Programming.Tips() »

Geometric Transformations in ‘C’ using OpenGL Graphics API

OpenGL is a software interface to graphics hardware. OpenGL is designed as a streamlined, hardware independent interface to be implemented on many different hardware platforms. A sophisticated library OpenGL Utility Library (GLU) provides the graphical modeling features such as geometric primitives, quadratic surfaces, Bezier, B-Spline curves and surfaces.

The interface consists of more than 300 distinct commands to specify objects and operations to produce interactive 2D / 3D applications. OpenGL is a state machine that is you put it onto various states that remain in effect until you change them.

Translation, rotation and scaling are the 2D geometric transformations whereas reflection and shearing are composite transformations. The geometric transformations are needed as a viewing aid, as a modeling tool and as an image manipulation tool. C program using OpenGL (GLUT) Library to perform geometric transformations.

```c
#include<glut.h>
#include<stdlib.h>

void object()
{
    glBegin(GL_TRIANGLES);
    glColor3f (1.0,1.0,0.0);
    glVertex2f(15,25);
    glVertex2f(75,25);
    glVertex2f(45,55);
    glEnd();

    glBegin(GL_LINE_LOOP);
    glColor3f (0.0,0.0,0.0);
    glVertex2f(15,25);
    glVertex2f(75,25);
    glVertex2f(45,55);
    glEnd();

    glBegin(GL_POLYGON);
    glColor3f (1.0,0.0,0.0);
    glVertex2f(30,30);
    glVertex2f(35,30);
    glVertex2f(35,35);
    glVertex2f(30,35);
    glEnd();

    glBegin(GL_POLYGON);
    glColor3f (0.0,0.0,1.0);
    glVertex2f(55,30);
    glVertex2f(60,30);
    glVertex2f(60,35);
    glVertex2f(55,35);
    glEnd();

    glBegin(GL_TRIANGLES);
    glColor3f (0.0,1.0,0.0);
    glVertex2f(40,40);
    glVertex2f(50,40);
    glVertex2f(45,45);
    glEnd();
}
```

```c
void axis()
{
    glColor3f (0.0,0.0,0.0);
    glLineWidth(2);
    glBegin(GL_LINES);
    glVertex2f(-100,0);
    glVertex2f(100,0);
    glVertex2f(0,100);
    glVertex2f(0,-100);
    glEnd();
    glLineWidth(1);
}

void reflect_x()
{
    glScalef(1,-1,1);
    object();
}

void reflect_y()
{
    glScalef(-1,1,1);
    object();
}

void reflect_xy()
{
    glScalef(-1,-1,1);
    object();
}

void trans()
{
    glTranslated (15,30,0);
    object();
}

void rotate()
{
    glTranslatef(15,25,0);
    glRotatef(30,0,0,1);
    glTranslatef(-15,-25,0);
    object();
}

void scale()
{
    glScalef(0.5,0.5,1);
    glTranslatef(0,0,0);
    object();
}

void display(void)
{
    glClear(GL_COLOR_BUFFER_BIT);
    glColor3f(0.0,0.0,0.0);
    axis();
    object();
}
```
trans(); //Figure (a)
rotate(); //Figure (b)
scale(); //Figure (c)
reflect_x(); //Figure (d)
reflect_y(); // Figure (e)
reflect_xy(); // Figure (f)
glFlush();

}  
void init(void)
{
    glClearColor(1.0,1.0,1.0,0.0);
glMatrixMode(GL_PROJECTION);
glLoadIdentity();
gluOrtho2D(-80,90,-80,90);
}

int main()
{
glutInitDisplayMode(GLUT_SINGLE|GLUT_RGB);
glutInitWindowSize(300,300);
glutInitWindowPosition(0,0);
glutCreateWindow("Transformations");
init();
glutDisplayFunc(display);
glutMainLoop();
return 0;
}

Figure (a) to Figure (f) shows the output screens.

Figure (a)  
Figure (b)  
Figure (c)  
Figure (d)  
Figure (e)  
Figure (f)  

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