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# COSC363 Assignment 1 Report

## The Scene

TT the robot owns a lifestyle farm with some free-range sheep and pigs.  Situated in the heart of the Robert Forest, this farm has an estimated net worth of $$$.  The Cottage provides a rest place for TT and clean water is supplied by the fountain.  TT likes walking around the animals and checking if they are happy and healthy.  The animals are very excited to see TT come over so that they jump, dance and wave tails.

*Figure 1: Overview*

*Figure 2: Robot shadow, water particles and a moving spot light*

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## Extra Features

1. **Planar shadows cast**: The robot has a shadow. This is done by the shadow transformation matrix.

2. **A spotlight on a moving/rotating object**: The spotlight is on the right arm of the robot for checking animals.

3. **Skybox**: The whole scene is textured by a set of skybox textures except that the floor is textured separately.

4. **Particle system**: This is shown as the water particles shooting from the fountain, which is handled by:
(1) Particle Structure: Defines the properties of a particle;
(2) init_particles(): Initializes particles with random speed in x, y, z directions and a random fade value to reduce life;
(3) update_position(): Updates particles' positions and draw them. If a particle dies or out of the desired visual domain, then it will be re-initialized.

5. **Two camera modes**: A first-person-view camera and a general camera. The first-person-view is achieved by rotating the whole scene by inverting the transformation that was applied to the robot.

6. **Custom-built models designed using vertex coordinates and polygon definitions**: Animals and trees are built by combining glut objects. For the construction of Cottage, please see Figure 3:

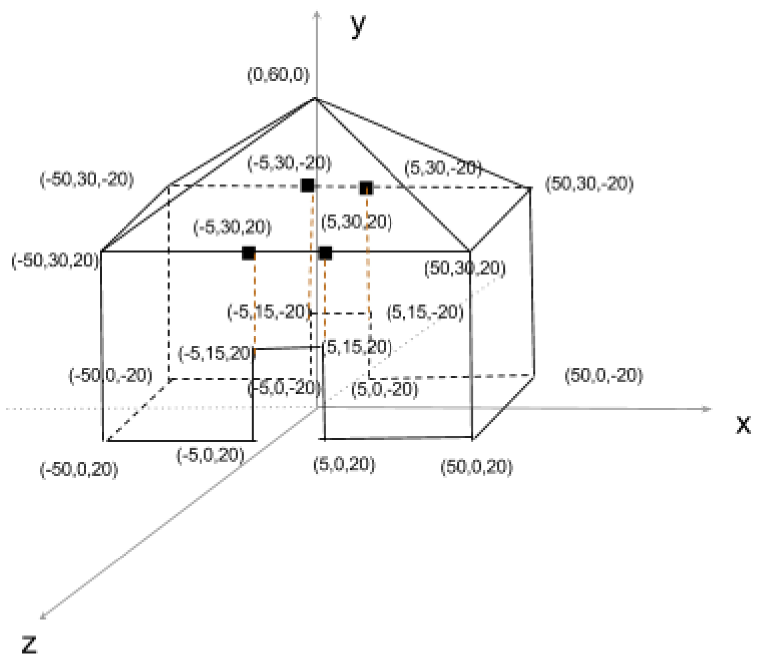


*Figure 3: Cottage*

7. **A custom-built sweep surface**: Fountain Base. Please see figure 4

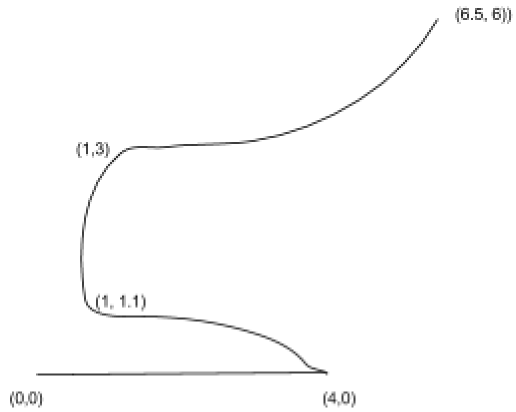


*Figure 4: Base curve for Fountain Base*

This base curve is plotted using the following set of 25 vertices:

```
//points on the sweep surface 'Fountain Base'
float vx[N] = {0,4,3.8,3.5,3,2.5,2,1.5,1,0.9,0.9,1,1.2,1.5,2,2.5,3,3.5,4,4.5,5,5.2,5.5,6,6.5};
float vy[N] = {0,0,0.2,0.4,0.5,0.7,0.8,0.9,1.1,1.5,2.5,3,3.2,3.5,3.75,3.8,3.83,3.89,3.9,3.95,4,4.2,4.5,5,6};
float vz[N] = {0};
```

## Control Functions

1. F/f: Change the camera to first-person-view.
2. G/g: Change the camera back to the default general view.
3. P/p: Freeze the movement of the objects.
4. S/s: Unfreeze the movement of the objects.
5. ↑: Move the general camera forward.
6. ↓: Move the general camera backward.
7. ←: Turn the general camera left by 5 degrees.
8. →: Turn the general camera right by 5 degrees.

## Challenges

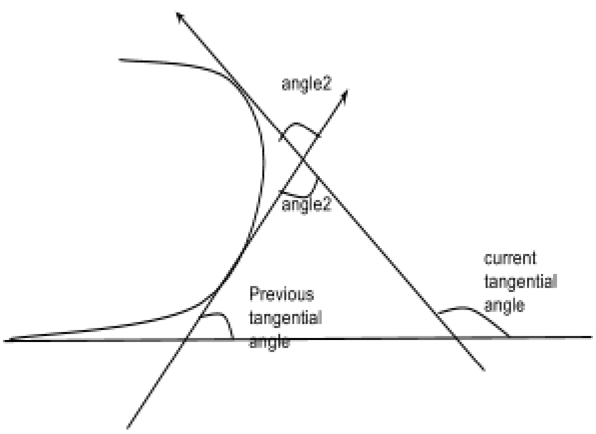


*Figure 5: Calculation of the self-rotating angle*

The robot walks in a Lemniscate curve[1]. Therefore its self-rotating angle varies as the tangent to the curve changes. The tangential angle to a Lemniscate curve is $\phi(t) = 3tan^{-1}sin(t)$. As shown in figure 5, $\phi current = angle\,2 + \phi previous$ where angle2 is the self-rotating angle. Therefore, In the timer, we could update angle2 as:
angle2 -= 3 * (atan(sin(t)) - atan(sin(t - 0.4)))
Although I can't guarantee the correctness of this caculation, it does give the desired visual effect after many attempts to use other methods.

[1] http://mathworld.wolfram.com/Lemniscate.html