# COSC363
Assignment 1 Report

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Scene Description

The scene is on another planet in the mountains where there is a giant cog that spins. The robots must keep it spinning or else the drone will shoot them all. In the scene there is a small cuboid robot, "Wallie" he has a job to sort the items that fall through the trap door from the level above. Wallie does this under the watchful eye of the drone near by. The spinning spot lights come from the motion detectors to help out the drone. Wallie has to pass the cogs to the level below though the trap door and throw the junk away. This is so that the spinning cog can continue to spin using the cogs as spare parts and Wallie doesn't get shot. The cog and vase drop from the trap door. Wallie then picks up the vase and rolls to the edge and throws it off the level then rolls to the cog picks it up and places it on the trap door to fall to the lower level.
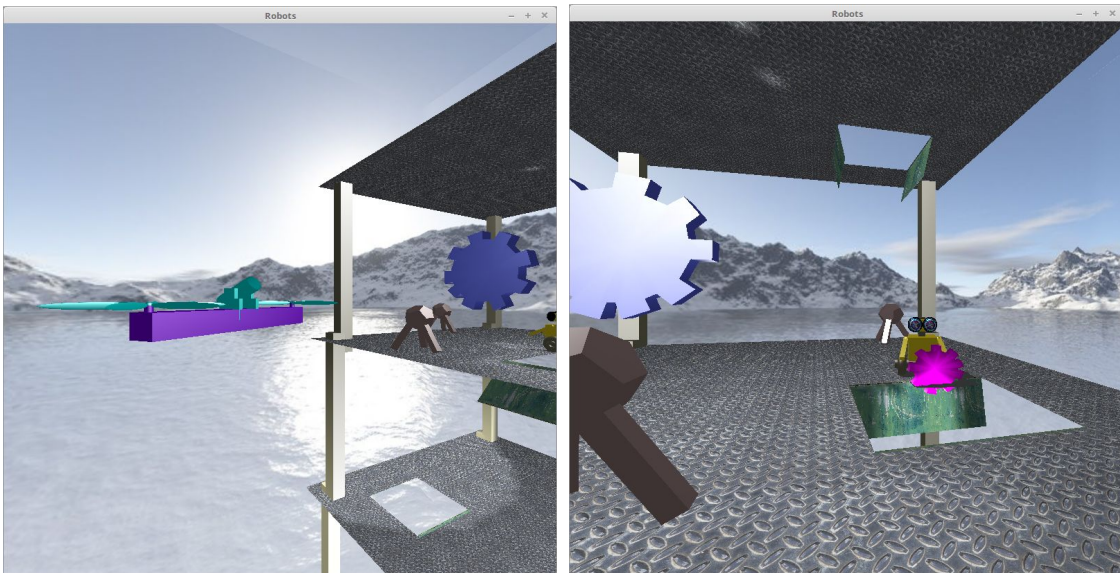
Left: Drone hovering and cog spinning. Right: Wallie dropping cog down trap door.
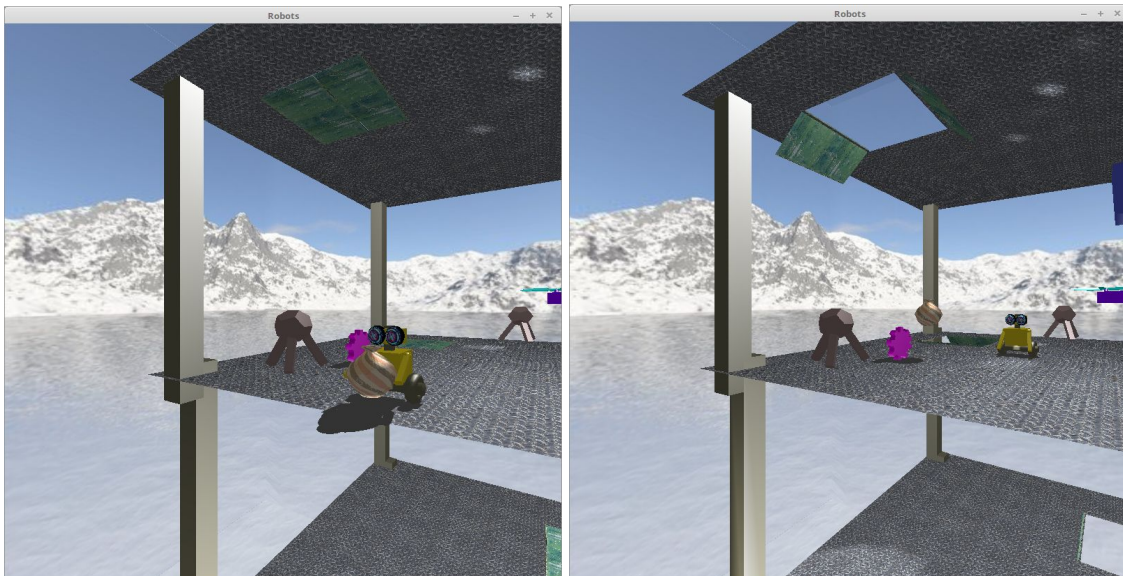
Left: Wallie throwing vase away. Right: vase and cog falling from trap door with wallie going to get them.
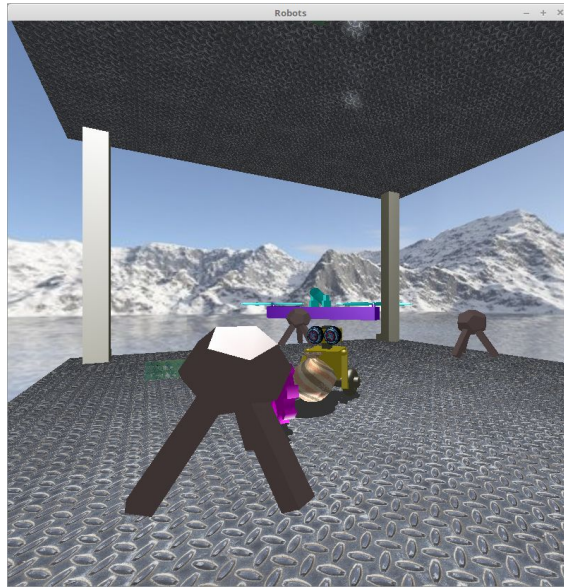
Wallie rolling to pick up the vase. Drone in background

Extra features:

Shadows

The robot and small cog and vase have planar shadows. These shadows disappear when the object goes below 0 in the y axis or if it goes out side of the ground plane.

Spotlight on robot

There is a small spot light in front of the robot. It is hard to see in some places due to other sources of light.

2 camera modes

The first camera mode is the default where you can move around the scene. The second is a first person view of the robot accessed by pressing 'p'. The view presents what he sees.

Physics models

There is gravity in the scene. The vase has a weight of 1.2kg and accelerates at a rate of 9.81 * 1.2 when it falls. The cog has a weight of 2kg and accelerates at a rate of 9.81 * 2 when it falls. This was done using the kinematic equation $d = 0.5 * a * t^2$ to calculate the distance the object fell where the acceleration is gravity * mass and the time was incremented by a small amount each time the timer is called.

When the robot throws off the vase the vase follows a parabolic arc and is affected by gravity. The total vertical distance that the vase fell was given by the kinematic equation $d = vi * t + 0.5 * a * t^2$. The angle that the vase starts off at is 60 degrees, about 1 radian, and the original velocity was 5 ms^{-1}. Therefore using the equation $5 * sin(1) * t - 9.81 * 1.2 * t^2$ gives the total distance the vase has travelled vertically. The horizontal distance is given by $5 * sin(1) * t$. These are added to offsets so that the vase appears in the correct starting location.

Sweep Surfaces

The vase is a simple surface of revolution see scanned drawing below. The x's on the drawing translate to the points I defined for it.
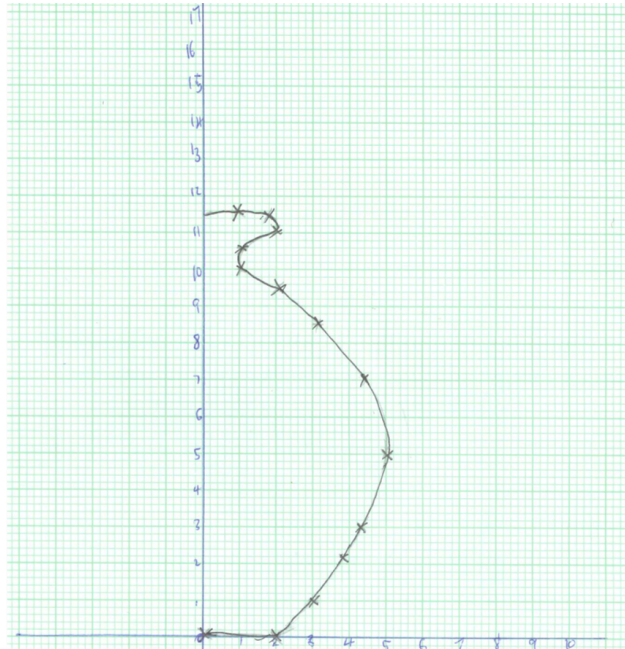
The rim of the cog was made using a sweep surface. The faces are filled in with triangles with one triangle between two adjacent vertices on the shape and the point 0,0. The back face is the same but an offset of 1 in the Z axis. The x's on the drawing translate to the points defined for the shape.
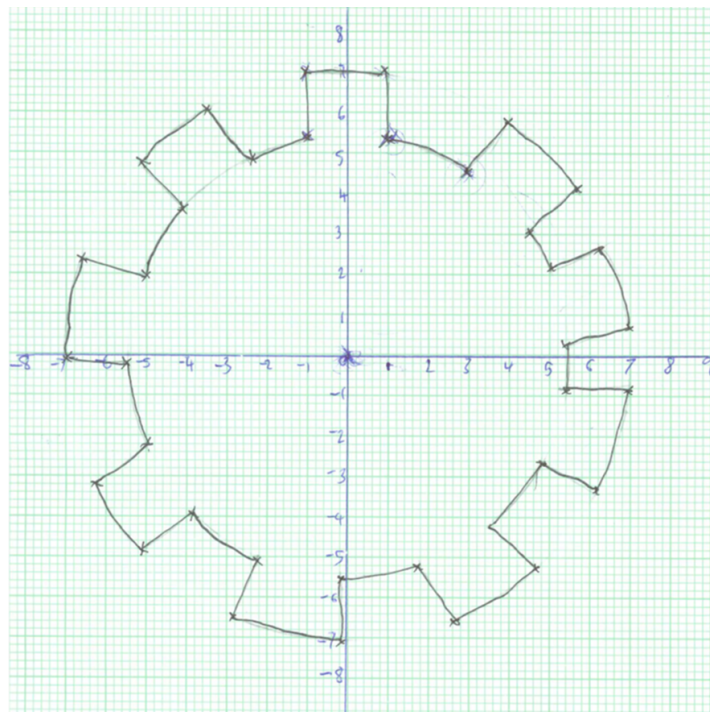
Sky box

As is the screenshots there is a snowy mountain view skybox surrounding the scene. This is made from 6 large quads with a texture on each that join together to look seamless.

Models

The models I designed are the vase, cog, drone and robot. The vase and the cog are sweep surfaces and the drawings can be seen above. The robot and drone are made up of GLUT objects that have been combined together. The tower itself is made of the trap door which is 2 quads, the floors which are 30 by 30 1x1 dimensioned squares so that the spotlights can illuminate properly, and 4 glut cubes as columns for each level.

Challenges

It was challenging to texture the ground as the texture had to go over multiple quads and the texture coordinates had to be calculated. I solved this problem by making the y texture coordinate increment every time a quad is drawn then for each row it is reverted back to 0. The x texture coordinate is only incremented each time x is incremented.

It was also challenging to make the vase rotate nicely with the robot when it was picked up. This was because I was scaling my vase after I translated it which meant my vase x and z where different from the robot's x and z even though they appeared at the same position. After I fixed this it was much easier and I managed to use the robots x and z with an offset for the vase and transform them together in a push pop block.

It was challenging making the textures for the sky box all line up so that they look seamless. This was partly based on the texture I chose. I didn't realise that 2 of my textures where flipped the opposite way to the others and that is why they would never line up.

Controls

- Pressing P toggles the first person view.
- The up and down arrows move the camera forward and backward.
- The left and right keys turn the camera to the left and the right.
- The page up and page down keys move the camera up and down.

Resources

1. Textures.com for floor and trapdoor.
2. COSC363 lecture notes and labs
3. http://gamebanana.com/textures/1875 for skybox
4. http://imgarcade.com/robot-eye.html for eye texture for robot
5. https://www.vecteezy.com/vector-art/125582-dirty-grunge-stripes-background for vase texture