# CPT205 Computer Graphics (2022-23)

Assessment2 – 3D Modelling Project

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# 1 Brief description of the design

The project simulates the scene of a temporary farm. These include square cabins (houses), the interior of which includes floors, tables and chairs, fans, lights, cupboards, Windows, curtains, beds and other common decorations. In addition, the farm has a fence, two animals and a warehouse with a door. Fan and lamp have corresponding keyboard interaction, controlling its switch. Both animals are in motion in the scene. In addition, it is possible to change the camera perspective to the animal perspective by interacting with the keyboard. The warehouse with the door has a small design that detects collisions and automatically pops up when the camera's Angle touches it. You can control the global light effect through keyboard interaction and realize the switch between day and night in the scene. In addition, according to different keyboard and mouse commands, you can view the farm from different angles.

# 2 Features of the 3D Modelling Project

## 2.1 Creation of geometry

The scene is made of geometric elements.

## 2.2 Hierarchical modelling

(1)Relative motion: The legs of a farm animal, the rotation of a fan, and the automatic opening and closing of a warehouse door based on the camera's position all show relative motion.
(2)Scene hierarchy: There are six rooms on the farm, each with a bed, a table, a chair, a floor and other items, which are grouped. This scenario uses layered modelling techniques.
(3)Hierarchical transformations: The transformation of the child node is relative to the parent node. This technique is embodied in the glPushMatrix and glPopMatrix, where the rotation, displacement, and deformation between the two are relative to the superior. The technology is in houses.

## 2.3 Transformations

This project used translation, scaling, and rotation techniques many times. For example, a warehouse door that automatically rotates open, a fence that encloses the house and so on. In these cases, the glTranslated, glScaled, glRotated functions are called.

## 2.4 Viewing and projection

First the gluLookAt(eye_x, eye_y, eye_z, look_x, look_y, look_z, up_x, up_y, up_z) function is called to determine the camera coordinates.
Then, Frustum perspective projection is used in this project. gluPerspective(GLdouble fovy, GLdouble aspect, GLdouble zNear, GLdouble zFar) is invoked.
Finally, the computer view is projected onto the monitor using the glViewport(GLint x, GLint y, GLsizei width, GLsizei height) functions. (In this project, because the viewport is not specifically specified, this function is not called and the default value is used.)

## 2.5 Lighting and Materials

For every light source, there are two components: diffuse light and parallel light. In OpenGL, ambient light is also treated as a component of a special light source. Therefore, in order to fully demonstrate the effect of light, the project designed the global parallel light, the camera torch light, the pipe lamp, and the camel light (namely global light 8 and torchlight 9). The glLightfv function is called. It defines not only the position

but also the GL_AMBIENT, GL_DIFFUSE, GL_SPECULAR. In general, the parameters of glLightfv determine its specific behaviour. In addition, glMaterialfv is called to define material properties that determine how the object reflects light.

### 2.6 Texture mapping

The Texture mapping technique was used to paint objects such as floors, walls, ceilings, curtains, wardrobes, doors, beds, pillows, tables and chairs inside the house. The code adopted the "Mapping images onto objects" implementation. loadGLSkyboxTexture is the texture loading setting for the skybox and LoadGLTexture is the loading setting for the other textures. The glGenTextures, glEnable(GL_TEXTURE_2D), and glBindTexture functions are called to achieve the target effect.

### 2.7 Animation

Animals moving around the farm, warehouse doors that pop open when a camera hits, and fans spinning in a room are all animated scenes.

### 2.8 Interactions

1Interactions using Keyboard: The keyboard callback function is used to change the camera angle, control the light source, switch angles and so on.
2Interactions using Mouse: A mouse callback function receives mouse input to control the camera's motion better.

## 3 A brief instruction section

### 3.1 Interactions using Keyboard

The code is designed so that

(1)The "q" key: Exit program
(2)The "w" key: Control the camera Angle to move forward horizontally
(3)The "s" key: Control the camera Angle to move backwards horizontally
(4)The "a" key: Control the camera Angle to move horizontally to the left
(5)The "d" key: Control the camera Angle to move horizontally to the right
(6)The "f" key: Fan switch
(7)The "g" key: Convert the field of view to an animal field of view
(8)The "8" key: Turn on and off the global lighting
(9)The "9" key: Turn on and off the tube light
(10)Up, down, left and right keys:
GLUT_KEY_UP: Move the camera Angle forward
GLUT_KEY_DOWN: Make the camera view backwards
GLUT_KEY_LEFT: Turn the camera Angle to the left
GLUT_KEY_RIGHT: Turn the camera Angle to the right

### 3.2 Interactions using Mouse

Right-click to move the camera. Release the right button to disable the camera.

# 4 A set of typical screenshots

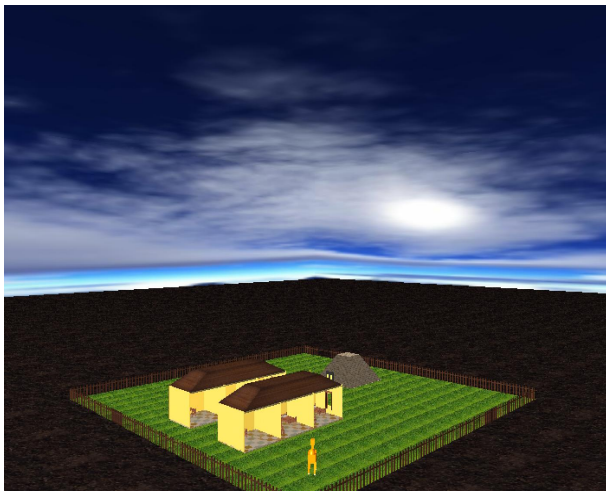

Figure 1: Daytime global view

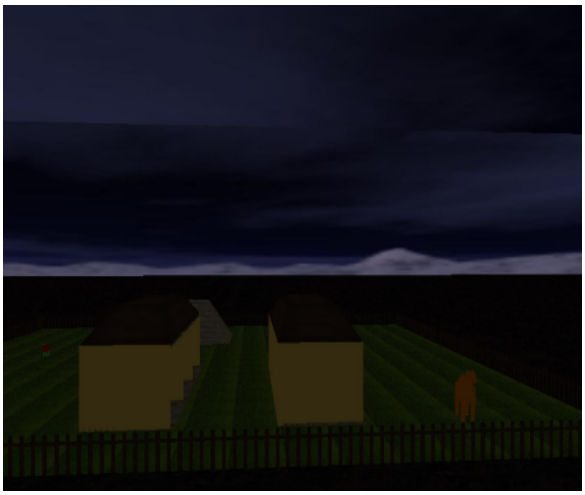

Figure 2: Night time global view

Figure 3: Interior of the room-no lights on

Figure 4: Interior of the room-lights on and fan switch

Figure 6: Warehouse diagram - the door is closed

Figure 7: Warehouse diagram - the door is open

Figure 5: Camera view switches to animal view