CS32420 – Report – jah79

1 Introduction

This assignment involved creating a house and numerous rooms, adding objects/items to the rooms and attempting to make the model as best looking as possible using textures, materials and lighting. This report will provide details of the creation of the house model I have created for the assignment and explain my reasons behind any decisions made along the way.

2 House Structure

2.1 Design

The first thing I did for this assignment was design how the house would look on paper, I sketched a few quick designs that came to mind and decided to choose this layout as it is simple and would be easy to navigate around as a user.

2.2 Floor

The floor was made of a PlaneGeometry, sized 1100x1100. I had to rotate the image to set it as the floor as it was created vertically. Throughout the assignment I have had to rotate many items, this was simply done by using 'Math.PI/180 * ##' where ## is the angle the object will turn. This floor plane was then used as the base scale for the house. I added a wood flooring image and used the same image for a bump map to try and give the floor an extra bit of texture. To do this I created a new mesh lambert type material by combining the image and the bump map and applied the new material to the object. I used mesh lambert as the floor is quite dull but as it is wood would still reflect some light.

2.3 Exterior Walls

The exterior walls were created with a box geometry. Similarly, to the floor plane, I added an image as part of the material to make the walls look better. The image was that of a brick wall. However, for the walls I decided to used mesh phong material instead as this would reflect some more light that the lambert material. I decided to use this after experimenting with the lights towards the end of the project. This extra reflectiveness meant the room was more lit up and looked better this way in my opinion. Two long walls were created of same length, these are the walls located towards the back of the scene. Towards the front of the house two slightly shorter walls were used to allow room for a doorway in the corner of the house.

2.4 Interior Walls

The interior walls were created in the same way as the Exterior walls, however used a different material which contained a more modern looking wall for the indoors. I decided to use a plain white plaster look as I believe it complemented the brick walls.

2.5 Doorways

There are three doorways in this scene. One is located at the front of the house in the corner, used as the entrance. This door was created by using two box geometries, to act as the doorframe and a cylinder to act as a sort of mini-porch. I gave these objects a metallic look using mesh standard material and adding roughness and metalness to it's properties.

The second doorway is located through the main door, to the right. From the hallway to the lounge. This was a simple doorway. The main indoor wall cutting the house in half was shortened slightly to allow room for the user to enter both sides and I then added a small box geometry in the gap to act as the wall above the doorway. I believe there is a way to enter each vertices of an object and create whichever shape you want, this would be good for such a situation, but I could not get my head around this technique. However, I would try to learn this technique for similar situations in the future especially as it could also be used to create a wall with windows.

The third doorway is an archway, linking the hallway to the kitchen. I first created a 2D arch shape by created a parametric geometry shape using a function which takes two number values, performs the operations required to make such a shape and returns the vectors required to make the mesh. The same function but with a slight change was used later in the project to create two cushions for the sofa placed in the lounge. I attempted to extrude the arch created but this was another thing I could not accomplish, I have however left the code I wrote while attempting commented out in the file. As extrusion did not work here, I simply duplicated the shape and placed one on each side of the wall to give the illusion of a 3D shape.

2.6 Path
Another box geometry, designed to be a flat walkway to guide the user to the house. I decided to start the user outside so the exterior of the house would also be seen by the user.

3 Living Room
3.1 Sofa
This object was the first object I created in this project by using several objects in a function to create one main object. In this case, the sofa is made up of multiple box objects of various sizes. I created a new function, within this function I created a new Object3D variable. For each part of the sofa created, it would then be added to this main object. For this function, it does not return the object but just makes the object and positions it, however it is possible to return the final object and I have used it this way later in the project.

On top of the sofa are two cushions created in a very similar way to the archway mentioned previously. This time I had to use both the *u* and *v* numbers passed through in the parameter to calculate the new vectors.

3.2 Rug
Another box object, made extremely thin and placed on level of floor plane to act as a carpet. Image and bump map added to the material of the carpet.

3.3 Table
Made from same function as the main table in the kitchen. Go to ‘Kitchen’ Section for more information.

3.4 Hologram
The hologram stand was made of a cylinder, one end of the cylinder is smaller than the other. The Hologram itself is a sphere that is following a dashed line geometry, this gave it the holographic globe effect. Within the render function is a line of code to rotate the hologram sphere. I had a cone shape to the base of the hologram pointing up to make it look as though the sphere was being projected from the stand. Using mesh phone material for the cone I was able to enable transparency and adjust the opacity to fit the role. In the centre of the hologram sphere is a blue light to make it seem as though the hologram itself is emitting a blue tint.

3.5 Monument
The stand of the monument was made with a simple cylinder shape. The art piece/monument is made of a torus knot. Three.js provides this odd shape and I thought it was worth using. I did not feel the need to use an image in the material for the monument as the red colour I chose suited it well.

3.6 Lamp
The lamp situated in the far corner of the lounge is made of two cylinders. One long, thin cylinder to act as the stand and one short, wider cylinder to act as a lampshade near the top. Slightly above the entire lamp is a point light to make the lamp seem more realistic.

3.7 Television
The television on the wall in the lounge a plain black box in the shape of a flatscreen TV. I originally had other plans for the TV. I saw on the threejs.org site in the examples section that it is possible to create a tile like canvas to act as a sort of window into a scene. I was hoping to use this technique on the TV but could not get it to work.

4 Kitchen
4.1 Table
As I planned to have two tables included in the scene, I decided to create a function to deal with the different size values. Function which requires three values to be passed in(height, width and depth), these values are then used to scale the object accordingly. Similarly to the creation of the sofa, a main Object3D was created in this function and the separate parts were added to this object. As I wanted to make a modern type of apartment, I decided to use only one centred leg on the small table in the lounge. I was hoping to add to this function to add legs but only to the kitchen table, however I was nearing the deadline of this assignment. I took inspiration for the table function from the Assign_SceneModelling example provided to us.

4.2 Cupboards
Long box object with cupboard image as material. Repeated the wrapping of the image on the X axis 5 times to get a row of cupboards.

4.3 Fridge
Another box shape, sized similar to that of a fridge. Image added to the material of the fridge to display a game like fridge.

5 Hallway
5.1 Vase
This is another technique I have learned from viewing some youTube tutroials. To create a vase-like object I create an array of points that gets passed into the geometry of the shape. The values passed though define the radius and frequency of oscillation along the Y axis. To create the shape, the geometry type I used was LatheGeometry().

5.2 Coat Stand
I wanted to add a coat stand object in the hallway but did not manage to create such a structure.

6 Player
6.1 Model
For the player model, I tried to make something along the lines of a pawn from chess or a cartoon-style human. To do this I created a function in which all the parts used to create player would be added to the player Object3D. For the body of the player I decided to use the same shape as the vase structure as it suits this role also. A sphere was used to form the head and the material used for each part of the body was a plain near-white colour. At first I left the model at that but when testing out the movement of the piece it became difficult to tell which way the player was face, and so I created a beak and attached it to the head of the player, facing in the direction of forward to the player.

My main idea for the camera was to focus on the player position and move when the player is moved, sort of like a 3rd person angle. However, I attempted many times to achieve this and used various methods but could not get it to work.

6.2 Controls – As mentioned above, I had tried to make the camera focus on the player and move when the player moves, but also allow the user to rotate the camera around the player. As I could not get this to happen, I had to compromise for the player moving while the camera remains focused on the centre of the scene (unless changed by mouse). As for the key controls, I decided to use the WASD keys instead of the arrow keys as I found the arrow keys also moved the screen for the user. At this point, I lowered the canvas slightly and added some text at the top of the HTML page to notify the user of the controls to this scene.

7 Lighting and Shadows
7.1 Ambient Light
Is used to make sure everything is at least slightly visible to the player. A general light.

7.2 Point Light
Used as the light source for the lamp in the lounge and to try light up the kitchen.

7.3 Spot Light
Targeted at the monument, used to add extra light in the lounge and cast a shadow of the monument on the wall behind.

7.4 Directional Light
Was removed and not required in this case, although I tried to implement it. However, when adding this light, it would begin to mess with the other lighting on the scene and I could not find a good balance to keep it in the scene.

8 Textures
All images used in this project were found on 'opengameart.org', which provides copyright free images for anyone to use in making games or animations. On this site, the bump maps were often provided alongside the image which was very useful.

9 Techniques Used & Possible Alternatives
9.1 Doorway Techniques
I created doorways by simply shortening the wall and adding a new object into the upper part of the gap created to form a doorway structure. However, this is not a good technique. I had researched a bit about three.js, mostly on threejs.org site, before I started the project. I found two techniques that would have worked better than the one I had used, I attempted to implement both but was not successful with either.

The first technique is to create your own shape by defining the position of each vertices of the shape. This is often used to create complex shapes that are difficult to create used the basic geometry library by three.js. A lot of code may be required for this depending on the size and complexity of the shape, a lot of the code would be very similar.

The second technique is object subtraction. This when you have two or more objects, each object has its colour. Using subtraction, it is possible to remove a part of a shape if it is crossing over another shape. The colour of the object is used to determine which object is which, and which object to subtract from the other.

9.2 Functions
Within the code I have, I have used a few functions to create an object (e.g. sofa, player model, table). However, I could have used more functions and I believe this would make the code more efficient, more understandable and more organised. I had already completed a large part of the project before I realised I could use functions in such a way. Although I partially followed this technique, if I was to rewrite the project I would use a lot more functions. Functions would be useful for whenever I need to use an object of similar properties as it would save repeated lines of code.

10 Problems Encountered
10.1 Camera Following Player
A main feature I was hoping to implement into the project was making the camera focus on the player and follow them when it moves as a 3rd person view. Hours of trying to get this working and I was still not able to.

10.2 Shadows and Lights
When adding the lights and shadows to the scene, I found one of the point lights was not acting as it should. To stop this, I lowered its intensity and radius, changed its position and adjusted the other lights appropriately. This worked but with the more lights I added the problem kept returning. I limited the amount of lights to 4 to stop any odd lighting from appearing.

As for shadows, some objects would not cast shadows even though they were set to cast shadows.

10.3 Making Windows – One of the first problems I encountered was making a window through the walls of the house. I understand this could be done with creating your own shape and defining the position of each vertices. There is also a technique called object subtraction that could be used to create the hole in the wall. I attempted object subtraction at one point but could not successfully implement it.

10.4 Making Complex Structures – I have attempted various techniques to create complex meshes but was not able to successfully implement them. These techniques include using vertices to define an object and using object subtraction.

10.5 Other Issues – When running the scene on my laptop I would sometimes get an unbearably low frame rate. This may be due to the shadows, lighting or just the models but it's unpredictable. Sometimes the frame rate would be really low and other times not so bad.

11 Materials Used

For this project I only looked through the examples provided to us on blackboard, the worksheets we had completed in the practical sessions and some youTube tutorials. See bibliography (13) for link to the youTube tutorial playlist.

12 Evaluation

I think the scene I have created is good. It shows use of various different geometries, materials, lighting, textures. I think the design is fine, however I would have liked to have added more complex structures, but I was not able to due to my current level of experience with three.js. Admittedly, the code is quite messy in places, but the comments help to clear that up a bit. If I was to repeat this project again in the future I would use more functions to not only organise code but to also have more efficient code. Perhaps I would have done this given more time, but other aspects of the project were more important.

13 Bibliography

CJ Gammon. (2017). *THREE.js Part 1: Intro*. [Online Video]. 28 August 2016. Available from: https://www.youtube.com/watch?v=ABV1mK1CGOY&list=PL08jItIqOb2qyMOhtEUoLh100KpccQiRf. [Accessed: 17 November 2017].