SSN COLLEGE OF ENGINEERING, KALAVAKKAM

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

UCS1712-Graphics and Multimedia Lab

Programming Assignment 6

3-Dimensional Transformations in C++ using OpenGL

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a) Perform the following basic 3D Transformations on any 3D Object.

1) Translation
2) Rotation
3) Scaling

Use only homogeneous coordinate representation and matrix multiplication to perform transformations. Set the camera to any position on the 3D space. Have (0,0,0) at the center of the screen. Draw X, Y and Z axis.

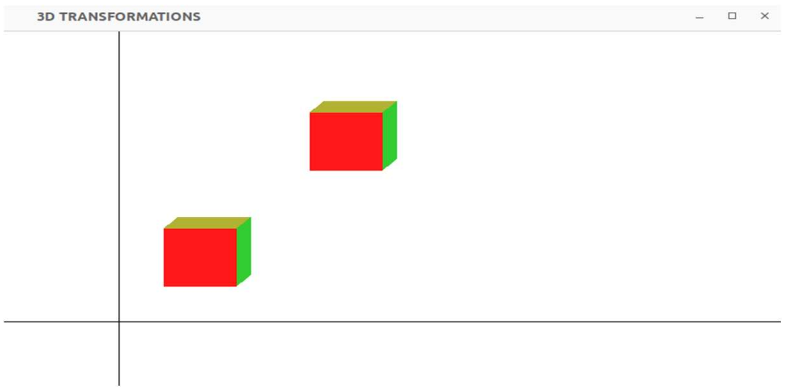
Source code:

```
#include <stdio.h>
#include <GL/glut.h>
#include <math.h>
#include <string.h>
#include <iostream>
using namespace std;
#define pi 3.142857

typedef float Matrix4[4][4];
Matrix4 theMatrix;
static GLfloat input[8][3] = {{40, 40, -50},
                              {90, 40, -50},
                              {90, 90, -50},
                              {40, 90, -50},
                              {30, 30, 0},
                              {80, 30, 0},
                              {80, 80, 0},
                              {30, 80, 0}};
float output[8][3];
float tx = 100, ty = 100, tz = 100;
float sx = -2, sy = 2, sz = 2;
float angle = 60;
int choice, choiceRot;
void setIdentityM(Matrix4 m)
{
    for (int i = 0; i < 4; i++)
        for (int j = 0; j < 4; j++)
            m[i][j] = (i == j);
}

void translate(int tx, int ty, int tz)
{
    for (int i = 0; i < 8; i++)
    {

        output[i][0] = input[i][0] + tx;
        output[i][1] = input[i][1] + ty;
        output[i][2] = input[i][2] + tz;
    }
}
void scale(int sx, int sy, int sz)
{
    theMatrix[0][0] = sx;
    theMatrix[1][1] = sy;
    theMatrix[2][2] = sz;
}
void RotateX(float angle)
{
    180;
    theMatrix[1][1] = cos(angle);
    theMatrix[1][2] = -sin(angle);
    theMatrix[2][1] = sin(angle);
    theMatrix[2][2] = cos(angle);
}
void RotateY(float angle)
{
    180;
    theMatrix[0][0] = cos(angle);
    theMatrix[0][2] = -sin(angle);
    theMatrix[2][0] = sin(angle);
    theMatrix[2][2] = cos(angle);
}
void RotateZ(float angle)
{
    180;
    theMatrix[0][0] = cos(angle);
    theMatrix[0][1] = sin(angle);
    theMatrix[1][0] = -sin(angle);
    theMatrix[1][1] = cos(angle);
}
void multiplyM()
{
    for (int i = 0; i < 8; i++)
    {
        for (int j = 0; j < 3; j++)
        {
            output[i][j] = 0;
            for (int k = 0; k < 3; k++)
            {
                output[i][j] = output[i][j] + input[i][k] * theMatrix[k][j];
            }
        }
    }
}

void draw(float a[8][3])
{
    glBegin(GL_QUADS);
    glColor3f(0.7, 0.4, 0.5);
    glVertex3fv(a[0]);
    glVertex3fv(a[1]);
    glVertex3fv(a[2]);
    glVertex3fv(a[3]);
    glColor3f(0.8, 0.2, 0.4);
    glVertex3fv(a[0]);
    glVertex3fv(a[1]);
    glVertex3fv(a[5]);
    glVertex3fv(a[4]);
    glColor3f(0.3, 0.6, 0.7);
    glVertex3fv(a[0]);
    glVertex3fv(a[4]);
    glVertex3fv(a[7]);
    glVertex3fv(a[3]);
    glColor3f(0.2, 0.8, 0.2);
    glVertex3fv(a[1]);
    glVertex3fv(a[2]);
    glVertex3fv(a[6]);
    glVertex3fv(a[5]);
    glColor3f(0.7, 0.7, 0.2);
    glVertex3fv(a[2]);
    glVertex3fv(a[3]);
    glVertex3fv(a[7]);
    glVertex3fv(a[6]);
    glColor3f(1.0, 0.1, 0.1);
    glVertex3fv(a[4]);
    glVertex3fv(a[5]);
    glVertex3fv(a[6]);
    glVertex3fv(a[7]);
    glEnd();
}

void display(void)
{

    glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);

    glColor3f(0.0, 0.0, 0.0);

    glBegin(GL_LINES);
    glVertex3d(-1000, 0, 0);
    glVertex3d(1000, 0, 0);
    glEnd();
    glBegin(GL_LINES);
    glVertex3d(0, -1000, 0);
    glVertex3d(0, 1000, 0);
    glEnd();
    glBegin(GL_LINES);
    glVertex3d(0, 0, -1000);
    glVertex3d(0, 0, 1000);
    glEnd();

    draw(input);
    setIdentityM(theMatrix);
    switch (choice)
    {
    case 1:
        translate(tx, ty, tz);
        break;
    case 2:
        scale(sx, sy, sz);
        multiplyM();
        break;
    case 3:
        switch (choiceRot)
        {
        case 1:
            RotateX(angle);
            break;
        case 2:
            RotateY(angle);
```

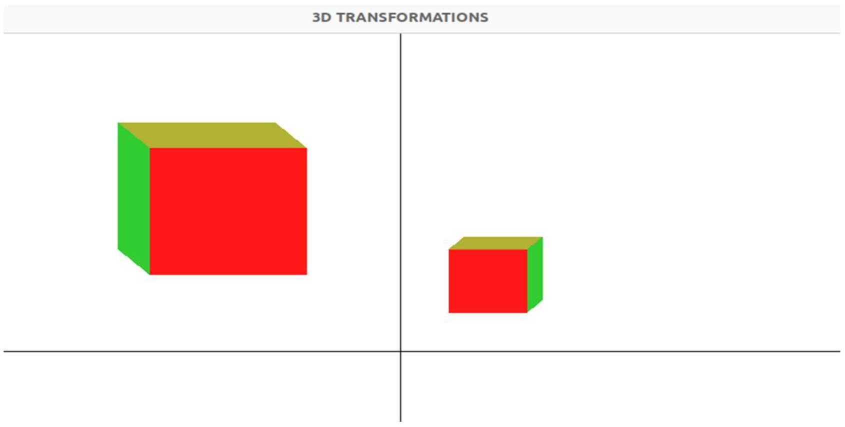
```cpp
            break;
        case 3:
            RotateZ(angle);
            break;
        default:
            break;
        }
        multiplyM();
        break;
    }
    draw(output);
    glFlush();

    glFlush();
}

int main(int argc, char **argv)
{

    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB | GLUT_DEPTH);
    glutInitWindowSize(1380, 700);
    glutInitWindowPosition(200, 200);
    glutCreateWindow("3D TRANSFORMATIONS");

    glClearColor(1.0, 1.0, 1.0, 1.0);

    glMatrixMode(GL_PROJECTION);
    glLoadIdentity();
    glOrtho(-454.0, 454.0, -250.0, 250.0, -250.0, 250.0);
    gluPerspective(100, 100, 100, 100);
    glEnable(GL_DEPTH_TEST);
    cout << "Enter your choice number:\n1.Translation\n2.Scaling\n3.Rotation\n=>";
    cin >> choice;
    switch (choice)
    {
    case 1:
        break;
    case 2:
        break;
    case 3:
        cout << "Enter your choice for Rotation about axis:\n1.parallel to X-axis."
             << "(y& z)\n2.parallel to Y-axis.(x& z)\n3.parallel to Z-axis."
             << "(x& y)\n =>";
        cin >> choiceRot;
        break;
    default:
        break;
    }
    glutDisplayFunc(display);
    glutMainLoop();
    return 0;
}
```

Output

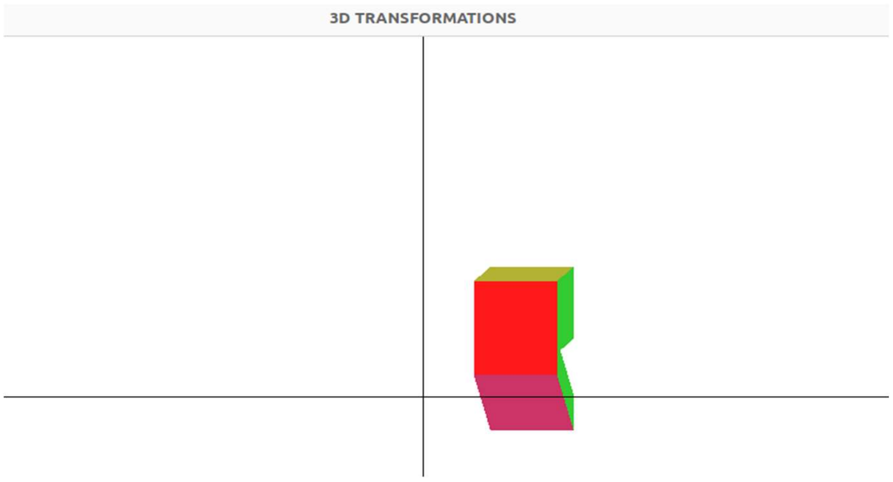
Translate along X and Y and Z



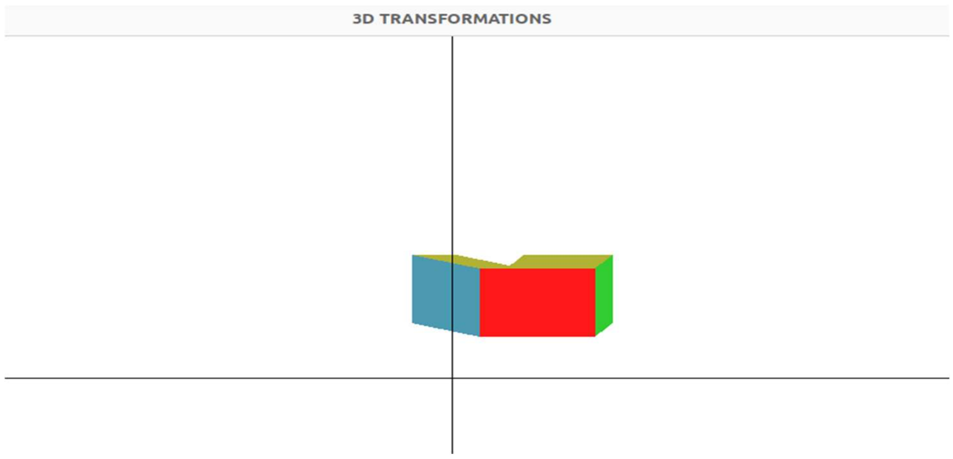
Scaling at X Y and Z



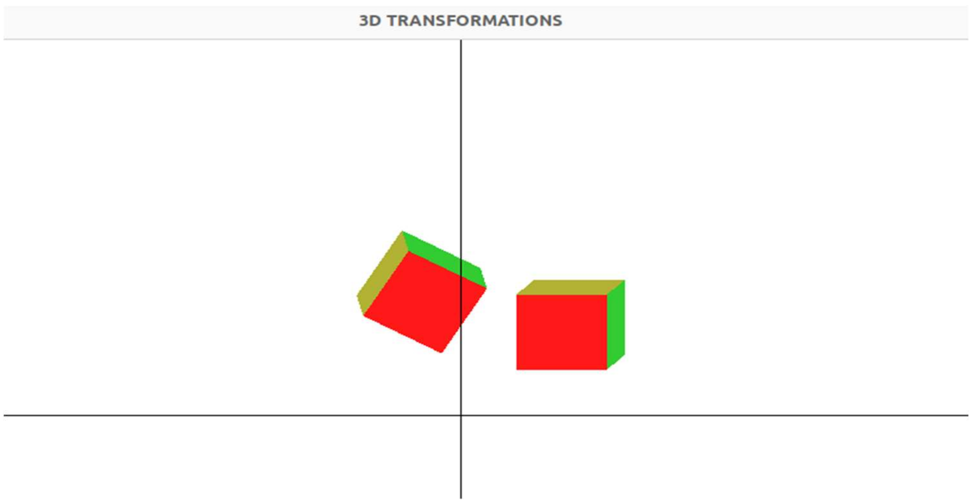
Rotation wrt X



Rotate wrt Y



Rotate wrt Z


3D TRANSFORMATIONS