Capacity Building in Teaching of AR/VR (CATCH_VR)
European Commission Project# 101129191 (ERASMUS-EDU-2022-CBHE)

Co-funded by the European Union

VIRTUAL REALITY TRAINING SESSION

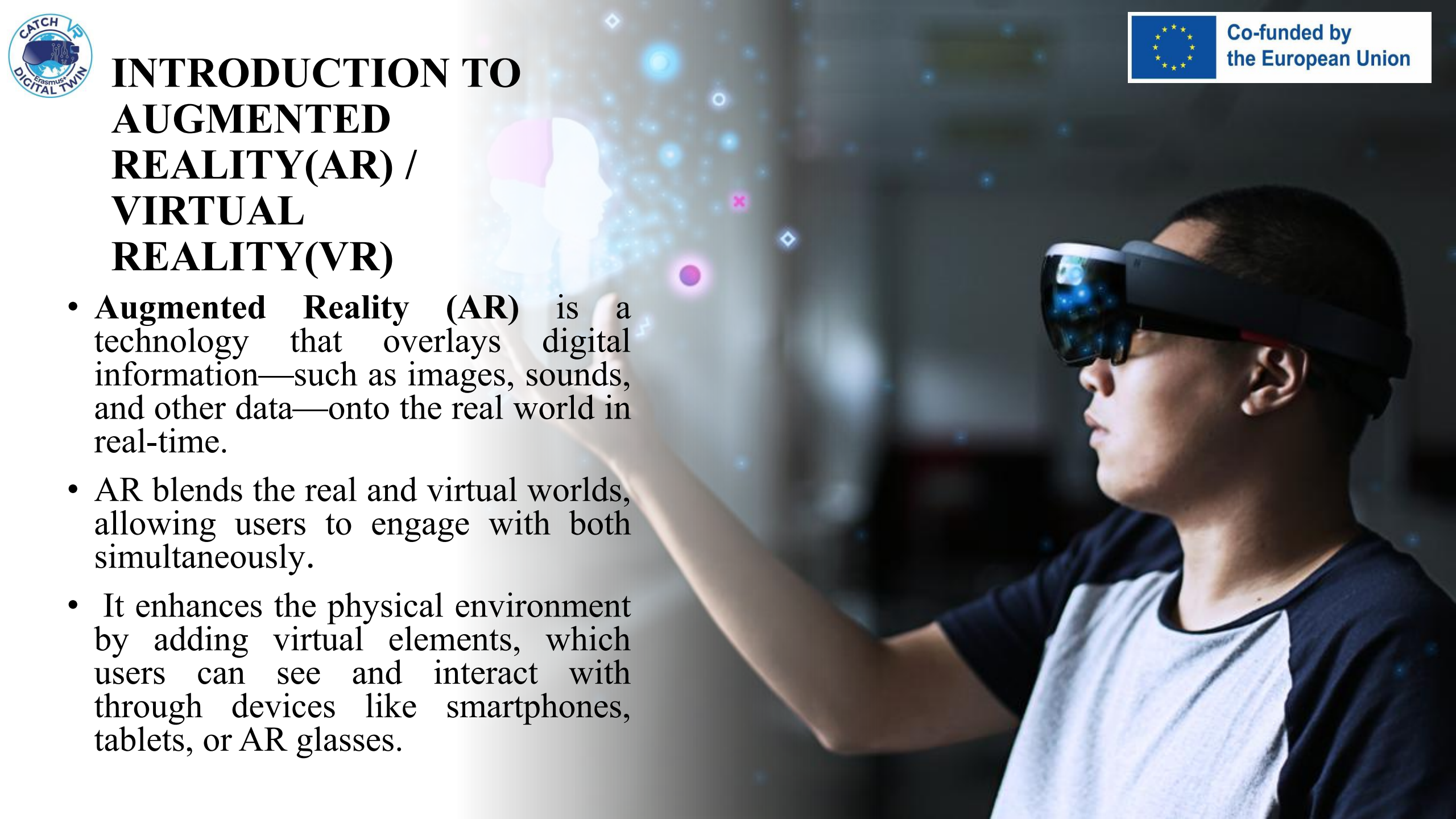
Conducted by : Engr. Durrisha Wadood

University of Engineering and Technology, Peshawar

15 November, 2025

INTRODUCTION TO AUGMENTED REALITY(AR) / VIRTUAL REALITY(VR)

- **Augmented Reality (AR)** is a technology that overlays digital information—such as images, sounds, and other data—onto the real world in real-time.
- AR blends the real and virtual worlds, allowing users to engage with both simultaneously.
- It enhances the physical environment by adding virtual elements, which users can see and interact with through devices like smartphones, tablets, or AR glasses.



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VIRTUAL REALITY

- **Virtual reality (VR),** is an immersive technology that transports users into computer generated environments providing a sensory rich experience that can simulate real world situation or create entirely new world

- To experience VR the users will have to wear a special headset which has screens inside.

- Unlike augmented reality, which blends the real and digital worlds, VR creates a **fully immersive** experience where users are entirely surrounded by and can interact with a virtual world

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KEY DIFFERENCES BETWEEN AR AND VR

How do AR and VR differ?

Augmented reality
uses the existing real-world environment and puts virtual information on top of it to create a sort of mixed reality.

Virtual reality
uses technology such as a headset to create an immersive 3D simulated environment.

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APPLICATIONS OF AR

- AR-integrated menus (Food & Beverages)
- Medical imaging (Healthcare)
- Warehouse Management (Logistics)
- Interior decoration apps
- Google lens etc.

AR-integrated menus

Medical imaging

Warehouse Management (Logistics)

Google lens

Interior decoration apps

APPLICATIONS OF VR

- Education and training
- Gaming
- Health care
- Military etc

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FUTURE TREND OF AR/VR

Some key future trends include:

1. **AI AND MACHINE LEARNING INTEGRATION:**

- **Personalized Content:** AI customizes AR/VR experiences based on individual preferences and behaviors.
- **Enhanced Interaction:** AI improves gesture, voice, and eye-tracking, making interactions more natural.
- **Intelligent Environments**: AI-driven virtual objects will behave more realistically, enhancing immersion.

2. AR IN EVERYDAY LIFE:

- **Smart AR Glasses**: The next generation of AR glasses will be lightweight and resemble regular eyewear.
- **Retail and Consumer Applications**: AR will transform the retail experience, enabling consumers to visualize products in their environment before purchasing.

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3. Social and Collaborative VR

- **Virtual Workspaces**: As remote work becomes more common, VR will offer virtual office spaces where teams can collaborate as if they were in the same physical location.
- **Social Platforms**: People gather in virtual spaces for social events, gaming, and shared experiences.
- **Remote Collaboration**: Teams can work together in 3D spaces, improving productivity and communication.

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DIFFERENT SOFTWARE AVAILABLE FOR VR PRODUCTION

1. Unreal Engine:

- **Best For**: Photorealistic VR experiences, architectural visualizations etc.

2. Blender:

- **Best For**: Asset creation and smaller VR projects. While not a game engine, it is often used to create assets for VR environments.

3. Amazon Sumerian

- **Best For**: Web-based VR applications**.** Integration with AWS (Amazon Web Services).

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WHY UNITY 3D IS BEST FOR VR/AR PRODUSTION?

1. Ease of Use and Accessibility

- Unity is beginner-friendly with a user interface that's intuitive, making it accessible even for non-programmers.
- It also has a massive community with extensive tutorials, documentation, and assets, making it easier to learn compared to other engines.

2. Cross-Platform Compatibility

- Unity supports a wide range of platforms for VR, including Oculus Rift, HTC Vive , PlayStation VR, Google Cardboard, and mobile platforms like iOS and Android.

3. Extensive Asset Store

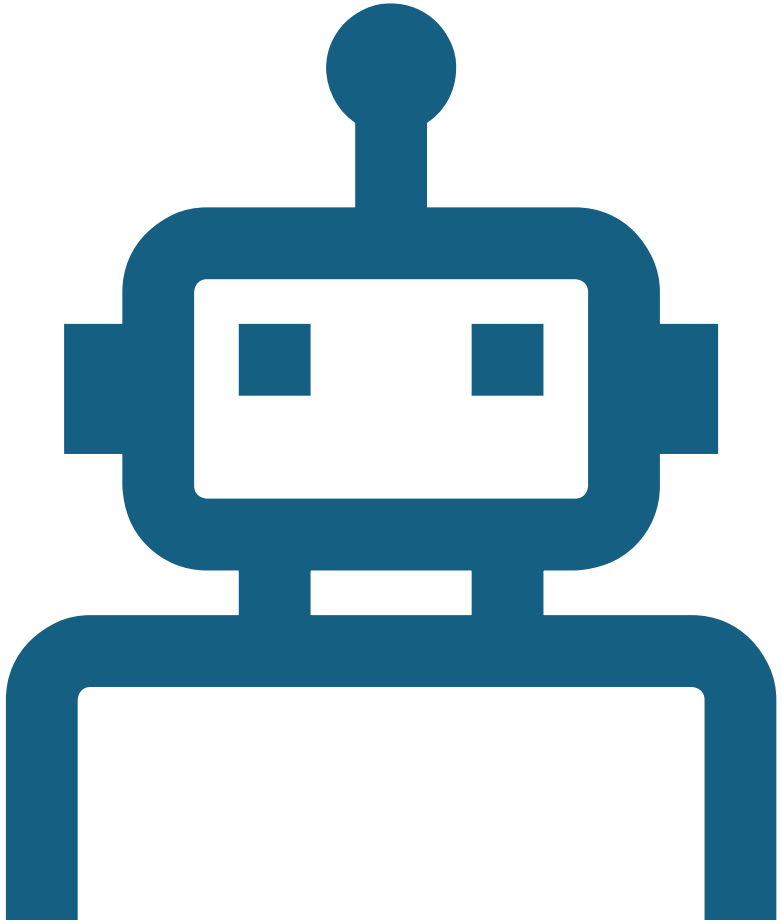
- Unity's Asset Store offers a wide variety of ready-made assets, plugins, and tools that speed up the VR development process.

4. Strong VR Development Tools and SDKs

- Unity integrates seamlessly with major VR SDKs (Software Development Kits), such as Oculus SDK, Steam VR, and Google VR SDK.
- This makes it easier to develop VR applications tailored to different hardware platforms without starting from scratch.

5. Fast Prototyping

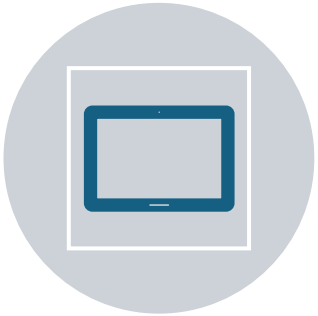
- It is ideal for rapid prototyping.
- Developers can quickly test VR interactions, visualize environments, and iterate changes without waiting for long compilation times, making the development process more efficient.



OVERVIEW OF UNITY FOR AR/VR

Unity is a cross-platform game engine developed by Unity Technologies, in 2005.

The focus of unity lies in the development of both 2D and 3D video games, simulations, and interactive experiences.



Unity supports over **20** different target platforms for deploying, while its most popular platforms are the **PC**, **android** and **iOS systems**

Unity uses **C#** as its primary scripting language, providing developers with powerful tools to create complex behaviors and interactions within their applications.

POPULARITY OF UNITY IN AR/VR DEVELOPMENT

➢Key features of popularity of unity in AR/VR development includes:

a) **User-Friendly Interface:** Unity offers a highly intuitive and user-friendly interface, making it accessible to both beginners and experienced developers.

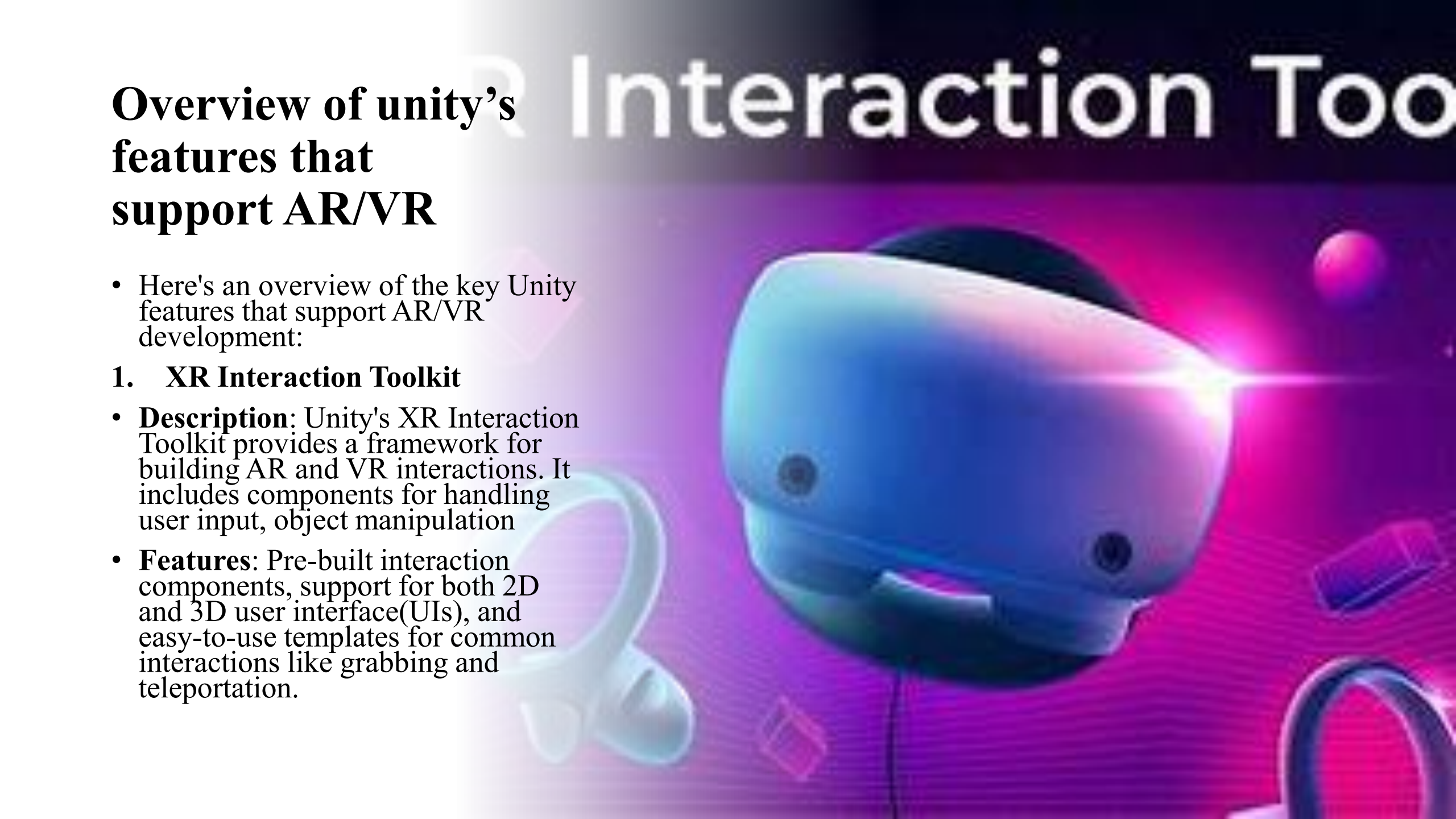
b) **Cross-Platform Support:** Unity supports multiple platforms, including major AR/VR devices like Oculus and Microsoft HoloLens, allowing for broader reach and compatibility.

c) **Robust Asset Store:** Unity's Asset Store provides a vast library of assets, tools, and plugins that speed up

d) **Continuous Updates and Improvements**: Unity regularly updates its platform with new features, performance improvements, and support for emerging technologies development and enhance functionality.

e) **Strong Community and Resources**: Unity has a large and active community, offering extensive tutorials, forums, and support that facilitate problem-solving and learning.

Overview of unity’s features that support AR/VR



- Here's an overview of the key Unity features that support AR/VR development:

1. **XR Interaction Toolkit**

- **Description**: Unity's XR Interaction Toolkit provides a framework for building AR and VR interactions. It includes components for handling user input, object manipulation
- **Features**: Pre-built interaction components, support for both 2D and 3D user interface(UIs), and easy-to-use templates for common interactions like grabbing and teleportation.

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2. XR Simulator

- **Description**: The XR Simulator allows developers to test AR/VR applications without requiring a physical device. It simulates device input and environmental interactions within the Unity Editor.
- **Features**: Device emulation, simulated hand tracking, and adjustable environmental conditions.

CONT..

3. Hand and Eye Tracking

- **Description**: Unity supports advanced input methods like hand and eye tracking, which are essential for creating intuitive and immersive AR/VR experiences.
- **Features**: Integration with platforms like Oculus, Windows Mixed Reality, and Magic Leap, support for natural hand gestures, and gaze-based interactions.

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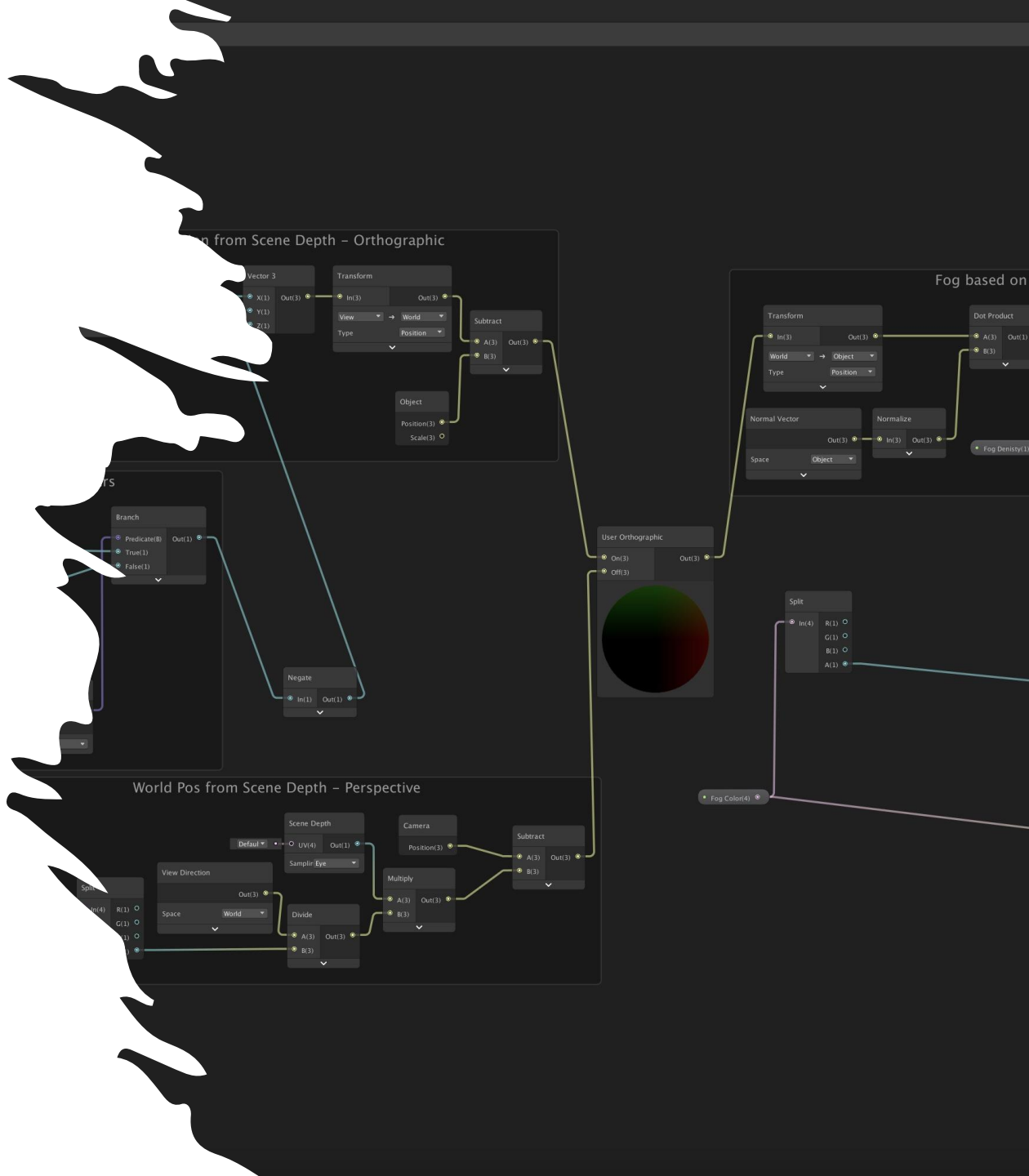
4. Universal Render Pipeline (URP)

- **Description**: URP is optimized for performance and visual quality across various devices, making it ideal for AR/VR development where performance is critical.
- **Features**: Real-time lighting, post-processing effects, and shader customization with a focus on maintaining high frame rates in AR/VR environments.



HOW TO INSTALL UNITY SOFTWARE??

- Before installing Unity Engine ,Unity hub is required .
- so first thing is to download unity hub.
- Go to internet browser > unity.com(Official website) as shown in figure1.1

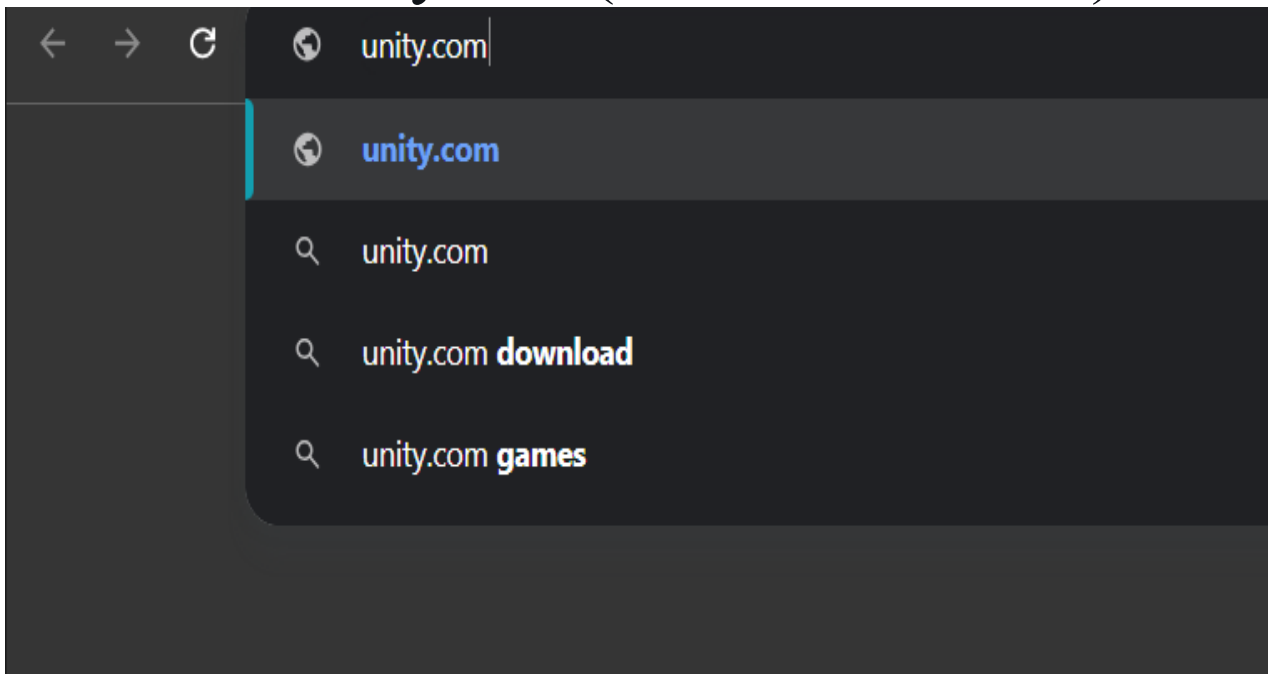


Figure 1.1

Conti...

- The above interface will be opened

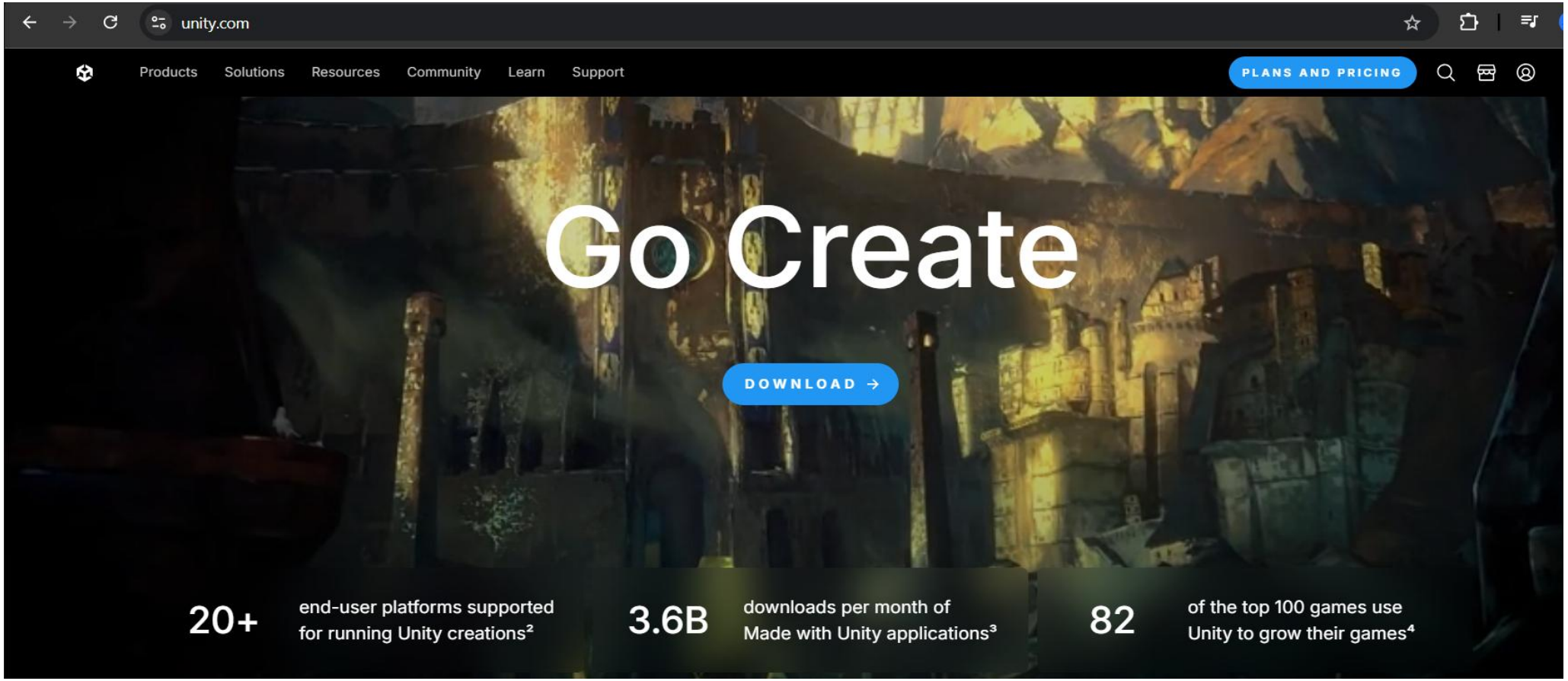


Figure 1.2

- Go to plans and pricing(on top left) >(Pick version of unity)>unity personal and it will start downloading

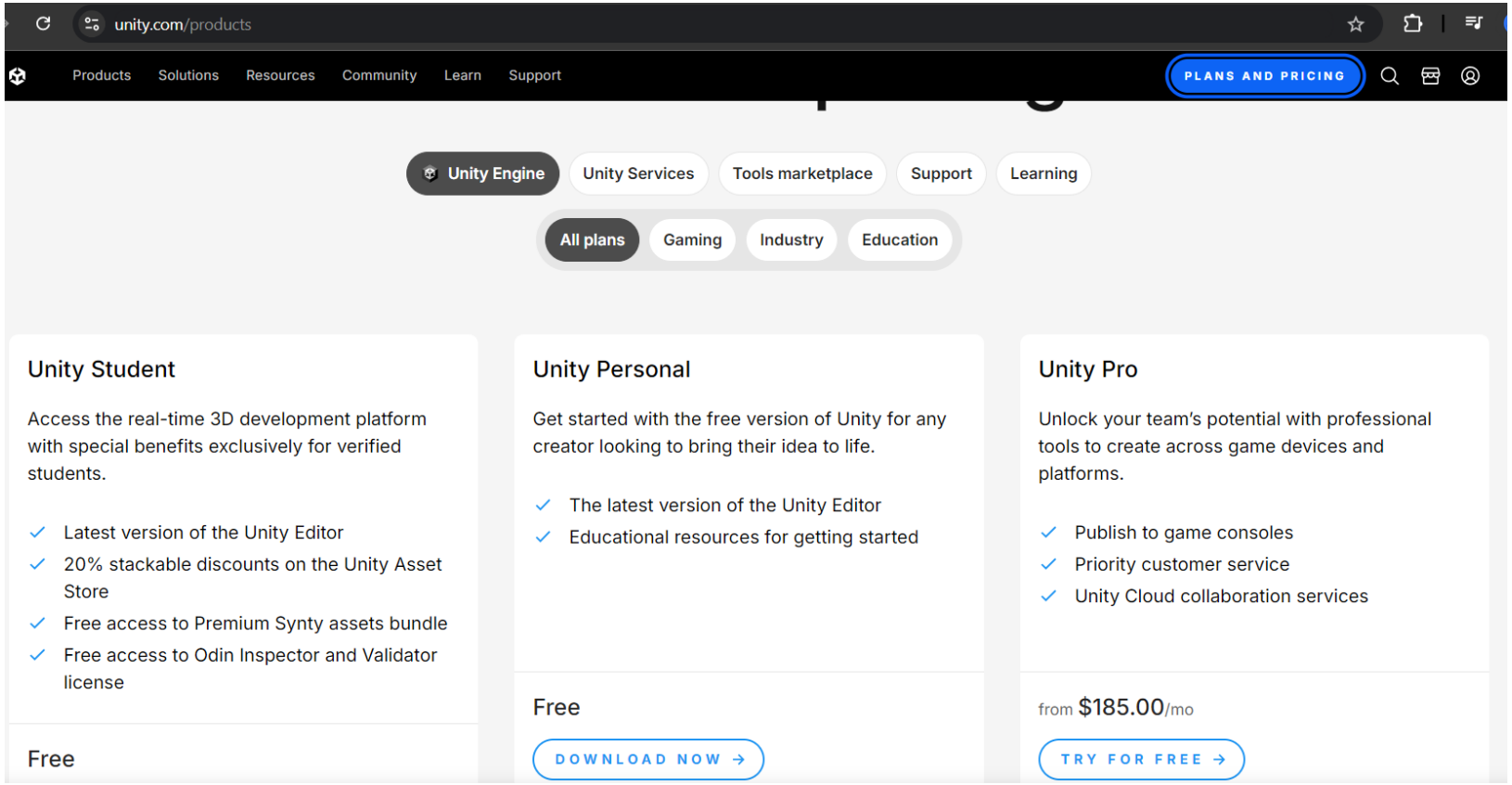


Figure 1.3

- In next step it will ask a location where to install unity hub setup

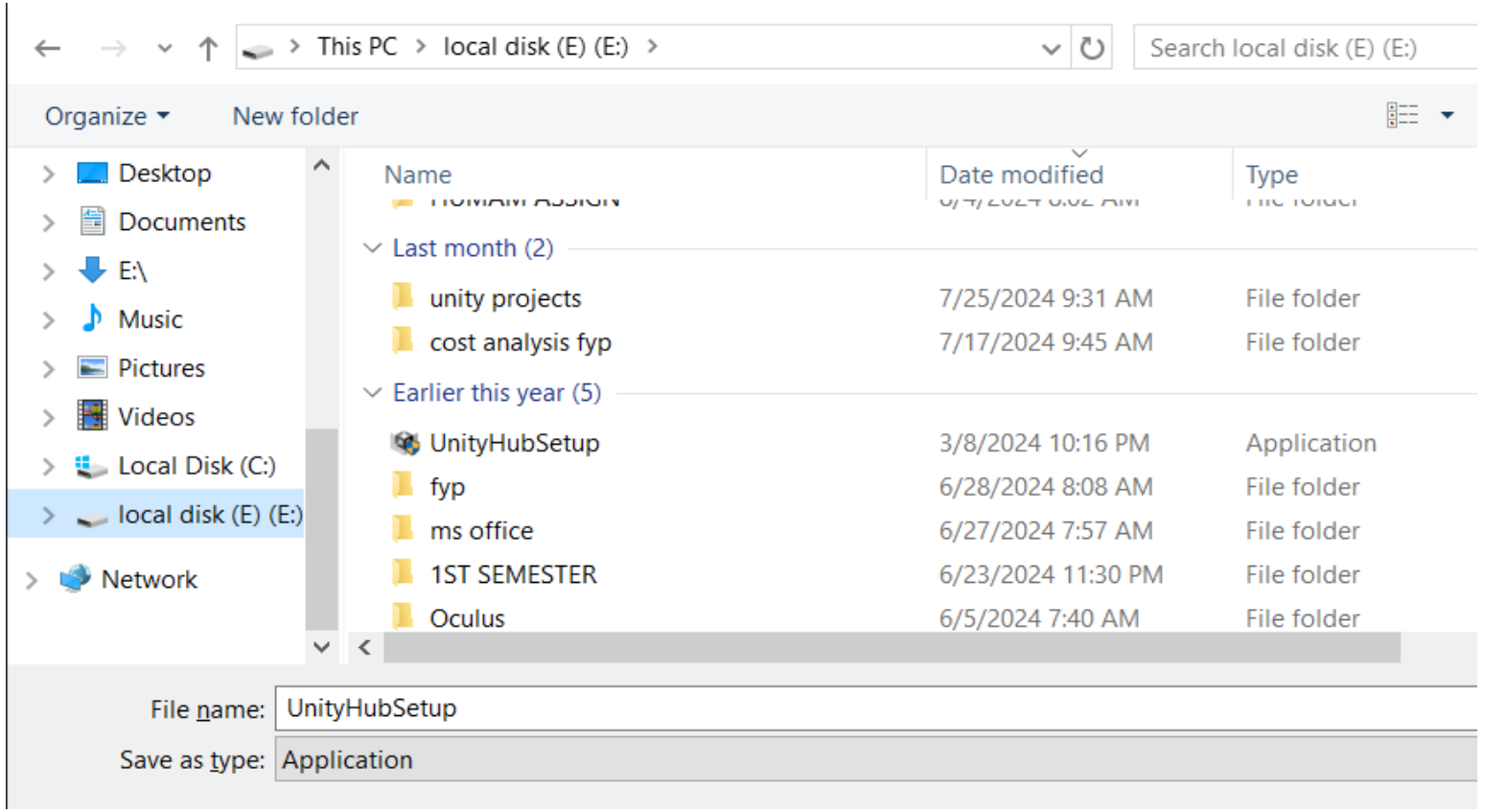


Figure 1.4

- Unity hub set completion

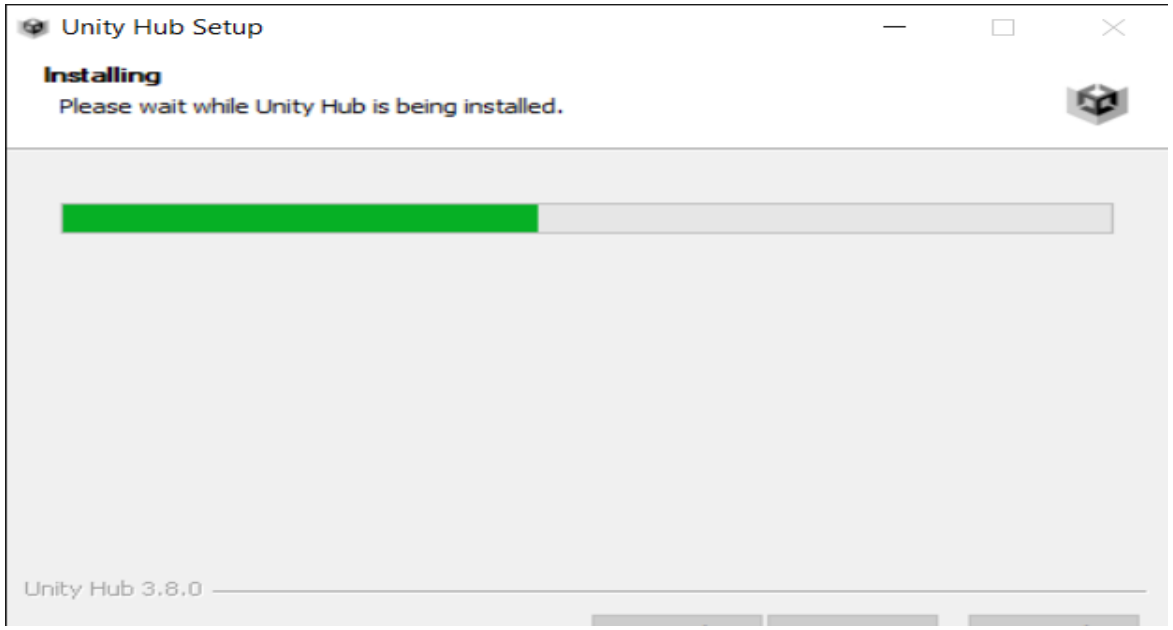


Figure 1.5

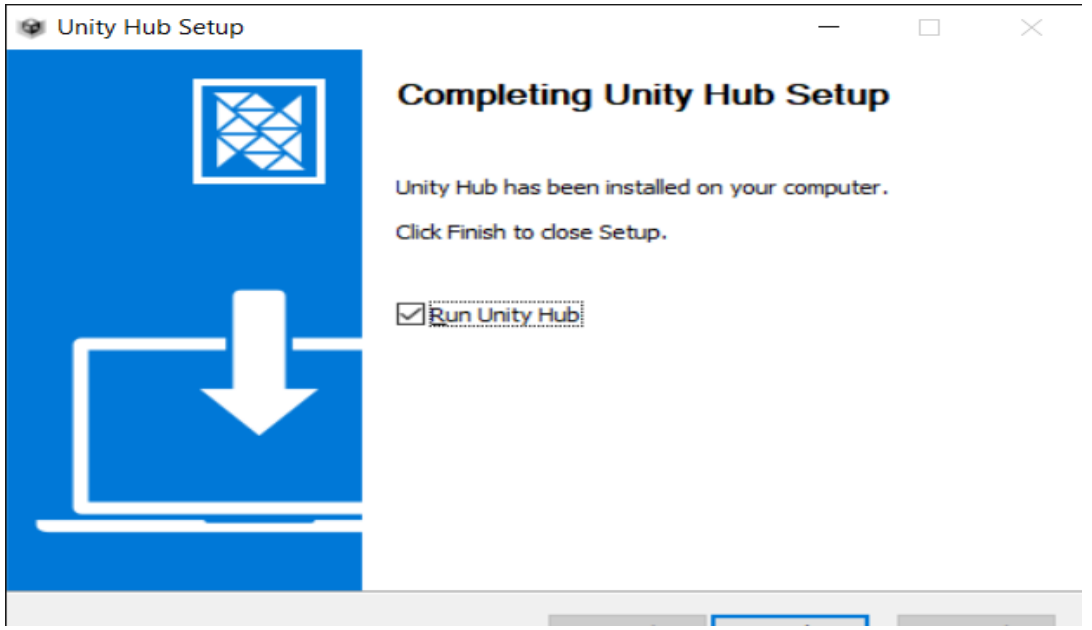


Figure 1.6

- Next step is to sign in or create unity hub account

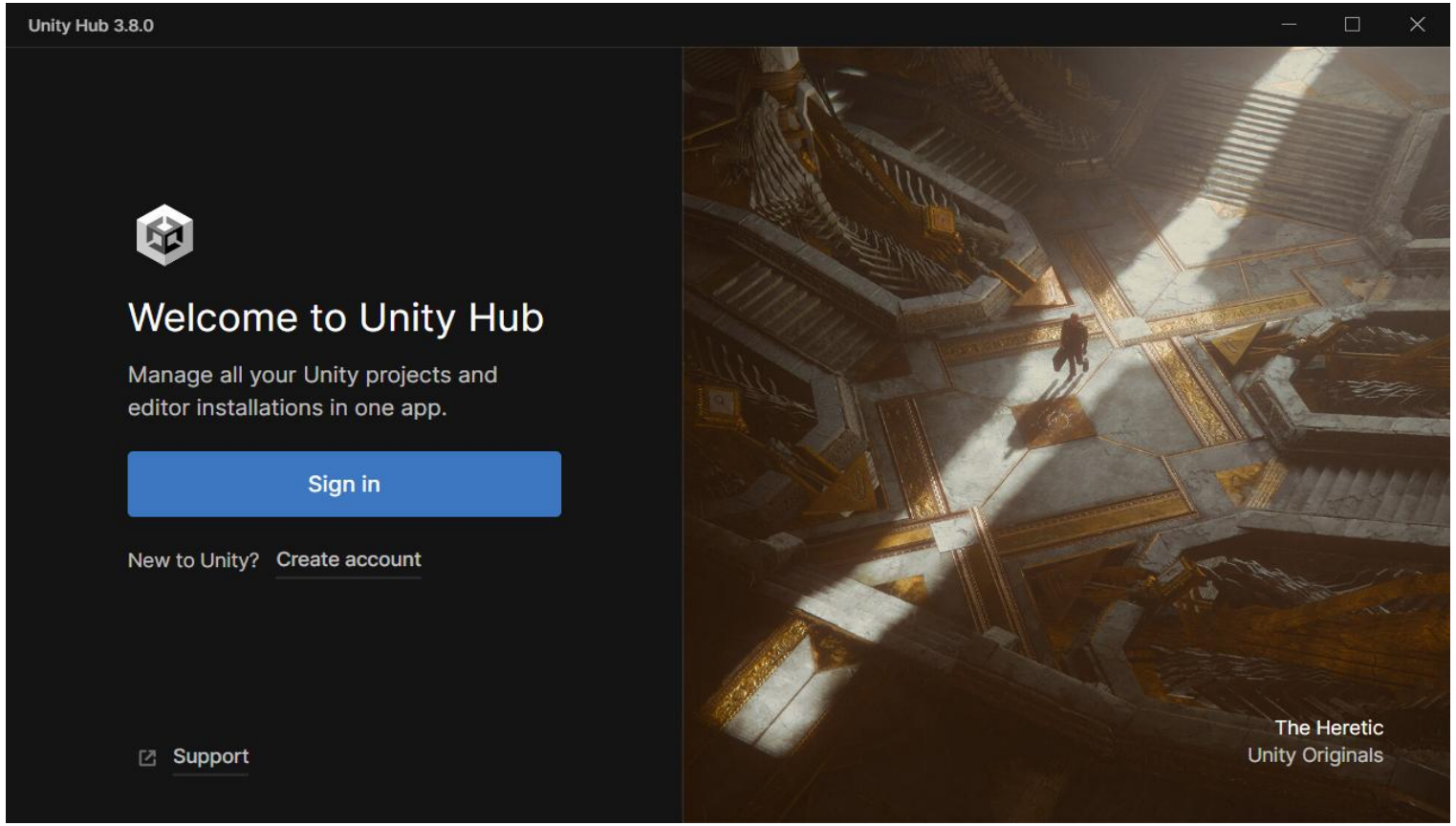
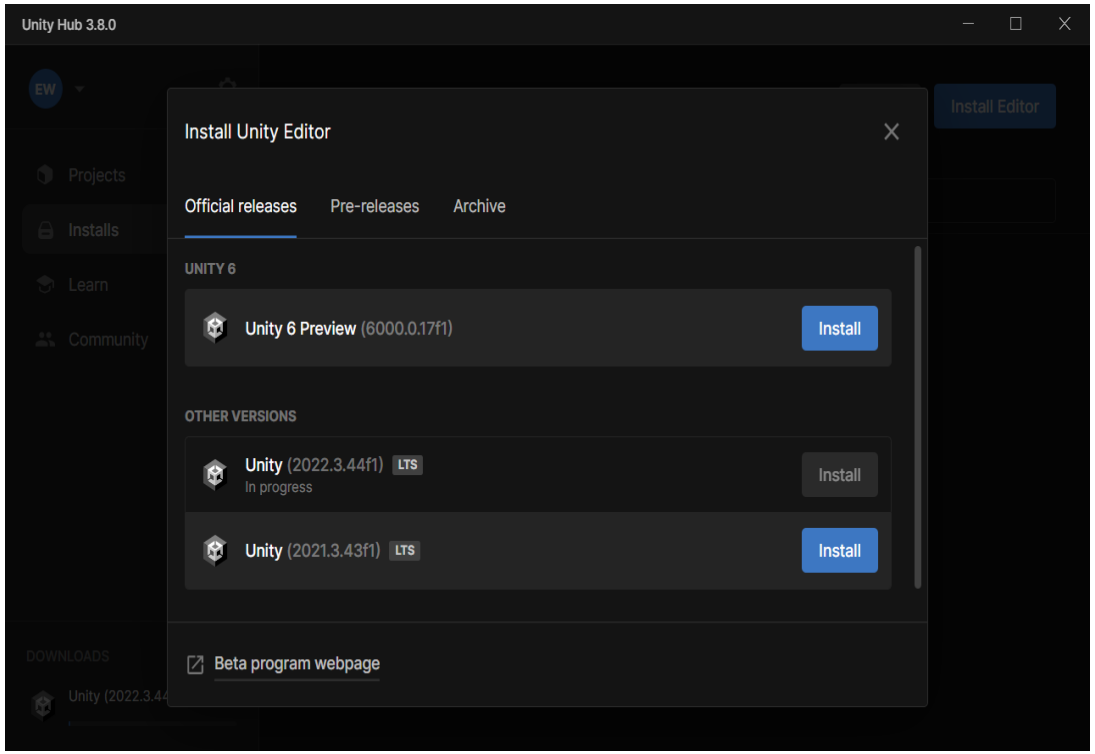
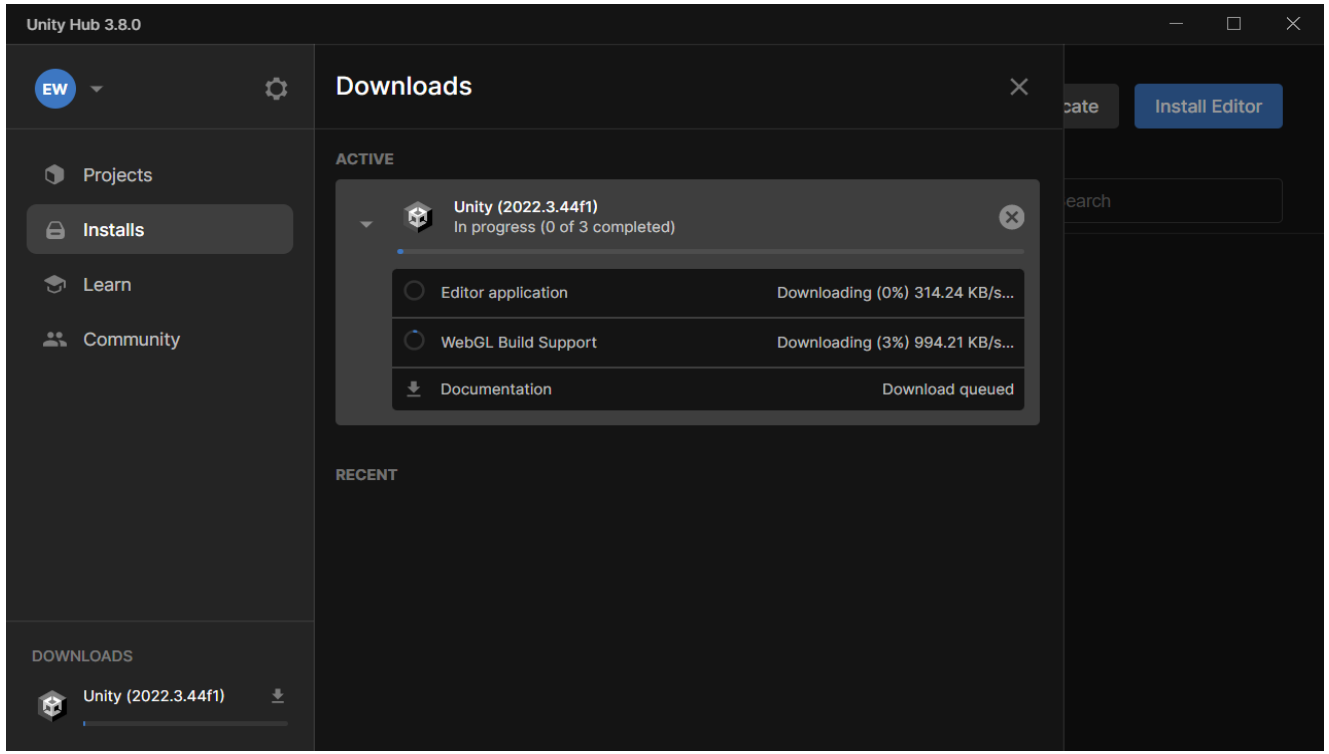


Figure 1.7

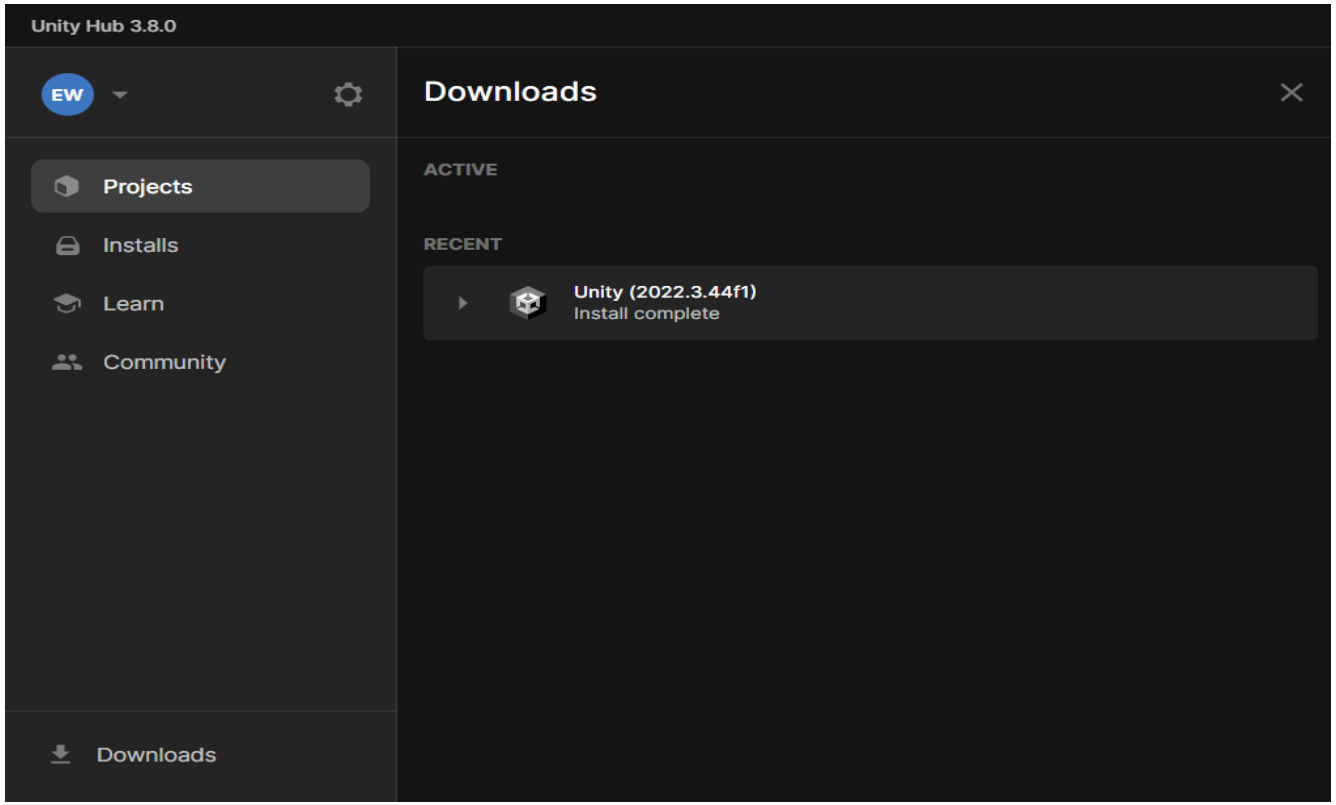
- Next to install unity editor





Figures 1.8

- And downloading completed.



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SETTING UP NEW VR PROJECT

1.Create a New Project:

- Open Unity Hub and click on the "New Project" button.
- Choose a project template (3D is usually sufficient for VR).
- Name the project and choose a location to save it, then click “Create Project ”as shown in **fig a**

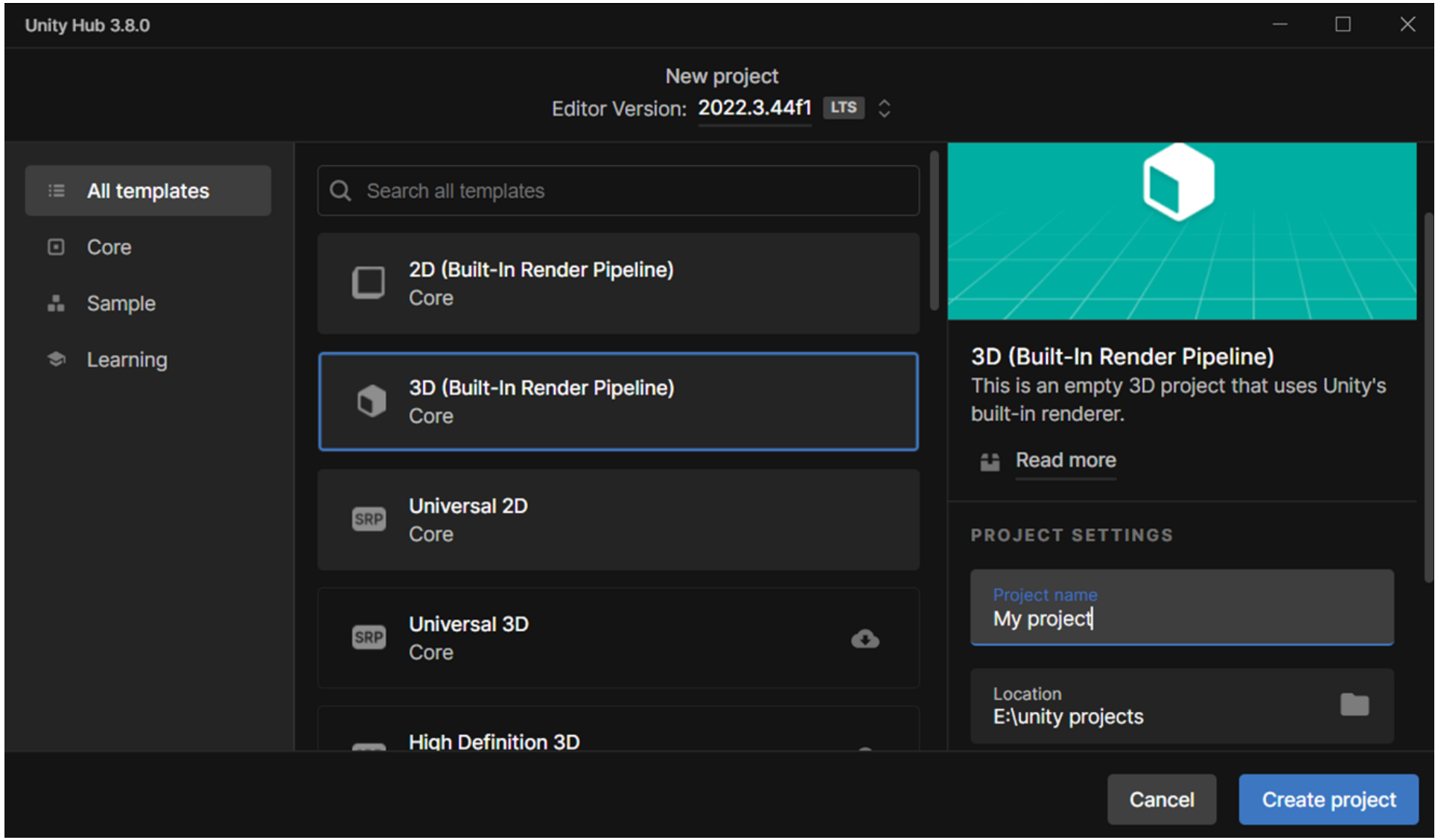

Unity Hub 3.8.0
New project
Editor Version: 2022.3.44f1 LTS
All templates
Core
Sample
Learning
Search all templates
2D (Built-In Render Pipeline)
Core
3D (Built-In Render Pipeline)
Core
Universal 2D
Core
Universal 3D
Core
High Definition 3D
3D (Built-In Render Pipeline)
This is an empty 3D project that uses Unity's built-in renderer.
Read more
PROJECT SETTINGS
Project name
My project
Location
E:\unity projects
Cancel
Create project

Fig. a

- **Install VR SDKs:**
- Open the Unity Editor and go to the Window > **Package Manager**.
- In the Package Manager, search for and install **open XR Plugin Management** shown in **Fig b.**
- After installation, go to Edit > Project Settings > XR Plug-in Management. In the XR Plug-in Management window, check the boxes for the VR platforms you want to target (e.g., Oculus, Open XR).

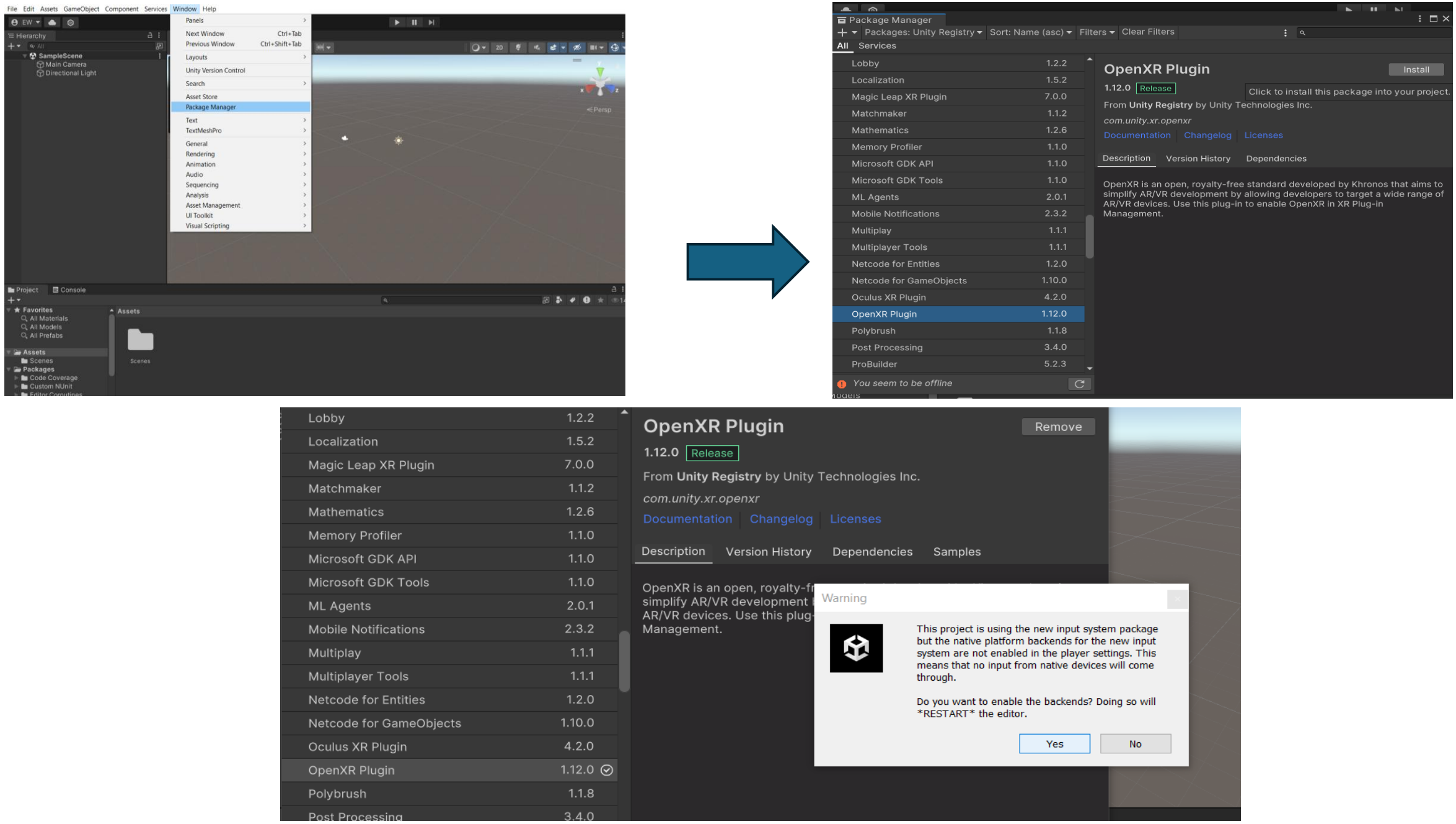

Window
Panels
Next Window Ctrl+Tab
Previous Window Ctrl+Shift+Tab
Layouts
Unity Version Control
Search
Asset Store
Package Manager
Text
TextMeshPro
General
Rendering
Animation
Audio
Sequencing
Analysis
Asset Management
UI Toolkit
Visual Scripting
Package Manager
Packages: Unity Registry
Sort: Name (asc)
Filters
Clear Filters
All
Services
Lobby 1.2.2
Localization 1.5.2
Magic Leap XR Plugin 7.0.0
Matchmaker 1.1.2
Mathematics 1.2.6
Memory Profiler 1.1.0
Microsoft GDK API 1.1.0
Microsoft GDK Tools 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 1.2.0
Netcode for GameObjects 1.10.0
Oculus XR Plugin 4.2.0
OpenXR Plugin 1.12.0
Polybrush 1.1.8
Post Processing 3.4.0
ProBuilder 5.2.3
You seem to be offline
OpenXR Plugin
Install
1.12.0 Release
Click to install this package into your project.
From Unity Registry by Unity Technologies Inc.
com.unity.xr.openxr
Documentation Changelog Licenses
Description Version History Dependencies
OpenXR is an open, royalty-free standard developed by Khronos that aims to simplify AR/VR development by allowing developers to target a wide range of AR/VR devices. Use this plug-in to enable OpenXR in XR Plug-in Management.
Remove
Samples
Warning
This project is using the new input system package but the native platform backends for the new input system are not enabled in the player settings. This means that no input from native devices will come through.
Do you want to enable the backends? Doing so will *RESTART* the editor.
Yes
No

Fig. b

3. Configure VR Settings

- Enable VR Support: In Edit > Project Settings > XR Plug-in Management, make sure the appropriate VR plugin is selected for your target platform.
- Adjust other settings in Edit > Project Settings > Player, particularly under XR Settings.

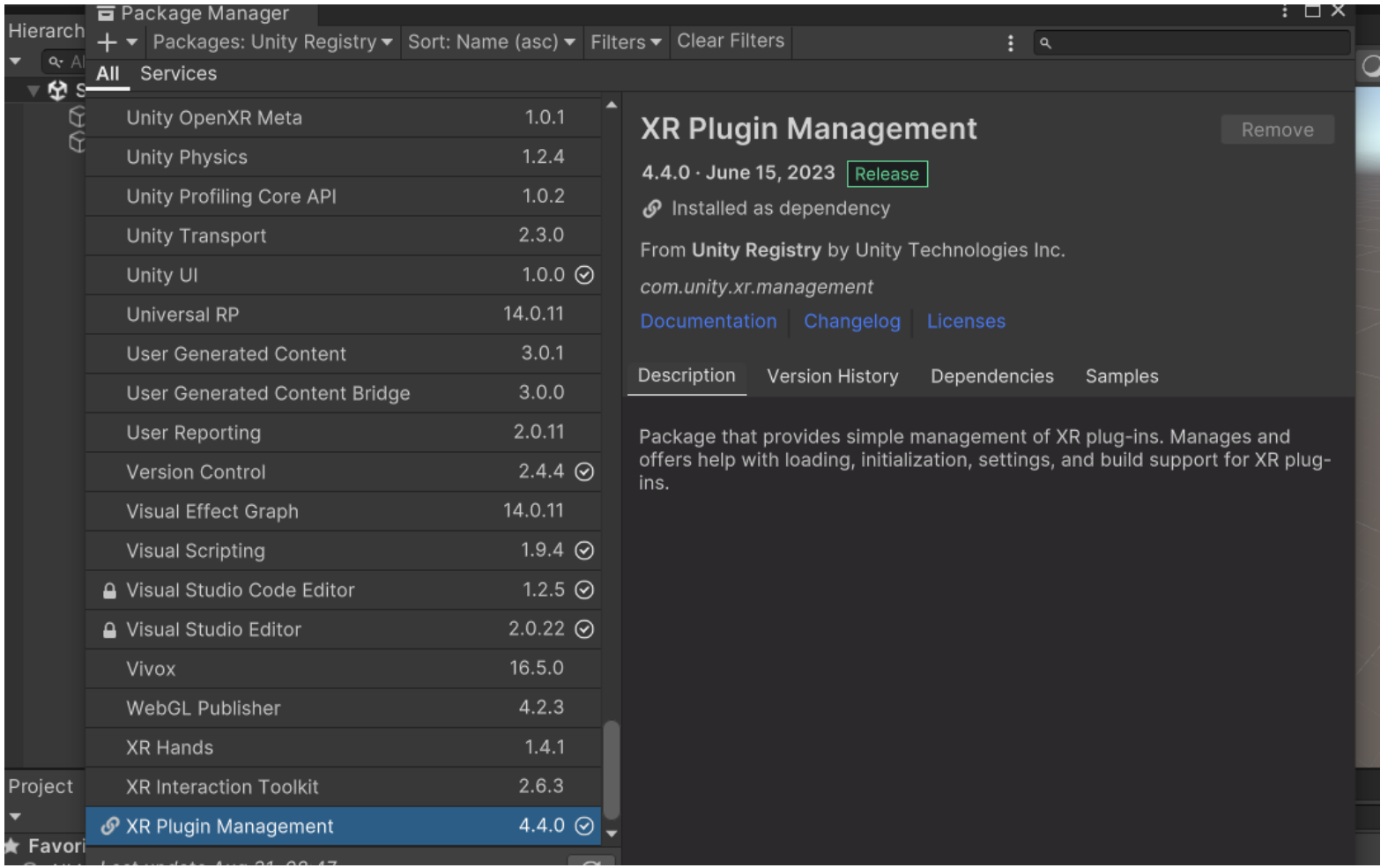
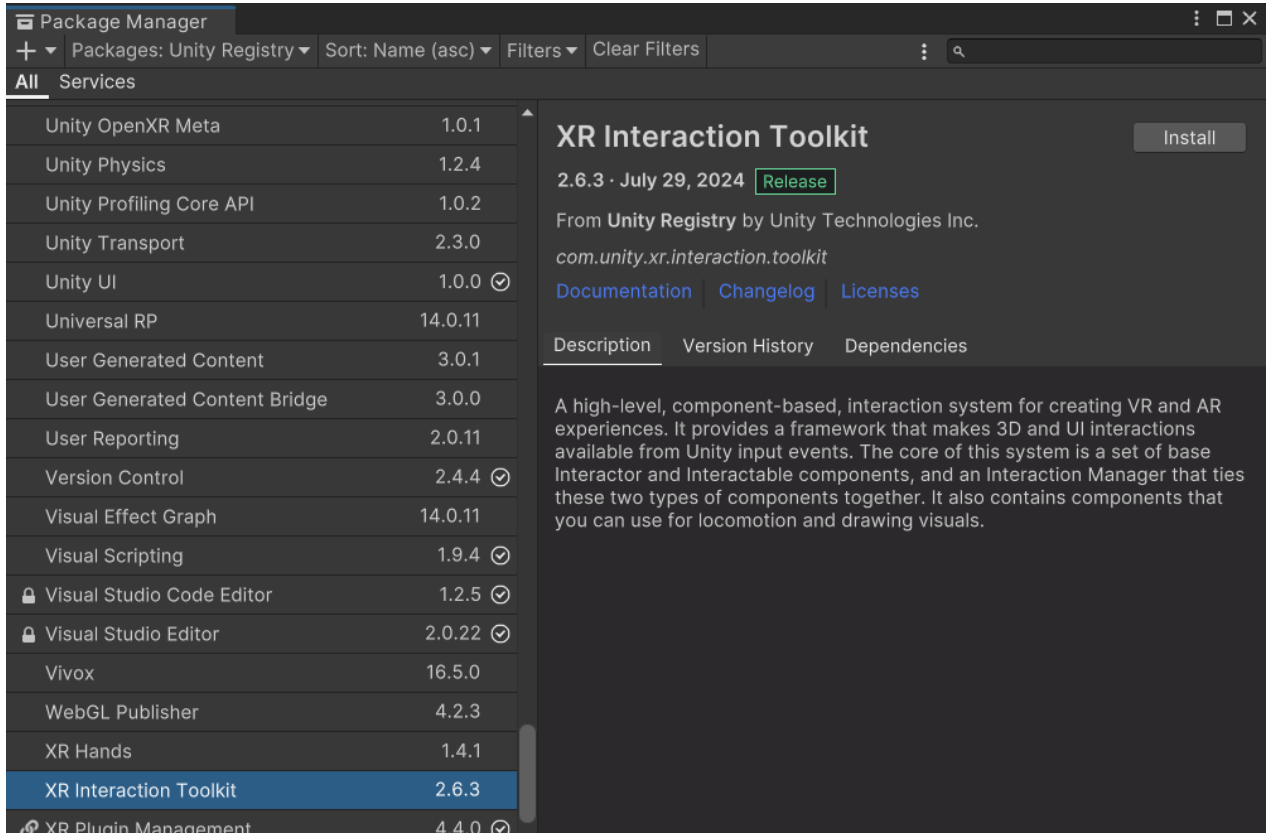

Package Manager
Packages: Unity Registry
Sort: Name (asc)
Filters
Clear Filters
All
Services
Unity OpenXR Meta 1.0.1
Unity Physics 1.2.4
Unity Profiling Core API 1.0.2
Unity Transport 2.3.0
Unity UI 1.0.0
Universal RP 14.0.11
User Generated Content 3.0.1
User Generated Content Bridge 3.0.0
User Reporting 2.0.11
Version Control 2.4.4
Visual Effect Graph 14.0.11
Visual Scripting 1.9.4
Visual Studio Code Editor 1.2.5
Visual Studio Editor 2.0.22
Vivox 16.5.0
WebGL Publisher 4.2.3
XR Hands 1.4.1
XR Interaction Toolkit 2.6.3
XR Plugin Management 4.4.0
XR Plugin Management
Remove
4.4.0 · June 15, 2023
Release
Installed as dependency
From Unity Registry by Unity Technologies Inc.
com.unity.xr.management
Documentation
Changelog
Licenses
Description
Version History
Dependencies
Samples
Package that provides simple management of XR plug-ins. Manages and offers help with loading, initialization, settings, and build support for XR plug-ins.
Project

Fig. c

4. Set Up VR Controllers and Interactions

- **Add VR Interaction SDK:**
  - Use Unity's XR Interaction Toolkit or Oculus Integration shown in **fig d**
  - Import the necessary package from the Unity Asset Store
  - **Set Up Camera and Controllers:**
  - Replace the default Main Camera with an XR Rig (provided by the XR Interaction Toolkit or the SDK one chose)
  - Right click in the hierarchy panel >XR>XR origin shown in **fig. e**


Package Manager
Packages: Unity Registry
Sort: Name (asc)
Filters
Clear Filters
All
Services
Unity OpenXR Meta 1.0.1
Unity Physics 1.2.4
Unity Profiling Core API 1.0.2
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User Reporting 2.0.11
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Visual Effect Graph 14.0.11
Visual Scripting 1.9.4
Visual Studio Code Editor 1.2.5
Visual Studio Editor 2.0.22
Vivox 16.5.0
WebGL Publisher 4.2.3
XR Hands 1.4.1
XR Interaction Toolkit 2.6.3
XR Interaction Toolkit
Install
2.6.3 · July 29, 2024
Release
From Unity Registry by Unity Technologies Inc.
com.unity.xr.interaction.toolkit
Documentation
Changelog
Licenses
Description
Version History
Dependencies
A high-level, component-based, interaction system for creating VR and AR experiences. It provides a framework that makes 3D and UI interactions available from Unity input events. The core of this system is a set of base Interactor and Interactable components, and an Interaction Manager that ties these two types of components together. It also contains components that you can use for locomotion and drawing visuals.

Fig. d

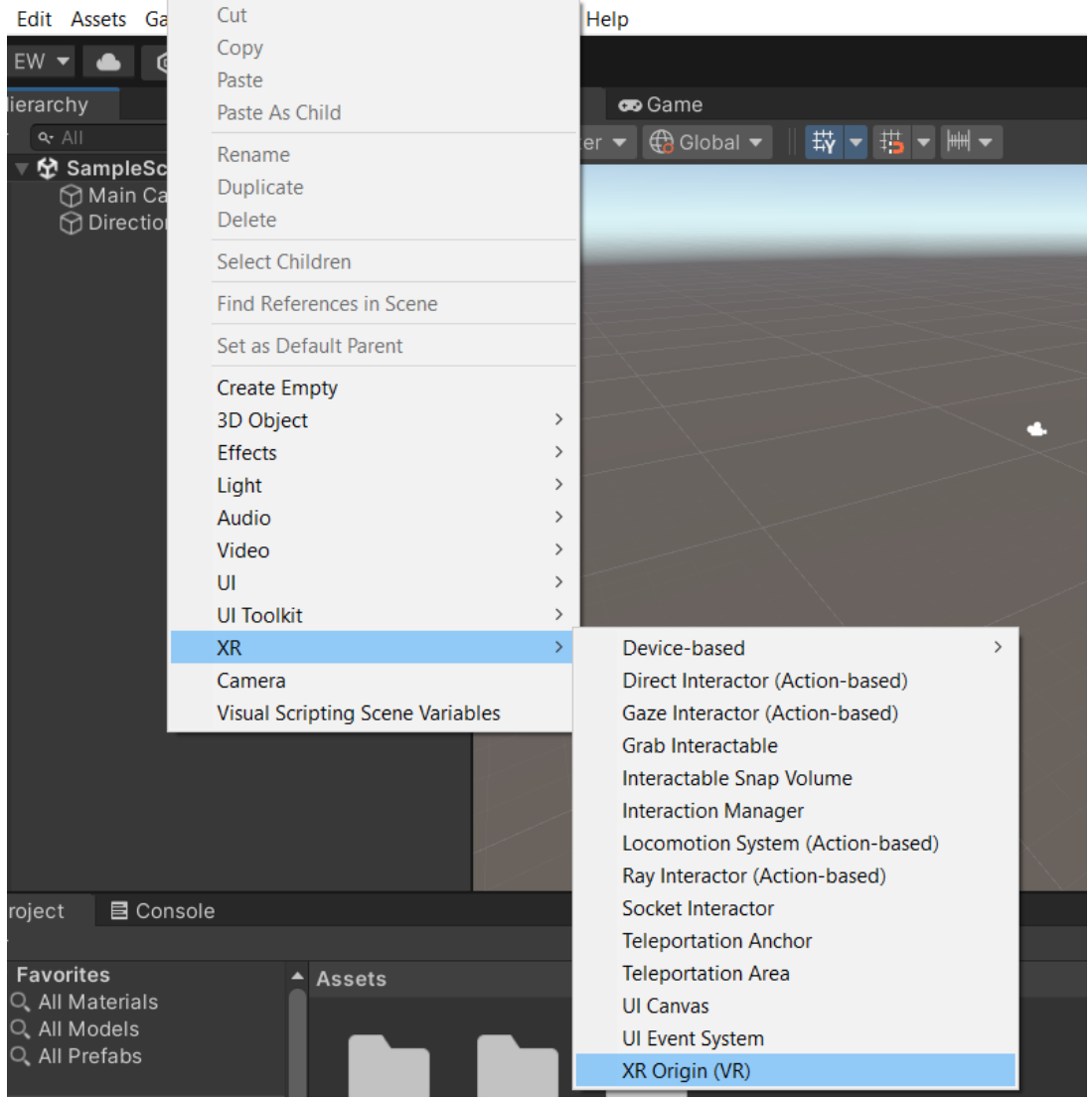
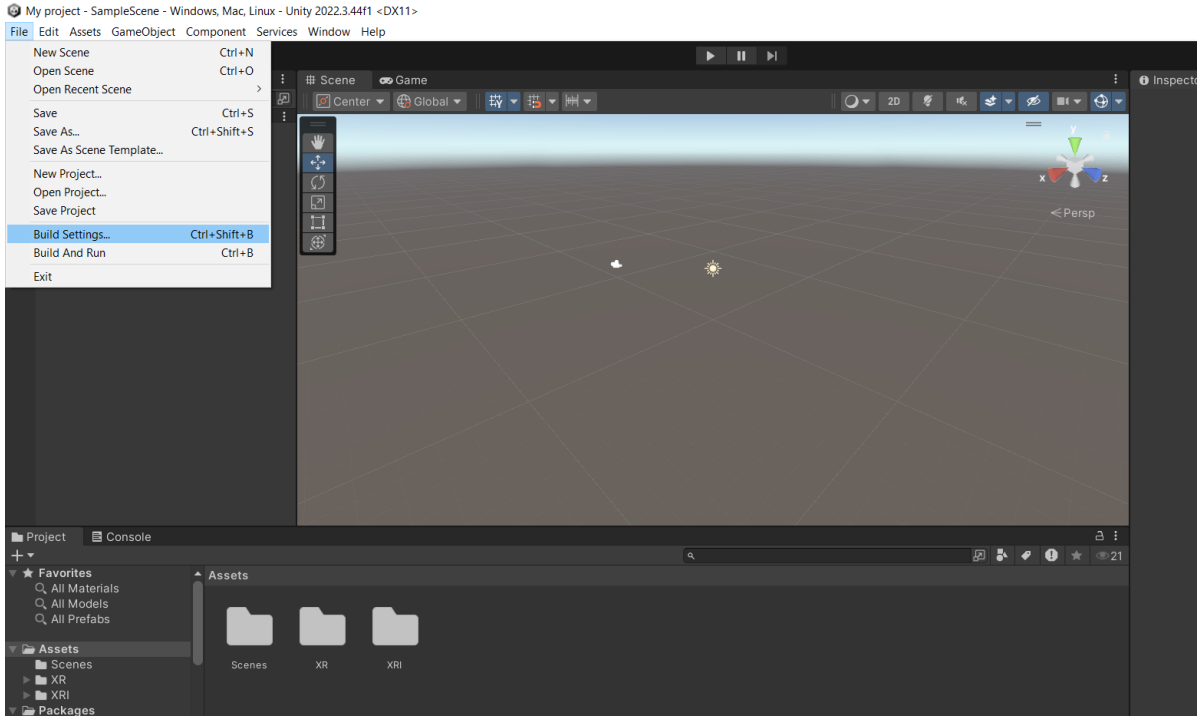
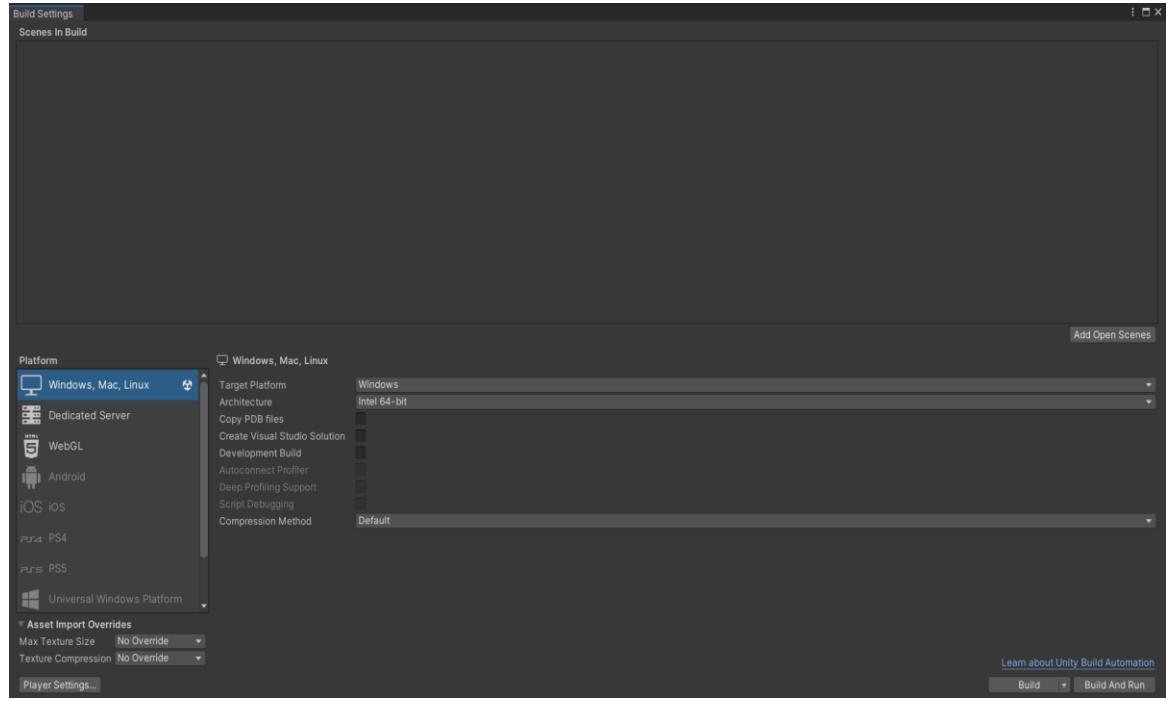

Edit
Assets
Help
Cut
Copy
Paste
Paste As Child
Rename
Duplicate
Delete
Select Children
Find References in Scene
Set as Default Parent
Create Empty
3D Object
Effects
Light
Audio
Video
UI
UI Toolkit
XR
Camera
Visual Scripting Scene Variables
Device-based
Direct Interactor (Action-based)
Gaze Interactor (Action-based)
Grab Interactable
Interactable Snap Volume
Interaction Manager
Locomotion System (Action-based)
Ray Interactor (Action-based)
Socket Interactor
Teleportation Anchor
Teleportation Area
UI Canvas
UI Event System
XR Origin (VR)
Hierarchy
Game
Global
Console
Favorites
All Materials
All Models
All Prefabs
Assets

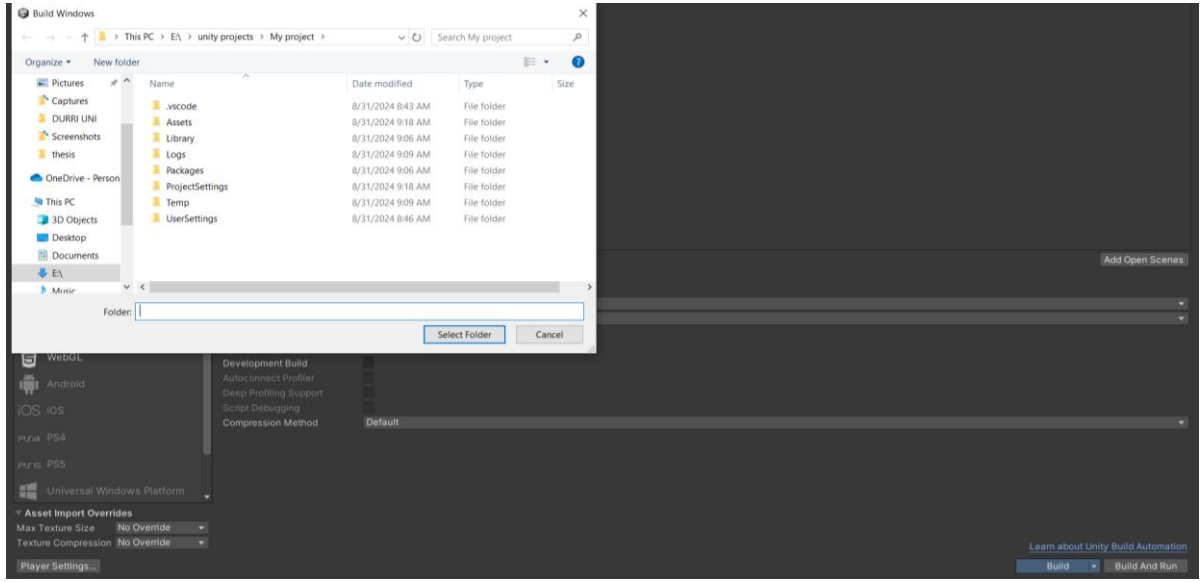
Fig. e

4. Build Settings:

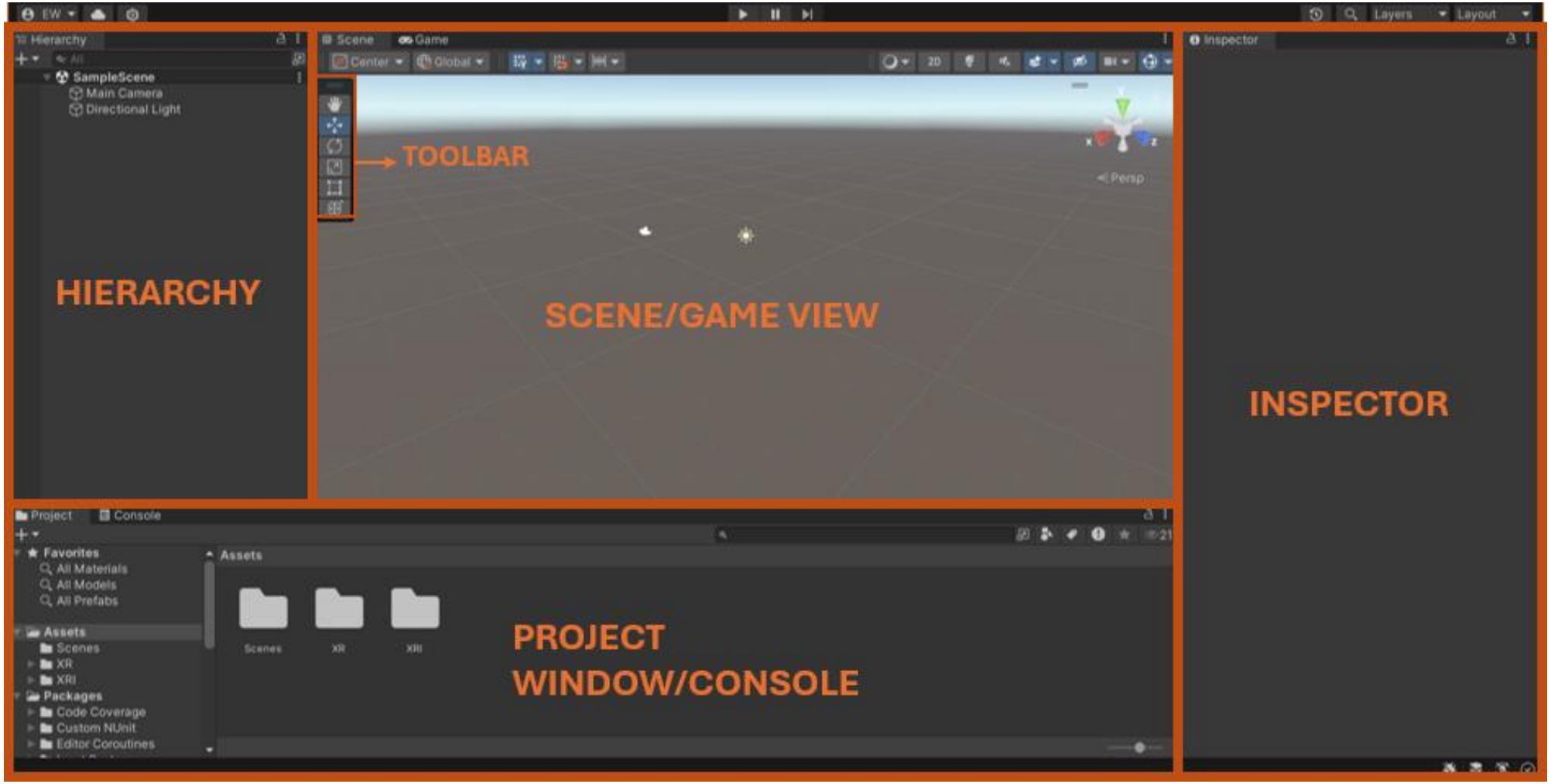
- Go to File > Build Settings and choose target platform (PC, Android for standalone VR headsets, etc)shown in **fig f.**
- Ensure the required scenes are added to the build.
- Configure build settings like resolution and quality to match your target VR hardware.


My project - SampleScene - Windows, Mac, Linux - Unity 2022.3.44f1 <DX11>
File Edit Assets GameObject Component Services Window Help
New Scene Ctrl+N
Open Scene Ctrl+O
Open Recent Scene
Save Ctrl+S
Save As... Ctrl+Shift+S
Save As Scene Template...
New Project...
Open Project...
Save Project
Build Settings... Ctrl+Shift+B
Build And Run Ctrl+B
Exit
Scene
Game
Persp
Project
Console
Favorites
All Materials
All Models
All Prefabs
Assets
Scenes
XR
XRI
Packages


Build Settings
Scenes In Build
Add Open Scenes
Platform
Windows, Mac, Linux
Dedicated Server
WebGL
Android
iOS
PS4
PS5
Universal Windows Platform
Target Platform Windows
Architecture Intel 64-bit
Copy PDB files
Create Visual Studio Solution
Development Build
Autoconnect Profiler
Deep Profiling Support
Script Debugging
Compression Method Default
Asset Import Overrides
Max Texture Size No Override
Texture Compression No Override
Player Settings...
Learn about Unity Build Automation
Build
Build And Run


Build Windows
This PC E:\ unity projects My project
Search My project
Organize New folder
Name Date modified Type Size
.vscode 8/31/2024 8:43 AM File folder
Assets 8/31/2024 9:18 AM File folder
Library 8/31/2024 9:06 AM File folder
Logs 8/31/2024 9:09 AM File folder
Packages 8/31/2024 9:06 AM File folder
ProjectSettings 8/31/2024 9:18 AM File folder
Temp 8/31/2024 9:09 AM File folder
UserSettings 8/31/2024 8:46 AM File folder
Folder:
Select Folder
Cancel
Add Open Scenes
Development Build
Autoconnect Profiler
Deep Profiling Support
Script Debugging
Compression Method Default
Asset Import Overrides
Max Texture Size No Override
Texture Compression No Override
Player Settings...
Learn about Unity Build Automation
Build
Build And Run

UNITY'S INTERFACE



KEY COMPONENTS OF THE UNITY INTERFACE:

1. **Scene View:**

- Where the user create and arrange game objects.
- Visually placed all assets (cameras, models, and all other pieces and objects that make up the game)

2. **Game View :**

- Preview how the scene will look in the actual game.

3. **Hierarchy Window:**

- List of all current Game Objects being used in the application

4. **Project Window:**

- Displays all the assets (scripts, models, textures) available in the project.
- Assets can be dragged into hierarchy window.

5. **Inspector Window:**

- Displays properties and settings for the selected object.

6. **Console Window:**

- Logs messages, warnings, and errors during development.

Navigation Tips:

- **Pan/Zoom/Rotate:**
  - Use mouse or toolbar to navigate within the Scene View.
- **Shortcuts:**
  - ‘W, E, R’ for Move, Rotate, and Scale tools.

BUILDING SCENE IN UNITY 3D

➢Introduction to Scene Building:

- A scene in Unity is a collection of Game Objects (like environments, characters, and props) arranged in a 3D space.
- Scenes are the foundational elements of any Unity project, representing different levels or environments.

STEPS TO BUILD A SCENE:

Step 1: Create a New Scene Go to File > New Scene or use the shortcut Ctrl + N.

- Choose a template if needed (e.g., 3D, 2D, etc.).

Step 2: Add Game Objects Primitive Shapes:

- Add basic shapes like cubes, spheres, and planes (Game Object > 3D Object > Cube)
- .**Models and Assets:** Import and place 3D models into the scene.
- **Terrain:** Use Unity's Terrain tool to create landscapes and environments.

Step 3: Organize with the Hierarchy Structure objects in the Hierarchy Window for better management.

- Use parent-child relationships to group objects.

Step 4: Adjust Object Properties .Use the Inspector Window to change the position, rotation, and scale of objects.

- Apply materials, shaders, and textures to enhance visual appearance.

Step 5: (Lighting Setup**)** Add light sources (Directional Light, Point Light, etc.) to illuminate the scene.

Step 6: (Camera Setup**)** Adjust the main camera to frame the scene from the desired perspective.

• Use multiple cameras for different views if necessary.

Step 7: Test the Scene Press the Play button to enter Game Mode and see the scene in action.

• Use the Game View to check how the scene will look to the player.

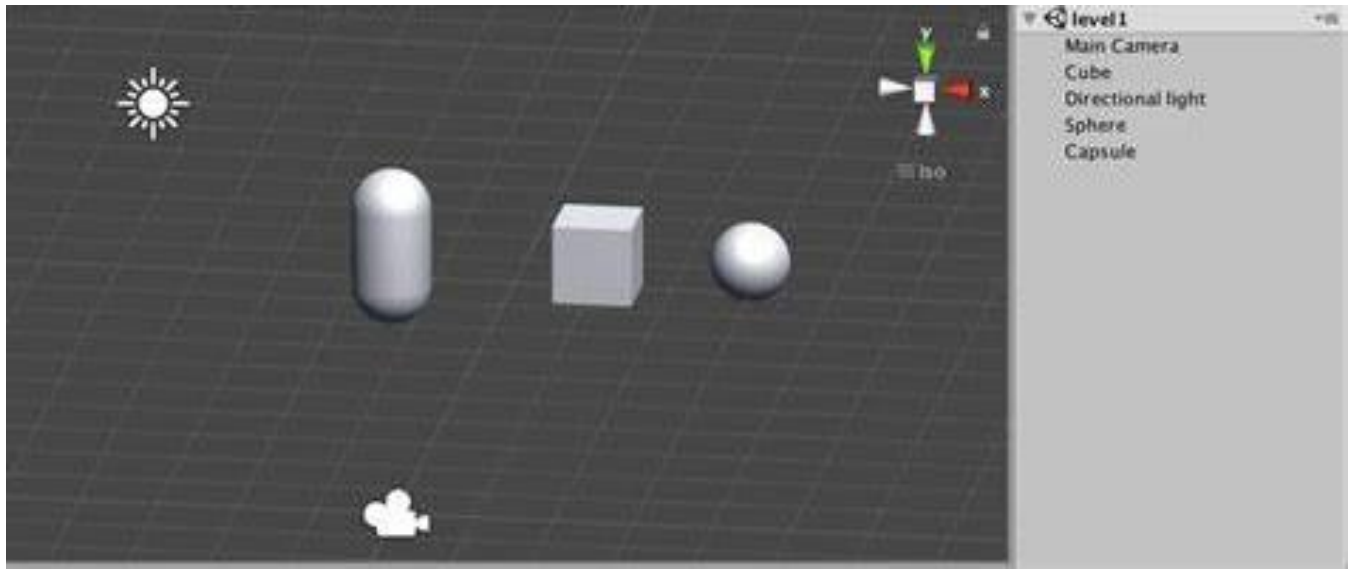
Finalizing the Scene:

- **Save the Scene:** Go to File > Save Scene or Ctrl + S.
- **Scene Management:** Use Unity's Scene Manager to load, unload, and manage multiple scenes.

GAME OBJECTS IN UNITY 3D

A **Game Object** is the fundamental building block in Unity.

It can represent anything in scene—such as characters, props, environments, cameras, lights. etc



➢ **Transform Component:**

Every Game Object has a Transform component.

It defines the Game Object's Position, Rotation, and Scale in the scene as shown in fig A

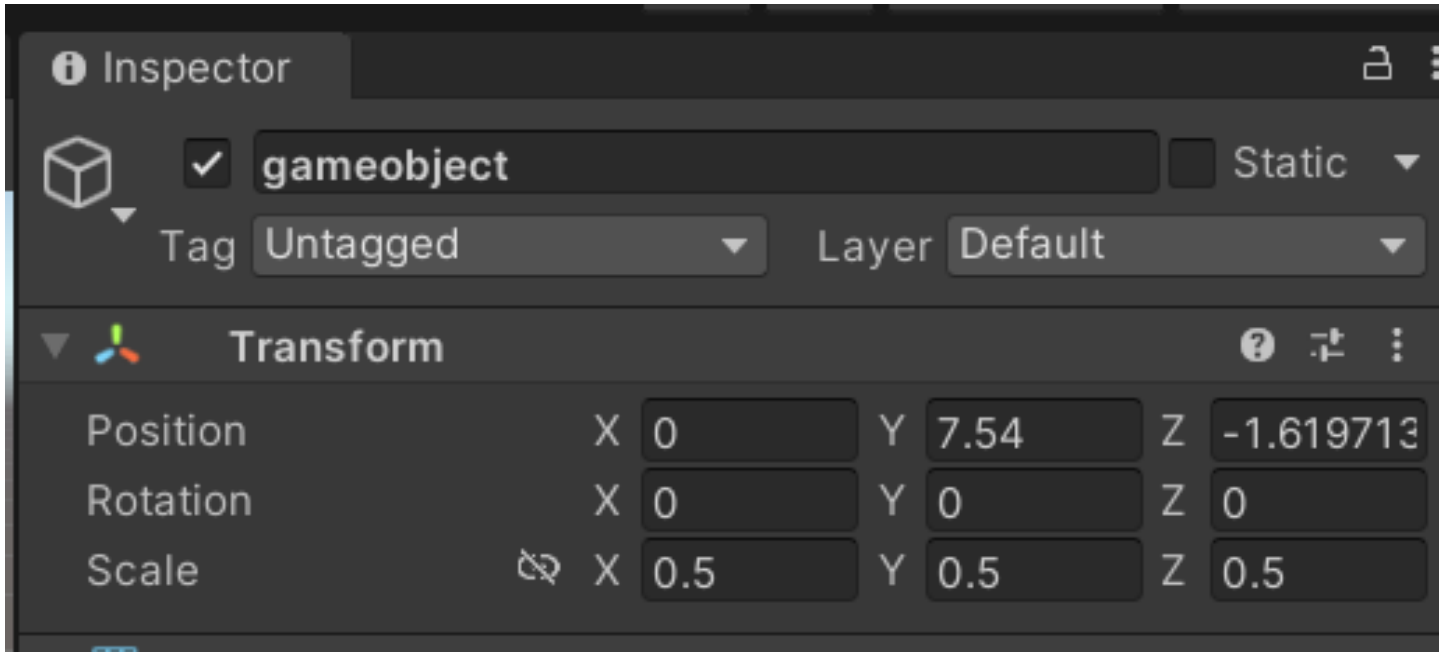


Fig. A

➢**Collider:**

Defines the physical shape of the Game Object for collisions.

Types include Box Collider, Sphere Collider(shown in fig B), Mesh Collider, essential for interaction detection (e.g., hitting or triggering)

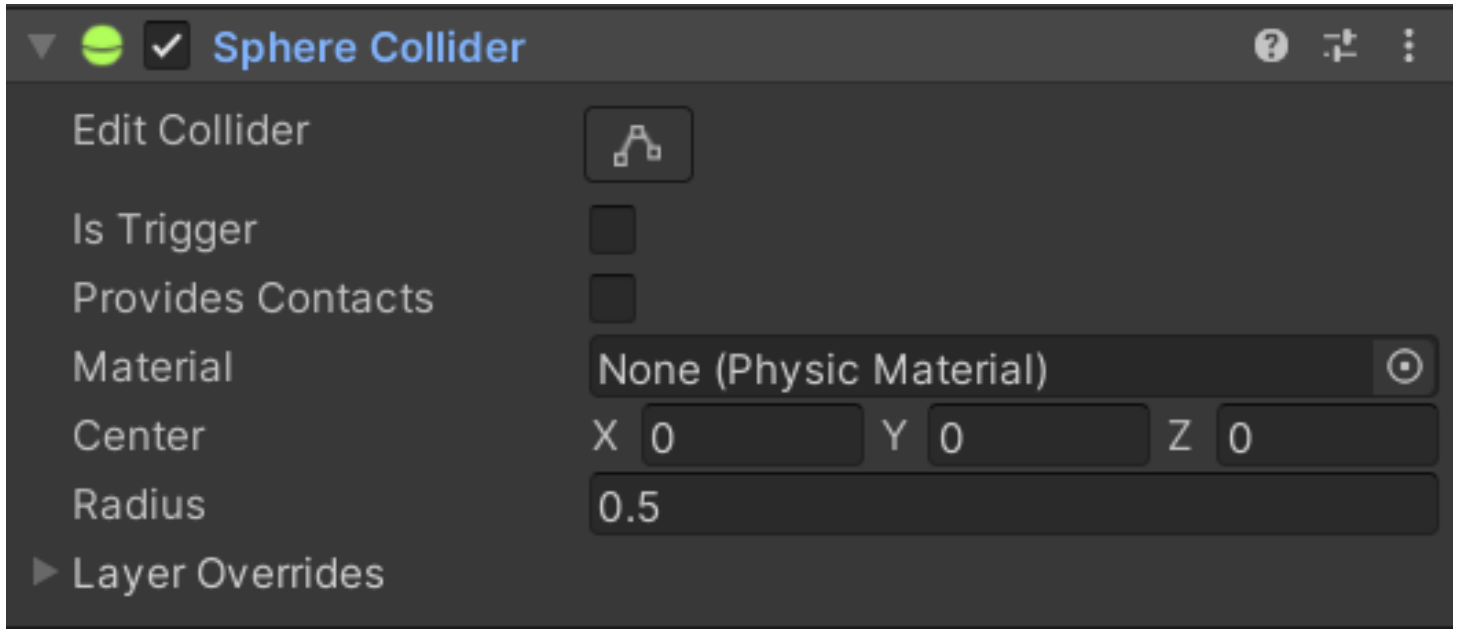
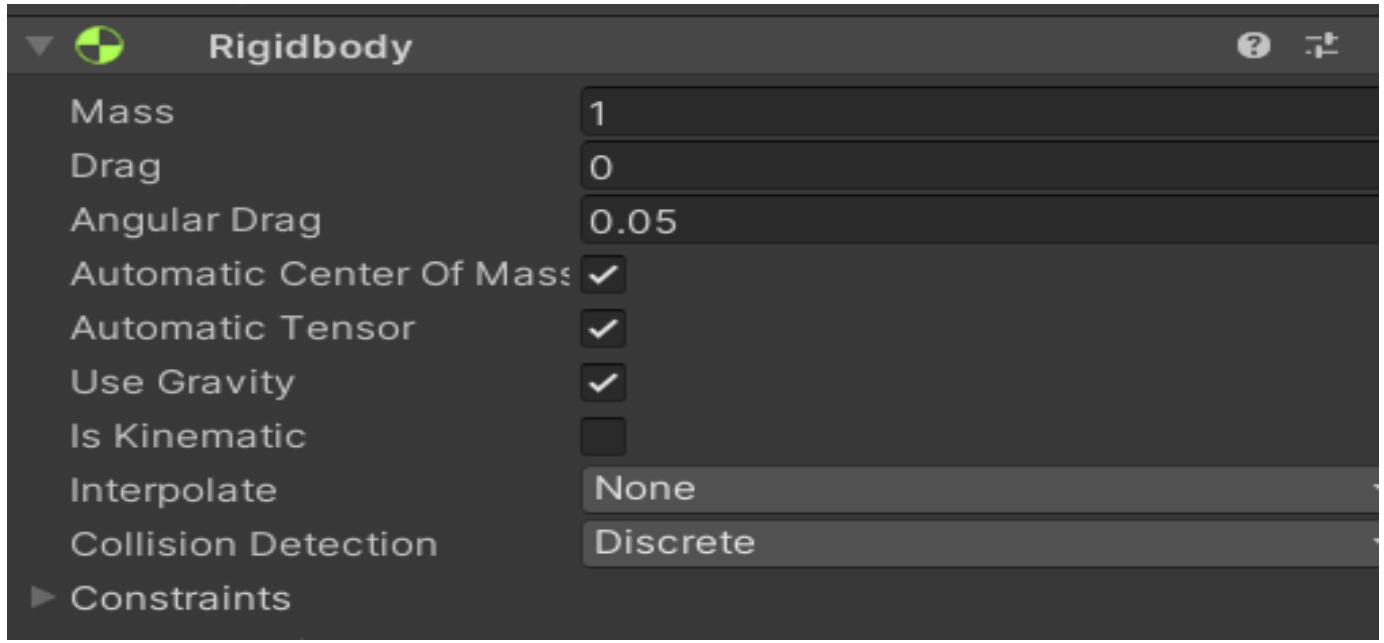


Fig. B

➢Rigid Body:

- Adds physics properties to the Game Object.
- Allows the object to be affected by gravity and forces.
- Controls dynamics like velocity and collision responses.



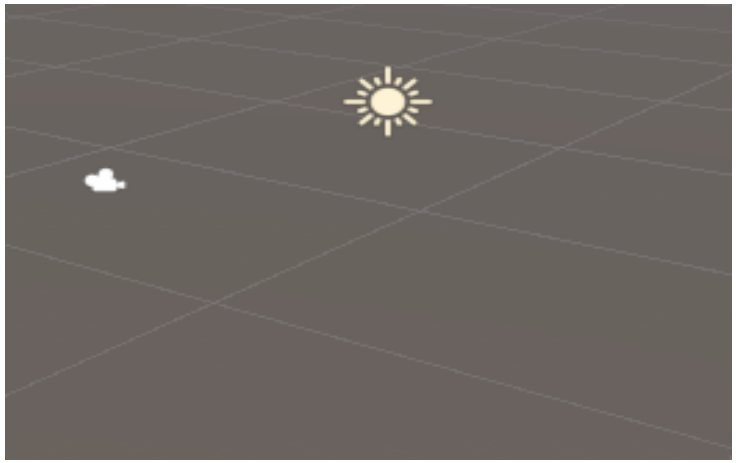
➢**Script Component:**

- Custom scripts (written in C#) that control the behavior of the Game Object.
- Attach C# scripts via the Inspector to enable interactivity, logic.

➢**Light:**

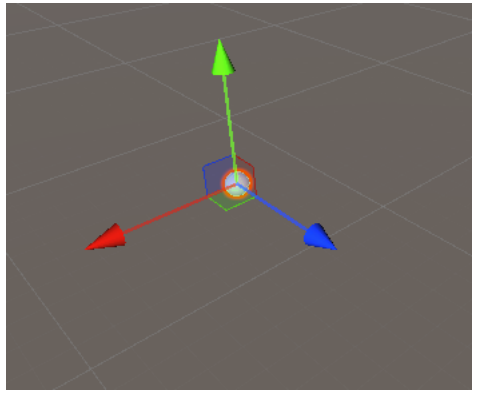
- Emits light in the scene.
- Different types include Directional Light(shown in Fig C), Point Light, Spotlight, etc.

FIG C

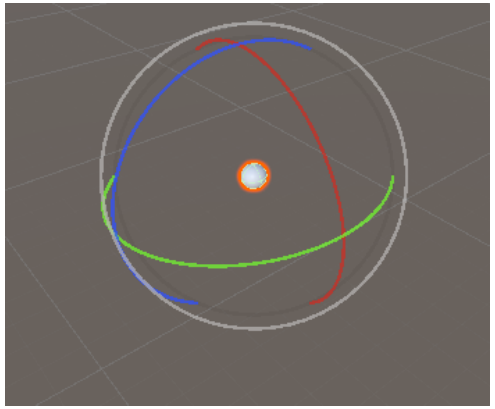


POSITIONING/SCALING OBJECTS

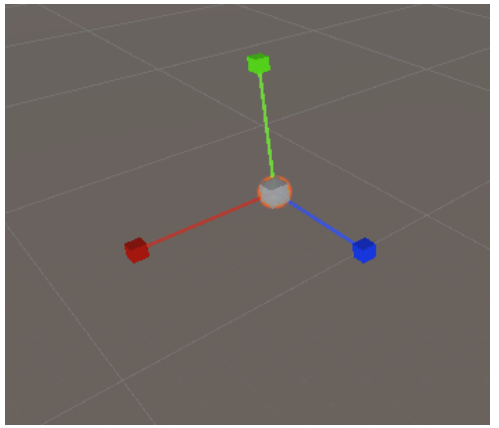
- Click on object and choose transform



Translate (W)



ROTATE(E)



SCALE(R)

MANIPULATING OBJECTS AND CAMERA

1. **Panning** refers specifically to moving the view around in the Scene.

- View without changing the camera's position or orientation in the game.
- using the **Middle Mouse Button (MMB)** .

2. **The View Tool** (Hand Tool) is the tool in Unity that use to pan.

- Press Q to activate the View Tool.

3. Camera Setup:

- To control what the camera sees, select the camera in the **Hierarchy** and use the **Transform** tool to position it as shown above fig. D

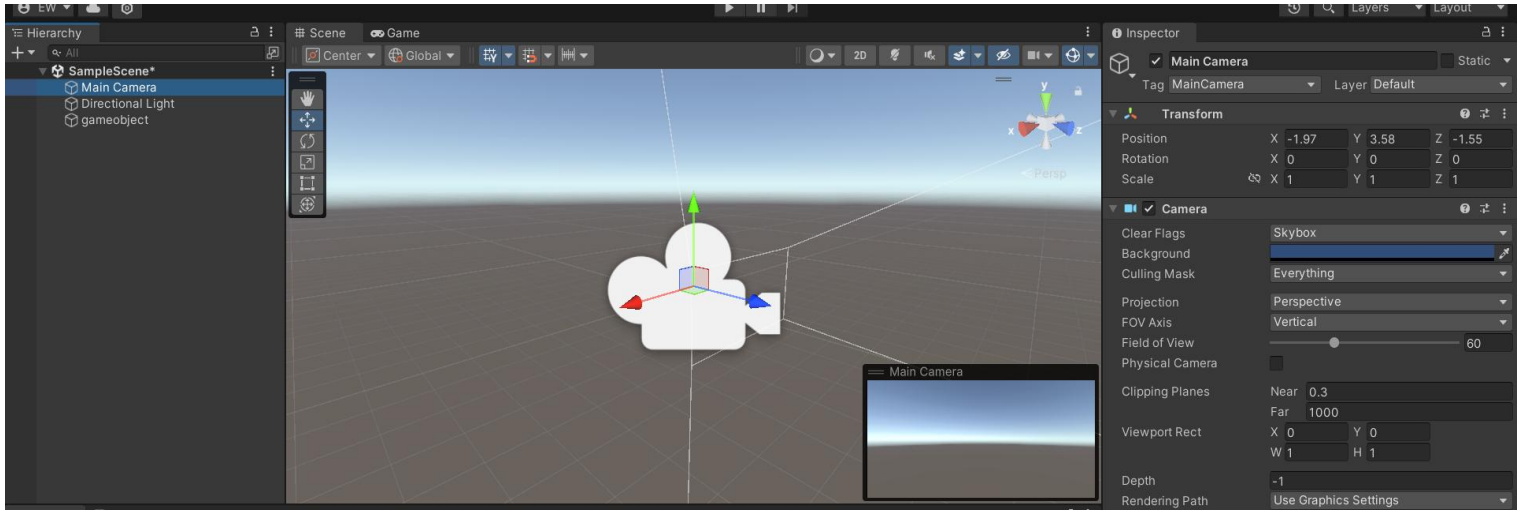


Fig. D

4. Scene View Navigation:

- **Right Mouse Button**: Hold and drag to rotate the view.
- **WASD Keys**: Move the camera forward, backward, left, or right in the scene.
- **Mouse Scroll Wheel**: Zoom in and out.
- **Q/E Keys**: Move the camera up or down.

UNITY COORDINATE FRAME

- In Unity, the concept of coordinate frames (or coordinate systems) is essential for understanding **how objects** are **positioned**, **oriented**, and **moved** within the 3D space.
- Left hand coordinate system as shown in above fig. E
- Select axes to translate object.

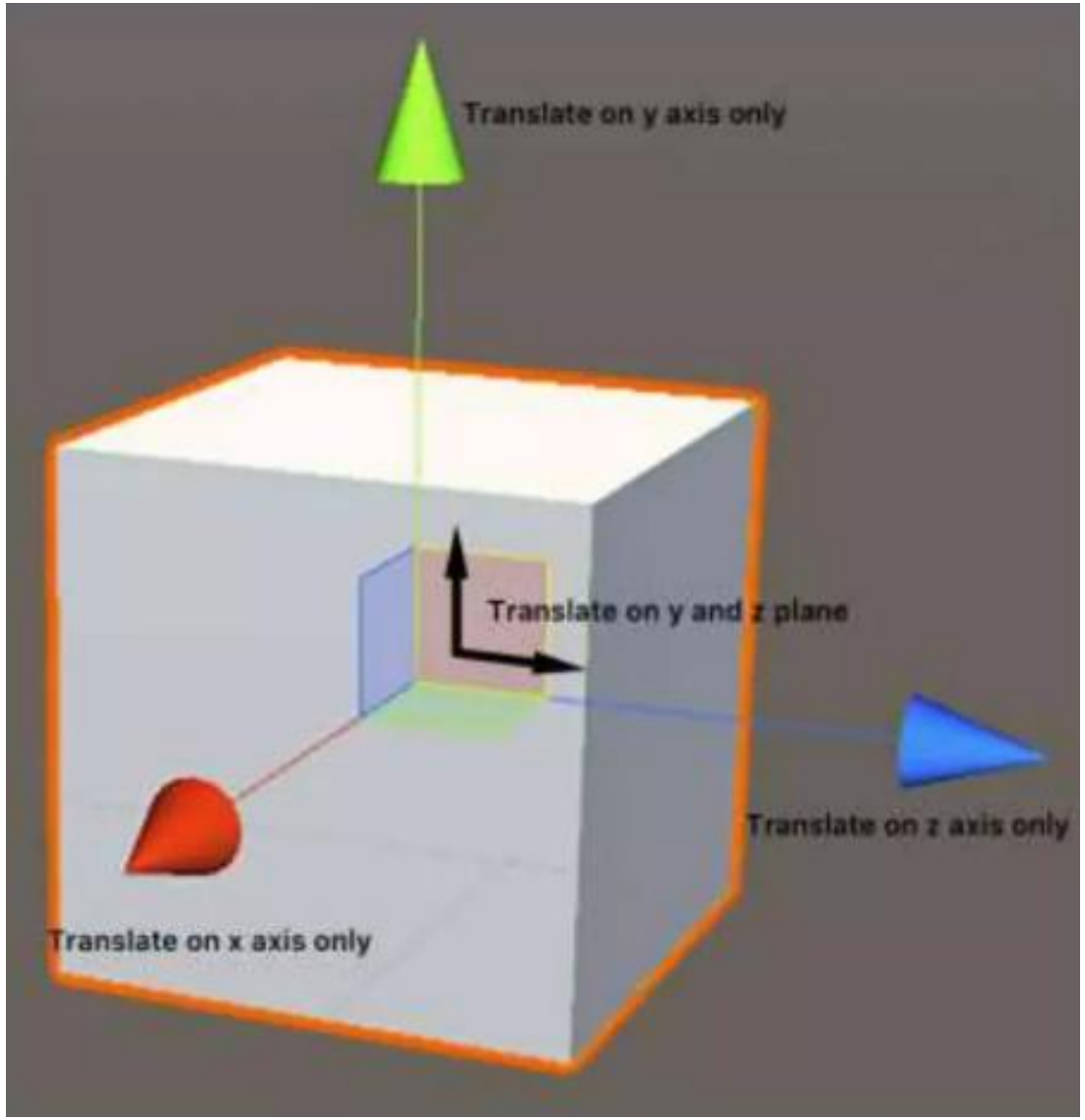
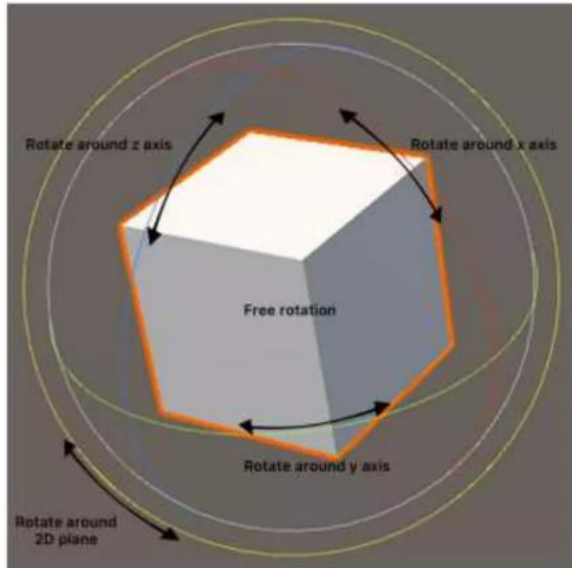
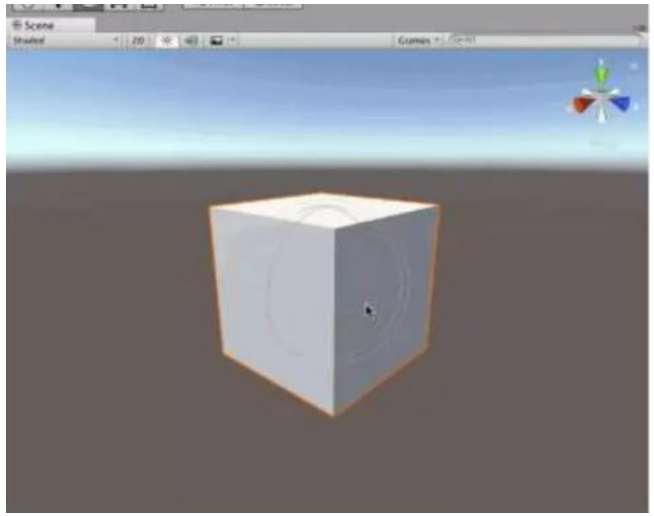


Fig. E

ROTATION ABOUT AXIS

- Use rotation tool, select rotation line

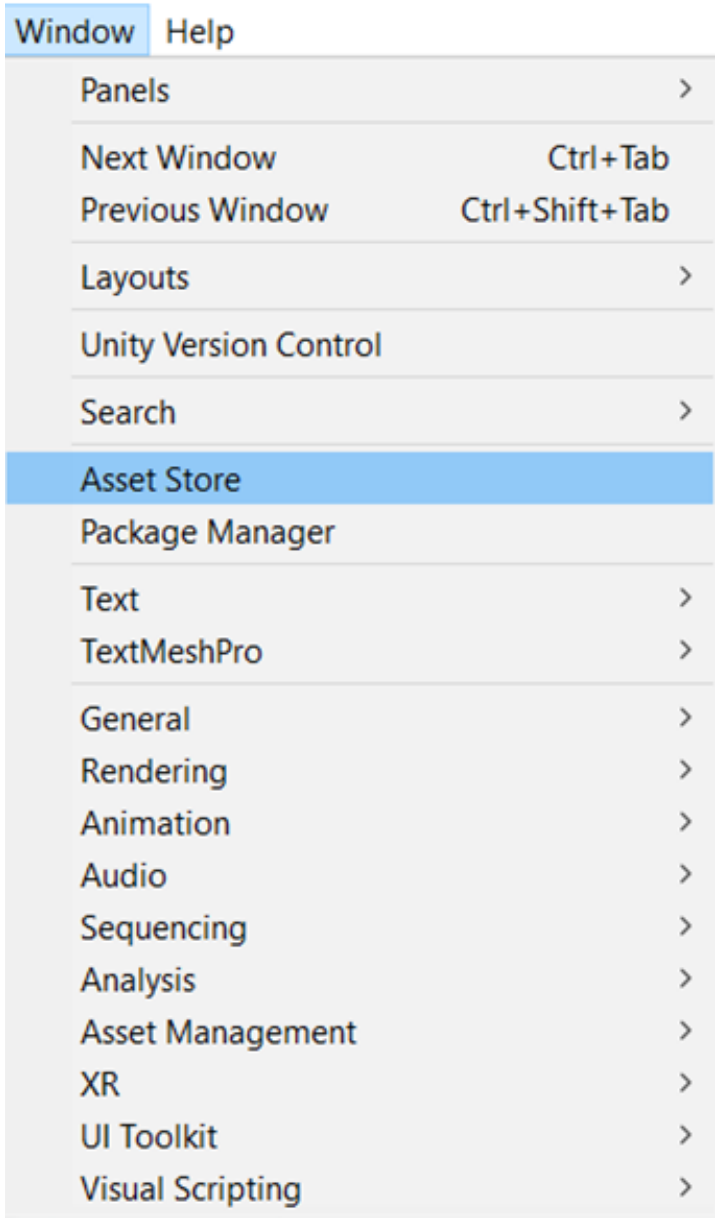




UNITY ASSETS STORE

The Unity Asset Store is an online marketplace that offers a wide range of assets for Unity developers, including

- 3D models
- Textures
- Animations
- scripts, sound effects, tools, and more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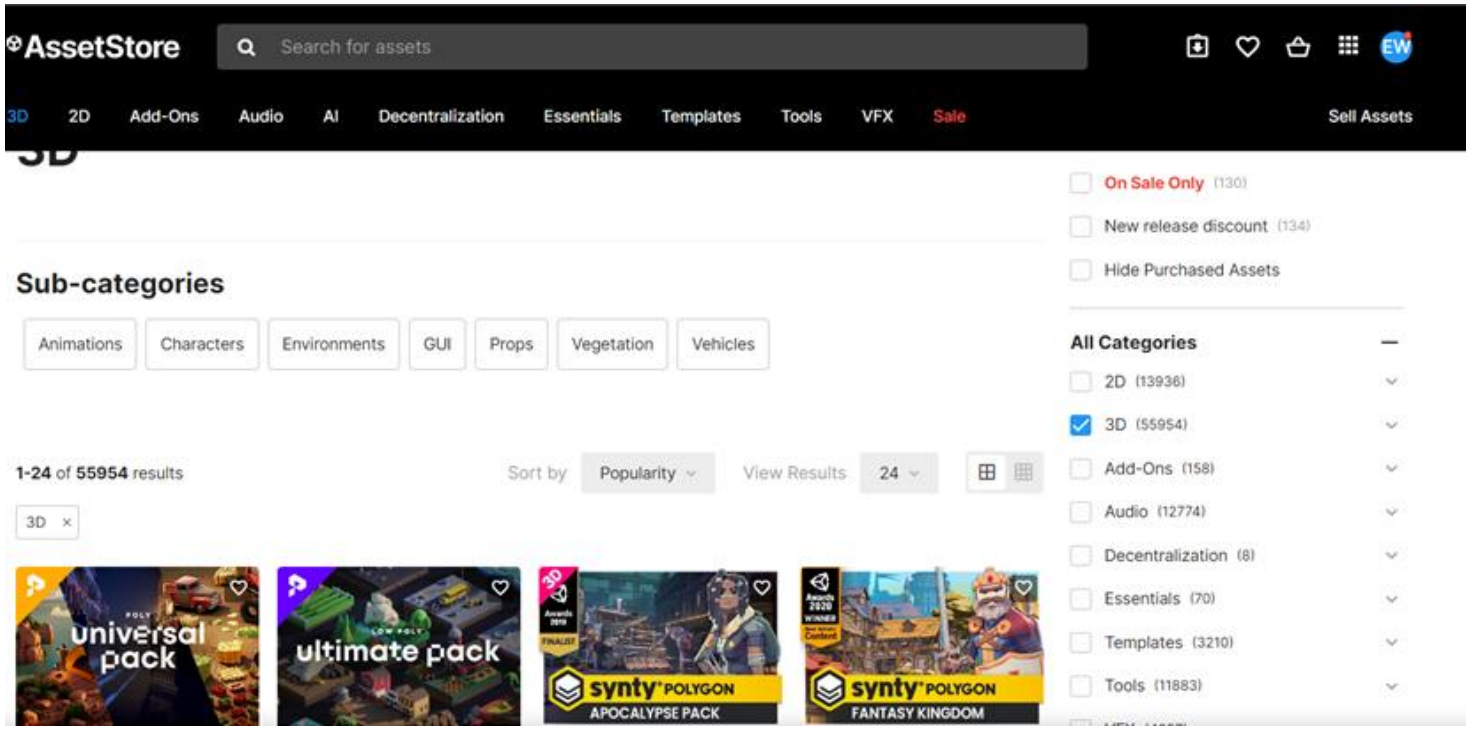
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