



**Universiti Tunku Abdul Rahman**

**Faculty of Information Science & Technology**

**UCCD3084 GRAPHICS PROGRAMMING FOR XR**

**GROUP ASSIGNMENT**

**Project Title: From Sparks to Safety: A Fire Extinguisher Experience**

**Team Name: FourZeroFour!**

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## **1.0 Project Scope & Environment Design**

The following explains the design of the virtual factory, describing the chosen setting and its main features and elements. It also covers the layout choices, such as where hazards and extinguishers are placed, and other elements that are placed into the scene, which gives the user a realistic and, most importantly, a practical training scene.

### **1.1 Project Scope**

#### **1.1.1 Objective**

This project aims to create an interactive virtual tutorial that trains users in basic fire safety procedures. It introduces the presence of flammable substances in a chemical factory and demonstrates the correct response during an emergency, in this case a blazing chemical fire caused by barrels containing hazardous materials. The tutorial specifically guides the user through the proper use of a fire extinguisher, applying the well-known PASS method (Pull, Aim, Squeeze, Sweep) to ensure clear and practical instruction on handling the equipment effectively.

#### **1.1.2 Boundaries**

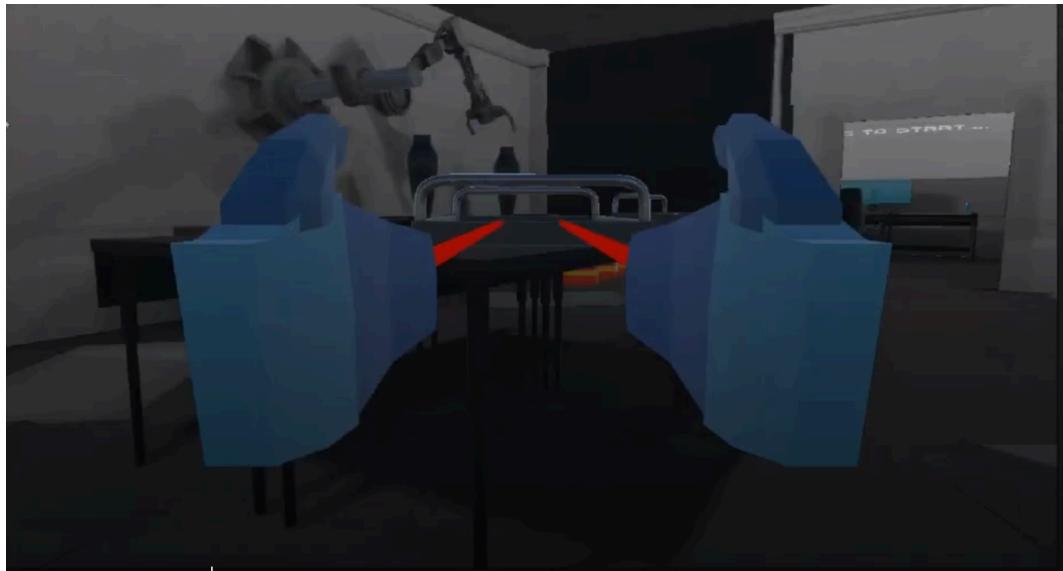
The scope of this project is limited to simulating the use of a fire extinguisher for extinguishing small-scale fires within a controlled virtual factory environment. The focus remains on providing users with a step-by-step tutorial to understand and practice the extinguisher operation process rather than addressing the full spectrum of fire safety protocols. Advanced measures such as large-scale evacuation drills, handling multiple types of extinguishers, or structural damage are not included. The design avoids unnecessary complexity to maintain accessibility and ensure the training remains practical, targeted, and easy to follow for users.

#### **1.1.3 Assumptions and Limitations**

The simulation assumes access to compatible hardware and input controls to ensure smooth interaction. Although the fire mechanics are simplified, the flames are designed to spread over time to create a sense of urgency, which adds to the realism in the scenario. However, the system does not simulate advanced behaviours such as structural damage, for example. Multiplayer functionality and complex physics beyond the tutorial requirements are also excluded, keeping the focus on the extinguisher training process.

## 1.2 Environment Design

The environment design for this project balances realism, functionality, and safety training protocols. The virtual factory layout was created with the intention of simulating a real chemical factory environment. Where fire hazards and accidents are prepared to be handled and emergency equipment must be strategically located. Diagram 1.1 shows the interior of the chemical factory.



*Diagram 1.1: The project scene*

### 1.2.1 Elements in the Scene

The core design element includes fire barrels, which will represent flammable objects commonly found in a chemical factory. These fire barrels are located at working areas to show that it is where hazardous materials might normally be stored or handled. This placement ensures that users can encounter potential danger zones in realistic locations, making the training simulation more relevant.

The fire barrels are located in two places in the factory, one in the inner room and one on the left side of the entrance. This positioning depicts the real-world scenario of how barrels in these settings can be found either in the storage, or in the working area. Diagram 1.1 shows the barrels in the scenes.



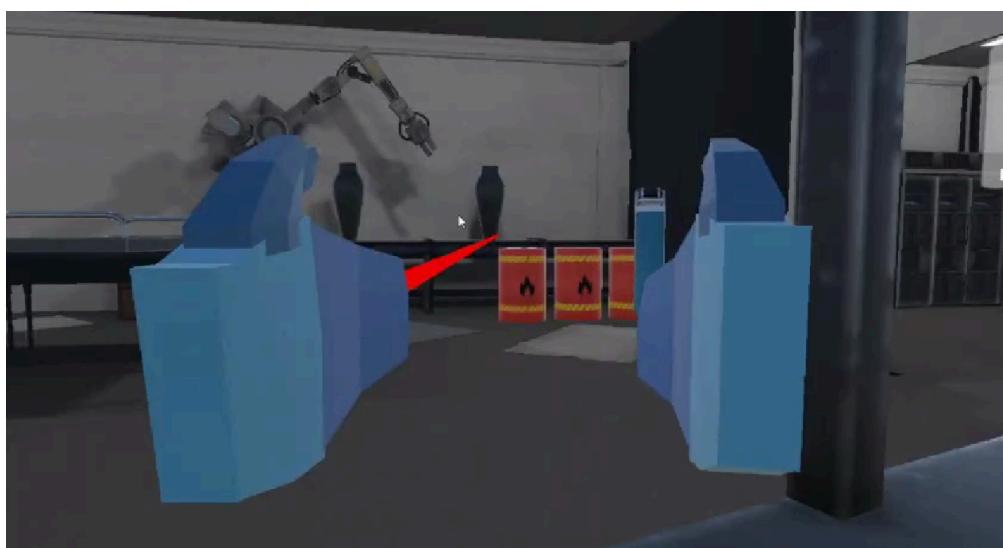
*Diagram 1.1: The barrels placed in the scene (Left: near the entrance, Right: In storage unit)*

As the trigger and to ignite the barrels, a lighter is implemented. This choice is important as it symbolises how even a seemingly harmless tool can turn into a significant threat when used near flammable substances. By simulating the act of lighting the barrels, users are able to notice how quickly a fire can start and spread in such an environment, reinforcing the importance of hazard awareness and preventive safety behavior. Diagram 1.2 shows the lighter that the user had picked up from the desk and had grabbed using the left or right controller to ignite the fire.



*Diagram 1.2 The Lighter*

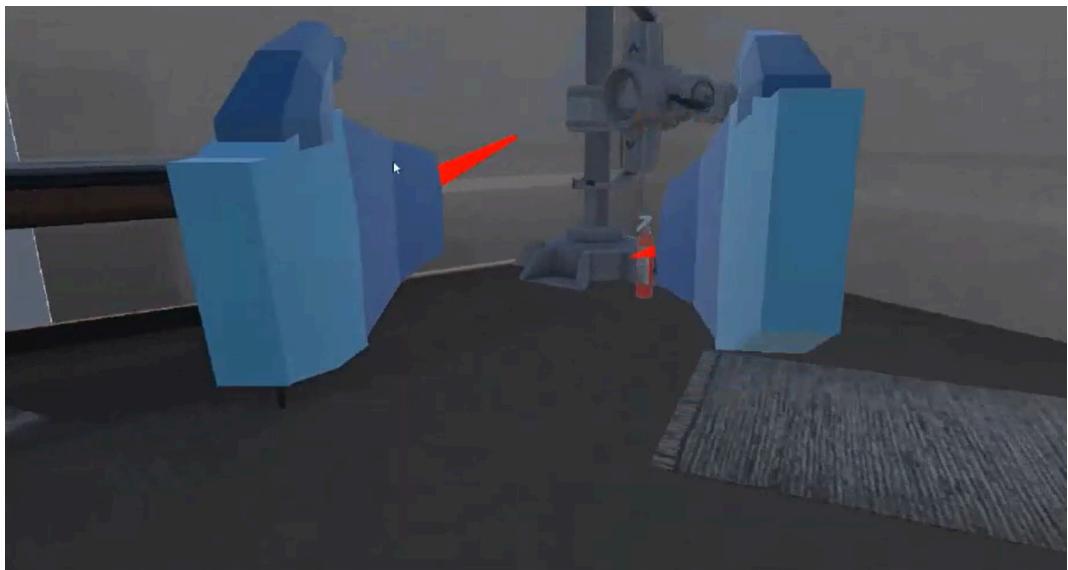
Another notable feature of the chemical factory environment is the inclusion of robotic arms as depicted in Diagram 1.3 below. While robotic arms are usually meant for automotive factories, it is also true that robotic arms have begun to be implemented and used in chemical factories for tasks such as handling hazardous materials, mixing chemicals, or transferring heavy containers. Inclusion of robotic arms can make sure that it reduces direct human exposure to harmful chemical substances as to protect their health and safety.



*Diagram 1.3: The robotic arm in the factory*

The placement of fire extinguishers is another important aspect of the design of the environment. It is placed next to the main entrance (as depicted in Diagram 1.4) for several important reasons:

- Visibility: Workers entering or moving through the factory can immediately see the extinguisher.
- Accessibility: When fire occurs, employees can quickly grab the extinguisher without hastily searching for it.
- Compliance: Safety guidelines recommend placing extinguishers near entry and exit points to ensure they remain usable even if the fire spreads further inside.



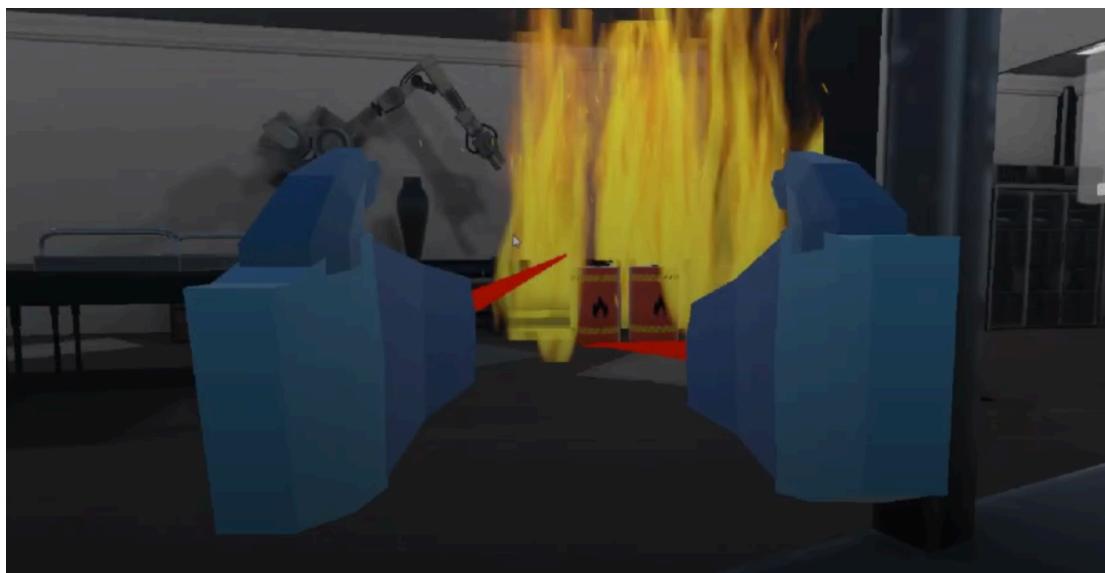
*Diagram 1.4: The placement of the fire extinguisher in the scene*

To support user guidance and improve the simulation process, a panel with a canvas and Text Mesh Pro UI is included in the scene. This interface provides users with on-screen introductions and step-by-step instructions as shown in Diagram 1.6, such as picking up the fire extinguisher, removing the pin, and holding to shoot at the fire. The UI ensures that users understand the correct sequence of actions, making the simulation realistic and easy to follow.



*Diagram 1.5: A user interface is displayed to guide the user on how to ignite the fire on the flammable barrels, which is by using a lighter and then to extinguish the fire using a fire extinguisher.*

And finally, the most essential feature of this project is the fire, which is depicted in Diagram 1.6. The fire is triggered when the lighter collides with the barrels, simulating the ignition of hazardous chemical substances. The fire is accompanied by sound effects to enhance immersion and realism. The flames are designed to grow over time, creating urgency for the user to act. When the extinguisher is used correctly, the fire is put out, producing visible sparks as feedback to indicate successful extinguishing. This feature not only adds interactivity but also reinforces the importance of a timely response during fire emergencies.



*Diagram 1.6: The fire*

The overall design is to replicate emergency response conditions while still being manageable within the VR framework. Implementing hazard placement, ignition sources, robotic machinery, and extinguisher location, it provides a safety training scenario that emphasizes both prevention and quick action.

## 1.2.2 Simulation Environment



*Diagram 1.7: Igniting fire on the barrels using the lighter*

To begin the ignition process, the user must first pick up the lighter. Once the lighter is in hand, they need to bring it close to the surface of the flammable barrels. Just like in real life, the fire will only start when the flame from the lighter makes contact with the barrel. The closer the lighter is held next to the barrels, the faster the ignition occurs, eventually causing the barrels to catch fire, as depicted in Diagram 1.7.



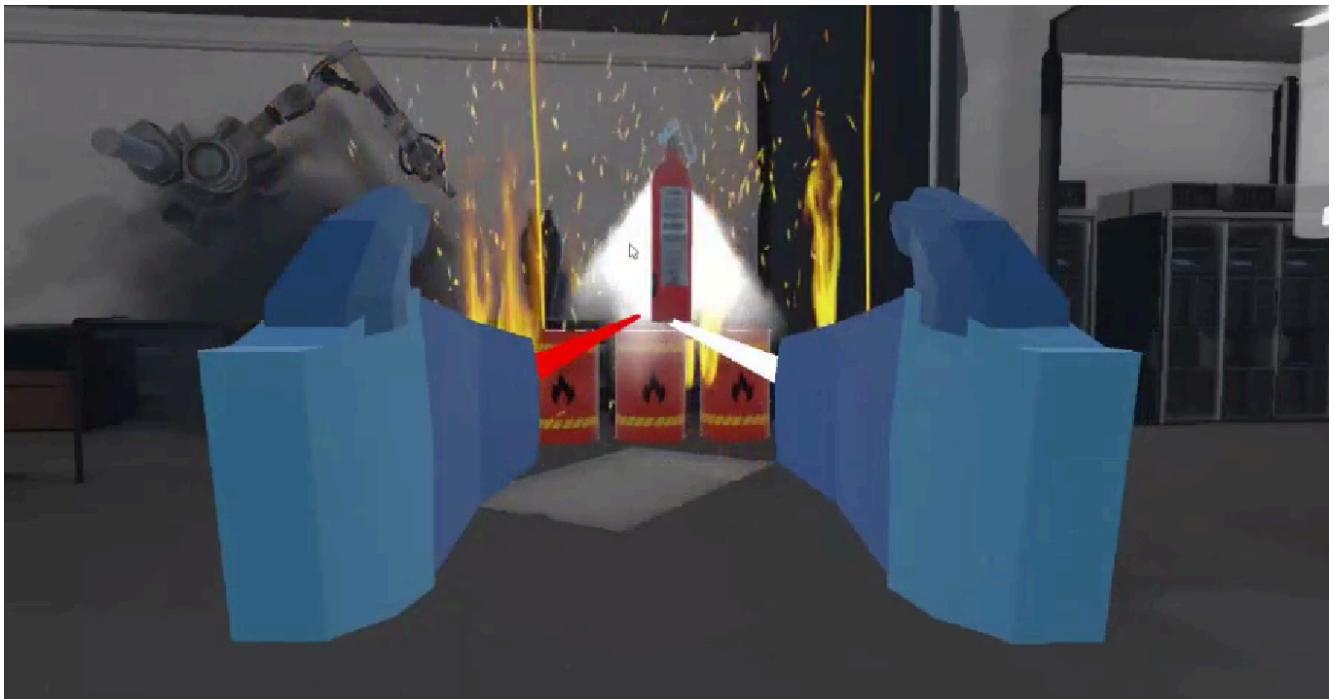
*Diagram 1.8: The fire ignited*

After the lighter makes contact with the flammable barrels, the fire is ignited as shown in Diagram 1.8.



*Diagram 1.9: Grabbing the fire extinguisher*

In order to extinguish the fire, users must locate the fire extinguisher located on the right side of the main entrance, as previously shown in Diagram 1.4. Once found, the extinguisher can be grabbed using either the left or right controller, as illustrated in Diagram 1.9.



*Diagram 1.10: Extinguishing the fire using the fire extinguisher*

Once the fire extinguisher is grabbed, the user must remove the pin, hold the extinguisher, and spray at the fire until it is completely put out, as shown in Diagram 1.10.

### 1.2.3 Asset Links (Credits)

Fire Particles: <https://assetstore.unity.com/packages/vfx/particles/particle-pack-127325>

Fire Extinguisher: <https://www.fab.com/listings/0474276e-bec7-4cb8-9941-49a784df24f1>

Lighter: <https://assetstore.unity.com/packages/3d/props/cigarette-lighter-pbr-106937>

Fire Barrels: <https://assetstore.unity.com/packages/3d/props/cigarette-lighter-pbr-106937>

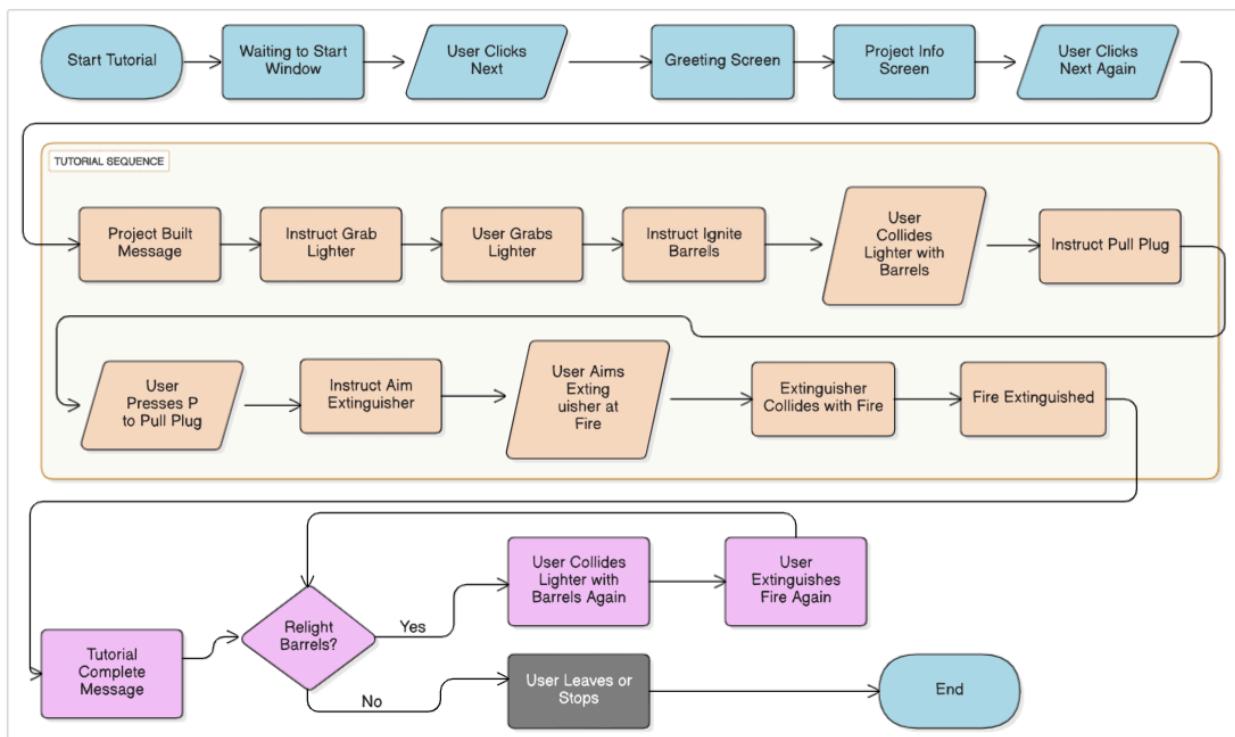
Font: <https://assetstore.unity.com/packages/2d/fonts/free-pixel-font-thaleah-140059>

Factory: <https://assetstore.unity.com/packages/3d/environments/sci-fi/free-sci-fi-office-pack-195067>

## 2.0 Visual Diagrams

This section presents a Flochart which illustrates the simulation flow of the project developed. The diagram illustrates the user's interaction with the scene during the fire emergency scenario, with a focus on the process of triggering the fire by colliding the lighter with the barrels, retrieving the fire extinguisher, and following the instructions to use it correctly. These visuals clarify the flow of actions and system responses that ensure an effective and realistic training experience.

### 2.1 Flowchart



The flow of the project starts off when the user enters the factory. The user is first presented with a waiting screen. This is followed by the introductory messages, such as greetings, and the project's information. The user advances through these steps by clicking "Next.". This onboarding stage prepares the user for the subsequent interactive tasks ahead.

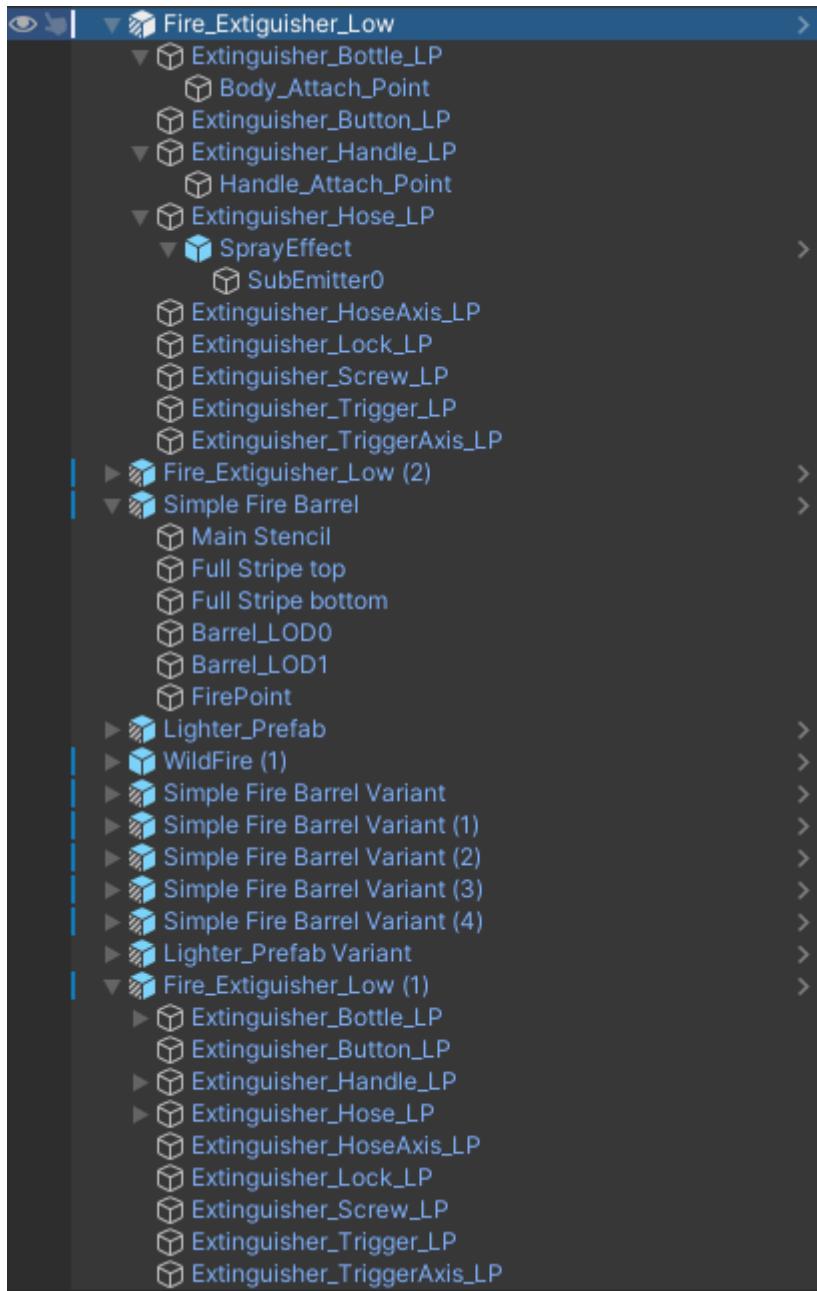
The tutorial sequence then instructs the user to grab a lighter, ignite the barrels, and trigger a fire scenario. Once the barrels are lit, the system guides the user to find the fire extinguisher and then pull the safety plug from it. Upon completion, the system instructs the user to aim the fire extinguisher toward the fire. When the extinguisher collides with the fire, the growing flames are thus extinguished, completing the core of this learning task. At this point, a completion message is displayed, confirming successful training.

After extinguishing the fire, the user is free to relight the fire on another set of barrels and consequently extinguish it, or choose to quit, which then ends the tutorial. This design ensures both structured instruction and flexibility for repeated practice, combining clarity with interactivity in the training experience.

### **3.0 Team Contribution Summary**

<b>Desmond Ho Jia Shen</b>	Fire extinguisher, Compiling, UI, Report writing
<b>Nge Ke Jia</b>	Fire, smoke and triggering of fire, Report writing
<b>Ong Yi Sheng</b>	Fire extinguisher, Compiling, UI, Report writing
<b>Tharini Vijesh Kumar</b>	Scene, Sound, Report writing

## Appendix



Important tool hierarchy

## Fire Extinguisher Inspector

Inspector

Fire\_Extinguisher\_Low (1)       Static

Tag Untagged      Layer Default

Prefab Fire\_Extinguisher\_Low     

Overrides      Select      Open

Transform

Position	X 7.457	Y 0.009	Z 30.836
Rotation	X 0	Y 0	Z 0
Scale	X 0.04	Y 0.06	Z 0.04

Rigidbody

Mass	5
Drag	0
Angular Drag	0.05
Automatic Center Of Mass	<input checked="" type="checkbox"/>
Automatic Tensor	<input checked="" type="checkbox"/>
Use Gravity	<input checked="" type="checkbox"/>
Is Kinematic	<input type="checkbox"/>
Interpolate	None
Collision Detection	Discrete

Constraints

Freeze Position	<input type="checkbox"/> X <input type="checkbox"/> Y <input type="checkbox"/> Z
Freeze Rotation	<input type="checkbox"/> X <input type="checkbox"/> Y <input type="checkbox"/> Z

Layer Overrides

Box Collider

Edit Collider	
Is Trigger	<input type="checkbox"/>
Provides Contacts	<input type="checkbox"/>
Material	None (Physic Material)
Center	X -0.00678775 Y 3.751273 Z 0.1448831
Size	X 2.986423 Y 8.502547 Z 2.476909

Layer Overrides

Audio Source

AudioClip	ExtinguisherSound
Output	None (Audio Mixer Group)
Mute	<input type="checkbox"/>
Bypass Effects	<input type="checkbox"/>
Bypass Listener Effects	<input type="checkbox"/>
Bypass Reverb Zones	<input type="checkbox"/>
Play On Awake	<input checked="" type="checkbox"/>
Loop	<input type="checkbox"/>
Priority	High      128      Low
Volume	1

XR Grab Interactable

Script	XRGrabInteractable
Interaction Manager	None (XR Interaction Manager)
Interaction Layer Mask	Everything
▶ Colliders	
Distance Calculation Mode	0
Custom Reticle	Collider Position
Select Mode	None (Game Object)
Focus Mode	Single
Single	Single
▶ Gaze Configuration	
Movement Type	Kinematic
Retain Transform Parent	<input checked="" type="checkbox"/>
Track Position	<input checked="" type="checkbox"/>
Smooth Position	<input type="checkbox"/>
Track Rotation	<input checked="" type="checkbox"/>
Smooth Rotation	<input type="checkbox"/>
Track Scale	<input checked="" type="checkbox"/>
Smooth Scale	<input type="checkbox"/>
Throw On Detach	<input checked="" type="checkbox"/>
Throw Smoothing Duration	0.25
Throw Smoothing Curve	[Curve Graph]
Throw Velocity Scale	1.5
Throw Angular Velocity Scale	1
Force Gravity On Detach	<input type="checkbox"/>
Attach Transform	None (Transform)
Secondary Attach Transform	None (Transform)
Use Dynamic Attach	<input type="checkbox"/>
Attach Ease In Time	0.15
Attach Point Compatibility Mode	Default (Recommended)
▶ Grab Transformers Configuration	
Add Default Grab Transformers	<input checked="" type="checkbox"/>
▶ Starting Multiple Grab Transformers	0
▶ Starting Single Grab Transformers	0
▶ Interactable Filters	
▶ Interactable Events	

Capsule Collider

Edit Collider

Is Trigger

Provides Contacts

Material None (Physic Material)

Center X 0 Y 3.299637 Z -0.05389154

Radius 1.290825

Height 7.59927

Direction Y-Axis

▶ Layer Overrides

Enhanced Fire Extinguisher Controller (Script)

Script FireExtinguishTrigger

**Fire Extinguisher Components**

Extinguisher Lock Extinguisher\_Lock\_LP

Extinguisher Trigger Extinguisher\_Trigger\_LP

Trigger Axis Extinguisher\_TriggerAxis\_LP

Hose Extinguisher\_Hose\_LP

Foam Particles SprayEffect (Particle System)

**Fire Detection Components**

Fire Particles None (Particle System)

Fire Audio None (Audio Source)

Fire Game Object None (Game Object)

**Extinguish Effects**

Steam Effect None (Particle System)

Extinguish Sound None (Audio Source)

**Animation Settings**

Trigger Rotation Angle 25

Trigger Speed 5

Lock Remove Distance 0.1

Lock Remove Speed 3

**Safety Settings**

Is Pin Removed

Is Trigger Pressed

Can Use Extinguisher

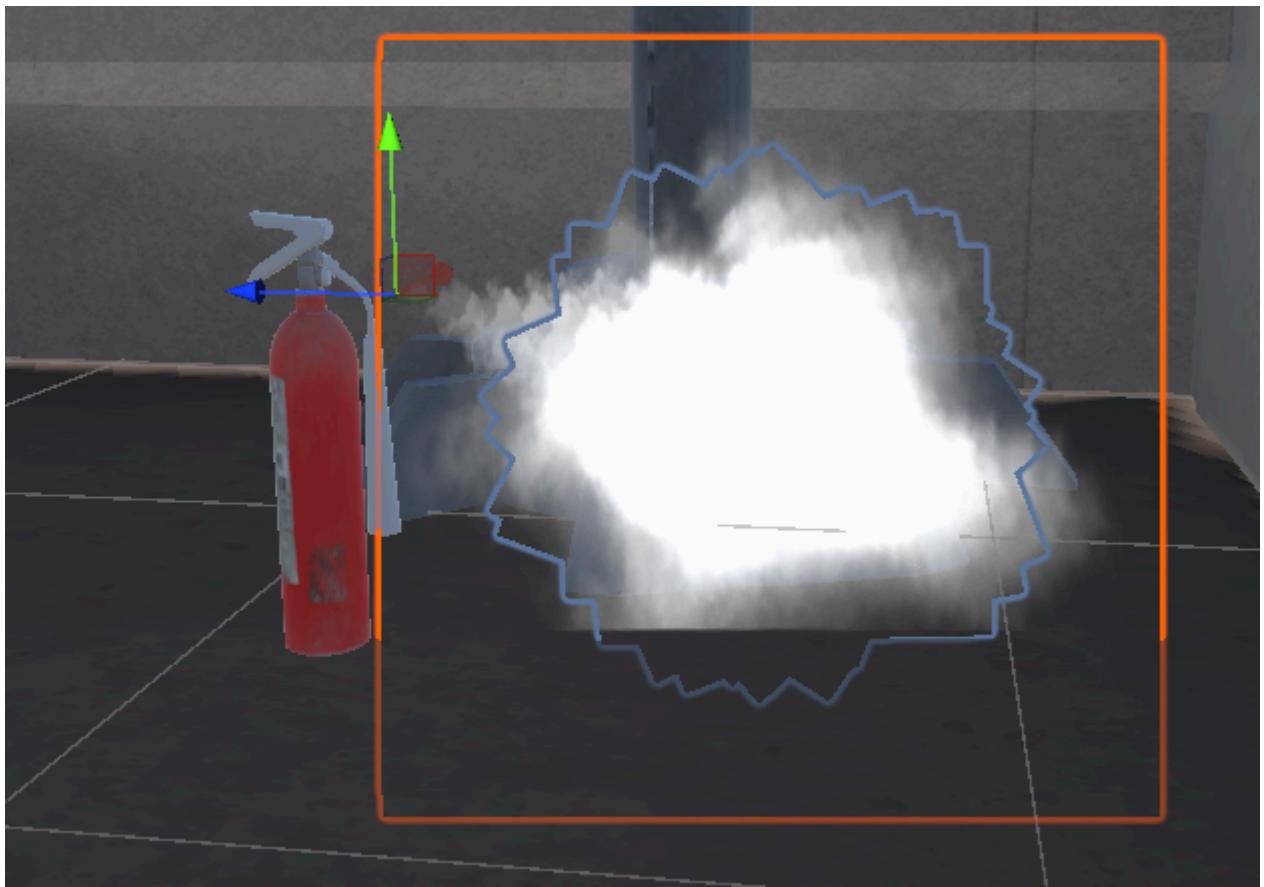
**Particle Settings**

Spray Force 20

Spray Duration 10

**Fire Extinguishing Settings**

Extinguish Time 10



## Smoke Effect of Fire Extinguisher Properties

The screenshot shows the Unity Editor's Inspector window for a game object named "SprayEffect". The object has the following properties:

- Transform**:
  - Position: X 1.5, Y 7.39, Z -1.94
  - Rotation: X 24, Y 163, Z 0
  - Scale: X 1, Y 1, Z 1
- Particle System**:
  - SprayEffect** component settings:
    - Duration: 5
    - Looping: checked
    - Prewarm: unchecked
    - Start Delay: 0
    - Start Lifetime: 1
    - Start Speed: 1
    - 3D Start Size: unchecked
    - Start Size: 1
    - 3D Start Rotation: unchecked
    - Start Rotation: 0
    - Flip Rotation: 0
    - Start Color: white
    - Gravity Source: 3D Physics
    - Gravity Modifier: 0
    - Simulation Space: Local
    - Simulation Speed: 1
    - Delta Time: Scaled
    - Scaling Mode: Local
    - Play On Awake\*: checked
    - Emitter Velocity Mode: Rigidbody
    - Max Particles: 1000
    - Auto Random Seed: checked
    - Stop Action: None
    - Culling Mode: Automatic
    - Ring Buffer Mode: Disabled
  - Emission settings:
    - Emission: checked
    - Shape: checked
    - Velocity over Lifetime: unchecked
    - Limit Velocity over Lifetime: unchecked
    - Inherit Velocity: unchecked
    - Lifetime by Emitter Speed: unchecked
    - Force over Lifetime: unchecked
    - Color over Lifetime: checked
    - Color by Speed: unchecked
    - Size over Lifetime: checked
    - Size by Speed: unchecked
    - Rotation over Lifetime: unchecked
    - Rotation by Speed: unchecked
    - External Forces: unchecked
    - Noise: unchecked

The image displays two overlapping Unity interface windows. The top window is the 'Collision' component editor, showing various settings for a 3D collision system. The bottom window is the 'Extinguisher Smoke Collider (Script)' component editor, showing the script component and its attached 'SprayEffect (Particle System)'.

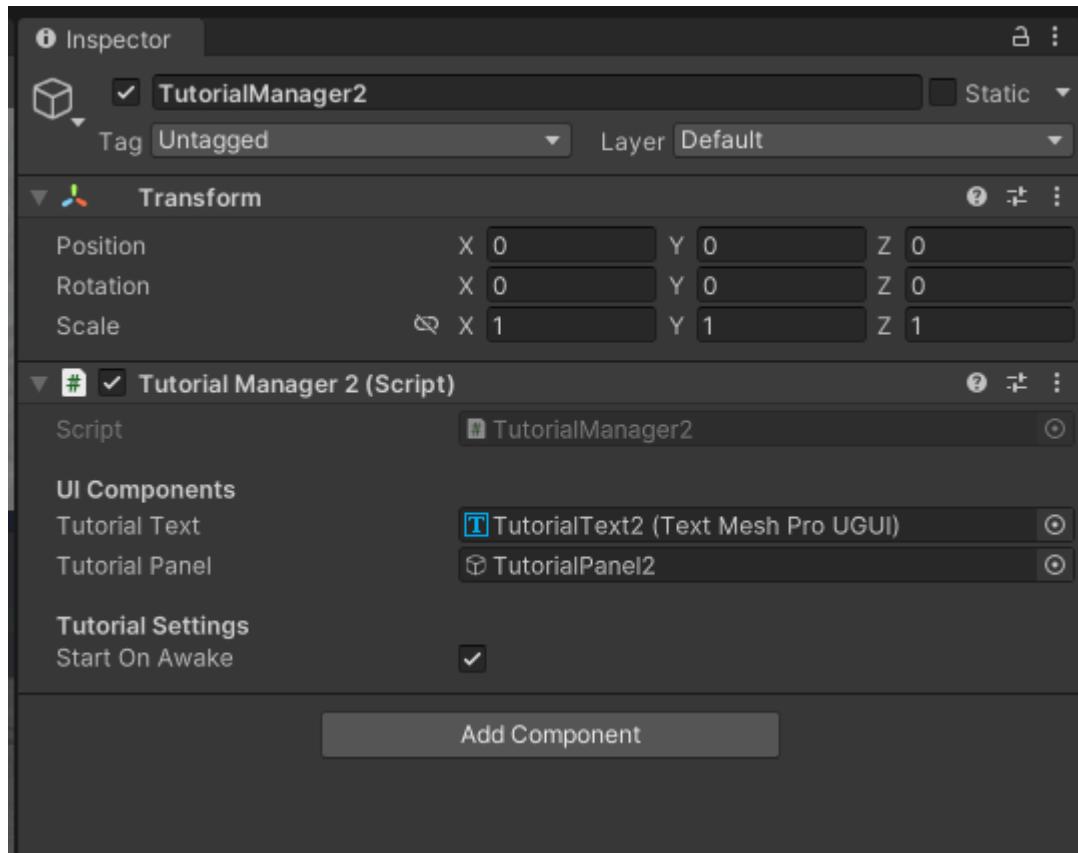
**Collision Component Settings:**

- Type: World
- Mode: 3D
- Dampen: 1
- Bounce: 0.1
- Lifetime Loss: 0
- Min Kill Speed: 0
- Max Kill Speed: 10000
- Radius Scale: 0.1
- Collision Quality: High
- Collides With: Everything
- Max Collision Shapes: 256
- Enable Dynamic Colliders:
- Collider Force:
  - Multiply by Collision Angle:
  - Multiply by Particle Speed:
  - Multiply by Particle Size:
- Send Collision Messages:

**Extinguisher Smoke Collider (Script) Component Editor:**

- Script: ExtinguisherSmokeCollider
- Smoke Particle System:**
  - Smoke Particles: SprayEffect (Particle System)
- Collision Settings:**
  - Collider Radius: 2
  - Max Colliders: 2
  - Collider Lifetime: 2
- Material:** New Material (Material)
  - Shader: Legacy Shaders/Particles/Additive
  - Add Component button

Tutorial Manager(Canva)



## Barrels and Fire



**Inspector**

**Simple Fire Barrel** Static

Tag: Untagged Layer: Default

Prefab: Simple Fire Barrel Variant

Overrides Select Open

**Transform**

Position	X: -0.5695455	Y: 0.044	Z: 0.3821096
Rotation	X: 0	Y: 0	Z: 0
Scale	X: 1	Y: 1	Z: 1

**LOD Group**

Fade Mode: None

LOD 0 100%	LOD 1 10%	Culled 1%
---------------	--------------	--------------

2%

Recalculate Bounds Recalculate Lightmap Scale

Object Size: 0.923315 Reset Object Size

► LOD 0: 7130 Triangles - 1 Sub Mesh(es)

► LOD 1: 182 Triangles (2.55% LOD0) - 1 Sub Mesh(es)

**Mesh Collider**

Convex:

Is Trigger:

Provides Contacts:

Cooking Options: Everything

Material: Barrel Physics mat

Mesh: Barrel\_LOD1

► Layer Overrides

**Rigidbody**

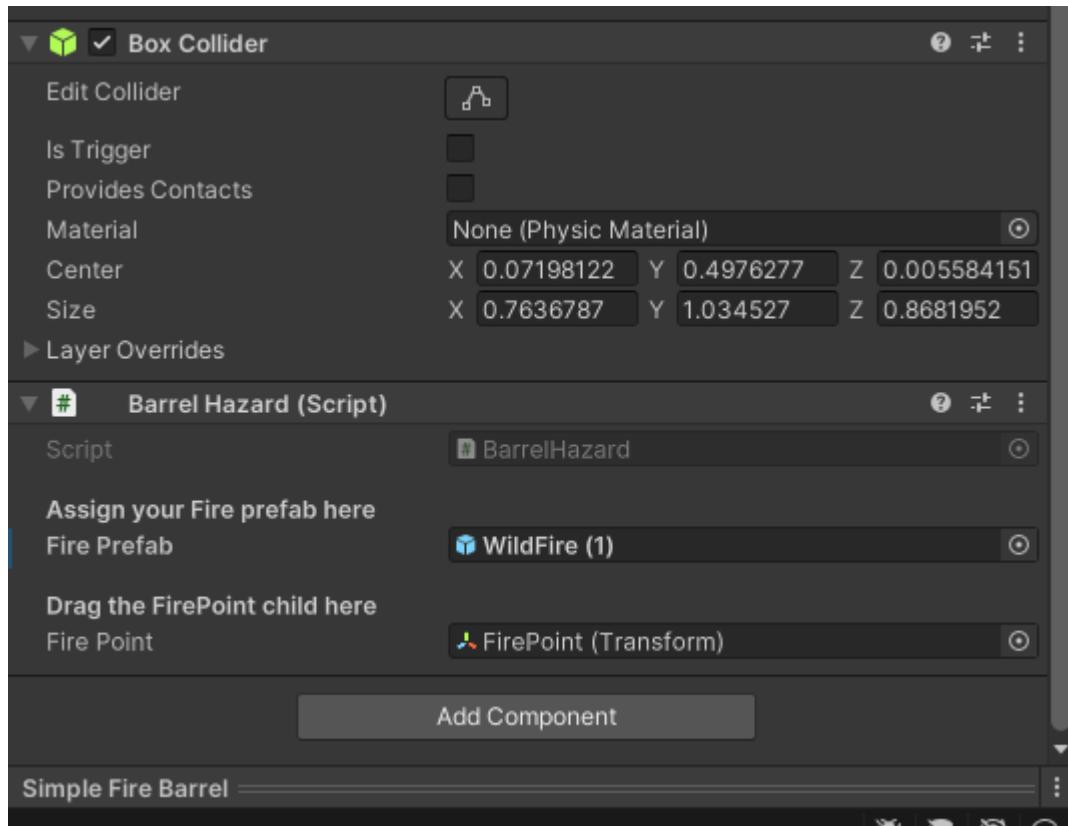
Mass: 2
Drag: 0
Angular Drag: 0.05
Automatic Center Of Mass: <input checked="" type="checkbox"/>
Automatic Tensor: <input checked="" type="checkbox"/>
Use Gravity: <input checked="" type="checkbox"/>
Is Kinematic: <input type="checkbox"/>
Interpolate: None
Collision Detection: Discrete

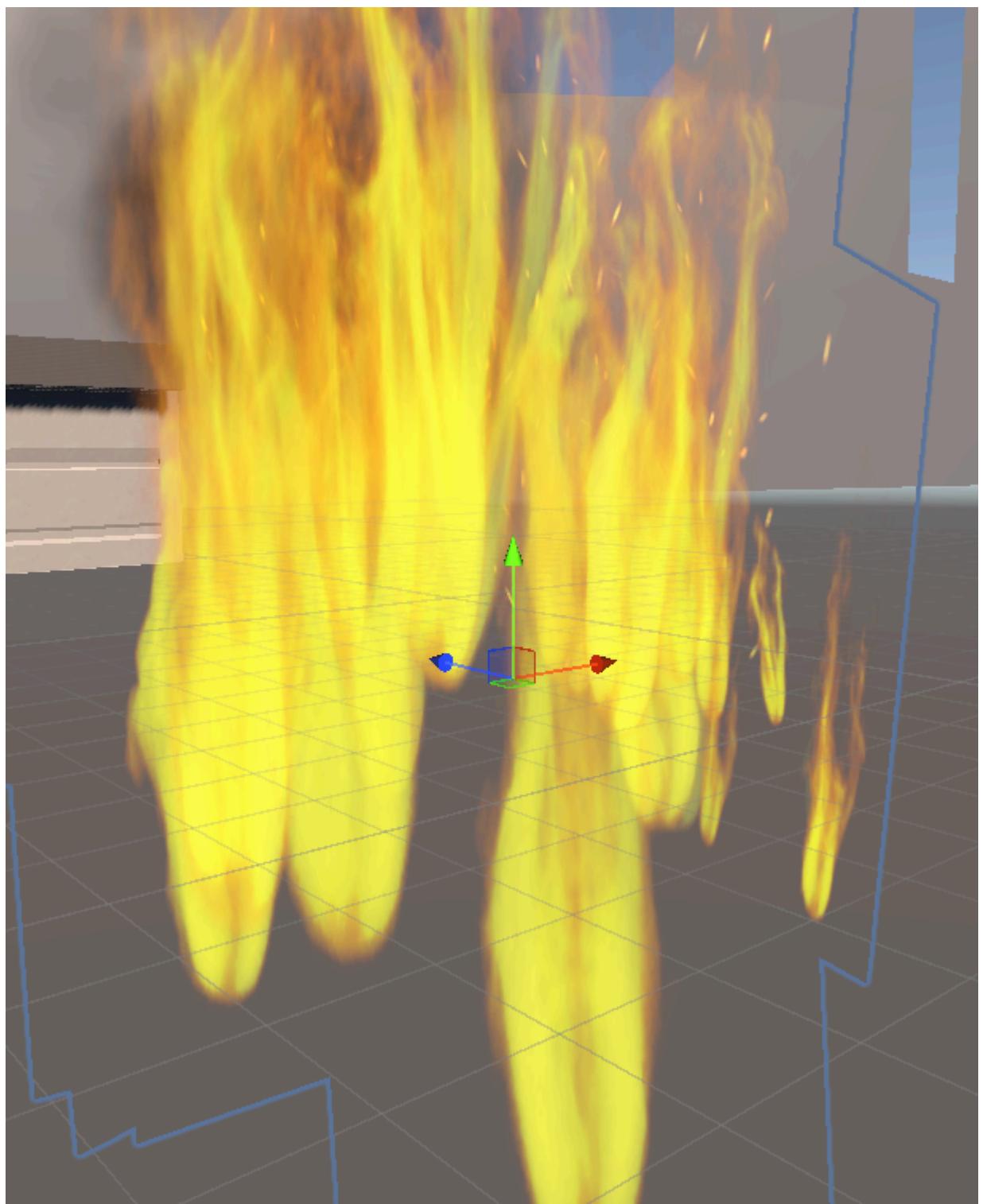
**Constraints**

Freeze Position: X:  Y:  Z:

Freeze Rotation: X:  Y:  Z:

► Layer Overrides





**Inspector**

WildFire (1) Static

Tag: Fire Layer: Default

Prefab: WildFire (1)

Overrides Select Open

**Transform**

Position X: 1.72 Y: 1.4 Z: 8.56  
Rotation X: 0 Y: 0 Z: 0  
Scale X: 1.6634 Y: 2.216647 Z: 1.6634

**Particle System**

Open Editor...

**WildFire (1)**

Duration	30
Looping	✓
Prewarm	✗
Start Delay	0
Start Lifetime	0.05
Start Speed	0
3D Start Size	✗
Start Size	3 1
3D Start Rotation	✗
Start Rotation	0 0
Flip Rotation	0
Start Color	✗
Gravity Source	3D Physics
Gravity Modifier	0
Simulation Space	World
Simulation Speed	1.25
Delta Time	Scaled
Scaling Mode	Local
Play On Awake*	✓
Emitter Velocity Mode	Rigidbody
Max Particles	600
Auto Random Seed	✓
Stop Action	None
Culling Mode	Always Simulate
Ring Buffer Mode	Disabled
<input type="checkbox"/> Emission	
<input checked="" type="checkbox"/> Shape	
<input type="checkbox"/> Velocity over Lifetime	
<input type="checkbox"/> Limit Velocity over Lifetime	
<input type="checkbox"/> Inherit Velocity	
<input type="checkbox"/> Lifetime by Emitter Speed	
<input type="checkbox"/> Force over Lifetime	
<input checked="" type="checkbox"/> Color over Lifetime	
<input type="checkbox"/> Color by Speed	
<input type="checkbox"/> Size over Lifetime	
<input type="checkbox"/> Size by Speed	
<input type="checkbox"/> Rotation over Lifetime	
<input type="checkbox"/> Rotation by Speed	
<input type="checkbox"/> External Forces	
<input type="checkbox"/> Noise	

**Box Collider**

Edit Collider

Is Trigger

Provides Contacts

Material None (Physic Material)

Center X -0.1396368 Y 0 Z -0.3705507

Size X 3.06801 Y 1 Z 1.741113

Layer Overrides

**Fire Extinguish Trigger Improved (Script)**

Script FireExtinguishTriggerImproved

**Fire Components**

Fire Particles Fire (Particle System)

Fire Audio None (Audio Source)

Fire Light None (Light)

**Extinguish Effects**

Steam Effect None (Particle System)

Extinguish Sound None (Audio Source)

**Settings**

Extinguish Time 2

Can Reignite

Reignite Delay 3

**Visual Settings**

Fade Out Smooth

Fade Curve

**Sphere Collider**

Edit Collider

Is Trigger

Provides Contacts

Material None (Physic Material)

Center X -0.0654933 Y 0 Z -0.2029902

Radius 1.405408

Layer Overrides

LargeFlame02 (Material)

Shader Universal Render Pipeline/Particles/Unlit

Particle System Curves