CS606: Computer Graphics / Term 2 (2020-21) / Programming Assignment 2

International Institute of Information Technology Bangalore

Announcement Date: Feb 1, 2021
Submission Deadline: 11:59 pm IST, Feb 14, 2021

Summary: Rendering and manipulation of 3D models.
Learning Objectives:
- Creating 3D models (using a modeling tool)
- Importing 3D mesh models
- Transformations of 3D objects
- View transformations
- Picking model objects and their constituent parts in 3D

Assignment: Simple 3D Model Viewer

The features to be covered in the assignment are listed below. Please see the section **Implementation Notes** at the end for suggestions on the design and implementation.

I. <u>Create a set of solid models</u> (at least 3). You can create them using Blender or other modeling tools, and save the models in a common format, or you can use publicly available models. At least one of the objects should contain 2 or more bounding surfaces/faces (and hence may need to be written out as separate files).

II. <u>Implement a WebGL program</u> with the following features:
The steps below should be triggered using keyboard, mouse or UI events. It should be possible to perform steps D to I in any order, and any number of times.

    A. Draw the axes of the scene (world coordinates). You could use a cylinder topped with a cone for each axis. Color the x, y, z axis with R, G, B respectively.
    B. Import the three 3D models generated in Step I. Each model is read in from one or more files, depending on how the faces have been saved in Step I. You can assume any one of the common formats - obj, ply, stl, etc
    C. Render the model objects positioned at the origin. Each model object is assigned a different color.

D. Position the objects at the corners of a triangle (on the x-y plane in world coordinates). Choose a triangle that is approximately centered at the origin of the scene.
E. Re-position the objects at the mid points of the sides of the triangle.
F. Rotate the objects: each object is rotated by 90 deg about a point within the object. One object about the x-axis, one about the y-axis and the third about the z-axis
G. Scale the 3 objects by 0.5x, 2x, 3x respectively
H. Picking objects or their faces: We have two selection modes: Object mode or Face mode
   1. If in Object mode, clicking on an object selects the model object where the mouse was clicked
   2. If in Face mode, picks the face of the object that was clicked
   3. Set the color of the selected object or face. Choose a "selection" color that is distinctly different from those of the model objects.
   4. Clicking away from any object unselects the last selected object or face
I. Use the mouse (left button down and drag) to rotate the camera about one of the x/y/z axes and the origin of the scene.

Implementation Notes:
1. Model: We will point you to sample code for importing ply/obj files to WebGL and also provide a couple of sample models to get started. You can also import readily available mesh files such as at
   https://people.sc.fsu.edu/~jburkardt/data/ply/ply.html
   Bonus marks will be awarded to those who generate their own models using Blender, and based on the quality of the models.
2. Primary axes: It would be easiest to create an instance of a cylinder+cone, appropriately positioned, using Blender, save that out as a model file, and import that into your WebGL program. You can then copy and rotate to create the three axes.
3. Object Transformations: All object transformations should be implemented by generating/modifying transformation matrices - one each for scale, rotate, translate - of the respective object, and applying these during the render process. Rotations are to be done using Euler rotations about three principal axes. We will be using quaternions in the subsequent assignments only.
4. User interactions: Define keyboard mappings or develop UI widgets for the interactive steps. At a minimum, set up a keyboard mapping for each of the steps A to I, and using the key should produce the effect described for that step.

Note that you will need to have additional key bindings for toggling selection mode between Object/Face, and for the camera rotation.

5. Camera manipulation: For this assignment, we will restrict to rotations about one of the three primary axes at the origin. You can select the axis of rotation with a key or other way to select the rotation mode. Use the direction in which the mouse is dragged (right or left) to decide if the rotation should be a positive or negative angle

Deliverables:

Submissions must be made on LMS.

1. The deliverables in a zipped folder must include a source code folder, a folder with screenshots, and a demo video not longer than 5 minutes. More details on the submission are given in the course handbook on the LMS course page.
2. If the deliverables are larger than the maximum allowable size on LMS, submit a text document with a repository URL (Google Drive, OneDrive, etc.). Care must be taken to not change this repository until grading is done.

Questions to be answered in the report:

1. To what extent were you able to reuse code from Assignment 1?
2. What were the primary changes in the use of WebGL in moving from 2D to 3D?
3. How were the translate, scale and rotate matrices arranged such that rotations and scaling are independent of the position or orientation of the object?

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