Assignment 4: Flight Simulator

Released: March 11
Part 1 Due: Mar 18 @ 12:30 PM
Part 2 Due: Mar 29 @ 12:30 PM

Submission 1 will not count towards any point and we are not going to give grade for Submission 1, but not submitting on time will cost you 20% penalty. We simply want to make sure that you have started the assignment, and we want to provide some feedback to you in time. Furthermore, you will be able to see some good designs from other students on Piazza.

Overview

Welcome to Assignment 4! In this assignment, you are going to build a flight simulator in Unity. You are going to construct a new environment, write script to support your plane, make a UI, and optimize the game to fulfill requirements from the Oculus Best Practice Guide! (What is Oculus Best Practice Guide? Your Assignment 3.)
Tasks to do in this Assignment for Oculus
(for Gear VR: read the Q&A at the end. READ IT NOW!)

Part 1: Environment
Build an environment for your flight simulator
Rubric: (40 pts)
A. Skybox: 5pts
B. Terrain and details: 10pts
C. Fog effects: 5pts
D. Water: 5pts
E. Reference photos: 15pts

Part 2: Flight Simulator
Build your flight simulator and Scripts
Rubric: (50 pts)
A. Plane: 1pt
B. Acceleration / Deceleration: 9pts
C. Rotate (comfort): 10pts
D. Ray Casting: 10pts
E. Spheres for shooting game: 10pts
F. Shooting Game: 10pts

Optimization
FPS seldom drops below 60: (-50pts~10pts)
First of all, we need a unique environment for your flight simulator. The environment you build should have at least a sky, water, and a terrain. Remember, the purpose of this part is to let you play with Unity graphics and make your environment look good. Therefore, you are always welcome to add other things into your scene besides these requirements! Please go over all of the requirements before you start.

All the techniques you need for this part of the assignment can be found online. There are tons of useful tutorials on Youtube too.

1. Use a Skybox for the sky. It is even better if you combine it with other techniques, such as importing the cloud meshes into the game or write a script to simulate the moving of real clouds.
2. Use Unity’s [Terrain Editor](https://unity.com) and build at least one terrain in the game (Similar to the terrain shown in the picture above). The terrain should at least:
   a. Have enough height details (it is suggested that you load it from a height map and further craft it, or else you will spend much more time adding the height information to this terrain using Height and other Tools)
   b. At least 3 different types of textures (search online or use the one in the package: /assets/import/environment, and you will find it in your assets)
   c. Normal map for each texture.
   d. Plants (/assets/import/environment, and you will find it in your assets), with shadow

You should use the Terrain Editor in Unity to build your terrain.
**Do not directly import a terrain mesh or use Terrain Composer or World Composer to help you with it.**

3. Unity’s fog can be controlled in “Lighting”. Play with it, such as the color and density. However, you must be very careful that effects can be extremely expensive and ruin your game. You are likely to come back to fix your fog effect in Optimization.

4. Add some water to your scene (/assets/import/environment, and you will find it in your assets). It can be an ocean, it can be some stream. Use your imagination and make the scene look good!

5. When placing your trees, shaping your terrain, or creating fog, make sure that you use at least 3 real life photos (or concept art) as your reference images, and consider the following questions: Where should you place the trees? What is the height of the trees compared to the mountain? How does your fog look, e.g. color, density? For Submission 1, please include the 3 photos (or concept art) and at least 3 screenshots of your flight simulator game for comparison, i.e. there should be some similarities between the screenshots of your flight simulator and the pictures you provide. If you think we will miss those clues, you can include a README file in your submission, telling us what to look for in your screenshots (see details at the end).
Now starts the Submission 2

Part 2: Flight

A flight simulator must take flight. You are going to build a plane in this part and write scripts to realize some functions: move, rotate, and shoot. In this Assignment, you can simply use a cube as your plane. After Assignment 5, when you are able to build some simple models, you can create your own planes and replace this box with your modeled plane.

The next step is to write some scripts to make the plane fly.

1. You should use an Xbox controller instead of keyboard. Of course, you can implement both of them during your development, but we are only going to test the Xbox controller version.

2. Your plane should be able to do the following:
   a. Acceleration / Deceleration
   b. Rotate
   You should implement these functions in your own way with the Xbox controller and Oculus Rift. Think carefully: What is the best way to rotate the plane to minimize discomfort? Should you use buttons or sticks? How fast should the rotation be? Remember to consult the Oculus Best Practice for suggestions.

3. Ray Casting is a very interesting technique. We are going to use it as the weapon of your plane, so that when you press the right trigger, your flight can “shoot” a ray. You should decide where the ray should shoot from.

4. Your simulator looks good, but we can make it better! You should scatter some spheres in the sky, so when your flight shoot at a ball, it should disappear. Also, these spheres should reappear after 5s after you shoot them. You decide the texture and the color of the spheres, but these spheres must be transparent, e.g. transparency from 0.4 to 0.7 is acceptable.
Optimization

We have a Titan Black graphic card, but it is still not good enough. In fact, nearly all graphic cards have to work hard to satisfy Oculus Rift.

The first objective is to increase the FPS (frames per second) so that it rarely drops below 60. According to Oculus Best Practice, we need stable FPS to maximize our experience. If your simulator has overall FPS above 60, then you are probably fine for this part. Note that if your FPS is only around 30 and has produced obvious lag, you will lose at most 50 pts, depending on whether your game is playable or not.

You will need to consider the following strategies:

1. Delete some of your assets or lighting in the simulator.
2. Lower the effect (shadow, fog) of your scene
3. Check pixel error of terrain (see terrain settings)
4. Are there some assets in your scene that have too many polygons?
5. Here
Submit instruction:

**Part 1:** A zip file containing 3+ photos and 3+ screenshots. README file is optional. Please keep a copy of your screenshots. When we give you feedbacks on Piazza, we will only post your screenshots and the feedbacks. We will not post your netID or names, so it is essential that you know which screenshot belongs to you.

**Part 2:** The same as previous assignments. Please keep a copy of your game, as we are going to further develop in Assignment 5.
Q&A

Q: I want to implement it on Gear VR, any advice?
A: Wow! You are awesome! Since the graphic performance of Samsung phone is limited (<10% of Titan Black), the following sections of your project will automatically get a full score, once you your game can run on your gear VR: The details of terrain (The shape is still important), water, fog effect, and we will have a much higher tolerance for your overall experience. However, as an exchange, you will need to figure out how to put them on gear VR, how to set up menus and how to further optimizing the game experience.

For **Part 1**, you are still required to submit the screenshots, but they should come from Samsung cell phone.

Please post on piazza if you need help getting a gear vr set and a Samsung phone. We have limited number of equipment, so it will be first come first serve. Also, since we are going to set up the Gear VR development environment in the lab during spring break, you might need to install NDK, SDK, Unity or other components on your own computer and work on it.

I highly suggest that you should evaluate the difficulty first. Please note that you need to write in your README file that you need to use gear vr.

Q: Can you debug my code?
A: NO

Q: There are not enough textures and maps inside the package provided by Unity.
A: Google and download the maps and textures

Q: I don’t know what a map is
A: Google

Q: Are there requirements on lighting?
A: NO

Q: Why there are negative points on optimization?
A: When people start to play your VR game and your game’s FPS makes them sick (Yes, ‘some’ game companies usually mess up on this point), their interests on the game will highly decrease, especially when there are tons of other alternatives out there.
Q: Will there be an extension?
A: NO

Q: Mar 18th is the spring break!!! No extension?
A: NO. But I suggest that you can install unity on your computer and work on your computer. You can finish all other functions except those need Oculus, which is around a half of the material. Please note that only Unity Pro (Those installed in lab) have the extra files we need, such as the image effect. Therefore, you will need to create a file on the lab computer and copy it back to your computer to work on it. START EARLY!

Q: Can I develop them in Unreal/CryEngine instead of Unity?
A: Good Idea! You are highly encouraged! If you want to have an “meaningful” spring break, you can learn some Unreal/CryEngine stuff and develop in the new environment. Note that Unreal's coding standard is different from the C++ programs we write. And in fact, a large majority of people (including me in most cases) who uses Unreal only uses its Blue Print visual script, which simplifies program’s logic into nodes, so you do not need to “write” any code. Read this article before considering learning new stuff.

As for CryEngine, I personally do not recommend it to people who has deadline of around two weeks – it is not that friendly to new users. However, if you are more experienced in CryEngine, you are more than welcome to use CryEngine.

Post on Piazza if you have any question concerning Unreal/CryEngine (except for coding). The TA system will function as normal during spring break on piazza.