CSCI 4458 | CSCI 5558
HW 02 - Transforms and Animations

Assigned: September 16, 2019
Due: October 04, 2019 @ 17:00h

Purpose

- To explore the underlying mathematics behind transformations and animations
- To implement a more complex scene which includes basic lighting, materials, animation, and transformations.

Part 1 (2 Points Each)

1. Three points are defined at $P_1 = (2, 4, -1)$, $P_2 = (3, 2, 1)$, $P_3 = (2, 3, 3)$. Use vector dot product to compute the cosine of the angle $P_1P_2P_3$.
2. Assume that P_1, P_2, and P_3 were entered counter-clockwise (CCW). Computer an up vector to the plane that contains the three points.
3. Computer the combined transformation matrix for a counterclockwise rotation of 45 degrees about the Y-axis fixing the point (1, 1, 1) followed by a scale of (1, 2, 2) fixing the point (-1, 1, 0).
4. Apply the combined transformation to the point (1, -1, 2).
5. Use quaternions to rotate the point (2, 0, 1) 60 degrees around the vector (1, 1, 1). Do the calculations two ways: (a) using the quaternion multiplication formula, and (b) using long multiplication. Remember that you will have to normalize the vector (1, 1, 1) so that you have a unit vector.

Part 2 {40 Points}

The levels are incremental. You only need to demo the last one. You will be trusted on whether or not you are using Vertex Buffer Objects.

1. (50% level) Build a rectangular house with a flat roof. Light it with a single light source. Walls can be the same color, with a different color roof.
2. (60% level) Make the roof more interesting (not flat) and add a door and two windows to one wall. At least one wall should be a different color.

3. (70% level) Animate the scene by flying around the house. Include windows on more than one wall. Please note that animation based on keyboard or mouse movements will not be considered, rather, you must utilize animation based on timers and the idle function.

4. (80% level) Use vertex buffer objects to define the house. Lighting should include one light source and ambient, diffuse, and specular lighting. You will also need to define the materials of each object in your scene.

5. (90% level) Make multiple (at least three) instances of the house using your vertex buffer objects.

6. (100% level) Change the base house shape so that it is no longer just a rectangle (it should have at least six walls). Attach a garage. Add a brick walkway to the front door. There should also be a back door. Doors should have handles or doorknobs. Your animation should include zooming in close so that you can see the door controls. Add anything else that you want to the scene.

Submission

Submit your written assignment as a Single PDF compiled using LaTeX to Moodle. The programming assignment must be demoed no later than 5pm on the due date.