COM6503: 3D Computer Graphics: Assignment 1 (40%)

Dr Steve Maddock

Deadline: 3pm, Wednesday 6 December

1. Introduction

The assignment will involve using modern OpenGL to render a scene. Scene graphs are required in the modelling process and animation controls are required for hierarchical models.

2. Learning outcomes

After completing this assignment, you will be able to:

- Use data structures and mathematics in representing and manipulating 3D objects
- Produce interactive software that makes use of a graphics API

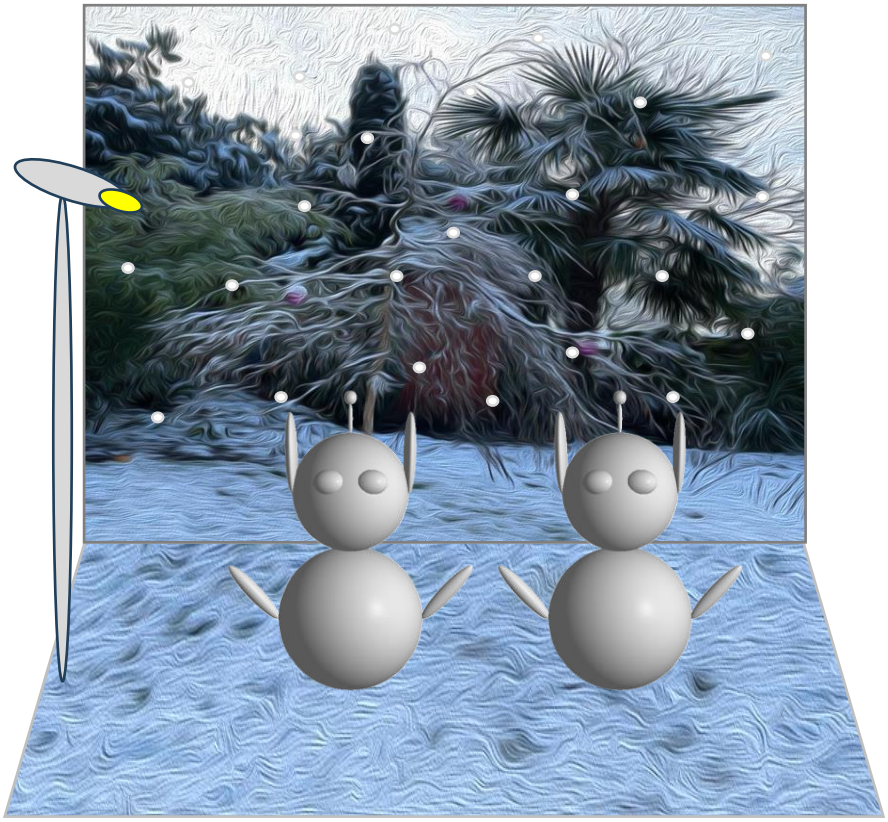

Figure 1. A snowy scene with two aliens and a security spotlight

3. Requirements

Figure 1 shows a snowy scene containing two aliens and a security spotlight. The whole scene can be modelled using transformed planes, cubes and spheres. The background to the scene should be animating, e.g. snow falling.

You must satisfy all the following requirements.

3.1 The backdrop

- In Figure 1, this is made of two planes with pictures of snowy scenes on them. The vertical plane is the view behind the aliens. They are standing on the horizontal plane. This is a minimal backdrop.
- The backdrop must be a snowy scene.
- The backdrop can be improved by making sure the texture maps on the planes match each other at the join.
- The vertical plane can be improved by making it an animated texture map, e.g. snow falling.
- The backdrop as a whole could be improved if the scene surrounded the aliens, either by using more vertical planes around the aliens or by using a skybox or by using a combination of planes and skybox.
- The quality of what you produce for this part of the scene will be part of the marking. Some possibles indicated above are more advanced than others. You must choose what to try.

3.2 The security spotlight

- There is a security spotlight next to the aliens.
- The spotlight continuously rotates around the top of its pole so that sometimes it points at the aliens.
- The spotlight is made of transformed spheres.
- This is an advanced requirement as you are responsible for working out how to implement a spotlight effect. (The relevant section in Joey's online tutorial might help.)

3.3 The aliens

- Each hierarchical model of an alien in Figure 1 is made up of 10 transformed spheres – a body, two arms, a head, two eyes, two ears and an antenna (which is made of two spheres).
- The hierarchy and associated transformations are more important than the quality of the individual pieces in the hierarchy. I want you to demonstrate that you understand transformations and a scene graph hierarchy.
- The model for each alien is the same.
- In Figure 1, the aliens are grey. You must texture-map each part of each alien. You must decide on textures for each alien model part and all the textures for one alien must be different to the other alien. You cannot use the same texture on each alien.
- I'll be looking for a little creativity in the texturing. For example, have you considered both diffuse and specular maps?
- Each alien can rock its whole body from side to side.
- Each alien can roll its head around its body a little. This can be side to side or forwards and backwards.
- An alien's head should always remain connected to its body – as long as the rolling movement is approximately correct that is acceptable.
- The aliens could animate synchronously or separately or both. You choose. This will affect the number of buttons on the user interface.
- I'll be looking for a little creativity in the animation.

3.4 General illumination

- The scene should be illuminated with at least two general world lights which can be positioned anywhere in the world.
- These general world lights will illuminate all parts of the scene and help visualise the scene during development and testing.
- When you switch off the general light(s), the effects of the security spotlight will be much clearer.
- You do NOT have to do shadows. Do not worry about shadow effects.

3.5 User interface

- A user-controlled camera should be positioned in the scene. Use the camera that was given in the tutorial material – the mouse can be used to change the direction the camera is pointing in and the keys can be used to move about. Do not change the key mappings from the one in the tutorial. If you change the key mappings it will make it difficult to mark. It doesn't matter that the camera can see outside the room.
- It should be possible to turn each of the general lights on and off (or dim, i.e. reduce the intensity) from the interface.
- It should be possible to turn the security spotlight (bulb) on and off.
- There should be buttons to control each alien's movements, i.e. 'Rock' and 'Roll'. The number of buttons will be determined by whether your aliens animate individually or synchronously or both. As an example, for a button labelled 'Rock 1', the first alien would rock from side to side for either a predetermined time period or continuously until a stop button is pressed. You choose.

3.6 Animation

- The animations are not straightforward and you may decide not to do this part, although that would affect your marks for this part.
- It is perfectly acceptable to animate the Euler angles to achieve movement of the hierarchy. Do not consider using quaternions, as this is beyond the requirements for this assignment.

4. Deliverables

- You should submit a zip file containing a copy of your program code (and any other necessary resources, e.g. image files for the textures and a readme.txt file that describes everything) via Blackboard – this can be done via the link to the assignment handout.
- You should submit whatever you have done, even if you have not completed all the requirements – for example, you might have produced a model of the scene but not done the animation. If you submit nothing, you cannot receive any marks.
- **The program MUST compile and run from the command window on a Windows PC or the terminal window on a Mac**. You should assume that the jogl environment (and paths) has already been set up, so you do not have to include this as part of what you hand in. I won't install 'YetAnotherIDE' to make your program work; I want to run the program (and, if necessary, check the compilation) from a command (or terminal) window.

- You must include appropriate comments in your program to identify that you wrote the code, e.g. /* I declare that this code is my own work */ /* Author <insert your name here> <insert your email address here> */
- You can make use of all the code that I have given you in the tutorial material. However, use your comments to state which bits/chunks/files are new.
- The body of the Blackboard submission message should state that the work you have handed in is your own.
- The name of the main class in your program should be **Aliens**. That way it is easy for me to run the program. (Last year, I wasted time for some handins trying to work out which was the main class to run.) It would be useful to include a batch/script file to automatically compile and/or run the program.
- *Optional*: You might like to make a short video of your animation. If you do so, **DO NOT** include this in the handin as it will be too big for Blackboard to handle – we tried using Blackboard for this in the past and it crashed the system!! Instead, put the animation on youtube or your personal website and give the URL of the animation in a readme.txt file. Indeed, if you are thinking of a career in the graphics industry, then you should be adding such animation pieces to your personal website (your digital portfolio) to show off what you are capable of.

5. Marking

I will check that the program meets the requirements listed above. The program **must** compile and do some part of the work requested even if it is not complete. Your program will be run and exercised thoroughly.

In considering the requirements, four aspects will be considered (including the quality of the work for each aspect):

- (30 marks) Modelling the scene: An alien must be a hierarchical model. How is the backdrop done? Is there a security light? (Consider drawing scene graphs for the scene before starting to program.)
- (27 marks) Texturing: Use of texture mapping in the scene, e.g. basic texture mapping, use of diffuse and specular textures, extra texturing effects for the backdrop.
- (18 marks) Lighting and interface controls: lights should behave correctly such that their effect is seen on the scene. Necessary interface controls, as described in the above specification, should also be included.
- (25 marks) Security light animation. Alien animation: rock and roll. Animation for both aliens. Is the animation plausible and smooth?

6. Unfair means

- The Department's student handbooks (UG and PGT, see below) give detailed information on the topic of unfair means and what happens if unfair means is used.
- Some students in previous years have placed solutions of their assignments on their personal world-readable websites – where possible, they have been asked to take these down. Be careful you are not attracted to these, as using any of their code would be regarded as use of unfair means – this has happened in previous years and students have failed the module as a result of doing this.

7. Late submission

- Standard Department rules will be applied if the work is handed in late – see UG and PGT handbooks below.

Links to handbooks

UG:
https://sites.google.com/sheffield.ac.uk/comughandbook

PGT:
https://sites.google.com/sheffield.ac.uk/compgtstudenthandbook