex objects in *The Room*. It is a multilayered object with sound effects, interactions, and description. It can be found under *Other objects* in the hierarchy.

Other objects > GlassContainer

The parent container holds the *Wine glass*, the *GlassTrigger*, direction, as well as a canvas for descriptive purposes (see section 4.4 Hover messages).

4.2.3.1 Shattering of glass

The shattering of the glass is achieved with Open Fracture, which has to be installed separately (check their documentation for installation).
The shattering of the glass is managed through the script *Fracture* and *Fracture Collision Detect*. The latter takes care of the collision detection, since the one built-in with *OpenFracture* does not operate properly. These scripts are applied to

GlassContainer > Wine glass

In order to achieve a nice fracture a *Fragment Count* of 100 has been used, as well as the texture *BA_Glass_02*, stemming from the *Apartment Kit*. The trigger options do not matter, since the

Fracture Collision Detect Script is used. That script needs a collision force (100 works for these purposes). An audio playback option has been implemented through this script. The Audio Source can be added under *Shatter*. The Audio Source is property of the *GlassContainer*.
The *GlassTrigger* is a hitbox that starts the shattering of the glass. As soon as an object moves into the hitbox, it applies the force specified to the target in a specified direction. This can be managed in the script *Push Glass* of the trigger. Force was found to be optimal around a value of 50. *Direction* is specified through an object placed in the environment, *object*, and the impulse target is the object that should shatter, *Wine glass*. To adjust the hitbox of the trigger the position and scale of the *GlassTrigger* can be adjusted under *Transform*.
direction is an empty object that only has the component *Transform.* It is target of the fall direction. After the impulse has been applied by *Push Glass* in the direction of *direction*, the glass will fall down and experience the specified force in *Wine glass*, *Fracture Collision Detect*.

4.2.3.2 Hover description

This object has descriptive boxes that appear when hovering over it. See section 4.4 Hover messages for further information.

4.2.3.3 Outline

This object has an outline. The outline gets disabled after the glass shatters. See section 4.3 Outlines for further information.

4.2.3.4 Sound effects

The Audio Source is component of the *GlassContainer* and is played by the script *Fracture Collision Detect*.

4.2.4 Light switch

The light switch has a descriptive use through the hover function, but it can also be set to enable a black screen upon clicking, that can be used for video recording purposes, for example, as seen in our YouTube video. Otherwise using the light switch toggles the light flickering.
The light switch can be found in the main hierarchy.

The Room > LightSwitch

4.2.4.1 Toggle light flickering

Upon interaction with the light switch, the script *Light Switch* will enable or disable the flickering of the lighting system. For more information see section 4.2.5.1 Flickering.

4.2.4.2 Enable black screen

To turn on the functionality of enabling the black final screen as described in section 4.1.3 Black final screen the screen needs to be added to the *XR Simple Interactable* of the *LightSwitch*. This is done under *Interactable Events*, *Select Entered*. The function *GameObject.SetActive* needs to have the checkbox underneath enabled for the black screen to display upon interaction.

4.2.4.3 Hover description

This object has descriptive boxes that appear when hovering over it. See section 4.4 Hover messages for further information.

4.2.4.4 Outline

This object has an outline. The outline stays activated after clicking on it. See section 4.3 Outlines for further information.

4.2.5 Lights

The lighting in this room consists of four spot lights in the corners of the room and a point light in the middle of the room. They can be found in the empty parent container *Lighting*.
A script toggles the flickering upon flipping the light switch.

4.2.5.1 Flickering

The script *Light Switch* of the *LightSwitch* periodically turns the lights on and off. The script rotates the lights 180 degrees upward and then back down to simulate flickering. It can be disabled with the *LightSwitch*.

4.2.6 Sandbags

The sandbags are children of an empty *Sandbags* parent container.

Sandbags > sandbags (x)

4.2.6.1 Hover description

One of these objects (has an outline, *sandbags canvas*) has descriptive boxes that appear when hovering over it. See section 4.4 Hover messages for further information.

4.2.6.2 Outline

One of these objects has an outline (*sandbags canvas*). The outline stays activated after clicking on it. See section 4.3 Outlines for further information.

4.2.7 Television

The television is another important feature of *The Room*. It features the news broadcast, as well as a hover description and outlines. It can be found in the parent container of furniture.

Furniture > TV

4.2.7.1 News broadcast

The *News Flash* is a plane fitted onto the screen of the TV. It has a *Vide Player* added to it.

Furniture > TV > News Flash

The *Video Player* holds the video clip fabricated by the group and gets turned on upon interaction with the TV through the *XR Simple Interactable*. After clicking again it stops.

4.2.7.2 Hover description

This object has descriptive boxes that appear when hovering over it. See section 4.4 Hover messages for further information.

4.2.7.3 Outline

This object has an outline. The outline gets disabled after clicking on it. See section 4.3 Outlines for further information.

4.2.7.4 Subtitles

The *News Flash* is accompanied with subtitles that are displayed simultaneously upon starting of the *Video Player*. The subtitles are managed with the script *Subtitle Data*, *Signal Receiver*, as well as the component *Playable Director*. These scripts and components work together with the object *The Room > SubtitleManager* to display the subtitles on the 4.1.2 CC Panel.The subtitles are timed with the *Playable Director* and manually synced to the video.

4.2.8 Toy truck

The toy truck is a small easter egg, as it is the only object in *The Room* that can be grabbed and freely moved around. It serves no other purpose than that. It is nested under the empty parent *Toys*.

Toys > ArmyTruck

4.2.8.1 Throwability

As mentioned, this is the only grabbable/throwable object in *The Room*. This is achieved with the component *XR Grab Interactable*.

4.2.8.2 Hover description

This object has descriptive boxes that appear when hovering over it. See section 4.4 Hover messages for further information.

4.2.8.3 Outline

This object has an outline. The outline stays activated after clicking on it. See section 4.3 Outlines for further information.

4.2.9 Posters

The posters in French and English serve an educative purpose. They have a hover description, as well as outlines applied to them.

4.2.9.1 Hover description

This object has descriptive boxes that appear when hovering over it. See section 4.4 Hover messages for further information.

4.2.9.2 Outline

This object has an outline. The outline stays activated after clicking on it. See section 4.3 Outlines for further information.

4.2.10 Window

The window consists of a plane with a picture texture added to it, as well as two sets of steel bars added on top of if. It has a hover description, as well as an outline.
The steel bars and a canvas for the description are children of the window plane, which can be found in the main hierarchy.

4.2.10.1 Hover description

This object has descriptive boxes that appear when hovering over it. See section 4.4 Hover messages for further information.

4.2.10.2 Outline

This object has an outline. The outline stays activated after clicking on it. See section 4.3 Outlines for further information.

4.3 Outlines

Outlines are provided for various objects in the game and indicate interactability, whether that be a message that appears when pointing at the object, or clicking, or actual grabbing.
The following items have an outline (items with * loose their outline after click interaction):

- Bullet hole
- Dog*
- Fire extinguisher
- First Aid Kit
- Fishing magnet toy
- Glass*
- Light switch
- Poster

- Sand bags
- Toy truck
- TV*

The outline is added to an object through the script *Outline*. All the outlines in *The Room* are set to the same colour # FFD100, the colour can be easily changed though in the inspector. All the outlines are set to “Outline Visible” as *Outline Mode*, since they are not supposed to be visible through solid objects. This is especially important for the beginning of *The Room* with the 4.1.1 Initial UI Screen and the 4.1.3 Black final screen, since they have a solid plane behind them to block outlines and outlines are still visible if they are set to “Outline All”.

4.4 Hover messages

The hover messages are an important feature of this product. They provide descriptions for the user and explain the meaning of various objects in *The Room*. The descriptions are provided in English and French.

Every object that has said functionality has a child, a canvas (usually named *Canvas (1)*, sometimes the names might slightly vary). That canvas has two panels, *Panel EN/FR*, that hold a textbox.

> *Canvas (1)* > *Panel EN/FR* > *Text (TMP)*

The Canvas, Panel, and Text can be moved through the values of *Pos X*, *Pos Y*, *Pos* Z of the component *Rect Transform*. The panel adds a blue background behind the text. The text can be edited in *Text (TMP)* under the component *TextMeshPro – Text (UI)*. If the sizing of the panel/textbox needs to be adjusted that can be done through the options *Width* and *Height* in *Rect Transform*.

Sometimes the rotation of the entire canvas may need to be adjusted.

5 Troubleshooting & Support

5.1 Error Messages or Behaviors

No error messages are issued by *The Room*. If error messages arise, they stem from third parties like Unity or the VR headset. Please seek information from the respective company.

Sometimes objects, especially the grabbable toy truck, might glitch through the floor and fall endlessly. In that case, restart *The Room* to reset the scene.

5.2 Special Considerations

VR headsets are often unstable and prone to errors. In case these arise, please safely disconnect, and reconnect your headset to your device. If the error persists, restart *The Room*. If that fails, contact the manufacturer of your VR headset.

5.3 Maintenance

No regular maintenance is required for this product.

5.4 Support

For support, issues, or technical difficulties, please reach out and report to the respective person for a subsystem:

General assistance:		
	Andreas Eisath	aeisa079@uottawa.ca
Hover messages:		
	Miray Albitar	malbe089@uottawa.ca
	Tobi Abdulkareem	aabdu245@uottawa.ca
Poster design:		
	Ashley Colin	acoli052@uottawa.ca
Sounds:		
	Girisha Mangur	gmang049@uottawa.ca

6 Product Documentation

This section outlines the creation of our prototype, from being a sketch to a fully functional environment on Unity. Our prototype is a simple living room with the associated furniture present. Yet, apart from that other elements have been added to showcase the damage caused by autonomous weapons and how the people were forced to make changes to protect themselves. We have implemented sounds and animation in the dog present to make the scene feel alive.

6.1 Subsystems

These are the required subsystems to be included in the environment to satisfy the design criteria generated. Note that this list is not exhaustive, more elements can be added if the designer feels that they will help the message to be clearer for the users.

Subsystem	Subsystem Description	Importance to the environment
Living room -Sofa -Table -Fan -TV -Light -Window	These are the elements usually present in a living room.	To demonstrate that the environment is in fact a living room, something which a large proportion of people relate to.
Cracked Walls	Damage caused by autonomous weapons.	Show impact of autonomous weapons.
Bullet holes	Damage caused by autonomous weapons.	Show impact of autonomous weapons.
Sandbags	To protect against oncoming bullets.	Show adaptability of civilians living amidst autonomous weapons.
Posters	To warn residents about unregulated autonomous weapons and know which rules to follow to be safe.	Show adaptability of civilians living amidst autonomous weapons.
Dog	The dog is animated, and an audio of a dog whining has been added to demonstrate its distress, hence through the dog, which senses the autonomous weapons in the background, the user may experience the same, without	Outline the moral and ethical concerns of the use of autonomous weapons. Show impact of autonomous weapons.

	actually encountering the autonomous weapons.	
Children’s Toys	Our environment has no characters, we have added toys to demonstrate that children live in this house.	Outline the moral and ethical concerns of the use of autonomous weapons.
Fire Extinguisher	To protect against fire caused by explosions due to autonomous weapons.	Show adaptability of civilians living amidst autonomous weapons.
Wine Glass	The wine glass is animated. It can break on impact, to show the rumbling that is caused due to autonomous weapons.	Show impact of autonomous weapons.
Metal Blinds	To prevent autonomous weapons from seeing inside the house, allowing the residents to remain hidden.	Show adaptability of civilians living amidst autonomous weapons.
First Aid kit	It is at hand to tend to any potential injuries, making movement to the hospitals dangerous.	Show adaptability of civilians living amidst autonomous weapons.
News channel	The news on the TV demonstrates the impact of autonomous weapons and the threat it has been.	Outline the moral and ethical concerns of the use of autonomous weapons. Show impact of autonomous weapons.
Light switch	It is interactive, the user is encouraged to switch off the light to remain hidden and therefore safe.	Show adaptability of civilians living amidst autonomous weapons.

6.1.1 BOM (Bill of Materials)

Item	**Links**	**Price**
Digital unity textures		
18 high resolution wall textures	https://assetstore.unity.com/packages/2d/textures-materials/brick/18-high-resolution-wall-textures-12567	$ -
Wooden Floor Materials	https://assetstore.unity.com/packages/2d/textures-materials/wood/wooden-floor-materials-150564	$ -
Digital unity assets		
5 animated voxel animals*	https://assetstore.unity.com/packages/3d/characters/animals/5-animated-voxel-animals-145754	$ -

Apartment Kit	https://assetstore.unity.com/packages/3d/environments/apartment-kit-124055	$ -
Ceiling Fan	https://assetstore.unity.com/packages/3d/props/tim-s-assets-old-ceiling-fan-103789	$ -
Free Rug Pack	https://assetstore.unity.com/packages/3d/props/interior/free-rug-pack-118178	$ -
Husky dog	https://assetstore.unity.com/packages/3d/characters/animals/husky-dog-160906	$ 9.99
Realistic Sandbags	https://assetstore.unity.com/packages/3d/props/exterior/realistic-sandbags-95964	$ -
Steel Window	https://assetstore.unity.com/packages/3d/props/industrial/steel-window-650	$ -
TV set	https://assetstore.unity.com/packages/3d/props/electronics/tv-set-26193	$ -
Fire extinguisher	https://assetstore.unity.com/packages/3d/props/fire-extinguisher-21147	$ -
HDR sky	https://assetstore.unity.com/packages/2d/textures-materials/sky/free-hdr-sky-61217	$ -
Cracked Plaster	https://assetstore.unity.com/packages/2d/textures-materials/decal-pack-1-94347	$ -
FROOD Free food items	https://assetstore.unity.com/packages/3d/props/food/frood-free-food-and-drinks-pack-152103	$ -
Scripts		
Quick outline	https://assetstore.unity.com/packages/tools/particles-effects/quick-outline-115488	$ -
Packages		
Character Controls	com.unity.charactercontroller	$ -
Applications		
Audacity		$ -
Canva		$ -
GitHub		$ -
Musescore		$ -
Unity		$ -
Free sounds		$ -
Visual Studio		$ -
Total		**$ 9.99**
Maximum		$ 50.00
Budget available		$ 40.01

6.1.2 Equipment list

Equipment	Equipment Description
Living room- Pro Builder Unity	Sizeable structure
Furniture- Asset Store Unity	Distinct Pieces
Bullet holes- PNG image	More than ten holes arranged haphazardly
Sandbags- Asset Store Unity	More than ten dozen, arranged around the inner wall.
Posters- Canva Custom-made Poster	One in each language: English and French minimum.
Dog- Asset Store Unity	One dog only.
Children’s Toys- Asset Store Unity	Minimum five to ensure that they are noticeable and give desired perception.
Fire Extinguisher- Asset Store Unity	One only.
Wine Glass- Asset Store Unity	One animated glass minimum.
Metal Blinds- Asset Store Unity	Depending on the number of windows in the room; one minimum.
First Aid kit- Asset Store Unity	One only.
News channel- Custom-made video	One only.
Light switch- Unity creation	One minimum; depends on number of light sources.

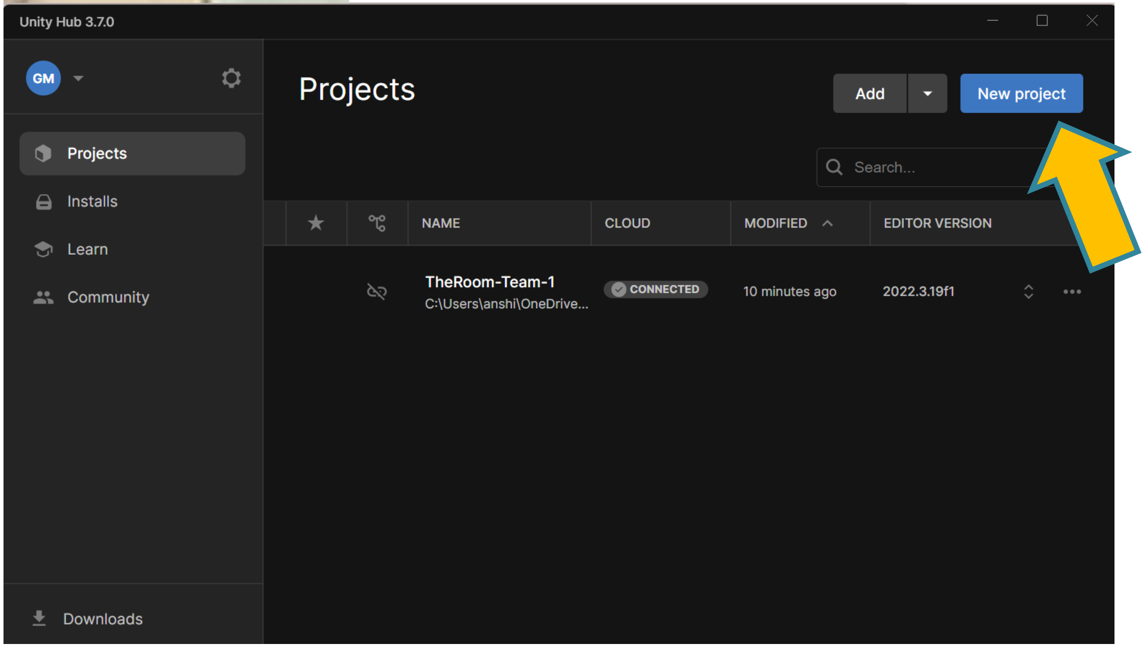
6.1.3 Instructions

Follow these instructions to create the virtual reality environment, The Room, with its functional properties.

6.1.3.1 Creating a new project

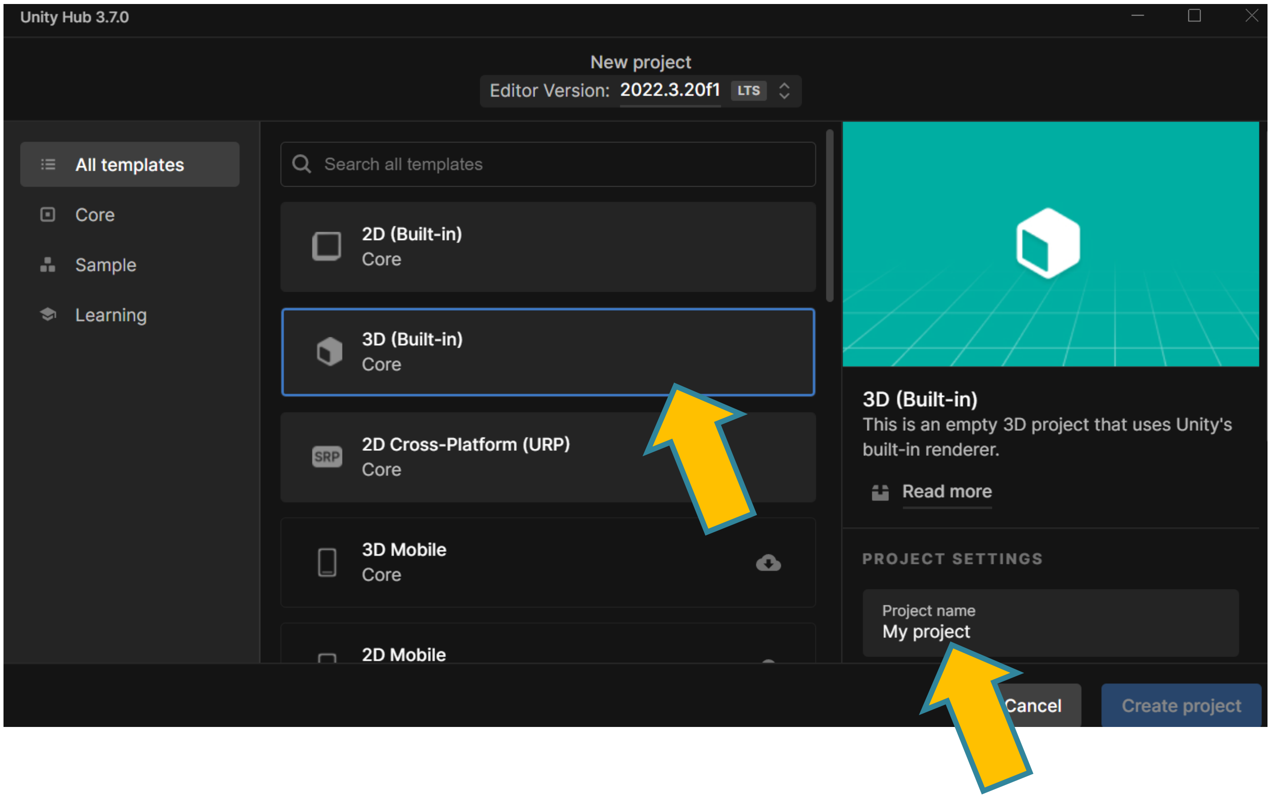
Go to Unity Hub and Open your project or Create a new project.

The image below depicts what is shown on clicking on Unity Hub. A new project can be created by clicking on the New Project blue button.



★		NAME	CLOUD	MODIFIED	EDITOR VERSION
		TheRoom-Team-1 C:\Users\anshi\OneDrive...	CONNECTED	10 minutes ago	2022.3.19f1

To create a new project:



Editor Version: 2022.3.20f1 LTS

3D (Built-in)

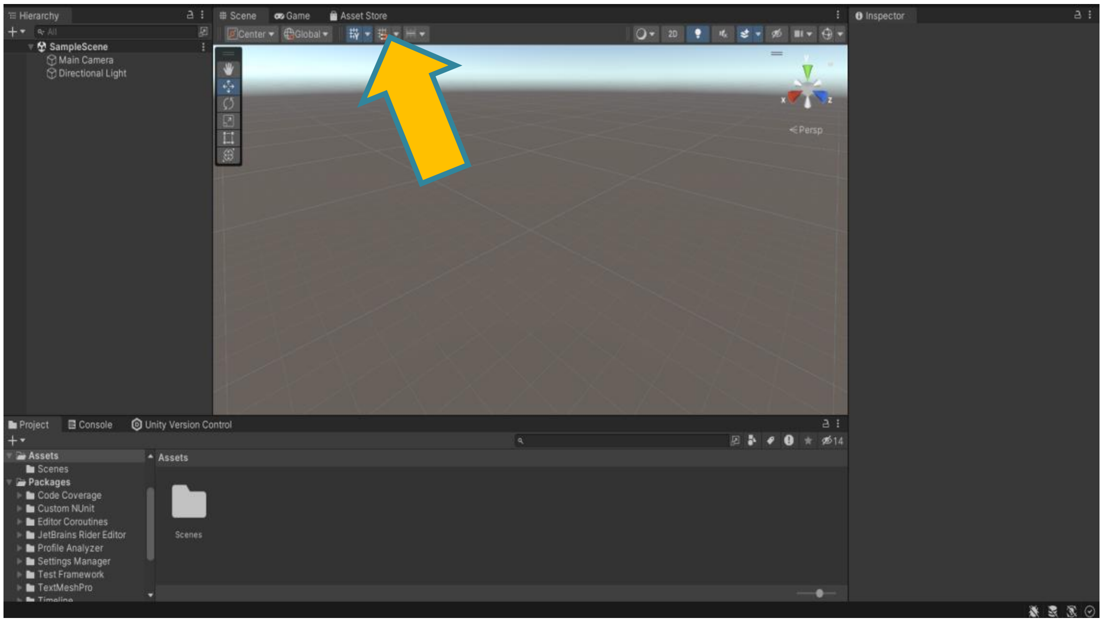
This is an empty 3D project that uses Unity's built-in renderer.

Project name: My project

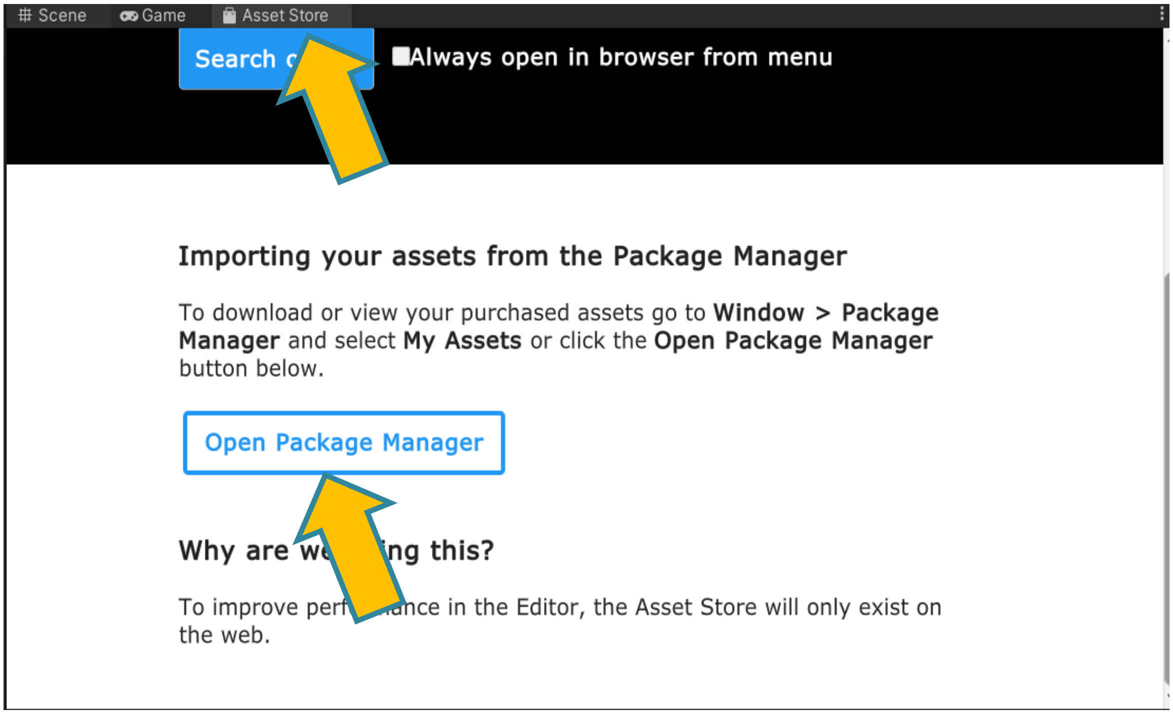
Ensure that 3D(Built-in) is chosen and give a name to your project, also choose a suitable location in a folder for your project, finally click on create project.

6.1.3.2 Creating the Living room

This is the scene; this is where you will create the project.



To create the living room, we need to install a function called Pro-Builder.
Click on Asset Store and Open Package Manager



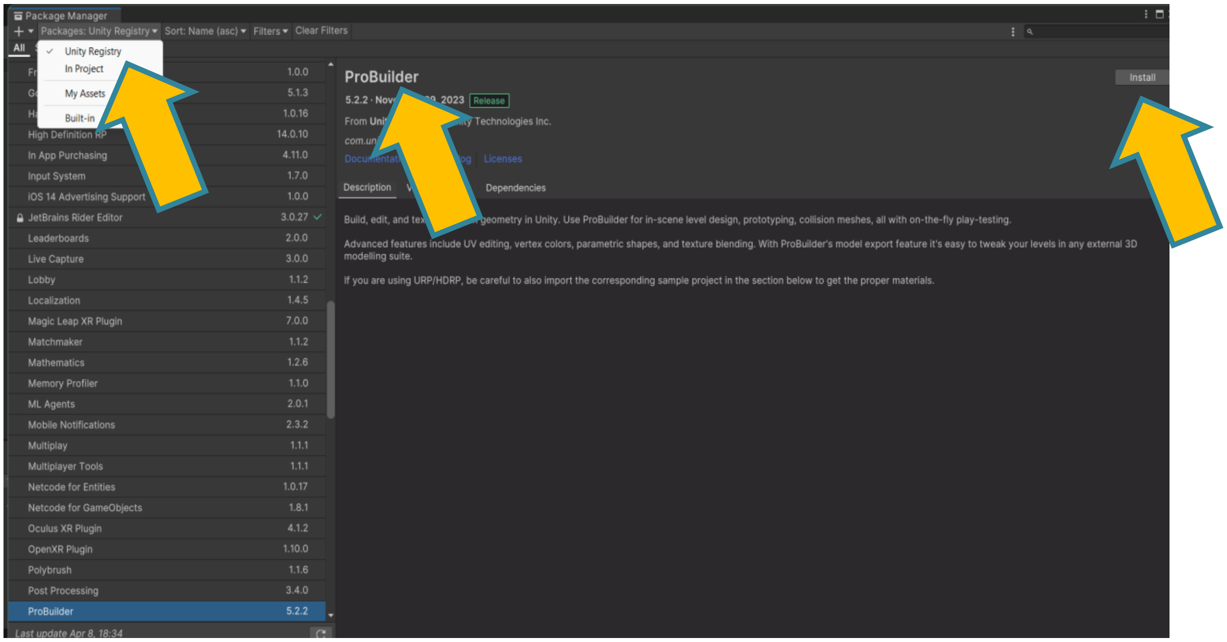
Importing your assets from the Package Manager

To download or view your purchased assets go to **Window > Package Manager** and select **My Assets** or click the **Open Package Manager** button below.

Why are we ing this?

To improve perf ance in the Editor, the Asset Store will only exist on the web.

In the package manager, find Unity Registry and search for Pro-Builder in the search bar and click on install.



Fr	1.0.0
Go	5.1.3
Ha	1.0.16
High Definition RP	14.0.10
In App Purchasing	4.11.0
Input System	1.7.0
iOS 14 Advertising Support	1.0.0
JetBrains Rider Editor	3.0.27 ✓
Leaderboards	2.0.0
Live Capture	3.0.0
Lobby	1.1.2
Localization	1.4.5
Magic Leap XR Plugin	7.0.0
Matchmaker	1.1.2
Mathematics	1.2.6
Memory Profiler	1.1.0
ML Agents	2.0.1
Mobile Notifications	2.3.2
Multiplay	1.1.1
Multiplayer Tools	1.1.1
Netcode for Entities	1.0.17
Netcode for GameObjects	1.8.1
Oculus XR Plugin	4.1.2
OpenXR Plugin	1.10.0
Polybrush	1.1.6
Post Processing	3.4.0
ProBuilder	5.2.2

Last update Apr 8, 18:34

ProBuilder

5.2.2 · Nov 2023 Release

From Uni ty Technologies Inc.

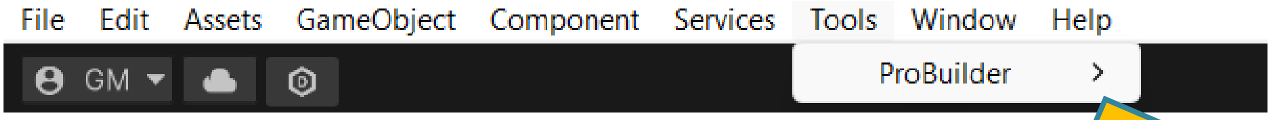
com.un

Build, edit, and tex geometry in Unity. Use ProBuilder for in-scene level design, prototyping, collision meshes, all with on-the-fly play-testing.

Advanced features include UV editing, vertex colors, parametric shapes, and texture blending. With ProBuilder's model export feature it's easy to tweak your levels in any external 3D modelling suite.

If you are using URP/HDRP, be careful to also import the corresponding sample project in the section below to get the proper materials.

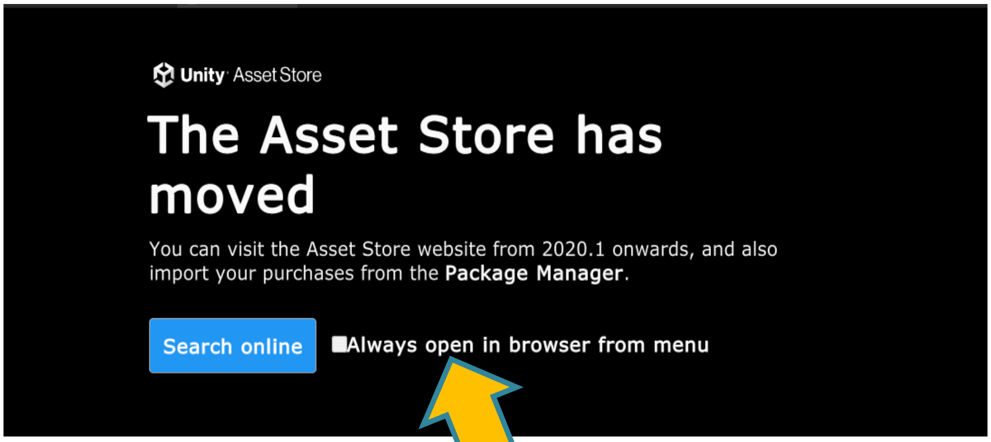
Once installed, we can create the room using Pro-Builder



6.1.3.3 *Adding Texture, Furniture and Other elements*

Once our room is made, we need to customize it, that is adding texture to the walls and ground as well as furniture to demonstrate that it is a living room. Adding most of the subsystems requires the same steps to be taken, so let us consider adding the dog to the room.

Go to Unity Asset Store.

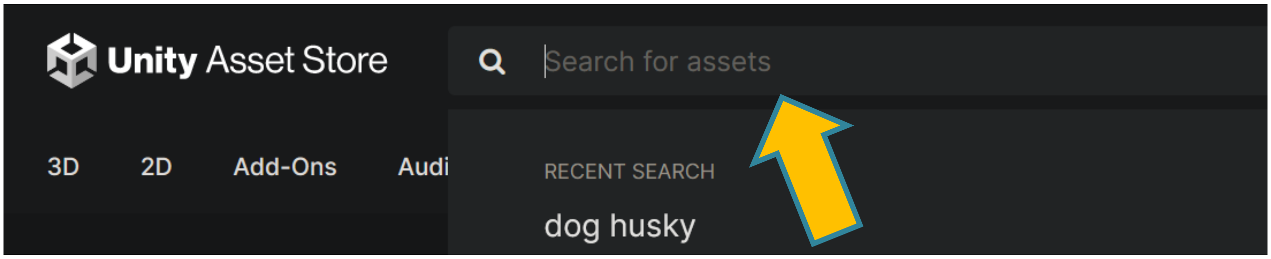


The Asset Store has moved

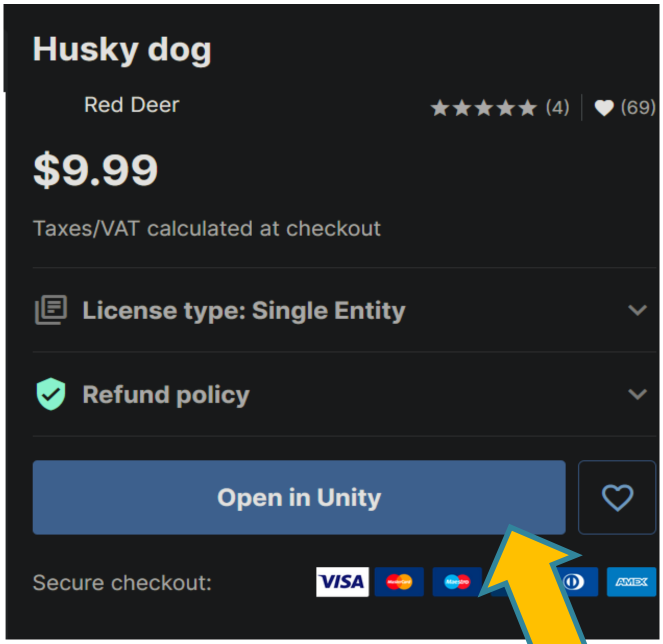
You can visit the Asset Store website from 2020.1 onwards, and also import your purchases from the **Package Manager**.

☐ Always open in browser from menu

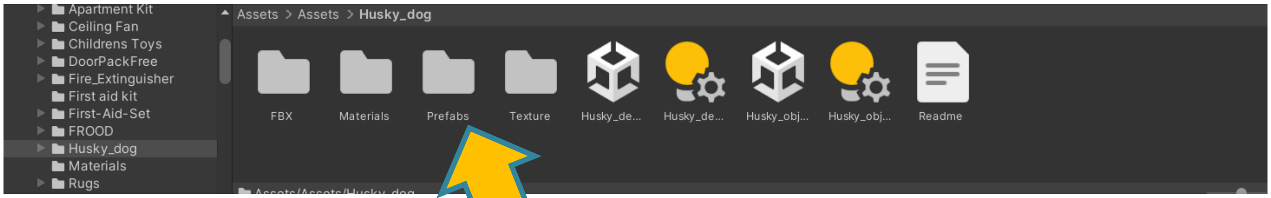
Look for the dog using the search ba



Download and open in Unity Scene, note that not all assets are free, for example, the dog. The steps to purchase this asset will be given when doing the transaction, click on Open in Unity when done.



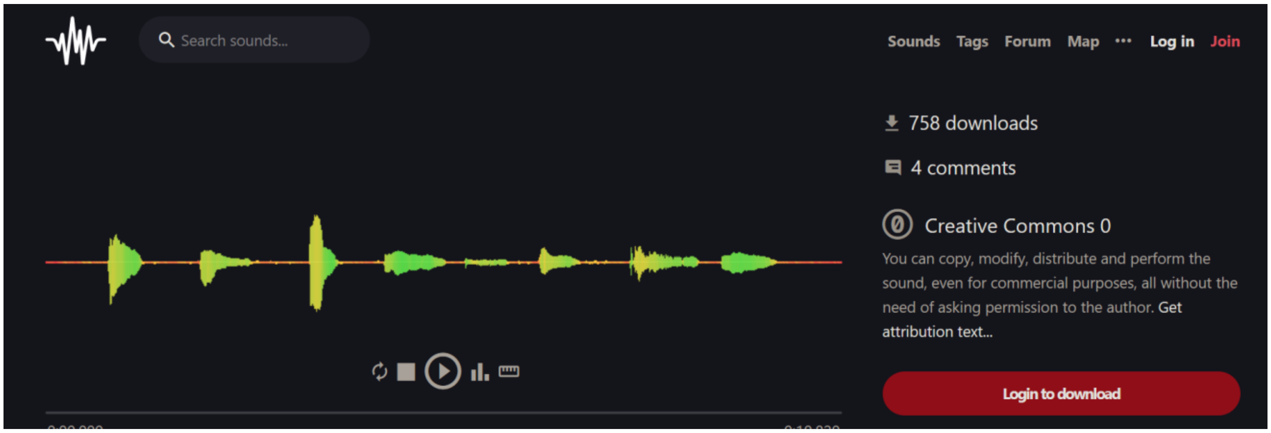
The asset should be found in the list as shown below, ready to be used.



6.1.3.4 Adding audio

To make the scene alive, sounds are a must, in this project, the user will be able to hear the dog whining, the sound of glass breaking, a background music relevant to the situation and a rumbling sound. Most of the steps taken to add sounds are the same, so once again we will consider the dog, but first we need audio files to add to our Unity Project.

- Go to https://freesound.org/
- Find a dog whine or a sound that corresponds to the action you want to interpret.
- fter ensuring that there are no copyright rules imposed by the author, download the audio file. Not: Aan account is required to download the audio file.



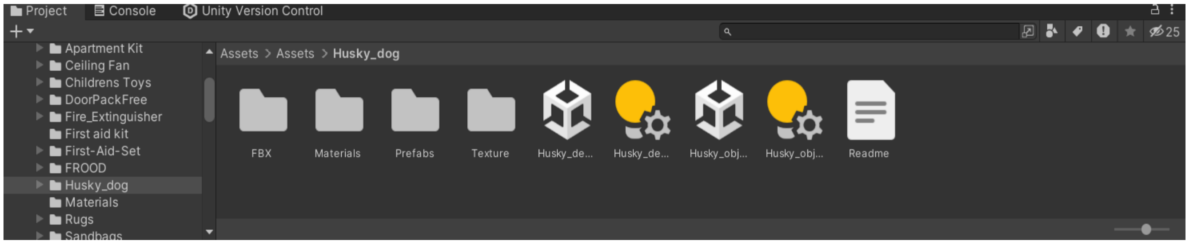
758 downloads

4 comments

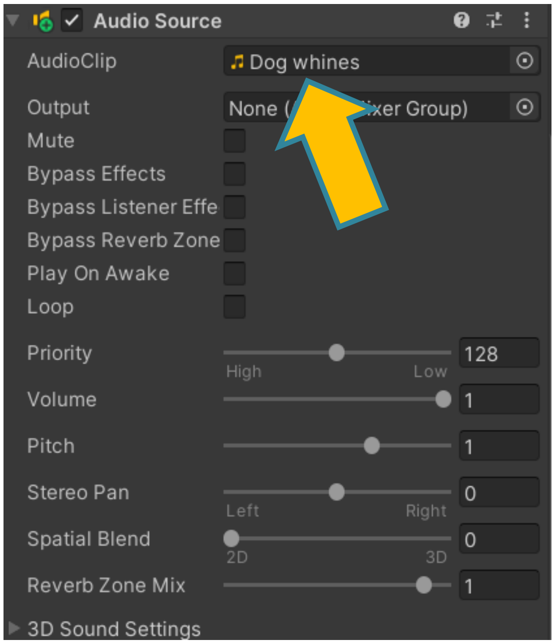
Creative Commons 0

You can copy, modify, distribute and perform the sound, even for commercial purposes, all without the need of asking permission to the author. Get attribution text...

- Once the audio file has been downloaded, we need to add it to the Unity Project. This can be done by simply dragging the audio file to a folder created in the window as shown below.



To add the audio file to the asset, we click on the asset and go to the Inspector Window, where the audio file can be dragged to audio source listed.



Audio Source

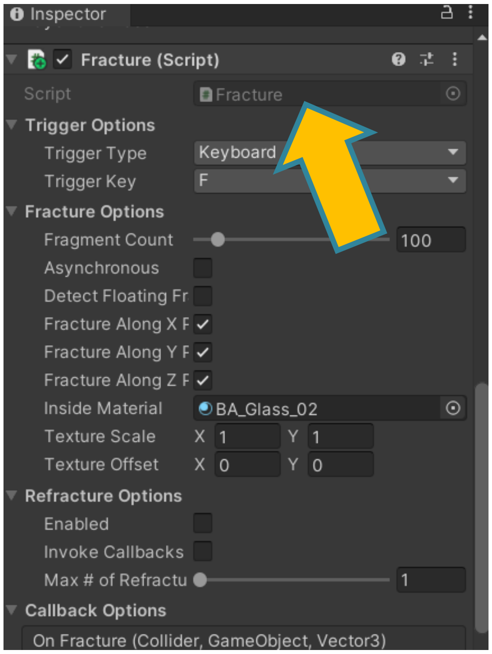
AudioClip	Dog whines
Output	None (Audio Mixer Group)
Mute	☐
Bypass Effects	☐
Bypass Listener Effe	☐
Bypass Reverb Zone	☐
Play On Awake	☐
Loop	☐
Priority (High – Low)	128
Volume	1
Pitch	1
Stereo Pan (Left – Right)	0
Spatial Blend (2D – 3D)	0
Reverb Zone Mix	1

More flexibility regarding the sound can be executed using Microsoft Visual Studio.

6.1.3.5 Animation

In this project, there are exactly two assets which are animated namely the dog and the wine glass, which breaks. We will consider the wine glass.

Select the wine glass and go to the Inspector Window.


Inspector

Fracture (Script)

Script Fracture

Trigger Options
Trigger Type Keyboard
Trigger Key F

Fracture Options
Fragment Count 100
Asynchronous ☐
Detect Floating Fr ☐
Fracture Along X F ☑
Fracture Along Y F ☑
Fracture Along Z F ☑
Inside Material BA_Glass_02
Texture Scale X 1 Y 1
Texture Offset X 0 Y 0

Refracture Options
Enabled ☐
Invoke Callbacks ☐
Max # of Refractu 1

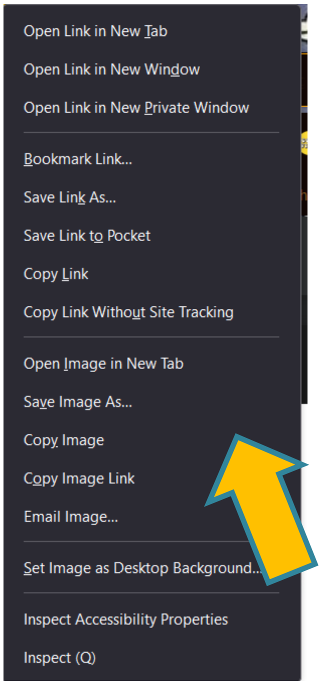
Callback Options
On Fracture (Collider, GameObject, Vector3)

Do the necessary changes in the scripts of Microsoft Visual Studio to make the glass break.

6.1.3.6 PNG Images

The window and the bullet holes are PNG images, which can be obtained from Google, ensuring that they can be used without any copyright issues. We will consider the bullet holes.

- Go to https://www.google.com/
- Search for realistic bullet holes as PNG images
- Right-Click and save the image



Add the image to a folder in the Unity Project and use the inspector window to customize the image in terms of its size and transparency.

For the window, create a plane using unity and add it on the wall before adding the PNG image.

6.1.3.7 *Adding the video*

The video is made separately and added as an asset in the folder before getting implemented to the TV. It can be added to an object in a *Video Player* in the Inspector of an object.

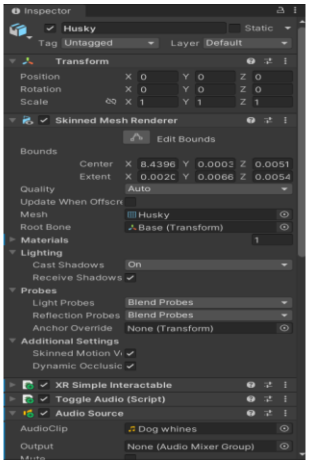
6.1.3.8 *Adding subtitles*

Subtitles are used to explain the roles of the assets.

Text is added using unity.

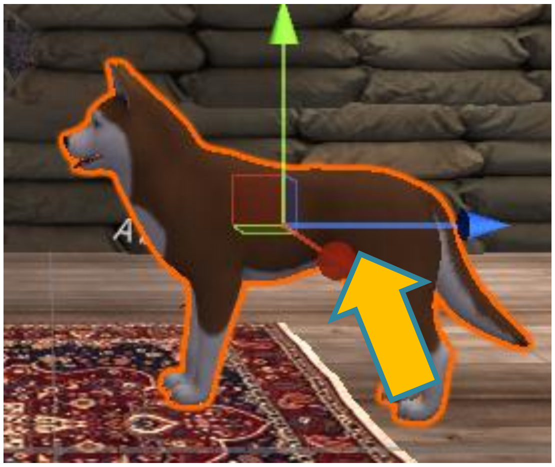
6.1.3.9 *Editing and Moving*

1.All editing regarding an asset can be made using the Inspector window as shown below:



☑ Husky ☐ Static
Tag Untagged Layer Default
Transform
Position X 0 Y 0 Z 0
Rotation X 0 Y 0 Z 0
Scale X 1 Y 1 Z 1
☑ Skinned Mesh Renderer
Edit Bounds
Bounds
Center X 8.4396 Y 0.0003 Z 0.0051
Extent X 0.0020 Y 0.0066 Z 0.0054
Quality Auto
Update When Offscre ☐
Mesh Husky
Root Bone Base (Transform)
Materials 1
Lighting
Cast Shadows On
Receive Shadows ☑
Probes
Light Probes Blend Probes
Reflection Probes Blend Probes
Anchor Override None (Transform)
Additional Settings
Skinned Motion V ☑
Dynamic Occlusic ☑
☑ XR Simple Interactable
☑ Toggle Audio (Script)
☑ Audio Source
AudioClip Dog whines
Output None (Audio Mixer Group)

2. Moving the asset is limited to the x, y and z direction and is done as follows.



The arrows depict the directions the asset, that is the dog can be moved. The green arrow, when clicked and holding it enables the dog to be moved upwards and downwards.
Note that even if its pointing in a certain direction, that is upwards for the green arrow, movement can be done in the negative direction as well.

6.2 Testing & Validation

6.2.1 Testing of walls, ceilings, and floors

We tested this first by creating 4 walls, a ceiling, and a floor. We then moved them toy could align and have no gaps between the walls, ceilings, and floors. After that, we used the VR headset to see how the room looked in the VR environment and then scaled it down appropriately, so it was not too big or too small for the user. We were able to scale our room to the right size.

6.2.2 Testing of furniture

We tested the furniture by first ensuring the furniture looked adequate in unity without any glitches. We then used the VR headset to see how the furniture looked in the unity environment and scaled it down appropriately. We then ensured the furniture had actual physical features by adding mass and making sure the user could not walk through the furniture. We were able to scale our furniture to the right size.

6.2.3 Testing of posters

We tested the posters by copying them into unity, scaling them down to an appropriate size and moving them to the correct position. We made sure the poster visible and not halfway between the wall or floating in the air. We were able to properly scale and position our posters.

6.2.4 Testing of bullet holes

We tested the bullet holes by copying them into unity, scaling them down to an appropriate size and moving them to the correct position. We made sure the bullet holes were visible and not halfway between the wall or floating in the air. We also made sure the bullet hole did not blend in with the wall texture by viewing it and ensuring the user could see the bullet hole clearly from a distance. We were able to properly scale, position and contrast our bullet holes on the wall.

6.2.5 Testing of hover functions

We tested the hover function by using the clicker to hover over the bullet holes and see if the text popped up. We were able to add the hover function and see the text descriptions to the required elements.

6.2.6 Testing of outline functions

We tested the outline function by using the VR headset and seeing if the outline was clearly visible in the environment. We were able to clearly see the outlines around specific objects in the VR environment.

6.2.7 Testing of dog

We tested the dog by first ensuring the dog looked adequate in unity without any glitches. We then used the VR headset to see how the dog looked and scaled it down appropriately in the unity environment. We then ensured the dog had actual physical features by adding mass and making sure the dog could not walk through the furniture or the user. To test the animation, we watched the code run for 5 minutes to see that it worked without any bugs and also to see whether it would walk through the walls or surrounding items. To test the whining and CC that accompanied it we used the VR headset and clicked on the dog to see if it would start whining and the CC will appear on the first click then if the whining will stop and the CC will disappear on the second click. We were able to successfully make the animations, so the dog does not take up too much space or walk through items. The dog did start whining and the CC appeared upon the first click, however on the second click the CC remained for a few seconds.

6.2.8 Testing of glass

We tested the glass by first ensuring the glass looked adequate in unity without any glitches. We then used the VR headset to see how the glass looked and scaled it down appropriately in the unity environment. We then made sure the glass did not fall through the furniture or floor. We then tested the interactable functions that allowed the user to pick up the glass by going in the unity environment and using the controller to move the glass all over the room. We test the glass shattering by having the user click on the glass or walk by it then seeing if the glass fell to the floor and shattered after the action. We had to ensure that the glass shattering sound also activated when the glass fell. And finally, we had the test the genuineness of the glass shattering by testing the realistic amount of force needed to knock it down and the position it should land on the ground by witnessing the shattering in the VR environment. We were able to ensure the movement of the glass and it could be moved anywhere. We were able to setup the shattering of the glass upon clicking on the glass again, walking past it or dropping it onto the ground with it looking realistic and the sound playing at the right time.

6.2.9 Testing of toys

We tested the toys by first ensuring the toys looked adequate in unity without any glitches. We then used the VR headset to see how the toys looked and scaled it down appropriately in the unity environment. We then made sure the toys did not fall through the furniture or floor. We then tested the interactable functions that allowed the user to pick up the toy by going in the unity environment and using the controller to move the toy all over the room. We were able to ensure the movement of the toys and it could be moved anywhere.

6.2.10 Testing of TV

We tested the toys by first ensuring the toys looked adequate in unity without any glitches. We then used the VR headset to see how the toys looked and scaled it down appropriately in the unity environment. We then made sure the toys did not fall through the furniture or floor. We then tested the interactable functions that allowed the user to start the news video and subtitles. To test the news broadcast, we clicked on the TV in the VR environment to see if the news video played along with the subtitles. To test the timing of the subtitles we watched the video and read the subtitles then shifted the timing of the subtitles to synchronise the video and subtitles. We were able to start and stop the video using clicks. However, if the video is stooped before the end the subtitles remain on screen. Then if the video is restarted the subtitles continue from where the video subtitles last started.

6.2.11 Testing of light switch

We tested the light switch by first ensuring the light switch looked adequate in unity without any glitches. We then used the VR headset to see how the light switch looked and scaled it down appropriately in the unity environment. We made sure the light switch visible and not halfway between the wall or floating in the air. We tested the on/off switch by going in the VR environment and clicking on the light switch to see if the animation will activate upon clicking. We then synchronised the light switch sound and the light dimming or increasing with the light switch. We tested this by observing the changes when we clicked on the light switch in the VR environment. We were able to successfully integrate the light switch animations, sound and light dimming/

increasing, however when the light switch was turned off it was not fully black because there was some light left in the room.

6.2.12 Testing of user interface

We tested the initial UI page by going in the VR environment and making sure all the text could be seen, and none of the features of the room could be seen through the initial page. We then tested to see if after clicking on start the page would go away and the user would see the actual VR environment.

6.2.13 Testing of window

We tested the window by copying them it into unity, scaling it down to an appropriate size and moving it to the correct position. We made sure the window was visible and not halfway between the wall or floating in the air. We were able to properly scale and position the window on the wall.

7 Conclusions and Recommendations for Future Work

In conclusion, our virtual reality prototype highlights the profound impact of autonomous weapons on civilian life while showcasing adaptive responses. Through meticulous design and implementation, we created an immersive environment that engages users and raises awareness of ethical concerns. Our project underscores the potential of VR as a tool for storytelling and social commentary. Looking ahead, further enhancements in visuals, interactivity, and accessibility, along with iterative testing and documentation, will propel future iterations. By sharing our insights and collaborating with the VR community, we aim to drive continued innovation in immersive experiences that inspire reflection and action on pressing societal issues. In future work, exploring the integration of advanced features such as hand tracking and spatial audio could further enhance user immersion and realism, advancing the impact of VR experiences on societal awareness and action.

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Unity Store. (n.d.-d). Free HDR Sky | 2D Sky | Unity Asset Store. Retrieved from assetstore.unity.com website: https://assetstore.unity.com/packages/2d/textures-materials/sky/free-hdr-sky-61217

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Unity Store. (n.d.-j). Steel Window | 3D Industrial | Unity Asset Store. Retrieved April 10, 2024, from assetstore.unity.com website: https://assetstore.unity.com/packages/3d/props/industrial/steel-window-650

Unity Store. (n.d.-k). TV Set | 3D Electronics | Unity Asset Store. Retrieved from assetstore.unity.com website: https://assetstore.unity.com/packages/3d/props/electronics/tv-set-26193

Unity Store. (n.d.-l). Wooden Floor Materials | 2D Wood | Unity Asset Store. Retrieved from assetstore.unity.com website: https://assetstore.unity.com/packages/2d/textures-materials/wood/wooden-floor-materials-150564

Unity store. (n.d.-a). Apartment Kit | 3D Environments | Unity Asset Store. Retrieved from assetstore.unity.com website: https://assetstore.unity.com/packages/3d/environments/apartment-kit-124055

Unity store. (n.d.-b). Tim's Assets - Old Ceiling Fan | 3D Props | Unity Asset Store. Retrieved April 10, 2024, from assetstore.unity.com website: https://assetstore.unity.com/packages/3d/props/tim-s-assets-old-ceiling-fan-103789

9 APPENDIX I: Design Files

Maker repo link to the project: https://makerepo.com/Andy775/1945.the-room-a-project-for-mines-action-canada

Table 3. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
Unity asset store	https://assetstore.unity.com/	N/A
Unity Lab	https://uottawa.brightspace.com/d2l/le/dropbox/417590/295538/DownloadAttachment?fid=16660228	N/A
Deliverables	https://teams.microsoft.com/_#/school/FileBrowserTabApp/E01%20-%20Team%201?threadId=19:8c5de01105fa4988bb832866080bf968@thread.tacv2&ctx=channel	N/A
Unity	https://unity.com/	N/A