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Assessment2: 3D Modelling Project

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Module Computer Graphics

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1 The design and features

1.1 Creation of geometry

In general, I use some basic geometry functions, such as glutSolidCube().
Sometimes, for simplicity, I create drawCuboid(double x1, double y1, double z1, double x2, double y2, double z2) function to build the single cubic model, as it can facilitate location of the cube; in addition, I create glRectXplane(int leftY, int leftZ, int rightY, int rightZ, float X), glRectYplane(int leftY, int leftZ, int rightY, int rightZ, float X), glRectZplane(int leftY, int leftZ, int rightY, int rightZ, float X) to build the rectangles quickly in the x plane, y plane, z plane, correspondingly.
To draw some tricky models, I declare GLUquadricObj* quadobj. For example, I can create a cylinder of different sizes at the top and bottom with gluCylinder(), which cannot be achieved by glutSolidCone().

1.2 The design of hierarchical mode

Most of the objects in this project use the method of hierarchical modelling. The graphical representation of the relationship of the objects in the room is as follows.

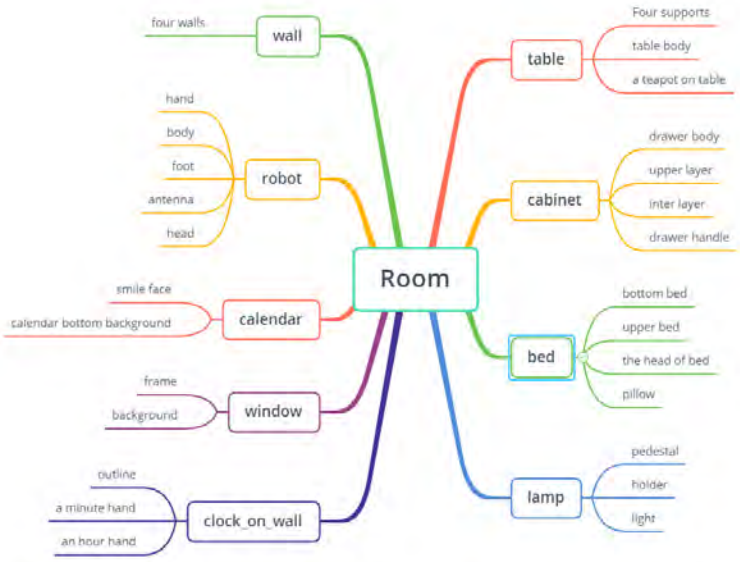

Fig. 1: Hierarchy

1.3 Transformations

Transformations are used in two cases.
The first case is for the creation of geometry. When we create a standard solid cube, we need to transform location, angle, and size of the model.
The second case is to change the view.

```
1         glTranslatef(move_right, move_up, 0);
2         glRotatef(angleX, 0.0, 1.0, 0.0);
3         glRotatef(angleY, 1.0, 0.0, 0.0);
```

With these three functions in the display(), the user can easily rotate and move the view.

1.4 Viewing and Projection

```
1     glMatrixMode(GL_PROJECTION);
2     glLoadIdentity();
3     glFrustum(-frustdum, frustdum , -frustdum, frustdum,
4     300., 800.);
5     glMatrixMode(GL_MODELVIEW);
6     glLoadIdentity();
```

I firstly change MatrixMode to GL_PROJECTION, and use glFrustum() to do the projection. And then I change MatrixMode back to the GL_MODELVIEW to do further operation, such as transformation.

1.5 Lighting and materials

For lighting, this program has two lights. The first light is from environment, its light varies according to the time. Details of how it performed will be mentioned in the animation part. The second light is from the lamp. I create a function control the material of the objects in the room, which make the process of creating objects easier.

1.6 Texture mapping

Two texture pictures are used in this program. One is the texture of floor, and another one maps four walls in the room. Firstly, the program reads two textures in .bmp format by setTexture() function. Then, we bind the texture and the position of the wall.

1.7 Animation and Interactions

The dynamic part of the program includes the rotation of robot and teapot, the state of the light, and the operations on clock. Using onTimer1() and onTimer2(), this is animated according to time. By clicking the right mouse, we can see the menu of operations in the program. Besides, This program is user-friendly, since the user can use the familiar button to operate the viewing. With 'w"s"a"d', the scene can be switched up, down, left and right. With '-"+', the scene can be zoomed in or out. With left mouse, the scene can be rotated smoothly. All of these are achieved by using glutKeyboardFunc(), glutMouseFunc(), glutMotionFunc().

2 Instruction section

Table 1: Instruction

Instruction	**Effects**
left mouse drag	rotate the scene
right mouse click	see the menu and operate the room by clicking the attributes
Esc	quit the scene
- or _	zoom decrease
= or +	zoom increase
A or a	look left
D or d	look right
W or w	look up
S or s	look down
O or o	open/stop the lamp
B or b	stop/restart the teapot
N or n	rotate/forward the teapot
M or m	stop/restart the robot
,	rotate/forward the robot
1-9 and some special keys (it is recommended to use this by the menu)	clock time
k	speed up the time
l	slow down the time

(a) The original scene

(b) Daytime

(c) Change the view

(d) Menu

(e) Turn on the lamp

Fig. 2: Effect pictures