

# Game and XR Development with Unity

Session 1  
3 June 2022

# Course Objectives

01

...

## Unity Basics

- Tool
- Interface
- Best Practices

02

...

## C# Scripting

- Basics
- Unity related functions
- Best Practices

03

...

## Game Development Basics

- Effects
- Animations
- Gameplay Mechanics

04

...

## VR & AR Development

- XR Development
- Production Pipeline
- Portfolio Projects



[Complete Outline](#)

# Session Objectives

01

## Deeper into VR

Optics, Display, Tracking, User Interface

02

## Deeper into AR

Devices, Marker vs Markerless AR, SLAM

03

## Unity Tech Stack

XR Tech Stack, XR Interaction Toolkit, AR Foundation

04

## Installing Unity

Unity Hub, Unity Interface



# Virtual Reality

- a three-dimensional, computer-generated environment
- can be explored and interacted with by a person
- ability to manipulate objects or perform a series of actions





# Deeper into Virtual Reality



01

Optics

02

Display

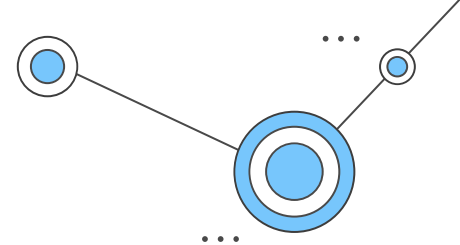
03

Tracking

04

User Interface

# Optics

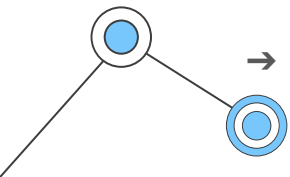
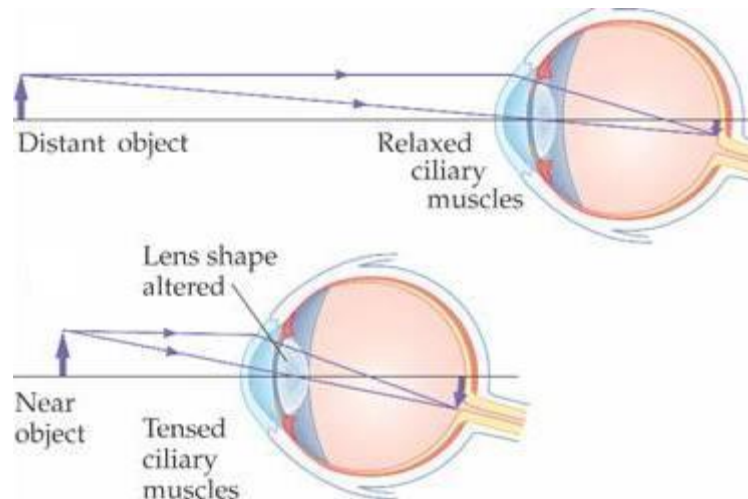


## → Naturally

- Far objects at  $\infty$ , lenses relaxed
- For objects near to the eye, lenses bends

## → VR Lenses

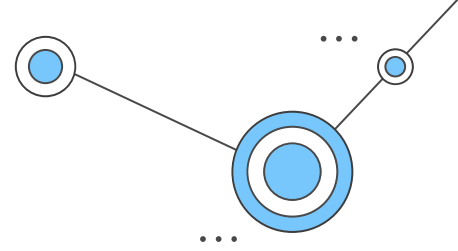
- From near-eye display onto the retina
- Magnifying property
- Size, shape and placement of the lenses --- Impact on the VR Experience
- Field of View, Focal Length, Optical distortion
- Comfort & Cost --- Trade-off



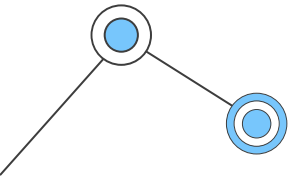
# Optics



# Displays



- High resolution OLED displays
- Rendering Latency
  - Motion-to-photon latency (needs to be under 300ms)
- Low persistence – eliminates motion-blur
  - each frame is displayed for a very small period of time, with a black screen for the remaining time
  - creates the illusion of crisp motion





# Tracking

- Where you are in space?
- Inertial Measurement Unit (IMU) – high speed rotational tracking
- Positional Tracking systems
  - Actively being researched
- Degrees of freedom?

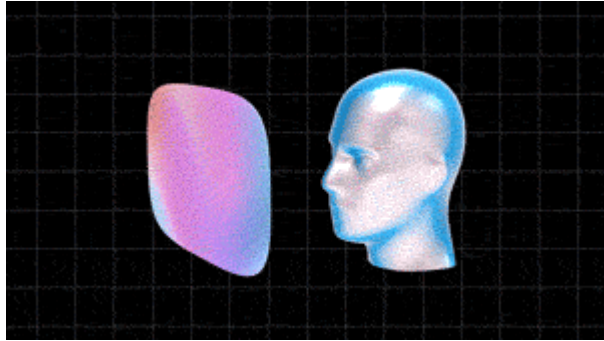
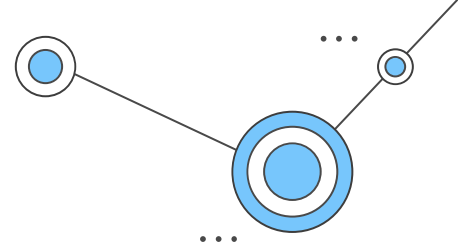
3DoF



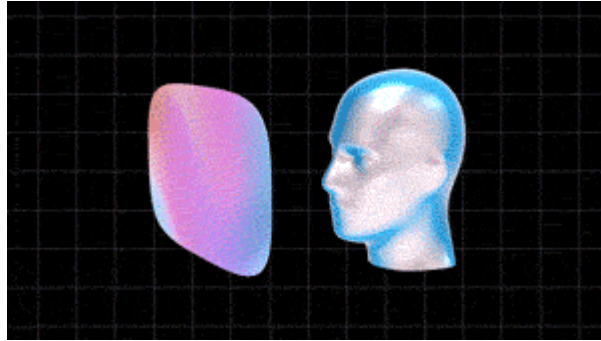
6DoF



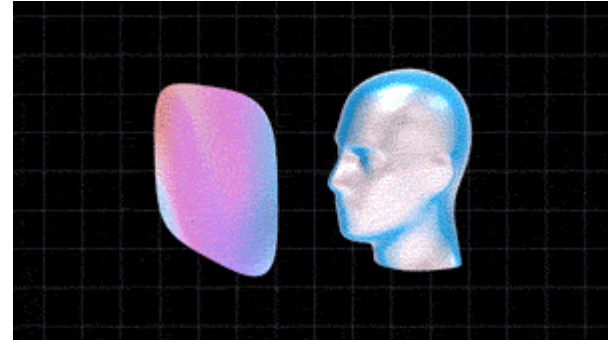
# Tracking



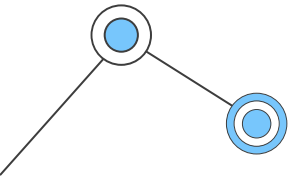
0 DoF



3 DoF

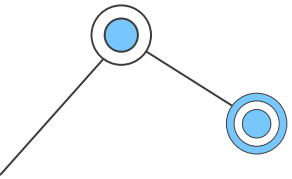
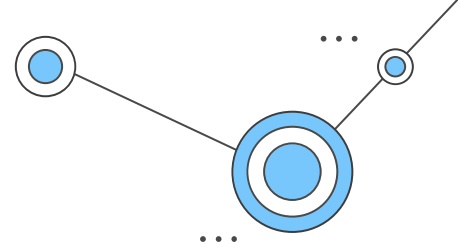


6 DoF



# User Interfaces

- Heads Up Display
  - Too close to the eye
  - Breaks immersion
- World space GUIs
- Strategically placed GUIs



# Challenge

- Motion/Simulator sickness
  - Caused due to mismatch between body's sense of motion and the visual system



# Augmented Reality

- superimposes a computer-generated image on a user's view of the real world
- enhances natural environments or situations and offer perceptually enriched experiences





# Deeper into Augmented Reality



01

Devices

02

Marker vs Markerless

03

SLAM

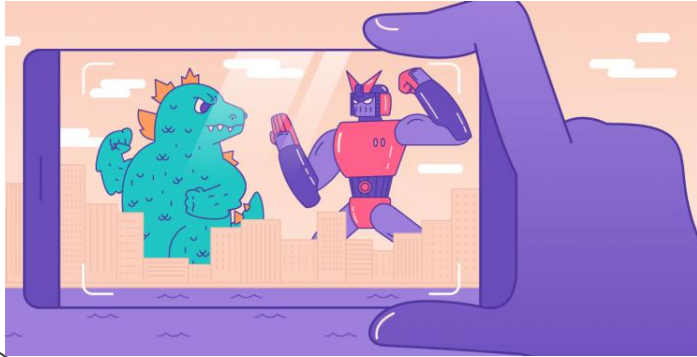
04

Geo-Location

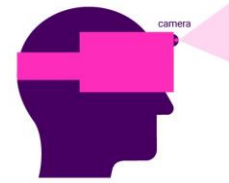
# Types of Devices

## → Head Mounted Displays

- Optical See-through
- Video See-through



Optical see through displays

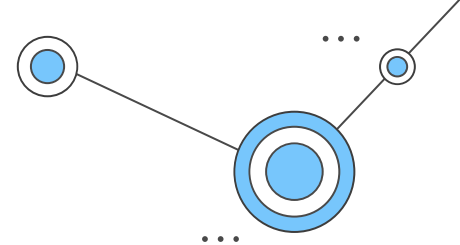


Video see through displays

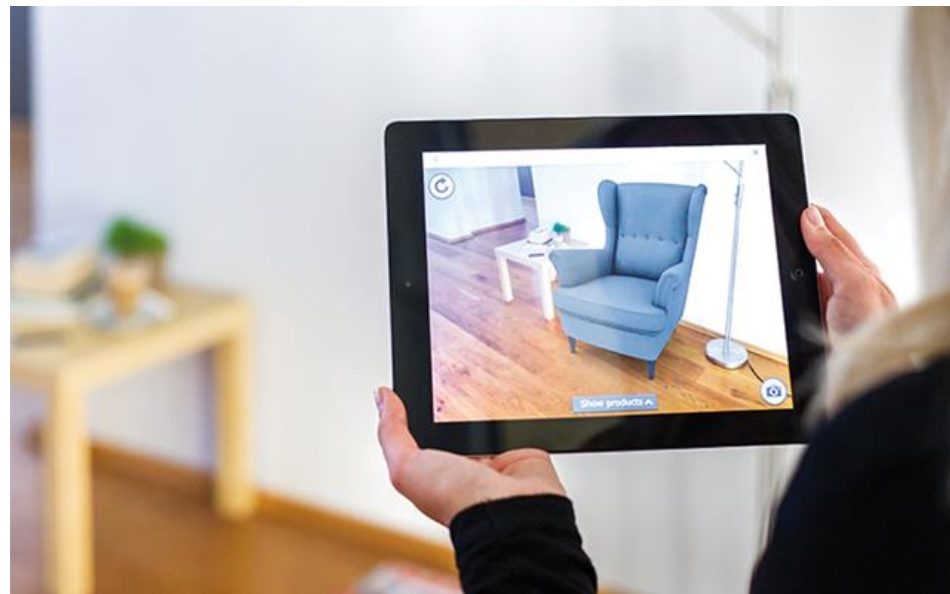
## → Holographic Displays

## → Handheld AR

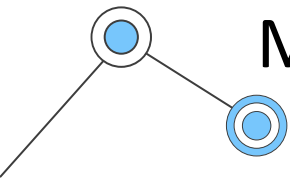
# Marker vs Markerless AR



Marker Based

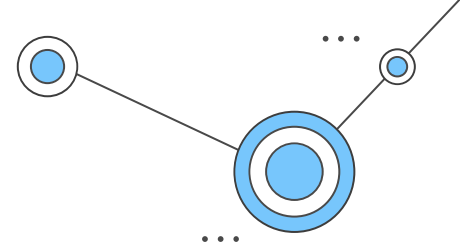


Markerless

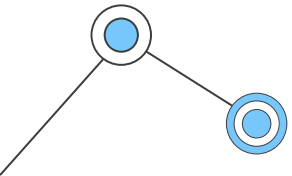




# SLAM



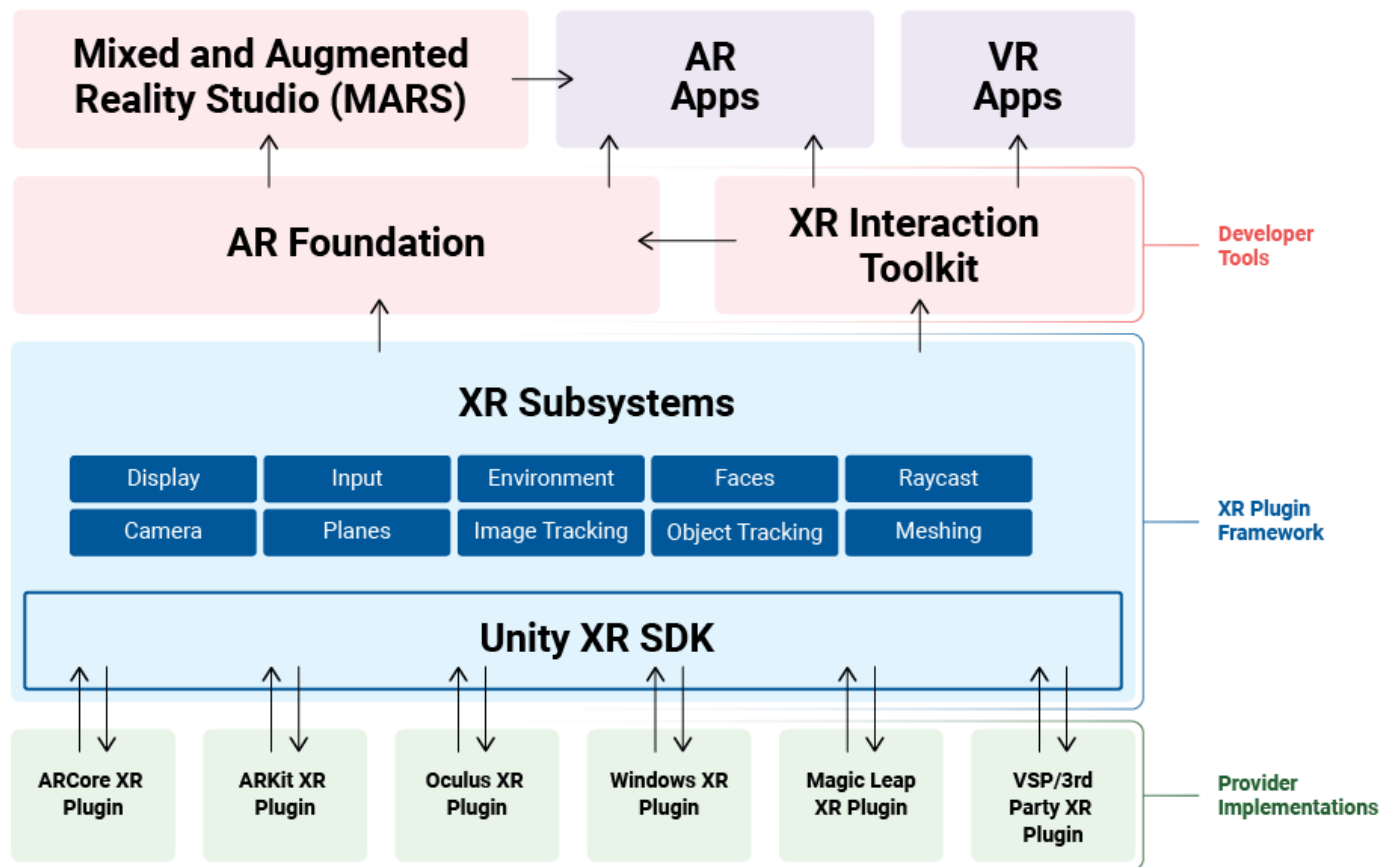
- Simultaneous Localization and Mapping
- Object and scene recognition
- Surface (horizontal and vertical) recognition
- Feature detection
- Geo-Tagged Augmentation



# Tech Stack



# Unity XR Tech Stack



# Unity's AR Foundation

## Supported Features

● — Supported  
● — Pending

Functionality	ARKit	ARCore	Magic Leap	HoloLens
Pass-through video	●	●		
Device tracking	●	●	●	●
Raycast	●	●	●	●
Plane tracking	●	●	●	●
Reference points	●	●	●	●
Point cloud detection	●	●	●	
Gestures			●	●
Face tracking	●	●		
2D image tracking	●	●	●	
3D object tracking	●			
Environment probes	●	●	●	
Meshing			●	●
2D & 3D body tracking	●			
Human segmentation and occlusion	●			
Collaborative participants	●			



**Move to Unity →**



# Thanks!

Do you have any questions?

[v\\_pandey@cs.iitr.ac.in](mailto:v_pandey@cs.iitr.ac.in)

+91 9971510759

[topmate.io/vishal](https://topmate.io/vishal)

