

CSE 191: Virtual Reality Technology

LECTURE #1: INTRODUCTION

Course Overview

Instructor

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XR Engineer at Qualcomm

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Office hours:

- Mondays 7-8pm
(except first office hour on March 31; no office hour on April 4)
- Zoom link on Canvas

Course Goals

Gain in-depth knowledge of virtual reality technologies.

Gain experience with the software pipeline for rendering in VR systems, with a focus on HMDs.

Get up-to-date overview of current VR and AR technology and research.

Prerequisites

CSE167 (Introduction to Computer Graphics) or equivalent

- Linear algebra
- Coordinate system transformations
- Shader programming

Useful Experience

Computer graphics programming

Software development with Unity

Programming in C#

VR Headsets

Oculus Quest 2 headsets can be borrowed from the VR lab.



Online Course Resources

Course web site:

- <http://ivl.calit2.net/wiki/index.php/CSE190S2022>

Canvas:

- Grade management
- Submission of homework projects
- Scheduling of student presentations

Piazza:

- Discussion board

Important Dates

Lectures:

- Tue 11:00-12:20pm in VR lab (room B210 in EBU-3B)

Office Hour:

- Mondays at 7pm live on Zoom, starting April 4th

Homework submission deadlines:

- Sundays at 11:59pm, see course schedule for due dates

VR app presentation scheduling due Sunday, April 17th

Written exam:

- During finals week
- On Canvas, to be done within 24 hour window

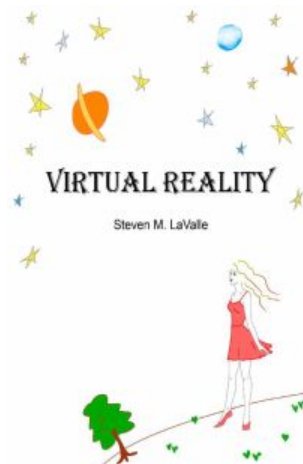
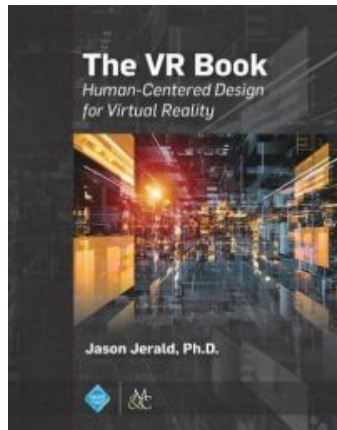
Homework Assignment Submission

Submit video of VR recording on Canvas

Books

No required books.

Recommended books:



[The VR Book](#) by Jason Jerald, 550 pages, Morgan & Claypool Publishers, October 16, 2015, ISBN-10: 1970001127, ISBN-13: 978-1970001129

[Virtual Reality](#) by Steven M. LaValle. To be published by Cambridge University Press. Available as PDF free of charge.

Class Structure

- One lecture per week
- One office hour per week
- Two programming assignments
- VR content presentation
- Final exam (on Canvas)

Grading

Programming Project 1	30%
Programming Project 2	30%
Written Exam	25%
VR App Presentation	15%

Cloud Storage

Unless otherwise explicitly authorized, each student is completely responsible to keep their code, homeworks, design files and other course work off of publicly accessible internet sites.

Example: it is **not allowed** to put code in a **public** Github repository.

However, you are **encouraged** to put your code in a **private** Github repository.

These rules expire after finals week.

Programming Environment

All homework projects will be using Unity.

Download free student license from:

<https://store.unity.com/academic/unity-student>

You can choose to use any other VR content development environment instead, but will only be able to get limited support from the instructor.

- Unreal Engine
- Lumberyard
- Cryengine
- C++/OpenGL
- Etc.

VR App Presentation

- Each student needs to present a **VR or AR app** in class
- It can be a game, entertainment or productivity app
- The app must be able to run on your VR device
- The app must be publicly accessible on the internet (e.g., Oculus Store, Steam, Viveport, Google Play, Apple Itunes, etc.)
- Enter your name, app title and app URL on scheduling page on Canvas for scheduling
- Presentation should be 10-15 minutes, followed by Q&A

Example for VR App

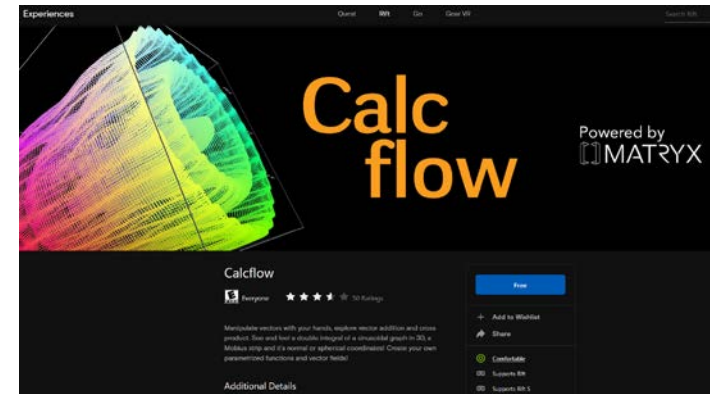
App: Calcflow

URL:

https://www.oculus.com/experiences/rift/1143046855744783/?locale=en_US

Comments:

- Visually teaches linear algebra concepts such as vector addition and cross product.
- Pros: Very polished, large variety of mathematical concepts are taught
- Cons: does not support Oculus Quest



Course Topics

We can't do all of the below in depth. Priorities?

- Overview of the state-of-the-art VR technologies and research trends
- Human visual system: 3D depth cues, color perception
- How to generate stereographic 3D images for human consumption
- VR software development with Unity
- Fundamental physics of 3D displays
- 3D display types: LCD, OLED, volumetric, light field
- Immersive VR systems: Head Mounted Displays, CAVE, smart phone VR, etc.
- 3D tracking systems and controllers
- Rendering to Head Mounted Displays
- Counteracting motion sickness
- Augmented reality devices
- Capturing and displaying panoramic 3D images and video

Introduction

*“I hear and I forget.
I see and I remember.
I do and I understand.”*

Confucius?, 551-479 BC

Virtual Reality: Definition

Definition of **virtual reality** on Merriam-Webster:

An **artificial environment** which is experienced through **sensory stimuli** (such as sights and sounds) provided by a **computer** and in which one's **actions** partially determine what happens in the environment.

Related Terms

Virtual environment

Artificial reality

Computer generated environment

Computer simulated environment

Synthetic environment

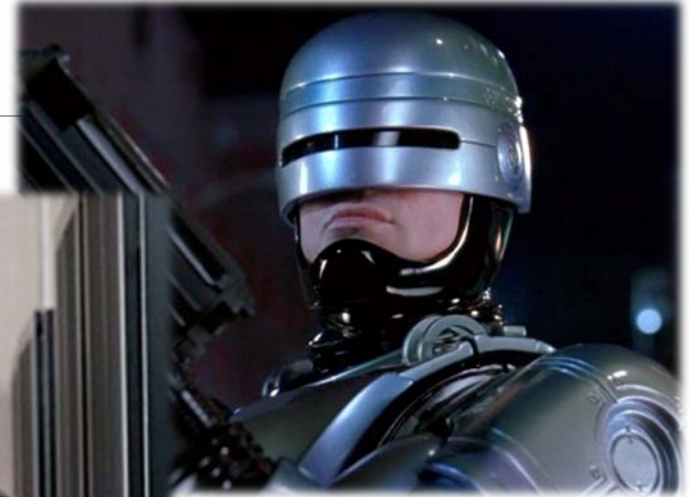
Spatial immersion

Cyberspace

Virtual worlds

Virtual presence

VR in Movies




Oculus

August 2012: Palmer Luckey revives VR with Oculus Kickstarter

March 2014: Facebook acquires Oculus for \$2B

Funded! This project was successfully funded on Sep 1, 2012.



23 OF 3 KICKSTARTER

9,522
backers

\$2,437,42
pledged of \$250,000 goal

0
seconds to go

Oculus
Project by
Oculus
Long Beach, CA
[Contact me](#)

First created - 24 backed

Has not connected Facebook

[oculusvr.com](#)

[See full bio](#)

318 Tweet Embed



Application Domains

Gaming

Entertainment

Training

Architecture

Medicine

Simulators

Scientific visualization



The VR Spectrum

The VR Spectrum

There is a wide umbrella of experiences that people call Virtual Reality.



Source: Wired

360° Video
monoscopic



Source: GreenBot

360° Video
stereoscopic (cardboard viewer)



Source: Pocket-Lint

VR Application



Source: Sam Yash AF/Getty Images

Hyper Reality
Mixed Reality



passive
experience

interactive experience

physical
fully immersive experience

The Mixed Reality Spectrum

