Spring 2021

CSE 190

VR Technologies

Discussion 5

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ANNOUNCEMENTS

- Homework 3 Released
  - Due **Sunday (5/16)**
  - Explore levels of VR immersion
- Extra-Extra Credit Opportunity
  - Fill Survey by **Friday (5/7)**
  - 2pts Extra Credit towards HW 2

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AGENDA

- Homework 3 Objectives
- Components
- Getting Started
- Debugging Tool

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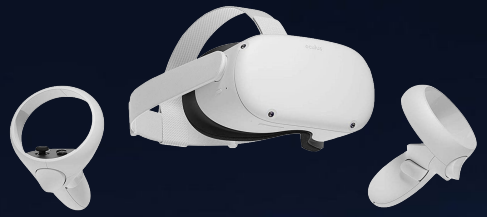
OBJECTIVES

Objectives

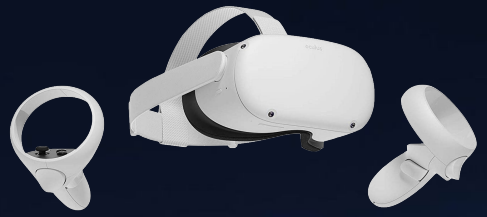
- Explore different level of immersion of VR
- Slowly taking away key components of VR environment
- Understand how FOV, tracking & rendering latency, stereo images would affect overall VR experience



COMPONENTS

Main Components

- Mono/Stereo Skybox
- Shrinking FOV
- Stereo Modes
- Head Tracking
- Tracking Lag
- Rendering Lag
- Extra Credit



Mono/Stereo Skybox

- A Skybox is a 6-sided cube that is drawn behind all graphics in the game.
- Used as 360 degree background
- Create new Material Asset -> Skybox

- By default, skybox is rendered monoscopic (both eyes sees same image)
- Fine for far-away objects, but not ideal for near objects
- A better skybox: render different images for different eyes
- Stereo images are provided

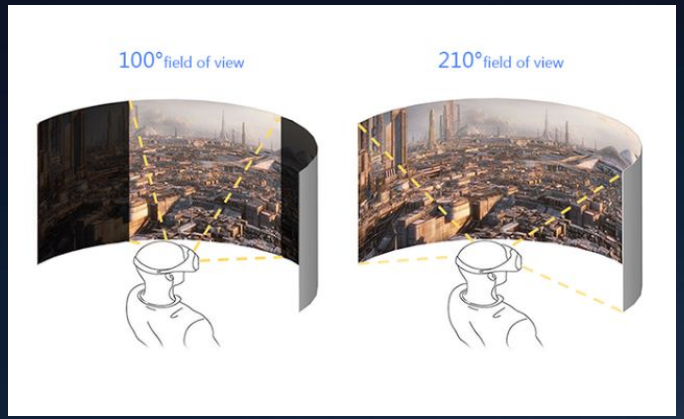
Mono/Stereo Skybox

Requirements for Homework 3:

- Create a skybox that acts as the background for the 3D environment
- Press “X” button to cycle through THREE different modes
  - Create a scene with a cube and render both cube and skybox rendered in stereo
  - No cube, just skybox rendered in stereo
  - No cube, just skybox rendered in mono

Shrinking FOV

- Reduce the field of view of both eyes to half of the original size
- Rendering a black frame on top of your left and right eye views, with the center being transparent



Stereo Modes

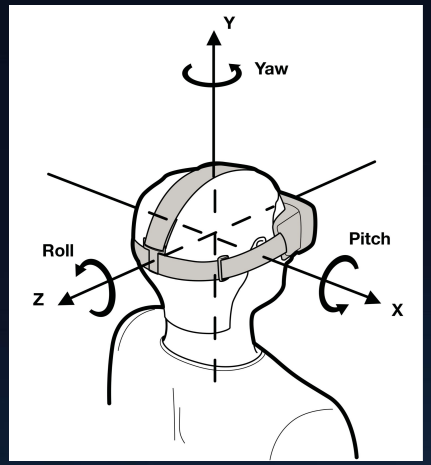
Requirements for Homework 3:

- Create a 3D Scene
- Cycle among different modes with “A” button
  - 3D Stereo
  - Monoscopic
  - Left Eye Only (Right eye black)
  - Right Eye Only (Left eye black)
  - Inverted Stereo (Left camera renders into right eye)

Head Tracking

Requirements for Homework 3:

- Create a 3D Scene
- Cycle among different modes with “B” button
  - Regular head tracking (both rotation and position is tracked)
  - Orientation Only (position is frozen)
  - Position Only (rotation is frozen)
  - Tracking disabled
- Unity has built-in support for this



Tracking Lag

Requirements for Homework 3:

- Create a 3D Scene with a sphere following the dominant hand's controller position
- Obtain current camera matrix, and replace it with the camera matrix for the next scene
- Save the camera matrices in a ring buffer with 30 entries
- Press right index trigger button to add one frame of tracking lag
- Press left index trigger to reduce one frame of tracking lag
- Display the tracking lag in frame count # on screen.

Rendering Lag

Requirements for Homework 3:

- Explore what it would look like if rendering a frame took more than 1/90th of a second
- Setup similar to tracking lag
- Right middle finger trigger to add one frame as rendering lag (render the same, duplicate frame)
- Left middle finger trigger to reduce one frame for rendering lag

Extra Credit

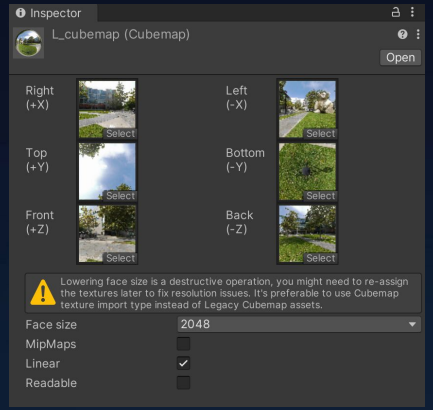
DIY 3D Experiences!

- **Stereo Image Viewer**
  - Use a camera or your smartphone to take two images of an identical scene
  - Two camera positions should be ~65mm apart from each other
  - Use the provided custom shader to render the images to each eyes
- **Custom Skybox**
  - Create your own panorama images for both eyes by using some smartphone apps
  - Convert to cubemaps
- **Super Rotation**
  - Magnify the rotation movement tracking of the head
- **Smoother Controller Tracking**
  - Use moving average as the pose parameters for the controllers

GETTING STARTED

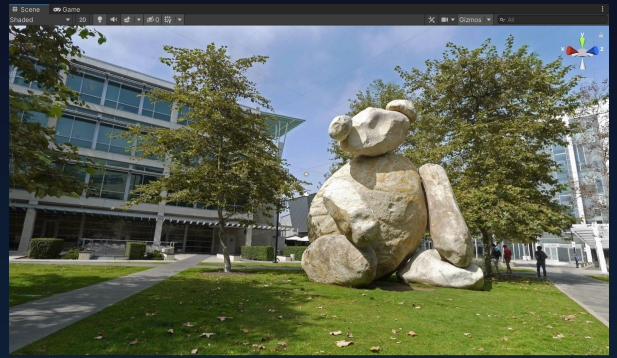
Creating Stereo Skybox

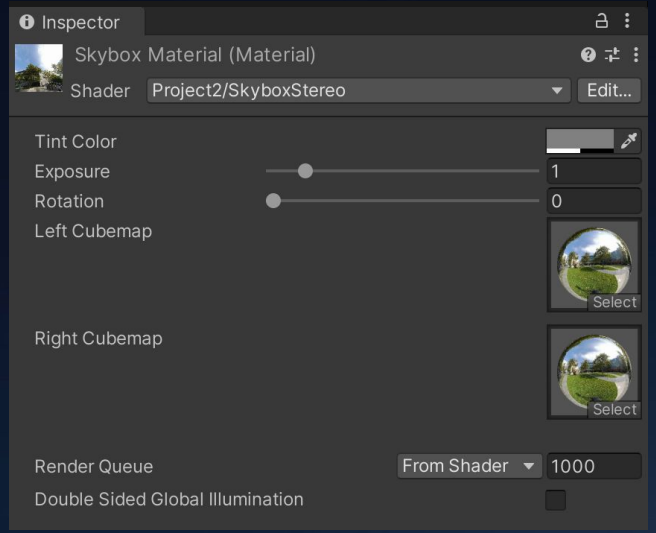
- Creating a stereo skybox requires two cubemaps
  - One for left eye image and another for right eye image
  - Assets -> Create -> Legacy -> Cubemap
  - Set face size to be 2048, images are provided on the course website
  - Create two of such cubemaps, one for left image, one for right image



Creating Stereo Skybox

- Create a Skybox Material
  - Assets -> Create -> Material
  - Import the SkyboxStereo material downloaded from the course website
- Add the left and right cubemap you have created from the last step
- Drag this newly created skybox into the scene.

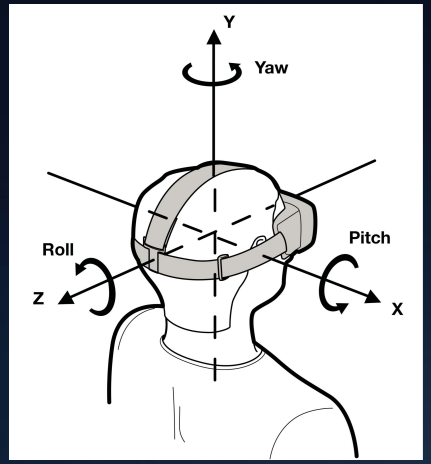




Change Head Tracking Mode

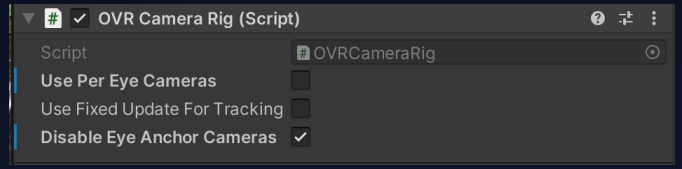
- Select the OVRCameraRig from OVRPlayerController
  - In inspector view, under OVR Manager

  - Those booleans can either be set here, or dynamically in code
    - Inside `OVRManager.cs`, find
      - `public bool usePositionTracking`
      - `public bool useRotationTracking`
    - Dynamically modify those values in your script

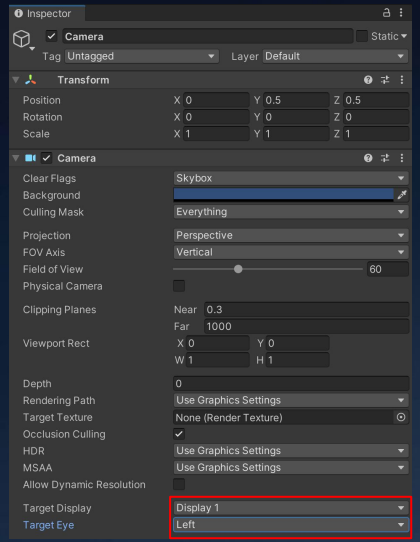


Stereo Mode & IOD (IPD)

- For these particular tasks, we need some hack since Oculus Integration doesn't offer the flexibility to render images only to left eye or right eye, nor to render inverted stereo
- Need to disable OVRCameraRig's anchor cameras and create your own custom camera rig



- Useful functions provided in the file shown on the website
- Create two cameras in hierarchy and have them parented
- Select target eye



Stereo Mode & IOD (IPD)

```
public class P2Utils
public enum RenderingMode { Stereo, Mono, LeftOnly, RightOnly };
public Camera leftEye;
public Camera rightEye;
public GameObject leftParent;
public GameObject rightParent;
public static P2Utils instance;
```

```
public void changeRenderingMode(P2Utils.RenderingMode mode)
```

Changes the rendering mode of the scene

```
public void setIODDistance(float distance)
```

Sets IOD distance – default is 0.065m (65mm)

DEBUGGING TOOL

Debugging Tool

- Debugging is trickier since app is running on VR and there isn't a terminal window on your VR
- Cannot see debug logs inside your VR interface
- Useful tool provided by Android Developer Support: ADB (Android Debug Bridge)
  - Obtain Android Debug Bridge on your machine:
    - https://www.xda-developers.com/install-adb-windows-macos-linux
  - In your terminal, navigate to the directory named "`platform-tools`" and use the command "`./adb device`"
    - If everything is setup correctly, you should be able to see your Oculus Quest Serial #

```
~/Doc/D/Ac/UC S/C/CSE 19/H/platform-tools
❯ ./adb devices
List of devices attached
1WMHH837PJ0515  device
```

```
05-03 10:36:02.820 23106 23127 E Unity   : NullReferenceException: Object reference not set to an instance of an object
05-03 10:36:02.820 23106 23127 E Unity   :   at TextLog.Update () [0x00042] in <9dd35ec113b547ab95b2993920ab4d26>:0
05-03 10:36:02.820 23106 23127 E Unity   :
05-03 10:36:02.820 23106 23127 I Unity   : Hello World!
05-03 10:36:02.820 23106 23127 I Unity   :
05-03 10:36:02.829 23106 23127 I Unity   : (0.1, 0.1, 0.1)
05-03 10:36:02.829 23106 23127 I Unity   :
05-03 10:36:02.834 23106 23127 I Unity   : (0.1, 0.1, 0.1)
```

    - `./adb help` provides a list of available commands you can execute
    - `./adb logcat` outputs all the log output from your VR (**make sure VR is always tethered to your machine**)
- https://developer.oculus.com/documentation/unity/unity-enable-device

QUESTIONS?