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# COSC363: Computer Graphics Assignment 1

## 1. Brief description

This is a scene of robots discovering a new planet. The scene contains these objects: a rainbow, a TV, a teapot on a stand, a space rover, butterflies and a custom space décor as shown in Figure 1.0. The textures used in this scene is on the walking robot, the skybox and the TV. Specular reflection can be clearly viewed on the teapot and the space décor. One robot has boosters and is doing a flip around a rainbow while another robot is walking on space décor. After the robot does the flip, it will fly in a circular motion in the sky following the butterflies. Also in Figure 1.1 it can be seen that the spotlight source is coming from the space rover's yellow light bulb. It is also apparent that the rover's body is floating, this is intended for futuristic effect. Figure 1.1 also shows a closer look of the custom space décor object that was designed using sweep and extrusion techniques.

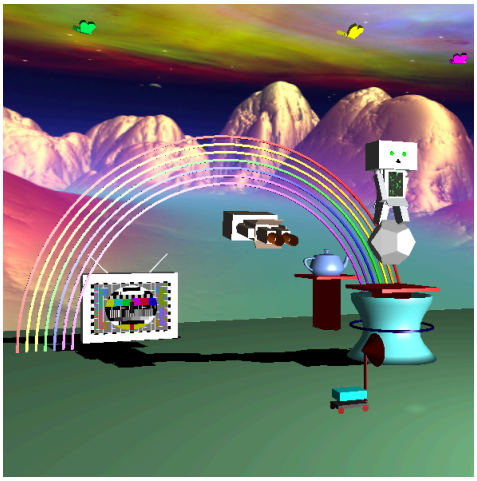

Figure 1.0. The overall scene showing all the objects in the scene.

Figure 1.1. A closer look at the space décor.

**2. Extra implemented features**

There are two camera modes: ground view and butterfly view. Shadows are generated for the space décor, flying robot and TV and a small spotlight moves with the space rover. A skybox is implemented for the top, left, right, back and front views and collision detection is implemented for the camera's x or z values so the camera will be restricted to the middle area of the box and cannot move outside the skybox. After the robot does a flip, it's collision to the ground is detected and then it boosts back up in the air and flies in a circular motion.

A formula is used for the rainbow. A half circular ring is then displayed in seven strips with different radii and colours. The ring uses GL_QUADS and draws three quads, one facing inwards, outwards and facing up. For every angle between 0 and 180 degrees in 5 degree intervals, the angle is converted to radians and then two angles are stored: the initial angle (angle1) and the initial angle added with the interval gap (angle2). Each angle, t, is then substituted into the parametric equations for a circle so that the coordinates of the points on the x and z planes can be found. The radius of the circle is represented as r and will change depending on which section of the quads are being calculated. For each quad, there will be four vertices. Given a width, height and radius, each 5-degree quad slice of the ring can be calculated using this equation:

$$x = r\cos(t)$$

$$z = r\sin(t)$$

For the quad facing up, the first coordinate calculation use angle1 as t and the difference between the given radius and width as r. The second calculation also uses angle1 but r is used as the value of the radius plus the width. The third and fourth calculation follow the same formula but uses angle2 as t. The normal and y values are fixed as the given height because the quad needs to be fixed to the highest part of the ring to be facing upwards. This step is repeated for all quads but with different normal and radius values so that the quad is facing the correct direction. The y coordinate value is specified as the height if the quad will be touching the edge of the quad that is facing up otherwise the y value is set to 0.

**3. Model descriptions**

Custom model of a space décor is built by a sweep surfaces such as extruded shapes and surfaces of revolution. Using the lab material [1] as guidance and by sketching on paper to design the shape and estimate the vertex values, the shapes were generated. The vertex data were roughly calculated from the sketched model on paper shown in Figure 3.0 and then small adjustments are made to the vertex data when the base curve is drawn on the scene. The rotated base curve is created with a triangle strip

using the given equations from the lecture notes [2] and each point is rotated about the y-axis by a degree. This step is repeated 360 times to get a smooth 360-degree revolution of the base curve.

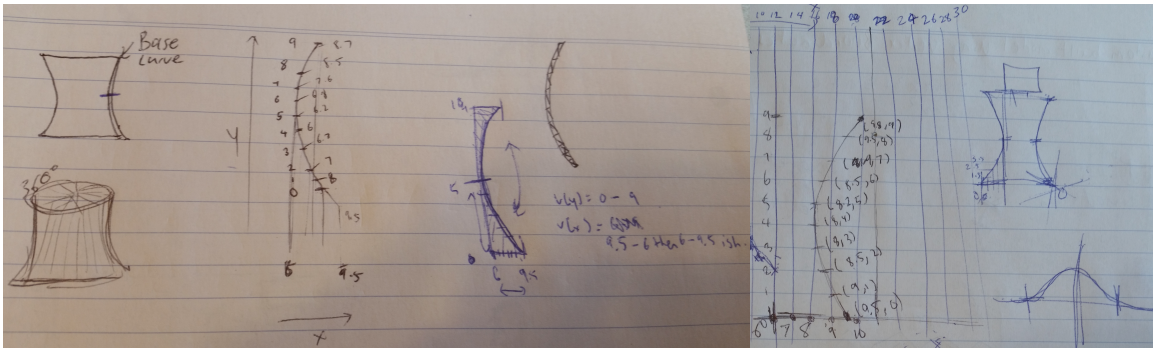


Figure 3.0: Rough sketches of the surface of revolution's vertex data for the base curve

For futuristic effect a dodecahedron object is continuously rotating above it and there is a sphere slowly orbiting around it attached to a ring. Inside the middle of the hourglass-like shape, there is an extruded model that acts as a column. This column is also used for the teapot stand. The base polygon is a hexagon; the vertices are calculated by the sketch shown in Figure 3.1. A quad strip is used to generate the surface of the extruded shape.

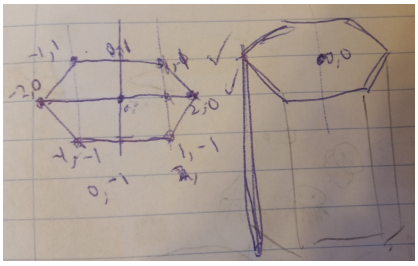

Figure 3.1 Rough sketch of extruded object.

The butterfly is a custom-built model designed using vertex coordinates and polygon definitions. The vertex coordinates for one wing was used because the wings are symmetrical. Figure 3.2 shows a sketch of the shape and its vertices.

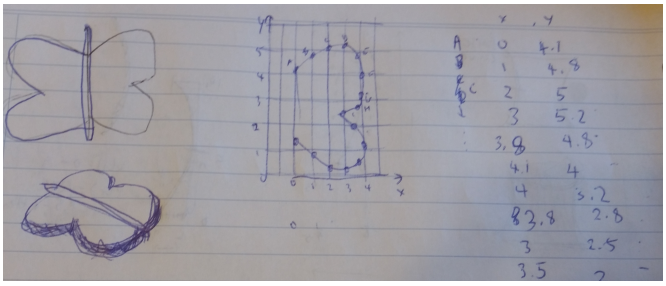

Figure 3.2: Sketch of butterfly model

**Challenges faced**

This assignment was very difficult for me because it took a long time to design the models before I started coding. Since my code was all in one big file it was hard to maintain and I ran into many problems such as bugs but also hard to navigate through my code during implementation.

**Control functions**

The control functions for interacting with the scene is simply the UP, DOWN, LEFT and RIGHT buttons to control the camera movement.

Press ‘b’ for butterfly-cam and ‘g’ for ground camera.

**References:**

1. Dr. R. Mukundan. (2017). *COSC363 Lab material*. Retrieved from http://www.learn.canterbury.ac.nz/
2. Dr. R. Mukundan. (2017). *COSC363 Lecture material*. Retrieved from http://www.learn.canterbury.ac.nz/