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COSC363 Assignment 1 Report

Models and their design

Figure 1 Scene showcasing all the models

Figure 2 Outside view of the front of the museum building

Pillars

The pillar models were generated by using a sweep surface method. The sketch that can be seen in the appendix in Figure A1 is what was used to work out the x and y values for each vertex. A table of these values can also be seen in Table A1 in the appendix section.

Museum Building

The museum building (Figure 2) is created using several scaled and transformed cube objects and a few quads. The front face of the building uses decals for the brick texture and a quad with a texture for the OpenGL Museum sign. The front of the building also uses the pillar models. The inside of the building can be seen in Figure 1.

Chest

The complete chest is made up of 9 transformed cubes for the base, 22 transformed cubes for the lid. The original sketches for the chest can be seen in Figure A2 in the appendix. A few minor changes (sizes and positions) were made when creating the model. The chest can be opened by pressing '1'.

Mimic chest

The mimic chest uses the chest model described above but also includes a total of 16 octahedron objects to form the teeth of the mimic. The original sketch can be seen in the appendix in Figure A2 with the sketches for the chest. The chest can be opened by pressing '2'.

Diamond

The diamond is another object that was generated by using a sweep surface method. The sketch for this can be seen in Figure 3. The diamond model is contained inside the chest and has a simple rotation animation and a floating motion.
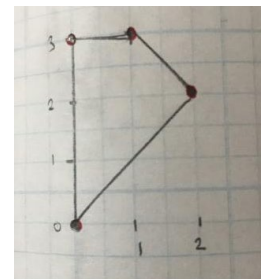

Figure 1 Vertices of the diamond

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Sword in the rocks

The sword is made up of 4 transformed cubes and 1 transformed octahedron for the tip of the blade. The rocks are made up of several cubes rotated and scaled varyingly. This model is lit from a light behind the sword which is the source of the light that is casting the planar shadow on the ground. The sword can be pulled out by pressing '3'.
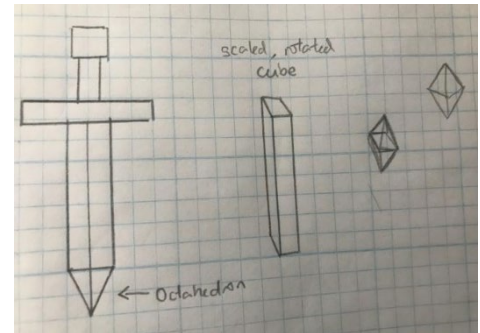

Figure 2 Original sketch of the sword

Lamp on a string

The lamp is made of a cylinder with two disks and a scaled cube for the string. The length of the string can be modified using '5 and '6' to decrease/increase the length. The '7' key can be pressed to activate the swinging animation again with the current length. A source of a spotlight follows the motion and rotation of the lamp.

Extra Features

Skybox

A skybox using textures provided as part of the lecture notes was added to the scene. The size of each quad is 1200x600.

Mathematical model for animating

A graph of these equations can be seen in the appendix.
The following functions were used together simulate the chest lid bouncing upon hitting the ground where θ is the open angle of the chest and t is time.
The open angle of 146 degrees is when the lid of the chest appears to hit the ground.

$$\theta = 146$$
$$\theta = 2t^2$$
$$\theta = \left(t - \sqrt{23} - \sqrt{73}\right)^2 + 100$$
$$\theta = \left(t - \sqrt{8} - 2\sqrt{23} - \sqrt{73}\right)^2 + 130$$

This "ease-out-cubic" function is used for the initial opening of the mimic chest lid as well as the pulling out of the sword in the rocks. Instead of a linear motion, the motion of the animation starts of rapid and smoothly slows down to a stop.

$$y = 1 - (1 - x)^3$$

This "ease in-out sine" function is used for when the mimic chest 'takes a breath' when the lid opens up again (after the initial opening).

$$y = -(\cos\left(\frac{\pi}{x}\right) - 1)/2$$

Physics-based animation – Simple pendulum

The lamp with a spotlight on the end of a string has an animation that follows a simple pendulum. The period of the swing is dependent on the length of the string (1 unit = 0.1m).

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The following equation was used to determine the angle the model should be rotated at θ depending on the length of the string L and time t.

$$\theta = \theta \max \cos \left(t \left(\frac{2\pi}{2\pi\sqrt{\frac{L}{g}}} \right) \right)$$

Moving and rotating spotlight

The lamp with a spotlight on the end of a string has an animation that follows a simple pendulum. The movement of the spotlight can be seen clearly on the floor as the model moves.

Planar shadow cast by an object

The sword model casts a planar shadow towards the centre of the room onto the ground. The code to do this from the lecture notes was used to achieve this.

Particle system

The sword model has a simple particle system surrounding it that generates fading in and out octahedron objects and 'random' x y and z positions around it.

Controls

Up/Down arrow keys –
Move camera forward/backwards
Left/Right arrow keys –
Turn the camera to the left/right
A / D – Move left/right
W / S – Move up/down
0 – Reset scene

1 – Open Chest
2 – Open Mimic
3 – Pull out the sword
4 – Toggle particles around the sword
5 – Lower the lamp
6 – Raise the lamp
7 – Start lamp swing

Instructions to run (Using Microsoft Visual Studio 2019)

➢ Install Microsoft Visual Studio 2019. https://visualstudio.microsoft.com/downloads/
➢ Unzip the .zip and open the COSC363_Assignment.sln file in Microsoft Visual Studio.
➢ Install/Download any workspaces that it suggests if you need to (May require a restart).
  o Reopen the COSC363_Assignment.sln file if needed
➢ Press "Local Windows Debugger" at the top to run the program or press Ctrl + F5

References

Image loading function used from Lab 3

Khan Academy – Simple Pendulums: https://www.khanacademy.org/science/ap-physics-1/simple-harmonic-motion-ap/simple-pendulums-ap/v/pendulum

HiClipart – "White Square Structure Angle Pattern, Vintage black brick wall background transparent background PNG clipart": https://www.hiclipart.com/free-transparent-background-png-clipart-dmqma/

easeOutCubic and easeInOutCubic functions: https://easings.net/

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Appendix

Table 1: The x and y values of each vertex for the pillar model

| N	Y	X	N	Y	X	N	Y	X
1	0	0.000	16	7.6	2.010	31	9.5	2.500
2	0	5.000	17	7.7	2.042	32	9.65	3.154
3	0.2	4.990	18	7.8	2.100	33	9.8	3.400
4	0.4	4.960	19	7.9	2.200	34	9.95	3.571
5	0.6	4.908	20	8	2.500	35	10.1	3.700
6	0.8	4.833	21	8.1	2.800	36	10.25	3.799
7	1	4.732	22	8.2	2.900	37	10.4	3.875
8	1.2	4.600	23	8.3	2.958	38	10.55	3.931
9	1.4	4.428	24	8.4	2.990	39	10.7	3.970
10	1.6	4.200	25	8.5	3.000	40	10.85	3.992
11	1.8	3.872	26	8.6	2.990	41	11	4.000
12	2	3.000	27	8.7	2.958	42	11	5.000
13	3	3.000	28	8.8	2.900	43	13	5.000
14	3	2.000	29	8.9	2.800	44	13	0.000
15	7.5	2.000	30	9	2.500			
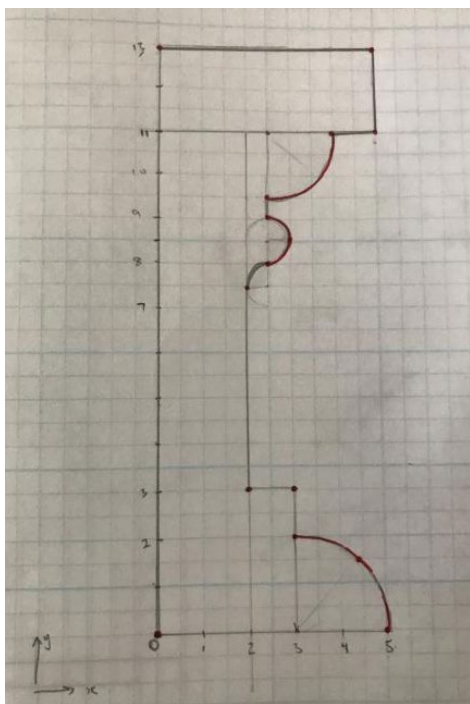
Figure 3 Sketch used for the pillar sweep object
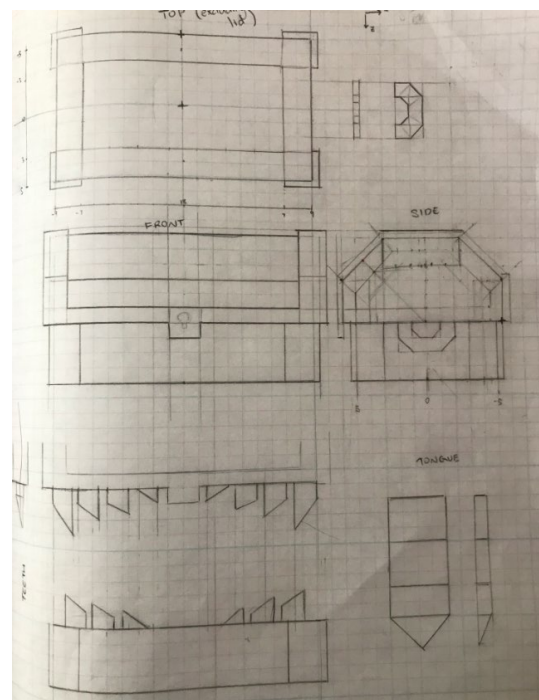
Figure 4 Original sketch of the chest and mimic