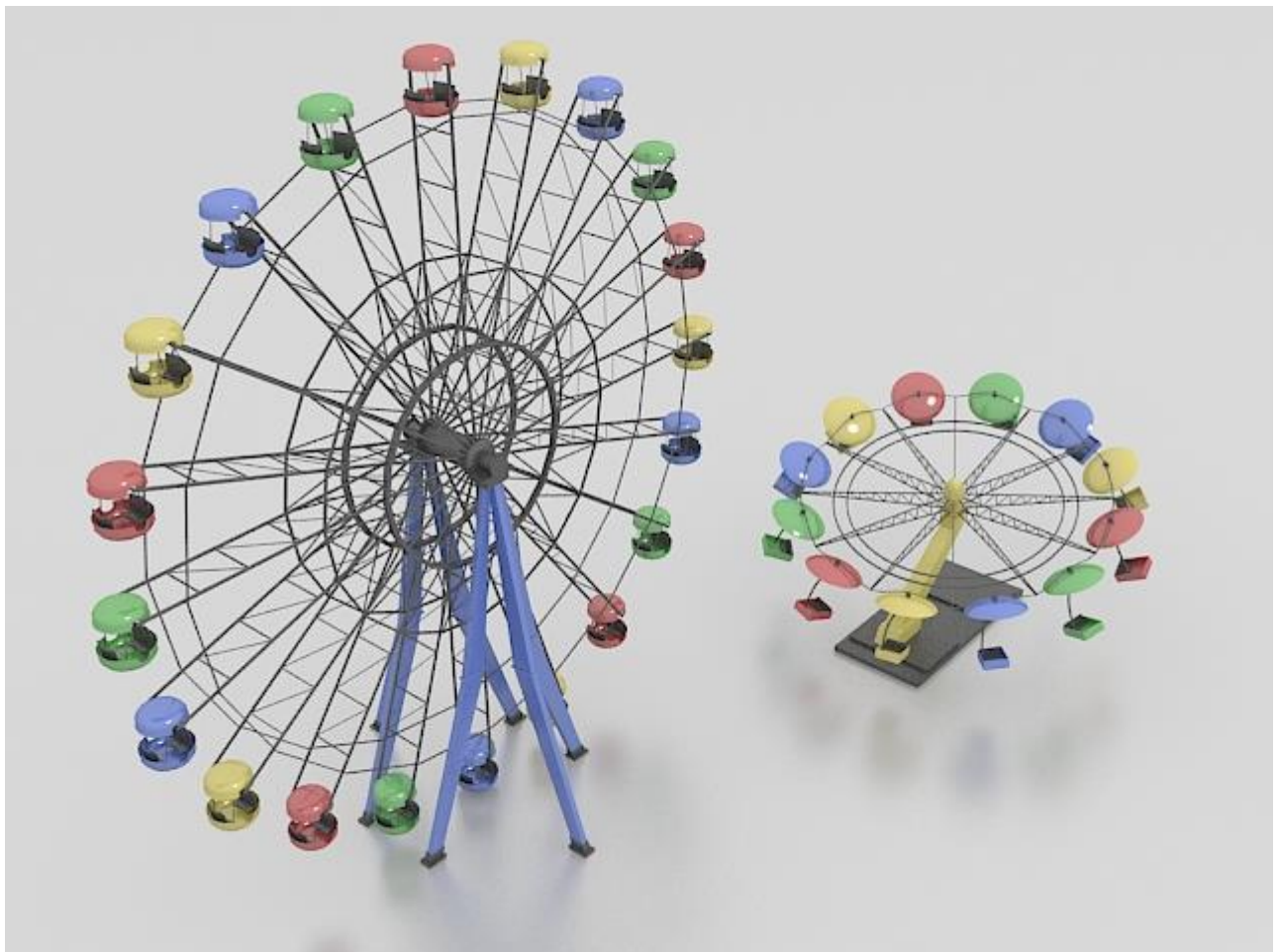


The ever-falling wheel

In AA3 we will create a Ferris Wheel with a physically-impossible variant called the Ever-Falling Wheel. For this purpose we will use 3 models:



All materials are available with the submission, although here can be found the following sources:

Chicken: <https://www.turbosquid.com/FullPreview/Index.cfm/ID/1266316>

Trump <http://www.denysalmaral.com/2016/11/free-lowpoly-donald-trump-3d-character.html>

Ferris Wheel: <http://www.cadnav.com/3d-models/model-27862.html>

Grades

All exercises count 1/2 point, except the last one, which counts 2 points.

Since the creation of the Big Wheel for the Chicago Fair in 1893, Big wheels or Ferris wheels have a long history as popular attractions.

Mandatory GUI Elements

The key A will trigger the following exercise. The Z key will trigger the previous exercise. All keys will work with normal case, not upper case (i.e., “a”, we do not care about “A”). Different keys will trigger different actions. A small menu will outline the possible key inputs, as listed below, will be shown:

Summary of keys:

- A: Following exercise
- Z: Previous exercise
- D: Day-Night transition triggering
- B: Light Bulb variant triggering
- T: Toon Shader variants triggering
- C: Camera position variants
- M: Model transitioning
- S: Depth and Stencil Shader variations
- P: Portal visible

In addition, **the number of the exercise loaded through the A and Z keys will be shown in the GUI** (01, 02, 03, etc.).

Scene Composition Exercise

1. Create a set of cubes and make them rotate around a circle, as if they were cabins of a Ferris Wheel. The circle will be centred on the X axis. Visualize them from a camera with a slightly elevated perspective and rotated 30 degrees along the Y axis, relative to the side of the wheel (i.e., if the rotation was zero degrees the wheel would appear as a vertical line). Make the cubes have their local rotation compensate and cancel the rotation of the circle. As a result, the cabins move along the circle, but their local rotation does not change (i.e., they stay axis aligned), as if they were the cabins of a grand wheel.

Tip: despite it looks like a rotation, it might be simpler to consider the movement of the cabin a displacement around a circle centred on the z axis:

$$pos(t) = \left(r * \cos \left(2\pi f t + \frac{2\pi i}{N} \right), r * \sin \left(2\pi f t + \frac{2\pi i}{N} \right), 0 \right)$$

Where t is time, r is the radius of the wheel, f is the frequency of rotation and the phase component is determined by N , the total number of cabins, and i , the cabin number.

Model Loading Exercise

2. Replace the cubes standing as cabins with the 3D models provided. Place the characters of Trump and the chicken in one cabin, facing each other. Place the structural elements of the Ferris wheel model. Make sure the M button transitions between the 3D models and the crude model based on cubes.



https://en.wikipedia.org/wiki/Ferris_Wheel

Camera Exercises

3. Place the camera alternating every 2 seconds between Trump's shoulder and the chicken's side, reproducing a shot reverse-shot scene. Make button C transition between the default camera position, and the shot-countershot camera positioning.

If you don't know what is a shot reverse-shot movie scene, here is a description:

<https://www.premiumbeat.com/blog/cinematic-shot-reverse-shot/>

Use as a reference example of camera positioning in a shot reverse-shot this video, between second 35 and second 50: https://www.youtube.com/watch?time_continue=5&v=wM6exo00T5I



If you prefer it, you can use as reference the opening trailer of mission impossible as seen in the 20 first seconds of this video: https://www.youtube.com/watch?time_continue=1&v=KOi9hHjmYq4



4. Make an additional camera view, this time from the axis of rotation of the wheel. Make sure half of the wheel appears on the left side of the screen, and half on the right.

Make an additional camera view, this time from the zenith of the cabin, emulating a god's eye shot of the two characters facing each other, with a slow counter-clockwise camera rotation. If the cabin roof is a problem, adjust the Z-near variable of the Camera variable in order to block its rendering.

Use as reference a scene from About a Boy, as found in second 0:55 of this video compilation:

<https://www.youtube.com/watch?v=mPIMouDYgtE>



Make button C transition between the different camera positions. In total it should be four:

- a) General shot
- b) Shot Counter Shot
- c) Lateral View
- d) Rotating god's eye shot

Light Source Exercises

5. Add a sphere as a light source, acting like an omnidirectional light. We will call this sphere the Sun. Make the Sun circle around the Ferris Wheel, and illuminate it with a diffuse shader. Make sure it rotates on a different axis than the Ferris Wheel, that at sunrise and sunset its light is more red, and that during the rest of the day the light is in the yellow-white range.
Make a day-night cycle lasts 20 seconds. Make sure the day and night last as long as each other (10 seconds each). At night, we want a low-intensity relatively dark blue ambient light. We also want a Moon. Create a second sphere as a light source, acting like a Moon. Make sure the moon rotates on at an angle of 135 relative to the sun rotation axis. And with a 9 seconds period (contrary to the sun). The Moon will act as a light blue diffuse omnidirectional light source. Make sure the shaders can combine the illumination sources of the Moon, the Sun and the ambient light.
6. Make the D key stop day-night transitions, or turn them on again. When they are stopped, compose the following illumination: the Moon is illuminating the scene, there is the low-intensity dark blue ambient light, and the Sun is not illuminating the scene. In addition, we will have a third sphere acting as a light source, as if it were a Light Bulb. Place the Light Bulb between the two models facing each other, slightly elevated, illuminating from the side. The light will be rather white, but with a distinctly stronger green component. Make the B key turn on the Bulb Light. When the day-night transitions are stopped, it should make a visible light. Use as a reference colour the Green Light coming from the Lighthouse in the Great Gasby movie.



<https://www.youtube.com/watch?v=YiqCuyj6Nvl> (minute 3.24)

7. Create an additional lightning effect by making the Light Bulb oscillate like a pendulum between -45 and +45 degrees. Make sure the oscillation occurs on the plane separating the two characters facing each other. Make sure the B button transitions between the three Light Bulb illuminations: turned off, turned on, and turned on with movement. Make sure that when the Day-Night transitions are stopped, it creates a visible effect. Take as a reference of illumination the moving bulb you can find from minute 1:00 in the very famous Hitchcock's Psycho scene:

<https://www.youtube.com/watch?v=xWHYmNrAFII>



Toon Shading Exercises

8. Make the T key activate a toon Shader effect where only the Sun illumination acts, and the Day-Night transitions are on. Pressing it again should activate again the diffuse illumination, compatible with all the variations triggered by the D and B keys.
9. Make the T key activate an additional Toon Shader illumination, where both the Sun and the Moon light sources act together, and the Day-Night transitions are on
10. Make the T key activate an additional Toon Shader illumination, where the night illumination and the oscillating light bulb act together, and the Day-Night transitions are off
11. Make the T key activate a contour highlight shader, in addition to the illumination in the previous exercise
12. Make the T key activate a refined contour highlight shader where, relative to the previous exercise, the contour of the 3D characters is thicker than the contour of the cabin or other objects.

Depth, and Stencil Buffer Exercises

13. Make the S key activate a scene composition where a Depth buffer test where the Wheel, as seen from the camera position of exercise 1, is only half visible, i.e., only the front version is visible. Pressing again S will activate the normal visibility of the wheel.
14. Make the S key activate an additional scene composition, with the camera positioned aligned with the wheel rotation axis. Create a Stencil buffer test, and use it to have each half of the wheel be rendered separately, with an empty space between the two halves.
15. Make the S key activate an additional scene composition. It will be the same composition as the previous exercise. However, in this case use two halves of two wheels, of two different colours, and with each rotating in opposite directions. Make sure that each half-visible wheel is always turning downwards. In addition, the cabin containing Trump and the Chicken is tele-transported from the lowest position of wheel 1 to the highest position of wheel 2, and reciprocally, from the lowest position of wheel 2 to the highest position of wheel 1.
16. Make the S key activate a modification of the previous exercise, where the camera is doing the shot counter shot transition. Make the colour of the two wheels the same, in order the movement feels as much as possible like a continuum.

Portal Exercises

17. Make the P key change the previous scene, with the tele-porting of the cabin, in order it looks like there is a portal where the cabin in the down position of one wheel seems to enter and come out in a second portal in the upper position of the other wheel.

Make sure the Day-Night transitions work by triggering the D key, and that the Light Bulb variations work by triggering the B key.

Make sure the different camera position transitions work when pressing C.

Make sure the different Toon shading options work when pressing T.

Summary of keys:

A: following exercise, and the exercise number will be shown in screen (01,02,03, etc.)

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D: Day-Night transition triggering

B: Light Bulb variant triggering

T: Toon Shader variants triggering

C: Camera position variants

M: Model transitioning

S: Depth and Stencil Shader variations

P: Portal visible

Delivery format

Your delivery will contain:

1. A two-page pdf document with the following items:
 - Page 1 should explain how to run the demo.
 - Page 1 should also explain your code is organized. This should include which are the main files, and the main environment (namespaces, classes, or other strategy). It should be clear from the document how you have organized the different materials for each element in the scene (3D models, shaders, light positions, camera transformations, etc.).
 - Page 1 should also include a link to a private repository containing the code. It should be possible to download, compile and execute the project only from this source code. I should be able to access to it
 - Page 2 should describe which were the main challenges and lessons learnt from doing these exercises.
 - For this document you are free to choose between Catalan, Spanish and English.
2. A folder called “executable” containing the built .exe, the needed dependencies to execute it, and nothing else