Application of Open GL Function in Computer Graphics

Xiangming Zhou1,*

1College of Aviation&Tourism, Jiangxi Teachers College, China, 335000

*Corresponding author e-mail: zxm436@163.com

Abstract. In order to make computer graphics from abstract to concreteness, Open GL visual programming technology is widely used in our life. The illumination, material and atomization in Open GL function are used to set up the triangular mesh model. Open GL function is introduced to achieve the goal of rebuilding the object.

Keywords: Computer Graphics, Open GL, Triangular Mesh Model

1. Introduction

Computer graphics is the science of using a mathematical algorithm to display stereogram or three-dimensional graph on a computer monitor in a grid form (Zhao Yufeng, 2008). In other words, the main research of computer graphics is to use what algorithms to represent graphics in the computer, and the calculation and processing of graphics.

One of the main purposes of computer graphics is to produce realistic graphics on a computer screen (Li Wenqiang, 2005). Therefore, firstly, the geometric representation of the object should be established. Then the virtual illuminant, texture, material, atomization and so on are attached to the geometry. These make the geometry displayed on a computer screen more like a real object. At present, computer graphics often uses with Open GL.

2. The Summary of Open GL

In fact, Open GL is a rich three-dimensional graphics function library. In addition to the basics Open GL function, but also it supports other function: Open GL utility library, Open GL auxiliary library, Windows private library. Open GL also provides double cache that can use to create animations. The function of Open GL provides a solid foundation for the realization of three-dimensional object reconstruction technology and the establishment of three-dimensional scene of human-computer interaction.

Open GL is easy to use and efficient. It closely connects with Visual C++, so as to achieving the manipulator of the graphics algorithms and calculation. It guarantees the validity and reliability of the algorithms. Open GL has many functions, for example, modeling, conversion, image enhancement image features, bitmap display, lighting settings, material settings, texture mapping, and double buffering.

3. Application of Open GL Function in Computer Graphics

The basics steps of computer graphics combined with Open GL functions to render a three-dimensional image of a real object are as follows:

*Corresponding author e-mail: zxm436@163.com
(1) Establish the basics model. First, the real object is transformed into a scene model that can be represented on the computer by the algorithm in computer graphics. Complex objects generally are represented as a triangular mesh model structures. A method can be displayed complex objects in real life on a computer screen. A technique is used to extract discrete points from the surface of a real objects. Then, those discrete points are input into the computer. An efficient algorithm is used to connect these points to form a triangular grid. Finally, a triangle mesh model describing a real object is created on the computer screen. The following figure is the corresponding triangle mesh model of the real object.

![Triangular Mesh Model](image)

**Figure 1. Triangular Mesh Model**

(2) Projection and viewpoint transformation. The represented model is input in the appropriate position in three dimensions. Viewpoint points also set so that the model can be centered. Meanwhile, the part, which the observer is interested, are displaying on the screen. Building good model how to display on the computer screen is the key. OpenGL mainly provides two projection methods. One is orthographies projection and the other is perspective projective (Ou Zhongya, 2011, 48-50).

The visual body of orthographies projection is similar to cuboids. Thus, in the process of projecting, no matter whether the object is close or far from the lens, the size of the object projected onto the screen remains unchanged. The orthographic projection function is:

\[
\text{Glortho} (\text{GLdouble } \text{left}, \text{GLdouble } \text{right}, \text{GLdouble } \text{top}, \text{GLdouble } \text{bottom}, \\
\text{GLdouble } \text{far}, \text{GLdouble } \text{near})
\]

The parameters in function represent clipping planes, namely near clipping plane with the far clipping plane, both of which are rectangles. Moreover, parameters in the function indicate that the coordinates of the left bottom and top right corner of rectangles corresponding to near clipping plane are \((\text{left}, \text{bottom}, \text{-near})\) with \((\text{right}, \text{top}, \text{-near})\). The coordinates of the left bottom and right top corner of rectangles correspond to the left bottom and right top of the far cutting plane.

The perspective projection is similar to a prism. It characterizes by large objects close to the point of view and small objects far from the point of view. This projection method often uses in the simulation of three-dimensional scenes and animations that need to reflect real events. The function of this projection mode is:

\[
\text{glFrustum} (\text{GLdouble } \text{bottom}, \text{GLdouble } \text{top}, \text{GLdouble } \text{left}, \text{GLdouble } \text{right}, \text{GLdouble } \text{near}, \\
\text{GLdouble } \text{far})
\]

The parameters of function only define the coordinates near the cutting plane. That is to say, the coordinates of the left bottom and top right corner are \((\text{left}, \text{bottom}, \text{-near})\) with \((\text{right}, \text{top}, \text{-near})\). But a parameter “far” is defined, which reflects the characteristics of perspective projection. And the corresponding coordinates are automatically generated by the system.

(3) Lighting settings, material settings, atomization settings. Real objects simulate by setting the lighting, material, and atomization functions in OpenGL. Firstly, setting the model of lighting. Lighting settings contain three forms: diffuse light, ambient light, specular light. The illumination function in OpenGL is as follows:

Create lighting source location: \(\text{glLighth} (\text{GL}_\text{LIGHTO}, \text{GL}_\text{POSITION}, \text{light } \text{position})\)

Define three kinds of lights: \(\text{glLighth} (\text{GL}_\text{LIGHTO}, \text{GL}_\text{AMBIENT}/ \text{GL}_\text{DIFFUSE}/ \text{GL}_\text{SPECULAR}, \text{light } \text{ambient}/ \text{light } \text{diffuse}/ \text{light } \text{specular})\)
Three parameters in the above function are customs specific values. For example, the specific value defining the location of the light source is as follows:

\[ \text{light\_position} = \{1,0,1,0,0\} \]

Secondly, setting the material of the model. It can divide into three types, which are similar to lighting source. It is common to setting both lights and material properties in a scene. When both properties are applying to an object, effect is a superposition of the two. If lighting source color is \((R_0, G_0, B_0)\) and material color is \((R_1, G_1, B_1)\). Then the final effect is \((R_0 * R_1, G_0 * G_1, B_0 * B_1)\). For example the definition function of the material is as follows:

\[
\text{glMaterialh(GLenum face, GLenum pname, TYPE param)}
\]

While taking \(GL\_FRONT\) shows that applied to the front of objects. And taking \(GL\_BACK\) means that the material should apply to the back of objects. Taking \(GL\_FRONT\_AND\_BACK\) indicates that material should apply to the back and front of objects. Usually, \(\text{“pname”}\) takes \(GL\_AMBIENT, GL\_DIFFUSE, GL\_SPECULAR, GL\_SHINESS\).

Atomization is widely using to bring objects closer to the real thing and to make it look more natural. Therefore, applying the effect of fog for the model can create a sense of distance and make the model have a three-dimensional sense. Moreover, the concentration of fogs can control, and the color of fog can set at will. The function to start the fogs and to control the fogs in the program OpenGL is:

\[
\text{glEnable(GL\_FOG)}
\]

\[
\text{glFogh(GLENUM PNAME, TYPE param)}
\]

the parameter \(\text{“pname”}\) usually is \(GL\_FOG\_MODE, GL\_FOG\_DENSITY, GL\_FOG\_START, GL\_FOG\_END, GL\_FOG\_COLOR\). While \(\text{“param”}\) takes the corresponding specific value.

After the above three steps, the simulation of the real object has completed. According to calling the corresponding output function, the simulated and reconstructed object has displayed on the computer screen.

Based on VC6.0 Platform, the experimental results are as follows:

(a) Material settings

(b) Light settings
Figure 2. Design and implementation of indoor roaming system

This system has a strength realistic effect. Indoor object layout is reasonable, light is better, as well as the interface is friendly.

4. Conclusion

The paper mainly sets the model in OpenGL by using the lighting, material, atomization. To some extent, it shows the three-dimensional rendering effect. Moreover, the OpenGL function has more powerful features such as texture settings, special lighting and atomizing effects, which will be widely used in the life.

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