UCS1712 – GRAPHICS AND MULTIMEDIA LAB

Assignment 08 - 3D Transformation

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Semester:	VII
Date:	October 27, 2021

1 Question 1

Aim:

Write a c++ program using OPENGL to perform 3D transformations – translation, scaling and rotation (along all three axes).

Algorithm

- Create a cpp file
- Import the libraries required for OPEN GL
- Initialise the display by setting the dimensions 640×480.
- Clear the display by making the colour white
- Read the co-oridantes of vertices (x_i, y_i) for all the points of 3D object.
- Implement scaling rotation and translation algorithms.
- Apply the matrices created to all the points
- Render the transformed object.

Program

```
#include<iostream>
#include<math.h>
#include<GL/glut.h>
using namespace std;

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,ty,tz;
float sx,sy,sz;
float angle;
```

```
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;
for(int i=0;i<8;i++)
{
output[i][0]=input[i][0]+50;
output[i][1]=input[i][1]+50;
output[i][2]=input[i][2]+50;
}
}
void RotateX(float angle) //Parallel to x
{

 angle = angle*3.142/180;
  theMatrix[1][1] = cos(angle);
 theMatrix[1][2] = -sin(angle);
 theMatrix[2][1] = sin(angle);
 theMatrix[2][2] = cos(angle);

}
void RotateY(float angle) //parallel to y
{

 angle = angle*3.14/180;
 theMatrix[0][0] = cos(angle);
 theMatrix[0][2] = -sin(angle);
 theMatrix[2][0] = sin(angle);
 theMatrix[2][2] = cos(angle);

}
void RotateZ(float angle) //parallel to z
{

 angle = angle*3.14/180;
 theMatrix[0][0] = cos(angle);
 theMatrix[0][1] = sin(angle);
 theMatrix[1][0] = -sin(angle);
 theMatrix[1][1] = cos(angle);
```

```
}

void multiplyM()
{
//We Don't require 4th row and column in scaling and rotation
//[8][3]=[8][3]*[3][3] //4th not used
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 Axes(void)
{
 glColor3f (0.0, 0.0, 0.0); // Set the color to BLACK
 glBegin(GL_LINES); // Plotting X-Axis
 glVertex2s(-1000 ,0);
 glVertex2s( 1000 ,0);
 glEnd();
 glBegin(GL_LINES); // Plotting Y-Axis
 glVertex2s(0 ,-1000);
 glVertex2s(0 , 1000);
 glEnd();
}
void draw(float a[8][3])
{


    glBegin(GL_QUADS);
     glColor3f(0.7,0.4,0.5); //behind
    glVertex3fv(a[0]);
    glVertex3fv(a[1]);
    glVertex3fv(a[2]);
    glVertex3fv(a[3]);

    glColor3f(0.8,0.2,0.4); //bottom
   glVertex3fv(a[0]);
   glVertex3fv(a[1]);
   glVertex3fv(a[5]);
   glVertex3fv(a[4]);

   glColor3f(0.3,0.6,0.7); //left
  glVertex3fv(a[0]);
  glVertex3fv(a[4]);
  glVertex3fv(a[7]);
  glVertex3fv(a[3]);

  glColor3f(0.2,0.8,0.2); //right
 glVertex3fv(a[1]);
 glVertex3fv(a[2]);
 glVertex3fv(a[6]);
 glVertex3fv(a[5]);

 glColor3f(0.7,0.7,0.2); //up
```

```
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 init()
{
    glClearColor(1.0,1.0,1.0,1.0); //set backgrond color to white
    glOrtho(-454.0,454.0,-250.0,250.0,-250.0,250.0);
    // Set the no. of Co-ordinates along X & Y axes and their gappings
    glEnable(GL_DEPTH_TEST);
     // To Render the surfaces Properly according to their depths
}

void display()
{
glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT);
Axes();
glColor3f(1.0,0.0,0.0);
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);
        break;
    case 3:
        RotateZ(angle);
        break;
    default:
        break;
    }
multiplyM();
    break;
}

draw(output);
glFlush();
}

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

```
{
    glutInit(&argc,argv);
    glutInitDisplayMode(GLUT_SINGLE|GLUT_RGB|GLUT_DEPTH);
    glutInitWindowSize(1362,750);
    glutInitWindowPosition(0,0);
    glutCreateWindow("3D TRANSFORMATIONS");
    init();
    cout<<"Enter your choice number:\n1.Translation\n2.Scaling\n3.Rotation\n=>";
    cin>>choice;
    switch (choice) {
    case 1:
        cout<<"\nEnter Tx,Ty &Tz: \n";
        cin>>tx>>ty>>tz;
        break;
    case 2:
        cout<<"\nEnter Sx,Sy & Sz: \n";
        cin>>sx>>sy>>sz;
        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;
        switch (choiceRot) {
        case 1:
            cout<<"\nENter Rotation angle: ";
            cin>>angle;
            break;
        case 2:
            cout<<"\nENter Rotation angle: ";
            cin>>angle;
            break;
        case 3:
            cout<<"\nENter Rotation angle: ";
            cin>>angle;
            break;
        default:
            break;
        }
        break;
    default:
        break;
    }
    glutDisplayFunc(display);
    glutMainLoop();
return 0;
}
```

Output

Figure 1: **Translation**

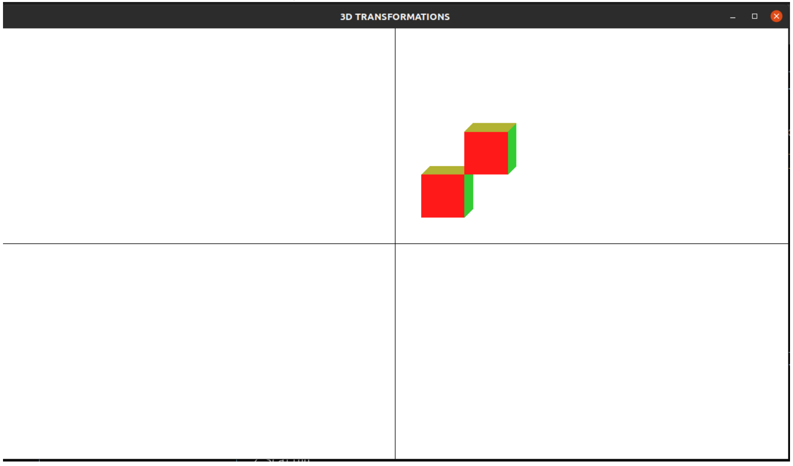


Figure 2: **Scaling**

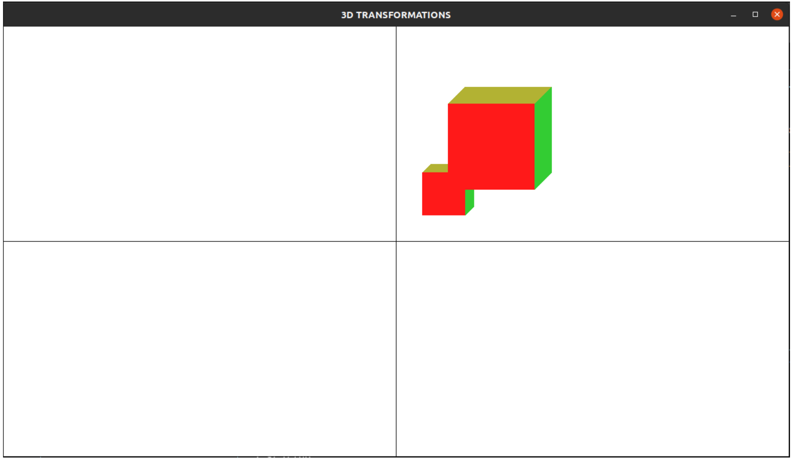
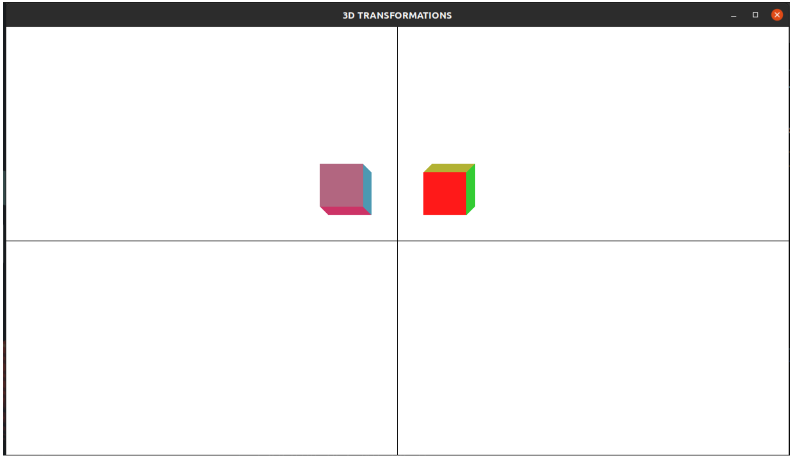


Figure 3: **Rotation**



Result

- OPENGL programs to perform 3D tranformations was designed and implemented successfully.