

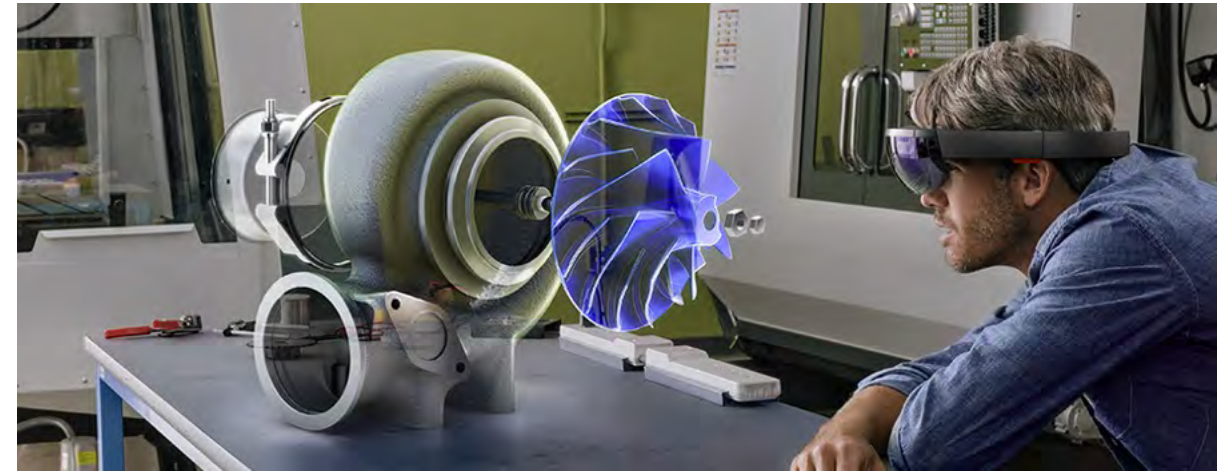
Augmented and Virtual Reality

CSCI 3907/6907
Spring 2022

3:30 PM - 6:00 PM, Thursdays

Dr. Hurriyet Ok
hurriyetok@gwu.edu

Office hours:
2:30 PM-3:20 PM Thursdays
or by appointment





Dr. Hurriyet A. Ok

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- Founder of VRT-U LLC, an AR/VR Venture based in McLean, VA
- Adjunct Professor, Computer Science, GWU
- Sr. Research Fellow at Cyber Security and Privacy Research Institute (CSPRI), GWU
- 25+ Years of Leadership in Enterprise Architecture, IT Infrastructure, and Cyber Security

Learning Objectives & Outcomes

By the conclusion of this course you should become proficient in immersive technologies and in their use for:

- Architecture/Construction
- Education
- Enterprise
- Entertainment
- Gaming
- Manufacturing
- Media
- Medical and Healthcare, etc.



Learning Objectives & Outcomes

- Explain computer vision algorithms for developing highly accurate image recognition systems.
- Recognize the importance of haptic devices for human-computer interaction and as effective guiding tools for navigation, enabling better user experience.
- Develop software solutions to overcome the mobile device hardware limitations.
- Assess various human-computer interfaces to select the most suitable interface for a given AR/VR application.

Learning Objectives & Outcomes (continued)

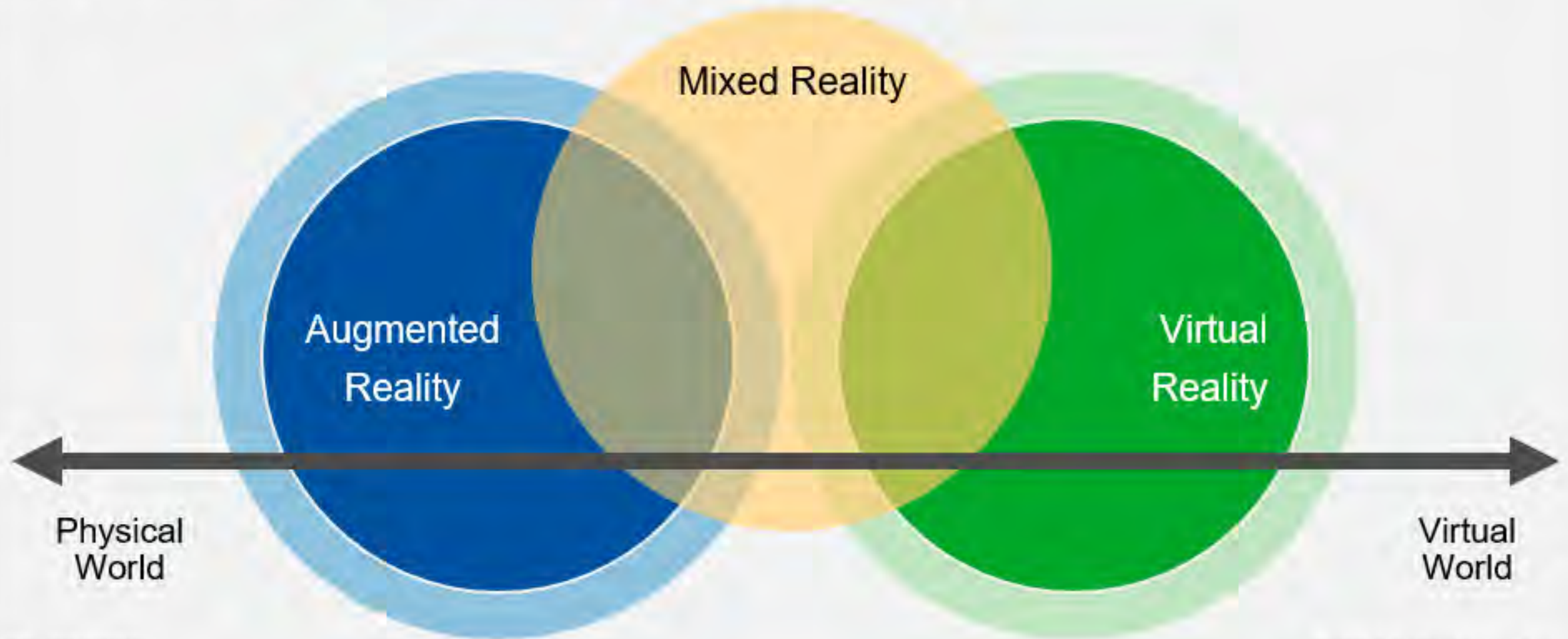
- Combine technical principles with visual arts to create virtual environments where users are comfortable and eager to engage for an enjoyable immersive experience.
- Share knowledge and unique expertise to collaborate with classmates in designing and developing AR/VR content.
- Investigate use cases where AR/VR technologies are effectively integrated in a specific industry other than entertainment & gaming, such as education, healthcare & medicine, manufacturing & logistics, construction & real estate, and law enforcement.

Immersive Technologies

- Virtual reality (VR) — Computer-generated (digital) environments to fully immerse users in a virtual "world."
- Augmented reality (AR) — Overlaying digital information on the physical world with no or very limited interaction with virtual objects.
- Mixed reality (MR) — A blend of the physical and digital worlds in which users may interact with digital and real-world objects while maintaining presence in the physical world.

Source: Virtual Reality and Augmented Reality: Using Immersive Technologies for Digital Transformation, Customer Experience and Innovation
3 July 2018 - Gartner Report: ID G00367666

The Relationship Between AR, VR and MR



ID: 367666

© 2018 Gartner, Inc.

An AR Smart Glass Experience – ODG R8



Virtual Reality - SteamVR featuring the HTC Vive



Immersive Technology Use Cases

Industry	Category	Example Use Cases
Consumer Packaged Goods	New Marketing Channels	VR: The Coca-Cola Co. provided customers with a virtual experience as part of an international marketing campaign. ¹
Automotive	Sales and Demos	VR: Volvo provided potential customers with the opportunity to test-drive its cars — virtually. ²
Commercial Sector (Mining)	Training and Simulations	VR: QinetiQ creates realistic virtual environments that simulate the harsh conditions in a mine for training purposes. ³

Source: Virtual Reality and Augmented Reality: Using Immersive Technologies for Digital Transformation, Customer Experience and Innovation
3 July 2018 - Gartner Report: ID G00367666

Immersive Technology Use Cases

Industry	Category	Example Use Cases
Manufacturing	Manufacturing Environments	AR: PTC is helping manufacturers to overlay real-time machine health and maintenance information. ⁴
Medical	Medical and Surgery	AR: Surgeons are using an AR-equipped camera to project their hands into the arthroscopic field of the residents who are in the operating room for training and real-time collaboration. ⁵
Manufacturing	Field Service Collaboration	AR: Fieldbit provides hands-free real-time AR visual collaboration with remote experts on complex machinery fixes. ⁶

Immersive Technology Use Cases

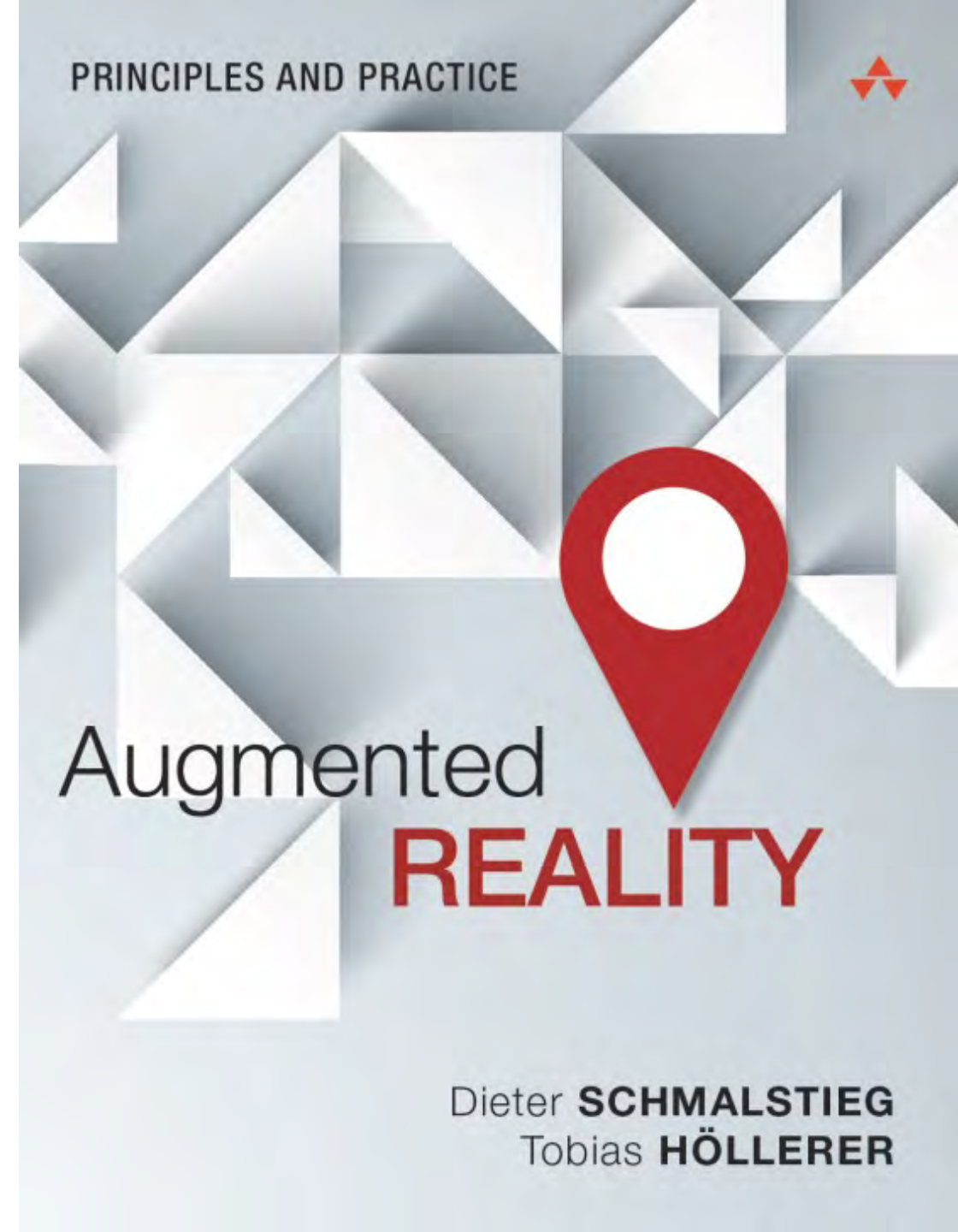
Industry	Category	Example Use Cases
Construction	Design Collaboration and Visualization	MR: Architects and designers can collaborate in real time to make instant changes to designs and plans with the Microsoft HoloLens. ⁷
Education	Education and Exploration	MR: 3D4Medical's Project Esper offers students a way to interact with and learn anatomy in an MR environment. ⁸
Digital Workplace	Office and Workspace	MR: Magic Leap demonstrates how to turn an office, table or desk into an interactive visual display

Augmented Reality – Principles and Practice

by Dieter Schmalstieg, Tobias Hollerer
2016, Addison-Wesley Professional

Available [Online](#) – GW Library

https://wrlc-gwu.primo.exlibrisgroup.com/permalink/01WRLC_GWA/1m68t01/cdi_askewsholts_vlebooks_9780133153200



Unity 2020 Virtual Reality Projects

Third Edition

by Jonathan Linowes
2020, Packt Publishing

Available [Online](#) – GW Library

https://wrlc-gwu.primo.exlibrisgroup.com/permalink/01WRLC_GWA/1m68t01/cdi_safari_books_9781839217333

Unity 2020 Virtual Reality Projects

Third Edition

Learn VR development by building immersive applications and games with Unity 2019.4 and later versions



Jonathan Linowes

Packt
www.packt.com

VIRTUAL REALITY

By Steven M. LaValle

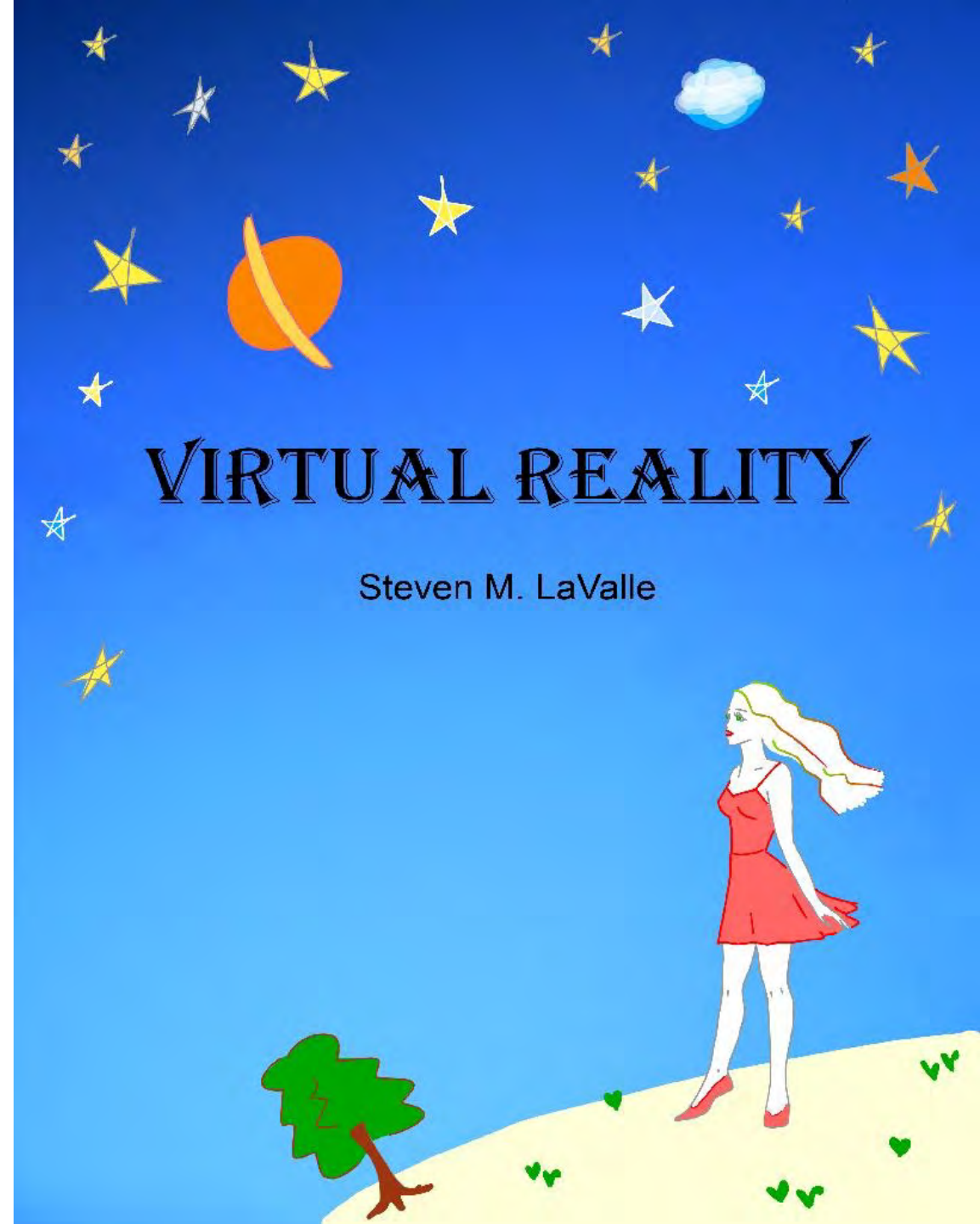
University of Oulu

2019, Cambridge University Press

Optional reading on
fundamentals of virtual reality systems

Available for free downloading at

<http://vr.cs.uiuc.edu/>



What is Augmented Reality (AR)?

Azuma's AR Definition

- Combines real and virtual
- Interactive in real time
- Registered in 3D

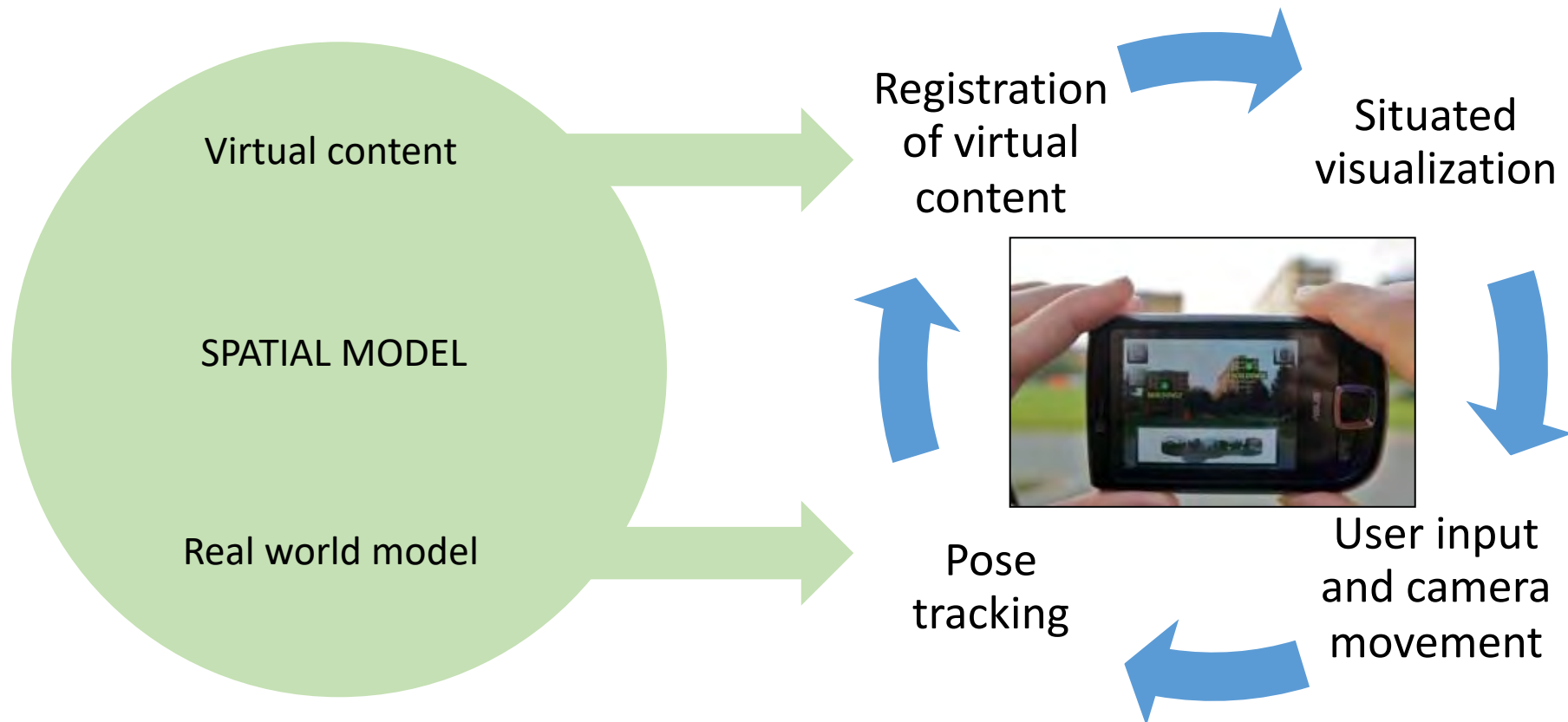
Ronald T. Azuma, "A Survey of Augmented Reality"
In Presence: Teleoperators and Virtual Environments 6, 4 (August 1997), 355-385



Photo: Microsoft

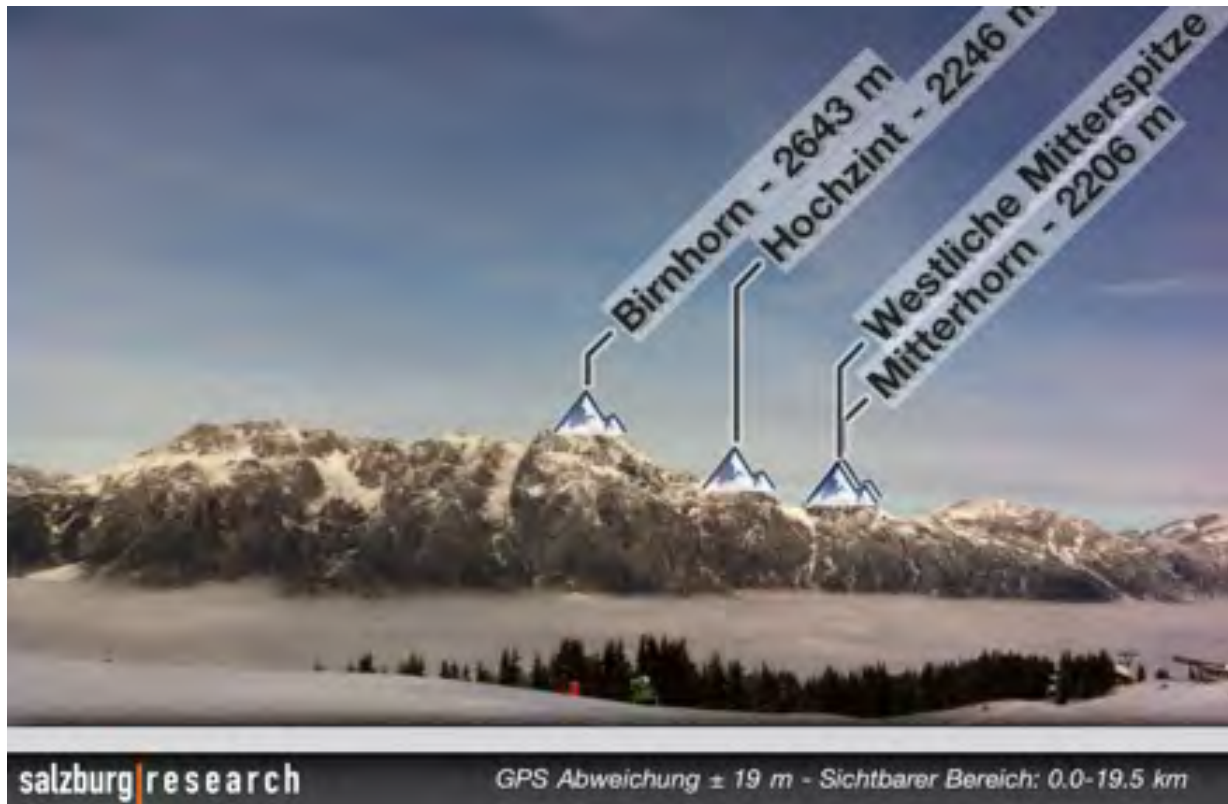
AR Feedback Loop

AR uses a feedback loop between human user and computer system. The user observes the AR display and controls the viewpoint. The system tracks the user's viewpoint, registers the pose in the real world with the virtual content, and presents situated visualization.



Navigation

Peak.AR showing mountain tops



Wikitude Drive superimposes a perspective view of the road ahead



Image: Wikitude GmbH

Parking Assistant

The parking assistant is a commercially available AR feature in many contemporary cars



Image: Brigitte Ludwig

Sport Broadcast Visualization

Augmented TV broadcast of a soccer game



Image: Teleclub and Vizrt, Switzerland (LiberoVision AG)

Augmented TV broadcast of a football game

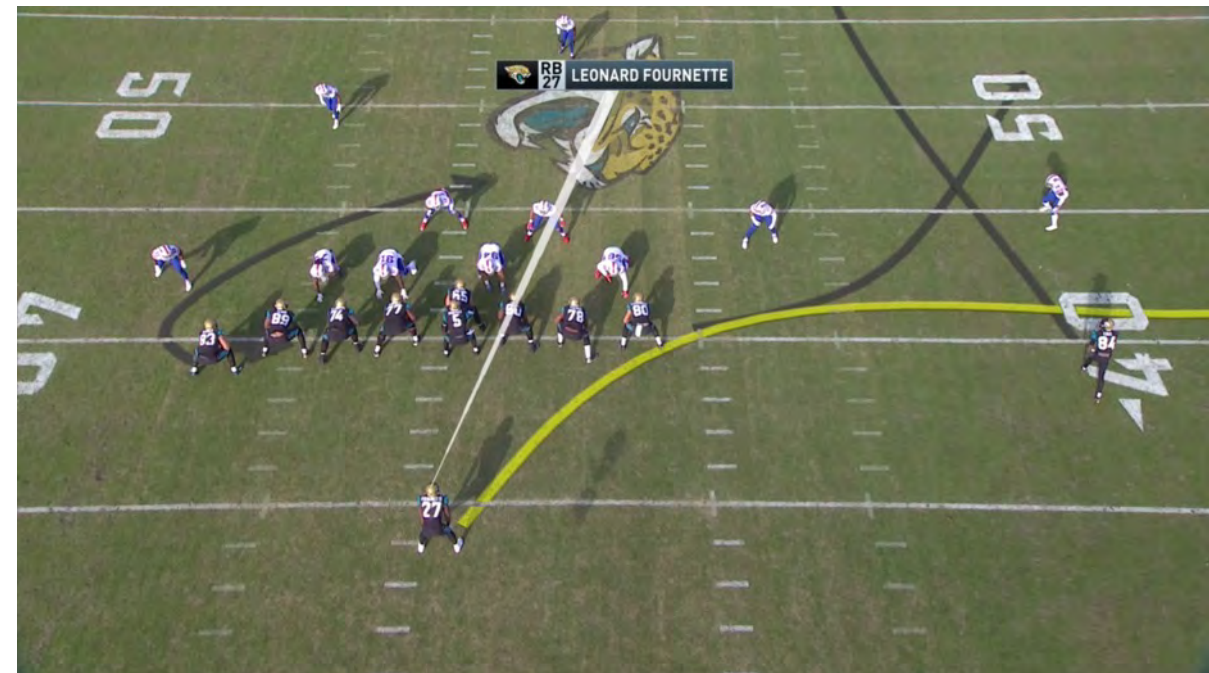
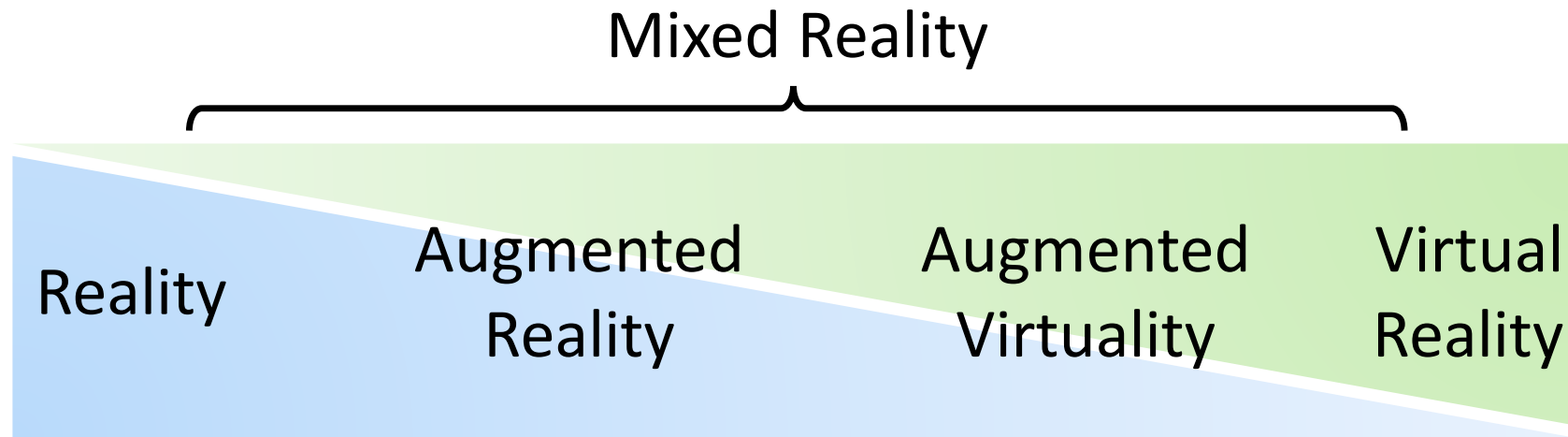


Image: CBS Sports





Mixed Reality Continuum



The mixed reality continuum captures all possible combinations of the real and virtual worlds

AR and VR Headsets and Technology



OCULUS GO



OCULUS QUEST



OCULUS RIFT



OCULUS RIFT S



WINDOWS
MIXED REALITY



HTC VIVE



HTC VIVE PRO



VALVE INDEX



MOBILE AR



MAGIC LEAP
CSCI 3907/6907



MICROSOFT HOLOLENS



MICROSOFT HOLOLENS 2
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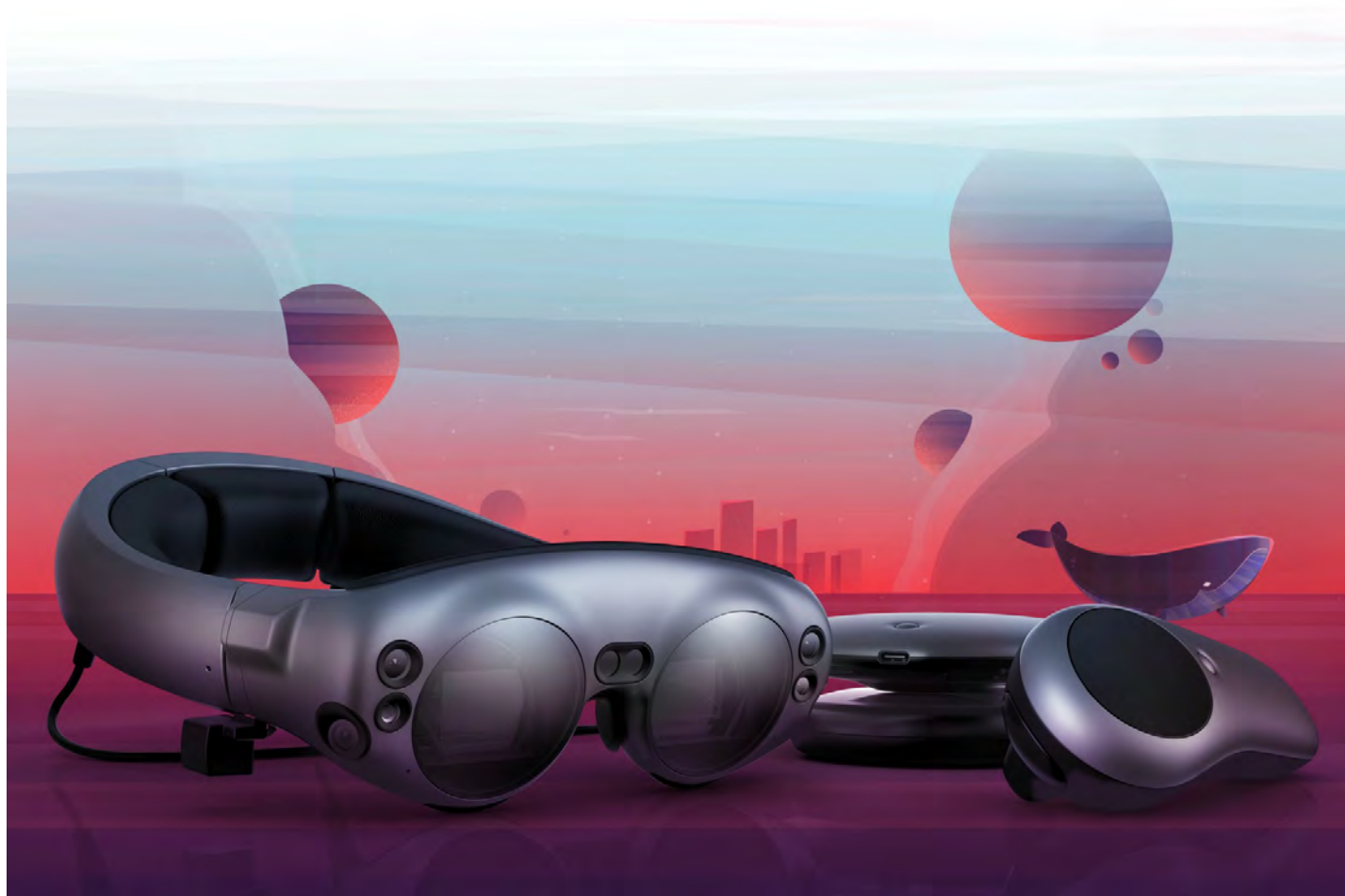
MICROSOFT'S HOLOLENS 2



MICROSOFT'S HOLOLENS 2



Magic Leap One



Magic Leap One



Oculus Quest 2



HTC VIVE Focus 3



HTC VIVE Focus 3



HTC VIVE Pro 2



Valve Index



Sony PS VR





henry

— Narrated by Elijah Wood —

68TH EMMY AWARDS WINNER

Dear Angelica

*"Oculus' new film
is a must-see."*
TechCrunch



Tilt Brush – A VR Experience



Google Earth VR



Unity Development Platform

In Class Exercise: Installing Unity

Create a Unity ID by signing up a free Student Plan

<https://store.unity.com/#plans-individual>

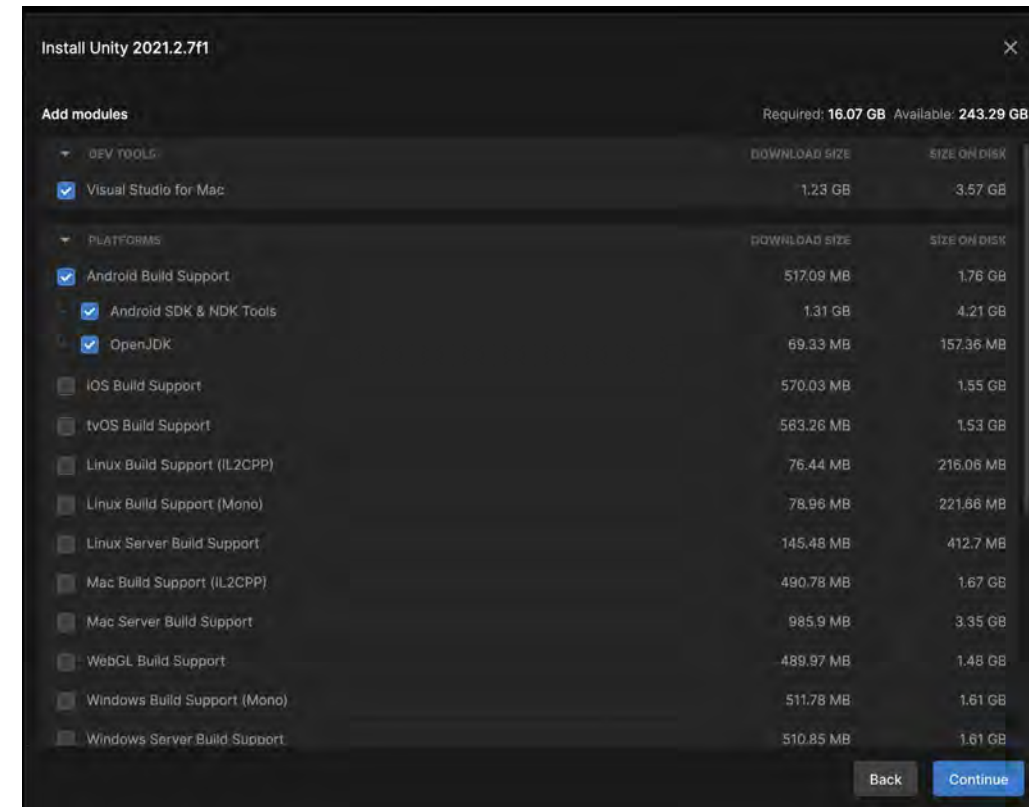
Download Unity Hub

<https://unity.com/download>

Current Unity Hub version: 3.0.0

Install Unity Editor using Unity Hub

Current version: 2021.2.7f1



Unity Tutorial

Getting started with Unity

Build your first Unity app

Create a project named “Roll-a-Ball by YOUR INITIALS”

<https://learn.unity.com/project/roll-a-ball>

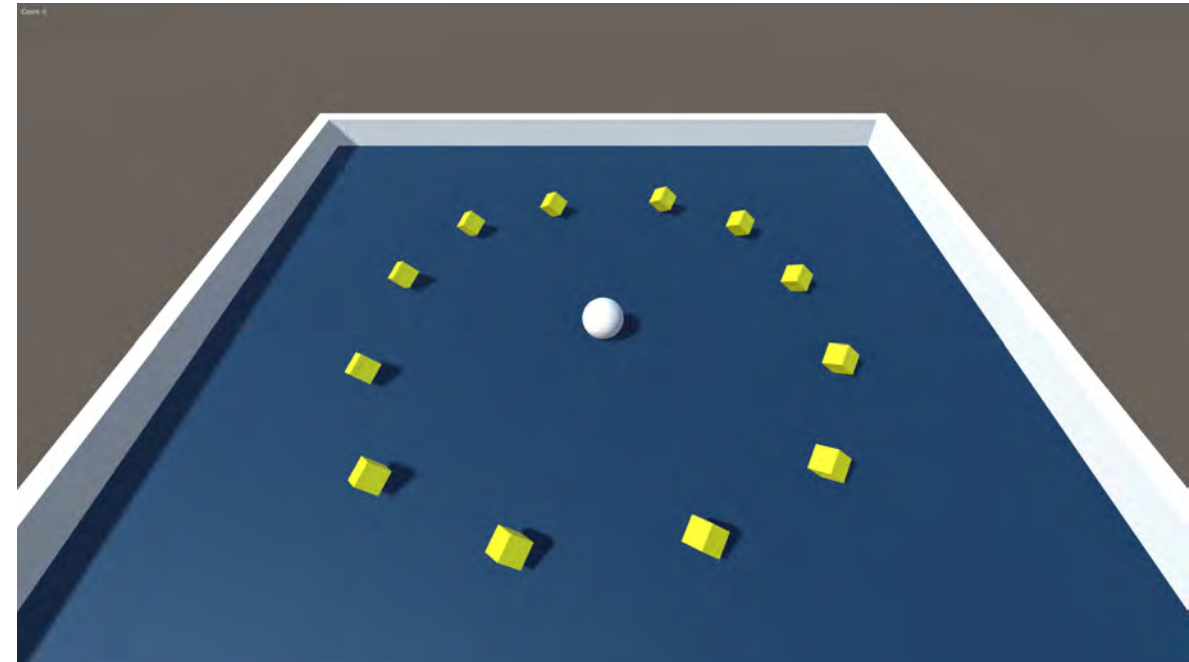
Follow the guideline and tips

See the pdf attachment in the Blackboard assignment.

Submit a screenshot

Post a screenshot of your Unity app on Blackboard to complete the assignment.

No VR Headset is needed for this Unity tutorial!



Unity Tutorial

OPTIONAL: Other simple Unity tutorials for additional practice

Option 1: Creating a simple diorama

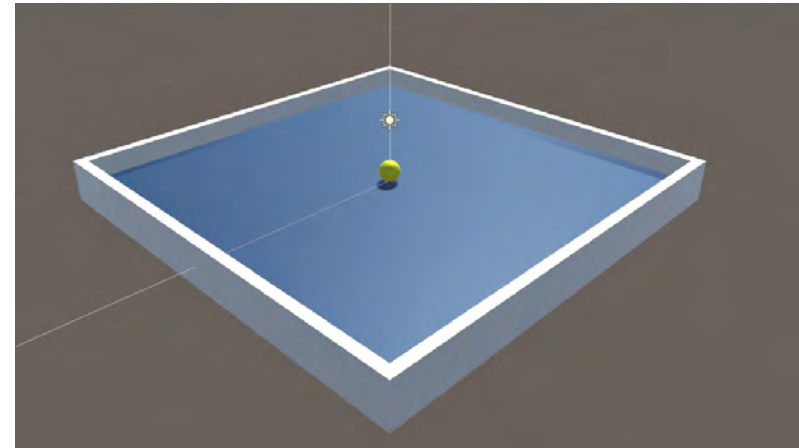
Read more details in Chapter “Understanding Unity, Content, and Scale” in the textbook “Unity 2020 Virtual Reality Projects” by Jonathan Linowes, 2020.

Option 2: Creating a simple ball game

See <https://developer.oculus.com/documentation/unity/unity-tutorial>

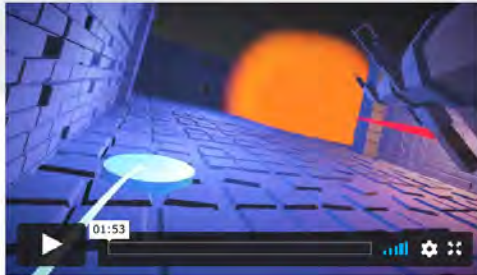
This tutorial is very similar to the “Roll-a-Ball” project.

No VR Headset is needed for any of these Unity tutorials!



VR Projects in Spring 2021

<https://vimeo.com/showcase/8436238>



Into The dungeon VR by Jekko Sy...

GW SEAS

Into the dungeon is a dungeon monster slaying game! Get ready I swear you might get too scared however! But fear...



Park Cleanup by Giana Fiore, Aug...

GW SEAS

Park cleanup is a virtual reality application that incorporates environmental protection into an entertainin...



VRcade by Jonathan Terry, Brian ...

GW SEAS

A collection of fan-favorite arcade games with a virtual reality twist.



VR Fishing by Mike Ehnot, Augme...

GW SEAS

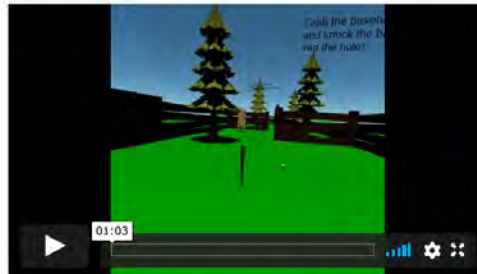
Explore a virtual pond where you can try to catch fish in virtual reality



VR Playgrounds by Gaozhi Liu, Au...

GW SEAS

A Virtual playground where players could enjoy several games and hang around.



VR Mini Golf by Arjun Vijay, Augm...

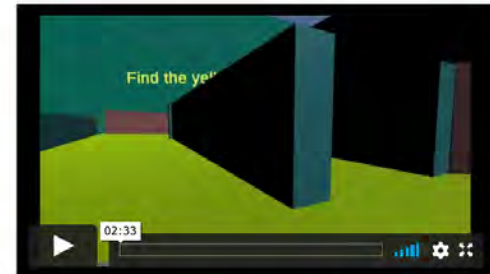
GW SEAS

A virtual mini golf area in which you must fight off enemies to score the ball



VR Card Flip Game by Yue Cao, A...

GW SEAS



Maze by KaYesu Machayo, Augm...

GW SEAS

A maze game where players can explore and navigate obstacles to find the prize.

VR Projects in Fall 2020

<https://vimeo.com/showcase/7892644>



Hospital Simulator by Adbullah Al...

Festival of Animation

The Hospital Room: explore a hospital room and interact with the different instruments in the room



Return to Monkey by Marcus Yon...

Festival of Animation

Return to Monkey is a goofy, entertaining virtual reality experience. We wanted to make a game where one could...



Wizard Training Simulator by Selin...

Festival of Animation

Explore a beautiful enchanted forest while searching for the secret targets your master hid for you to find in our Wizar...



Jurassic World by Joglekar Soma...

Festival of Animation

Know more about the different species of dinosaurs, explore their world and experience the look and feel of a ...



Museum of Renaissance Musical ...

Festival of Animation

This project focuses on making an immersive Virtual Reality (VR) experience for an exhibit of a Museum of Musical...



My Museum by Zaid Suleiman Fal...

Festival of Animation

Explore a museum with statues and artwork and have a feel of the museum while you walk around and enjoy the...



Temple Shoot by Danny Nsouli Fal...

Festival of Animation

The goal of the game is to get as many points as possible by shooting down the evil masks. Each mask will grant th...



Zombies by Jialiang Liang, Zheng ...

Festival of Animation

Man vs. Zombies is a first-person VR game in which players will be able to use weapons to eliminate zombies i...