

GNG 1103  
**Design Project User and Product Manual**

**Lumber Rescue**

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## List of Acronyms and Glossary

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Table 1. Acronyms

Acronym	Definition
UI	User Interface
FOV	Field of View
UPM	User and Product Manual
LRS	Lumber Rescue Simulation

Table 2. Glossary

Term	Acronym	Definition
Universal Render Pipeline	URP	A rendering system within Unity is designed to provide high-quality graphics across a wide range of platforms while maintaining performance, especially for mobile and VR development.
Virtual Reality	VR	VR is a technology that uses computer-generated environments to simulate real or imaginary worlds, allowing users to interact with and explore those environments in a fully immersive way.
Three-Dimensional	3D	Three-dimensional refers to objects or environments that have depth, in addition to height and width—the three dimensions of space.

# 1 Introduction

This User and Product Manual (UPM) provides the information necessary for all general use and applications to effectively use of The Lumber Rescue Simulation (LRS) and for prototype documentation. The simulation is designed to immerse users in a VR experience that is meant to educate users on the impact that climate change has on wildfires. The underlying assumption is that users will engage with the simulation for educational, training, or research purposes. It is also assumed that users have a basic understanding of VR technology and its operation. Users will experience how wildfires behave under different climate conditions by being presented with historical statistics and scenarios that illustrate climate change trends. This VR is intended for educators and students interested in fire ecology and environmental studies.

The simulation should only be used in open and clear spaces, that are free of obstructions. It could potentially cause motion sickness or discomfort; usage should be monitored and for short periods of time.

This manual is meant to serve as a guide for the optimal and safe usage of the application as well as maximize the benefits and educational aspects of the application.

## 2 Overview

Wildfires are becoming increasingly severe and frequent due to climate change. Methods of education about this topic is often overlooked, and when discussed it can be difficult to properly portray the magnitude of the situation. This VR simulation addresses the gap by providing an **immersive, hands-on learning experience** to educate users first-hand about the changing climate's negative effects.

This unique VR experience grants users the ability to view the world and the topic in a new light. With the interactive system, users can view the perspective of a real-world experience of another human, that would otherwise be impossible. This difference in perspective allows users to view real-world statistics and experiences without any of the danger. This education aspect sets this system apart, giving a unique learning experience for students and educators, with public applications as well.



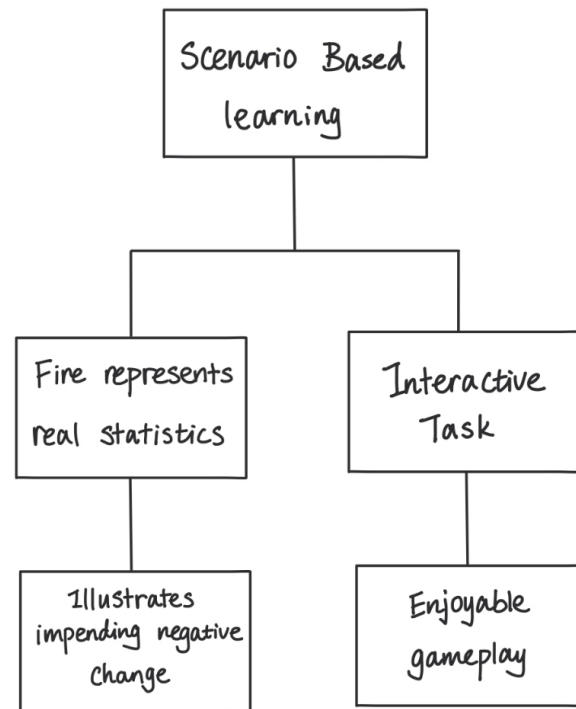
### Key Features

- Scenario Based learning



- Fire represents real statistics
- Interactive tasks
- Enjoyable gameplay
- Illustrates impending negative change

*Figure 1. Key Features*



## 2.1 Conventions

N/A

### 2.1.1 Instructional Formatting

This simulation consists of a series of prompts and cutscenes. These sections serve the purpose of educating the user and informing users what actions must be taken.

Control inputs are coded to the VR hand controls. Both controls allow the user to interact with and pick up the axe. The left-hand joystick is used for movement features while the right-hand joystick is used for assistance in head movements

The VR works seamlessly with the application, once the application is started on the computer system the simulation will start.

## **2.2 Cautions & Warnings**

Before the use of the prototype, it's important to note extended use can lead to motion sickness, eye strain or physical discomfort. It is therefore a good idea to take breaks every 20–30 minutes. Make sure your surroundings are clear of obstacles to avoid accidents while using the system. Lastly, for your safety, avoid using the VR system while under the influence of alcohol or drugs.

## 3 Getting started

This section provides a detailed guide for use of the VR system. Users do not need technical background, these instructions follow a clear, logical sequence that ensures ease of use.

### 3.1 Configuration Considerations

VR wildfire simulation combines hardware and software to seamlessly deliver an immersive experience. Built with Unity, the software handles 3D rendering, physics, and user feedback. Users navigate the software via head movement and the aid of controllers.



### 3.2 User Access Considerations

The VR wildfire simulation has different access levels for usability and security. The public can explore but not modify the software. Developers have full access to updates and improvements, while technical support manages troubleshooting and user permissions. Accessibility features include hardware compatibility, mobility support, and security measures to protect data. Some features may be restricted based on user permissions or hardware limitations.

### 3.3 Accessing/setting up the System

#### Step 1: Get Your Equipment Ready

- Use a VR headset (like Meta Quest or HTC Vive).
- Make sure your computer is strong enough to run VR.
- Set up a clear space to move around.
- Connect your headset to the computer and install any apps it needs.

#### Step 2: Set Up the VR Program

- Open the program where the VR is built (Unity)
- Turn on the settings that let the project work with your headset.
- Add tools that let you move around and use your hands in VR.

#### Step 3: Test It Out

- Turn on Developer Mode on your headset so it connects properly.
- Try running the project and see if everything works in the headset.

### 3.4 System Organization & Navigation

- a. Main Components:
  - VR Headset
  - Controllers
  - Computer/Console
- b. System:
  - Help menu
  - Log in
  - Start screen
  - Start simulation
  - Exit simulation
  - Settings

### **3.5 Exiting the System**

1. Pause or Exit the Experience
  - a. Press the menu button on the VR controller to bring up the Maker Repo menu.
  - b. Select "Exit Simulation" to close the wildfire experience.
2. Return to Maker Repo
  - a. After exiting the simulation, you will return to the Maker Repo home screen.
3. Close Maker Repo
  - a. If using a PC, close the Maker Repo application by clicking "Quit" or closing the window.
4. Turn Off the VR System
  - b. Standalone Headset: Power off the headset by holding the power button and selecting "Turn Off".
  - c. PC-Connected Headset: Exit Steam VR or Oculus software, then turn off the headset and shut down the computer if no longer needed.

## **4 Using the System**

### **Input Requirements:**

- Users point the VR controller's laser pointer at menu buttons
- A firm press of the trigger button (audible click sound) confirms selection

### **System Response:**

- Selected menu items depress slightly (haptic vibration)
- Smooth fade transition loads the selected scene

### **Movement Controls:**

- **Forward/backward motion:** **Left Joystick** tilt up/down (0-100% pressure sensitive)
- **Directional turning:** **Right Joystick** left/right
- **Right index finger key:** Pick up the axe

### **Feedback Mechanisms:**

- Variable vibration intensity based on movement speed
- Subtle footstep sound effects synchronized with movement
- Dynamic FOV adjustment during sprinting to reduce motion sickness

### **Action Sequence:**

- Approach trees (with flowers underneath)
- Perform downward swinging motion
- Ensure the controller is securely fastened around your wrist and firmly gripped.

### **UI System:**

- Timer on the middle top of the interface.
- As the level increases, the time decreases.
- The thermometer is in the lower left corner of the interface.
- As the level increases, the temperature rises.
- The hygrometer is in the lower left corner of the interface.
- As the level increases, the humidity decreases.

*Table 3. User Role Matrix*

<b>Function</b>	<b>Student</b>	<b>Educator</b>	<b>Administrator</b>
Movement	✓	✓	✓
Tree Chopping	✓	✓	✓
Fire Interaction	✓	✓	✓

Dashboard Access	✓	✓	✓
Cutscene Control	✓	✓	✓
Session Configuration	-	✓	✓
System Diagnostics	-	-	✓
Content Editing	-	-	✓

## 4.1 Core System Functions

### Functional Description:

The system provides 360° environmental navigation through combined physical movement and controller-based locomotion. Users explore a dynamic forest ecosystem with climate change effects.

### Key Components:

- Thumb stick Motion Control
- Physical Movement Tracking

### User Mastery Requirements:

1. Thumb stick pressure control for variable speed
2. Head orientation for natural viewing
3. Play area boundary awareness

### Caveats:

- Rapid thumb stick movements may trigger nausea
- Play area limitations may cause boundary warnings





## 5 Troubleshooting & Support

Remember that someone who is not an engineer must be able to follow these steps. This section explains how to recover from system errors, correct common issues, and restore full functionality when something goes wrong. Each sub-section focuses on a specific type of problem or recovery procedure. Each part is written for users who may not have a technology background, so you can follow along step by step.

### 5.1 Error Messages or Behaviors

**The following are common problems users may encounter, possible error causes and possible corrective actions.**

**Issue: VR displays “No headset detected”/ remains black.**

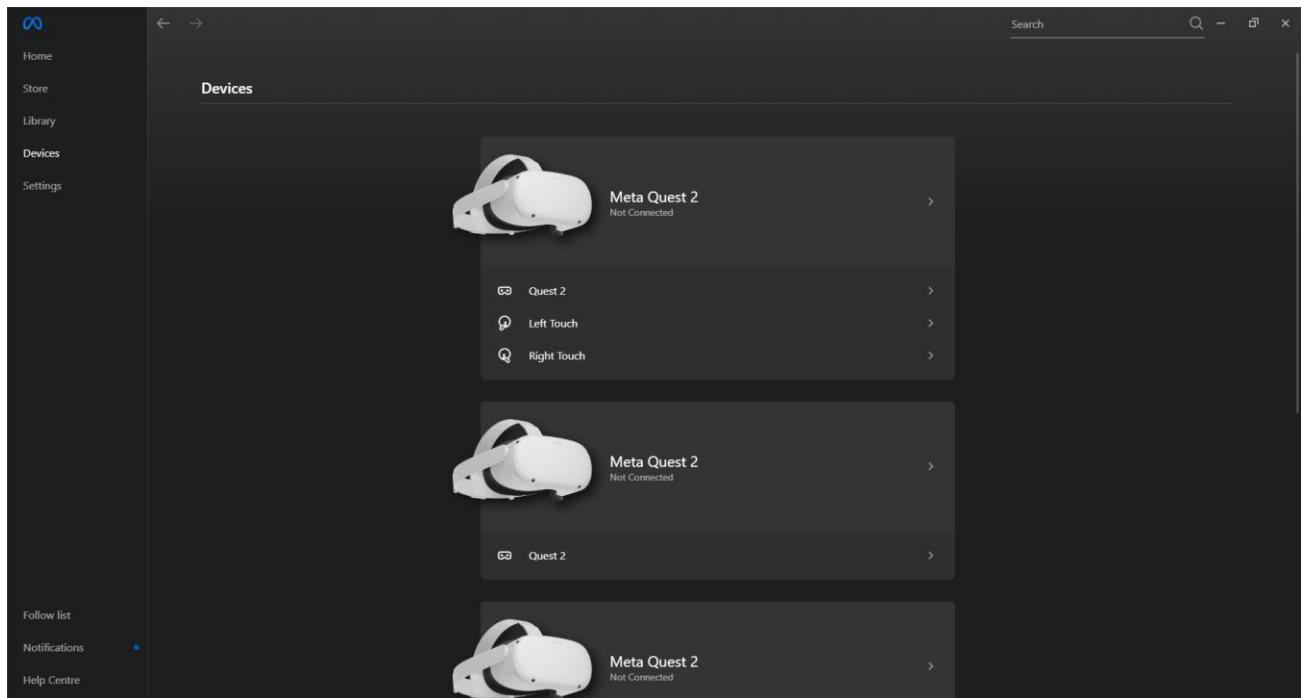
- **Possible Cause:** Loose USB or Meta Quest connection or headset not properly recognized.
- **Corrective Actions:**

1. Check all the VR connections to the PC.
2. Reconnect the headset and restart the Meta Quest software.
3. If all the above fails, restart your computer.

**Issue: Oculus Touch controllers are not responsive or not tracked.**

- **Possible Cause:** Open XR not correctly configured or missing pairing step.
- **Corrective Actions:**

1. Ensure the headset and the controllers are shown connected in Meta Quest app > Devices.
2. In Devices, re-pair or re-link the Oculus Touch controllers if needed.



**Issue: Application freezes or crashes during use.**

- **Possible Cause:** System overload or incompatible software version.
- **Corrective Actions:**
  1. Use Task Manager (Ctrl + Shift + Esc) to close unnecessary programs.
  2. Check the update of your devices.
  3. Restart your computer.

**Issue: No audio in VR headset.**

- **Possible Cause:** Wrong audio output selected, or VR headset not recognized as the default device.
- **Corrective Actions:**
  1. Check the volume settings.

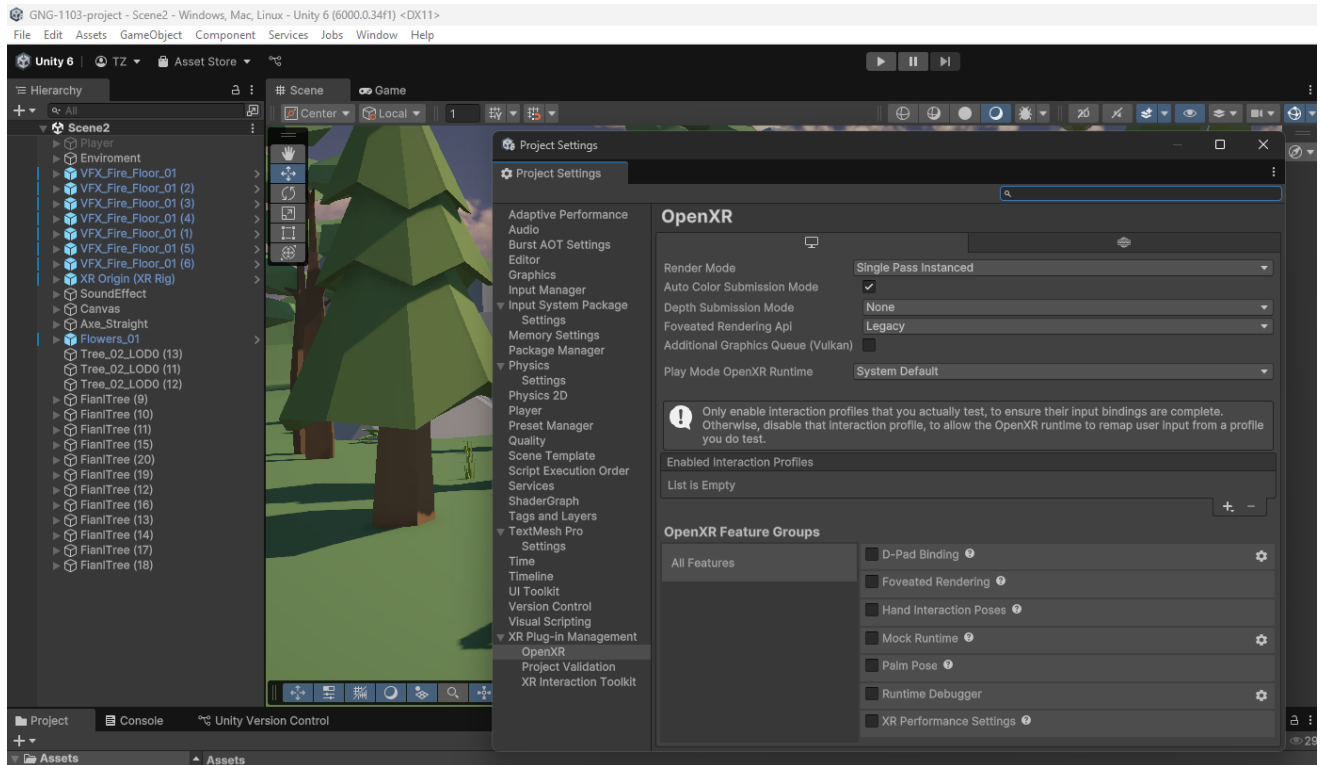
2. Click the speaker icon on your desktop, click “Sound settings”, then check all your sound devices in Advanced.
3. Re-plug the VR headset.

**The following are common possible errors in Unity testing.**

**Issue: Player and camera do not move in Unity.**

- **Possible Cause:** Loss the VR connection or not properly recognized.
- **Corrective Actions:**

1. Pause the game and re-play it.
2. Unity > Edit > Project settings > OpenXR. RenderMode: Multi-pass, Play Mode OpenXR Runtime: Oculus OpenXR, add Hand Interaction Profile and Oculus Touch Controller Profile in Enabled Interaction Profiles.
3. Check the VR connection in Meta Quest.



## 5.2 Special Considerations

- **Reconfiguration after reconnecting VR:**

Oculus Touch may need to be reconfigured in OpenXR every time you reconnect your VR headset.

- **Pay attention to lighting and space conditions:**

Avoid direct sunlight or strong overhead lighting. Make sure you have a safe, clean play area with enough room to move around.

## 5.3 Maintenance

Regular maintenance helps prevent unexpected errors or system failure. Perform the following checks routinely:

**Before Using:**

- Ensure all cables are connected properly, and VR connected properly.
- Restart the computer and launch the Oculus app fresh.
- Close the unnecessary programs.

**Weekly Maintenance:**

- Check for Oculus software and driver updates.
- Inspect cables for any signs of wear or damage.
- Test camera and player control functionality in Unity.
- Clean your VR headset and controller.

## 5.4 Support

If you encounter issues that cannot be resolved through the above procedures, you can contact the system support team for help.

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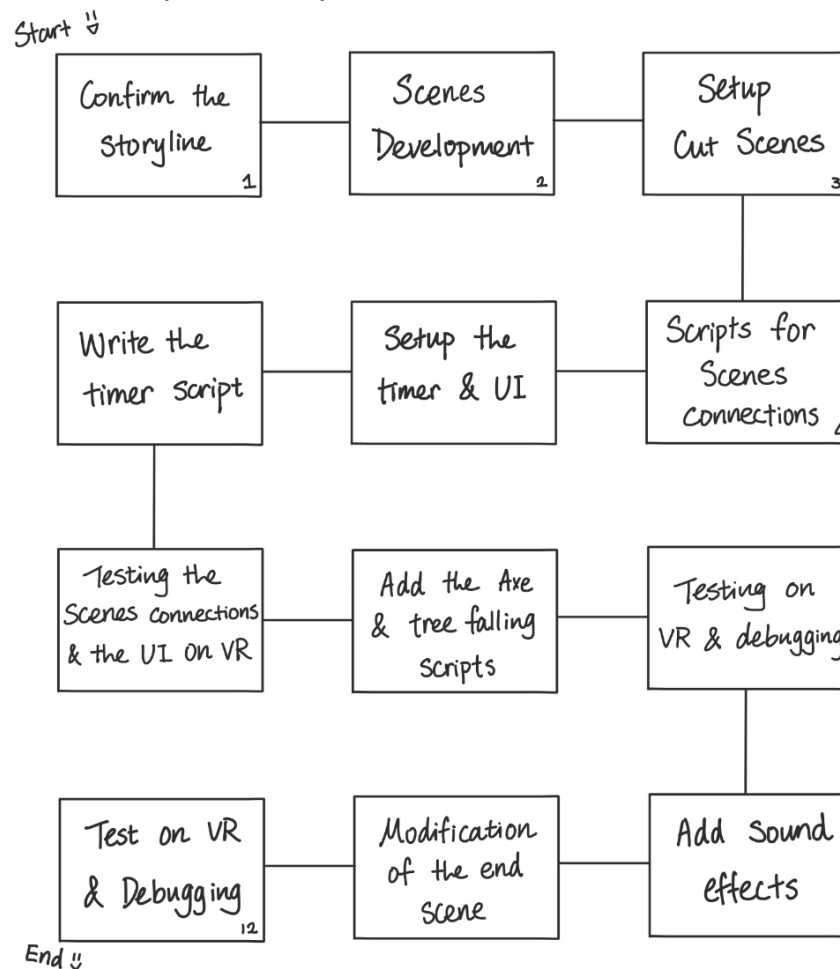
Email: [oosho034@uottawa.ca](mailto:oosho034@uottawa.ca)

Name: Ryanne Khan

## 6 Product Documentation

This section details how the final VR prototype was developed, including key decisions, trial-and-error, and supporting documentation. The goal is to provide a clear guide that others could follow to replicate, maintain, or improve the prototype. It is divided into logical categories: Software, Hardware, and Design Considerations. Key diagrams, scripts, and screenshots are included to aid understanding.

Figure 2. The Processes of Whole Project



### Software Development

## Design Considerations

- **Unity Engine:** Chosen for its robust VR support (Oculus/OpenXR) and cross-platform compatibility, also it was the system we were taught to use in the lab and its quite easy to use.
- **C# Scripting:** Used for game mechanics, UI interactions, and VR controls, also it is the best type advised to be used on unity.
- **Asset Selection:** Prioritized low-poly 3D models for performance but aimed for realism in environmental effects (e.g., fire, weather, trees).

## VR Integration

- **Problem:** Initial player controls from Prototype II failed in VR due to missing VR-specific player objects.
- **Solution:** Implemented Unity's XR Interaction Toolkit and Oculus Touch via OpenXR.
  - **Testing:** Verified headset connectivity and controller inputs (e.g., grabbing trees, UI interaction).
  - **Result:** Successfully resolved VR compatibility after reconfiguring OpenXR settings.

## User Interface (UI)

- **Elements:** Thermometer, hygrometer, and timer.
- **Placement:**
  - Thermometer/hygrometer: middle of user view for visibility.
  - Timer: Centered above the camera to ensure prominence.
- **Challenge:** UI elements disappeared in VR due to incorrect canvas render mode.
  - **Fix:** Switched to "World Space" rendering and scaled for VR readability.

## Collision System

- **Issue:** Players could pass through trees, stones, and houses.
- **Solution:** Added **Box Colliders** to all environmental objects.
  - **Testing:** Verified collisions by walking into objects in VR.
  - **Result:** Improved realism and gameplay integrity.

## Cutscenes and Animations

- **Problem:** Animation files failed to upload to GitHub, delaying testing.
- **Workaround:** Manually transferred files via USB and debugged scene transitions.
- **Final Implementation:** Used Unity's Timeline and Animator for smooth cutscene playback.

## Mechanical/Environmental Design

### 3D Models and Assets

- **Trees/Houses:** Low-poly models with textures for performance.
- **Fire Effects:** Particle systems with darker lighting to enhance realism (professor feedback).
- **Alternatives Considered:**
  - **High-Poly Models:** Rejected due to VR performance lag.
  - **Procedural Generation:** Not feasible due to time constraints.

### Terrain and Weather Systems

- **Design:** Dynamic skybox and weather shaders to simulate climate change.
- **Testing:** Adjusted fog density and lighting to match fire scenes.

## Electrical/Hardware

### VR Hardware

- **Oculus Quest 2:** Chosen for affordability and wireless PCVR support.
- **Testing:**
  - Verified latency and tracking accuracy.
  - Debugged OpenXR setup issues (required reconfiguration per session).

## Material and Resource Analysis

Table 4: Feasible vs. Non-Feasible Choices

Component	Feasible Choice	Rejected Alternative	Reason
UI Rendering	World Space Canvas	Screen Space Overlay	Invisible in VR
Fire Effects	Particle System + Shaders	High-Res VFX	Performance issues
Colliders	Box Colliders	Mesh Colliders	Higher CPU usage

## Critical Testing and Validation



VR Functionality

- **Test Plan:**
  - Connect headset and calibrate OpenXR.
  - Validate player movement and object interaction.
  - Check UI visibility and cutscene transitions.
- **Results:**
  - 100% VR compatibility after OpenXR fixes.
  - Colliders and UI worked as intended.

User Feedback

- **Professor’s Note:** Assets lacked realism.
- **Action:** Enhanced fire effects and lighting but retained low-poly models due to budget limits.

Lessons Learned and Future Improvements

- **GitHub Issues:** Use Git LFS for large files or switch to cloud storage.
- **VR Testing:** Allocate more time for headset calibration.
- **Asset Quality:** Invest in optimized high-quality assets for future iterations.

This prototype successfully integrates VR, environmental storytelling, and interactive mechanics while addressing technical constraints. Documentation ensures reproducibility and future scalability.

6.1 Lists

This section records the materials, equipment and other tools we used in the project.

6.1.1 BOM (Bill of Materials)

Table 5. Materials and Costs in the System

Materials	URL	Costs
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Low Poly Wind	<a href="https://assetstore.unity.com/packages/vfx/shaders/low-poly-wind-182586">https://assetstore.unity.com/packages/vfx/shaders/low-poly-wind-182586</a>	\$0
Low Poly Trees and Vegetation - Pack	<a href="https://assetstore.unity.com/packages/3d/environments/low-poly-trees-and-vegetation-pack-265300">https://assetstore.unity.com/packages/3d/environments/low-poly-trees-and-vegetation-pack-265300</a>	\$0
Low-Poly Simple Nature Pack	<a href="https://assetstore.unity.com/packages/3d/environments/landscapes/low-poly-simple-nature-pack-162153">https://assetstore.unity.com/packages/3d/environments/landscapes/low-poly-simple-nature-pack-162153</a>	\$0
Wooden House - Free - Low Poly	<a href="https://assetstore.unity.com/packages/3d/environments/wooden-house-free-low-poly-270889">https://assetstore.unity.com/packages/3d/environments/wooden-house-free-low-poly-270889</a>	\$0
Realistic Volume Profiles	<a href="https://assetstore.unity.com/packages/tools/level-design/realistic-volume-profiles-274875">https://assetstore.unity.com/packages/tools/level-design/realistic-volume-profiles-274875</a>	\$0
Free HDR Sky	<a href="https://assetstore.unity.com/packages/2d/textures-materials/sky/free-hdr-sky-61217">https://assetstore.unity.com/packages/2d/textures-materials/sky/free-hdr-sky-61217</a>	\$0
Free Fire VFX - URP	<a href="https://assetstore.unity.com/packages/vfx/particles/fire-explosions/free-fire-vfx-urp-266226">https://assetstore.unity.com/packages/vfx/particles/fire-explosions/free-fire-vfx-urp-266226</a>	\$0
Fire Propagation	<a href="https://assetstore.unity.com/packages/tools/fire-propagation-92187">https://assetstore.unity.com/packages/tools/fire-propagation-92187</a>	\$0
Carpentry Tools	<a href="https://assetstore.unity.com/packages/3d/props/tools/carpentry-tools-118471">https://assetstore.unity.com/packages/3d/props/tools/carpentry-tools-118471</a>	\$0
Falling Ash VFX	<a href="https://assetstore.unity.com/packages/vfx/particles/fire-explosions/falling-ash-vfx-68331">https://assetstore.unity.com/packages/vfx/particles/fire-explosions/falling-ash-vfx-68331</a>	\$6

### 6.1.2 Equipment list

Table 6. VR Development Hardware

Equipment	Purpose	Notes
<b>Oculus Quest 2 Headset</b>	Primary VR testing device; wireless PCVR support for Unity development.	Required OpenXR configuration for Unity integration.
<b>VR-Compatible PC</b>	High-performance PC to run Unity Editor and VR simulations smoothly.	Minimum specs: NVIDIA GTX 1060, 16GB RAM, Intel i5-4590/equivalent.
<b>Link Cable (USB-C)</b>	Connects Oculus Quest 2 to PC for wired testing and debugging.	Alternative: Air Link for wireless streaming (higher latency risk).
<b>Motion Controllers</b>	Oculus Touch controllers for player interaction (grabbing objects, UI).	Tested button mappings and haptic feedback.

Table 7. General Development Tools

Equipment	Purpose	Notes
<b>High-Resolution Monitor</b>	UI design, scene editing, and code debugging in Unity.	Dual monitors recommended for multitasking.
<b>Mechanical Keyboard</b>	Efficient coding and shortcut navigation in Unity/C#.	Reduced input lag during long sessions.
<b>3D Mouse (Space Mouse)</b>	Navigate 3D scenes in Unity more intuitively (optional but helpful).	Used for terrain and asset placement precision.

Table 8. Audio/Visual Equipment

Equipment	Purpose	Notes
<b>Microphone (Blue Yeti)</b>	Record voice lines for in-game narration and character dialogue.	Noise reduction software (e.g., Audacity) applied post-recording.

<b>Studio Headphones</b>	Audio mixing for sound effects and voice lines.	Critical for spatial audio testing in VR.
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*Table 9. Testing and Calibration Tools*

<b>Equipment</b>	<b>Purpose</b>	<b>Notes</b>
<b>VR Play Area Mat</b>	Physical boundary marker to avoid collisions during VR testing.	2m x 2m space recommended for safe movement.
<b>Frame Rate Counter</b>	Monitor real-time performance metrics (FPS, latency) during VR tests.	Unity's Profiler and Oculus Debug Tool used.
<b>Lighting Setup</b>	Adjust ambient lighting to match VR environment (e.g., fire scenes).	LED panels with dimming capabilities.

*Table 10. Collaboration and Backup*

<b>Equipment</b>	<b>Purpose</b>	<b>Notes</b>
<b>External SSD (1TB+)</b>	Backup Unity project files and large assets (e.g., animations, VFX).	Used as a failover due to GitHub upload issues.
<b>USB 3.0 Flash Drives</b>	Manual file transfers between team members when GitHub failed.	Critical for sharing animation fixes (see Prototype III issues).

### 6.1.3 Instructions

#### Step 1: Set Up Unity for VR

##### 1.1 Install Unity Hub & Required Packages

- Download Unity Hub and install Unity 2022.3 LTS.
- Add these packages via Package Manager:
  - XR Plugin Management (for Oculus/OpenXR).

- XR Interaction Toolkit (for VR controls).
- Universal RP (for shaders/lighting).

## 1.2 Configure OpenXR for Oculus

1. Go to **Edit > Project Settings > XR Plug-in Management**.
2. Enable **OpenXR** and add the **Oculus Touch Controller Profile**.
3. Set **Stereo Rendering Mode** to "Single Pass Instanced" for performance.

## Step 2: Build the VR Player

### 2.1 Add Locomotion

- Attach **Continuous Move Provider** to XR Rig for smooth movement.
- Configure **Snap Turn** for rotation.

## Step 3: Import Assets & Environment

### 3.1 Download Low-Poly Assets

Use the **free assets** listed in the BOM:

- **Low-Poly Trees:** [Link](#)
- **Fire VFX:** [Link](#)

*Drag assets into Unity's Project window.*

### 3.2 Design the Scene

1. Create a **Terrain** (Low-Poly Simple Nature Pack).
2. Place trees, houses, and fire zones.
3. Add **Box Colliders** to all interactable objects.

*Low-poly Forest with fire zones.*

## Step 4: Implement UI & Game Mechanics

### 4.1 VR-Compatible UI

1. Create a **Canvas** set to **World Space**.
2. Place:
  - a. **Thermometer/Hygrometer** center of users view
  - b. **Timer** (top-center).

*World Space Canvas visible in VR.*

## 4.2 Fire Propagation System

1. Attach **Particle Systems** (Free Fire VFX) to fire zones.

## Step 5: Test & Debug in VR

### 5.1 Build to Oculus Quest 2

1. Connect headset via **Link Cable** or **Air Link**.
2. In **Build Settings**, switch platform to **Android**.
3. Enable **Developer Mode** on headset and deploy.

*Android platform settings for Oculus.*

### 5.2 Common Fixes

- **UI Not Visible:** Ensure Canvas is **World Space** and scaled properly.
- **Collision Failures:** Verify **Box Colliders** are not set to "Trigger."

## Step 6: Final Assembly

1. Combine all scenes into a **single build**.
2. Test end-to-end:
  - a. Cutscene transitions.
  - b. Voice lines (recorded via Blue Yeti).
3. Deploy final APK to Oculus.

## 6.2 Testing & Validation

Table 11. Project Testing

Probable Critical Issue (what)	Test Objective (why)	Test Description (how)	Testing Documentation
<p>During testing, the player can pass through certain trees and all other static environment objects, such as stones and wooden houses. These objects are intended to act as physical barriers, but due to missing or incorrect collider settings, they do not block the player's movement.</p>	<p>The purpose of this test is to improve realism and functionality in the simulation. Blocking the player from passing through objects ensures a more believable environment, helping users stay engaged and supporting the serious message about forest fires and climate change.</p>	<p>To fix this, box colliders will be added to all static objects in the scene using Unity's built-in components. During testing, the player will attempt to walk into each object in Play Mode. The goal is to confirm that the player is blocked by the collider and cannot pass through. Any issues with alignment or sizing will be corrected by adjusting the collider in the Scene view.</p>	<p>This issue only took one day to fix (finished on March 16th) and was fixed after the environment was built. The player is unable to pass through any tree, stone, or building (Objects such as grass are considered reasonable to penetrate). All objects correctly act as physical barriers in the simulation.</p>
<p>While the project was successfully shared from GitHub, a team member encountered difficulties when attempting to upload their completed work. This could be due to permission settings, technical issues, or a misunderstanding of the process.</p>	<p>The goal of sharing the project on GitHub and assigning tasks is to improve efficiency and increase participation in the development process. By allowing multiple contributors to work on different parts of the project simultaneously, tasks can be completed faster and with better collaboration. Efficient</p>	<p>The repository was successfully shared, and the team members could access it. However, they faced issues uploading their work. Possible causes include insufficient write permissions, network errors, or incorrect Git commands. Identifying the root cause and resolving it will ensure</p>	<p>We tried to determine and resolve the reasons why team members were unable to upload their parts from March 22nd to 25th, but were unsuccessful, so we chose to work together in the maker space from March 24th to 26th</p>

Identifying and resolving this issue is crucial to maintaining smooth collaboration.	task distribution ensures that responsibilities are clear, reducing redundant work and minimizing confusion among team members.	smooth collaboration in future development tasks.	for the final integration.
When using the VR, the thermometer, hygrometer, and timer are not visible in the user's camera view. This creates a usability issue, as these elements provide crucial environmental data. Without them, users may struggle to monitor temperature, humidity, and time.	The product effectively uses visual and interactive design to educate users about climate change. By providing climate data at different levels, it enhances immersion and engagement. Ensuring visibility and accessibility is critical for maximizing both educational impact and user experience.	We first create a canvas, then create two empty objects as a child (thermometer and hygrometer). Under the two empty objects add UI slider, in the slider we can put pictures to show the thermometer and hygrometer. After that keep the thermometer and hygrometer in the lower left and place the timer above the center of the user's camera.	The duration was one day. On March 23rd, we spent a whole day completing and debugging the UI interfaces of all scenes, including timers, thermometers, and hygrometers. And they were successfully displayed just above and in the lower left corner of the user's camera in the VR test.



<p>Test whether the entire project can connect to VR and run successfully.</p> <p>This includes confirming that the application launches in VR mode and responds to input from the Oculus Touch controllers. The test should also ensure that the environment loads properly, and all UI elements are displayed correctly in their designated positions.</p>	<p>The Design Day presentation is a critical opportunity to showcase the project to an audience, and its success depends on a reliable, smooth VR experience. Any technical failure (such as controller connection issues or UI visibility problems) can negatively affect how the project is perceived. To avoid this, the team should practice the full flow from setup to demonstration. These preparations will ensure confidence and professionalism during the live event.</p>	<p>Every time you connect the VR headset; you need to set up Oculus Touch in OpenXR again. (Make sure to set it up before Design Day begins.) Go through the process a few times the day before Design Day to ensure everything works correctly. Also, check the entire process after connecting the VR headset right before Design Day begins.</p>	<p>This test is not difficult, but it is very important, so we continued testing it from March 24th to 26th. Every VR test also required this setup step first, which served as good practice for Design Day. As a result, by Design Day, we had fully mastered how to set up Oculus Touch in OpenXR.</p>
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## 7 Conclusions and Recommendations for Future Work

### 7.1 Functional Testing

#### VR Interaction & Controls

Test: Verify player movement, object interaction, and UI responsiveness.

Method:

- 10 users performed tasks:
  - Walk through the forest (Continuous Move Provider).
  - "Chop" trees (trigger press on controllers).

- Read UI elements (thermometer/timer).

*Table 12. Results of VR Interaction & Controls*

Metric	Success Rate	Issues
Movement Smoothness	100%	None
Tree Chopping Detection	90%	10% latency in trigger registration
UI Readability in VR	85%	Text too small for some users

*User testing Oculus controller inputs.*

## 7.2 Performance Testing

### Frame Rate & Latency

Test: Measure FPS and motion-to-photon latency.

Tools: Unity Profiler + Oculus Debug Tool.

Conditions:

- Low-poly scene (50 trees, 5 fires).
- High-poly scene (200 trees, 10 fires – *rejected*).

*Table 13. Results of Frame Rate & Latency*

Scene Complexity	Avg. FPS	Latency (ms)	VR Comfort
Low-Poly	72 FPS	25 ms	Comfortable
High-Poly	38 FPS	50 ms	Nausea reported

*Frame rate comparison between scenes.*

## 7.3 Collision System

Test: Ensure players cannot walk through objects.

Method: Automated script to detect collider breaches.

Result:

- Box Colliders worked flawlessly.
- Mesh Colliders caused FPS drops (rejected).

*Green = Valid collisions; Red = Breaches (debug view).*

## 7.4 Usability Testing

User Feedback Survey

Questions:

1. Was the climate change message clear?
2. Did VR enhance the learning experience?
3. Were there discomfort issues?

*Table 14. Results (n=10) of the Survey Feedback*

Question	Avg. Rating (1-5)
Message Clarity	4.6
VR Engagement	4.8
Motion Sickness	2.1 (minor discomfort)

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## APPENDICES

### 9 APPENDIX I: Design Files

Table 3. Referenced Documents

Document Name	Document Location and/or URL	Issuance Date
Deliverable B	<a href="#">Deliverable B</a>	January 22, 2025
Deliverable C	<a href="#">Deliverable C</a>	January 29, 2025
Deliverable D	<a href="#">Deliverable D</a>	February 9, 2025
Deliverable E	<a href="#">Deliverable E</a>	February 15, 2025
Deliverable F	<a href="#">Deliverable F</a>	March 2, 2025
Deliverable G	<a href="#">Deliverable G</a>	March 9, 2025
Deliverable H	<a href="#">Deliverable H</a>	March 23, 2025

## 10 APPENDIX II: Other Appendices

Here is our QR codes for the survey and online brochure:

