ЛАБОРАТОРИЙН АЖИЛ №7-8

3-D TRANSFORMATIONS AND PROJECTIONS

CURVES AND SURFACES

Лабораторийн ажлын даалгавар:

1. Дурын 3D хэмжээст хоёр объектыг сонгон авч зураад өөрчлөлтүүдийг хийнэ үү?

A. Translation
B. Rotation

Объектууд нь ирмэгээр болон талаар будсан байхаар хоёр сонголттой байна. Доорх шоог улаан өнгийн ирмэгээр зурах жишээтэй танилцана уу.

Жишээ:

```
#include <GL\freeglut.h>

GLfloat xRotated, yRotated, zRotated;

void redisplayFunc(void)
{
   // buffer tseverleh
   glClear(GL_COLOR_BUFFER_BIT);

   glLoadIdentity();
   // translate the draw by z = -4.0
   // z utgiig -8.0aas bagasgaval het jijig esvel hol bolno.
   glTranslatef(0.0,0.0,-5.0);
   // red
   glColor3f(0.9, 0.0, 0.0);
   // x huvid translation
   glRotatef(xRotated,1.0,0.0,0.0);
   // rotation Y
   glRotatef(yRotated,0.0,1.0,0.0);
   // rotation Z
   glRotatef(zRotated,0.0,0.0,1.0);
   // scaling
   glScalef(1.0,1.0,1.0);
   // built-in (glut library) function , cube zurah.
   glutWireCube(1.0);
   // Flush buffers to screen
   glFlush();
   // sawp buffers (double buffering ashiglaj bgaa) (zuraad hiih zuraad hiih hadgalah)
   glutSwapBuffers();
}

void reshapeFunc(int x, int y)
{
   if (y == 0 || x == 0) return;  //Nothing is visible uyd return hiigdene

   glMatrixMode(GL_PROJECTION);
   glLoadIdentity();
   //harah ontsog:40
   //clipping hiih oiriin zai: 0.5
   // clipping holiin zai: 20.0
```

```
    gluPerspective(40.0,(GLdouble)x/(GLdouble)y,0.5,20.0);
    glMatrixMode(GL_MODELVIEW);
    glViewport(0,0,x,y);
}

void idleFunc(void)
{
    // rotation by x
    xRotated += 0.03;
//    yRotated += 0.01;
//    zRotated += 0.01;
    redisplayFunc();
}

int main (int argc, char **argv)
{
    //Initialize GLUT
    glutInit(&argc, argv);

    glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB);
    // window size
    glutInitWindowSize(350,350);
    // create the window
    glutCreateWindow("Cube3d animation");
    glPolygonMode(GL_FRONT_AND_BACK,GL_LINE);
    xRotated = yRotated = zRotated = 0.0;

    glClearColor(0.0,0.0,0.0,0.0);

    glutDisplayFunc(redisplayFunc);
    glutReshapeFunc(reshapeFunc);
    glutIdleFunc(idleFunc);

    glutMainLoop();
    return 0;
      }
```

Объектууд:

Cube

1. glutWireCube(double size);
2. glutSolidCube(double size);

Sphere

1. glutWireSphere(double radius, int slices, int stacks);
2. glutSolidSphere(double radius, int slices, int stacks);

Cone

1. glutWireCone(double radius, double height, int slices, int stacks);
2. glutSolidCone(double radius, double height, int slices, int stacks);

Torus

1. glutWireTorus(double inner_radius, double outer_radius, int sides, int rings);
2. glutSolidTorus(double inner_radius, double outer_radius, int sides,int rings);

Teapot

1. glutWireTeapot(double size);
2. glutSolidTeapot(double size);

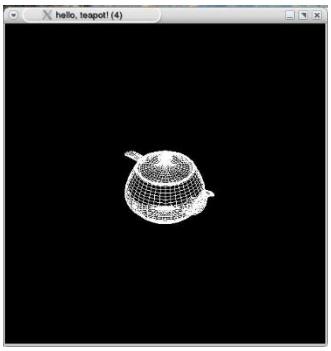
2 **Bezier** Муруй/Bezier Curves (50 оноо)

A. Жишээ програмыг судлан, glutSolidTeapot функцын оронд glutWireTeapot функцийг туршиж үзнэ үү.

B. Bezier нэгтгэсэн хос муруйн хувьд ямар нөхцөлд C^1 continuity авч үзэх вэ? Жишээн дээр тайлбарлана уу.

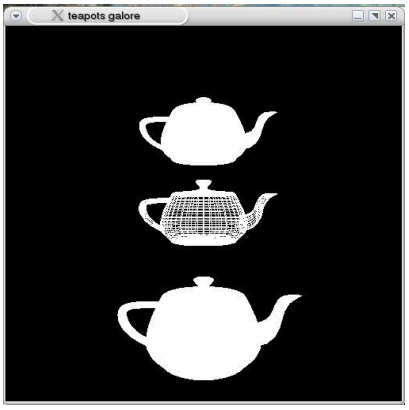
C. Bezier муруйг ашиглан дурын сэдвээр дүрслэл бий болгоно уу.

Жишээ код: Utah teapot




```
// helloteapot.cc

#include <GL/gl.h>
#include <GL/glut.h>

void display () {

   /* clear window */
   glClear(GL_COLOR_BUFFER_BIT);

   /* draw scene */
   glutSolidTeapot(.5);

   /* flush drawing routines to the window */
   glFlush();

}

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

   /* initialize GLUT, using any commandline parameters passed to the
      program */
   glutInit(&argc,argv);

   /* setup the size, position, and display mode for new windows */
   glutInitWindowSize(500,500);
   glutInitWindowPosition(0,0);
   glutInitDisplayMode(GLUT_RGB);

   /* create and set up a window */
   glutCreateWindow("hello, teapot!");
   glutDisplayFunc(display);

   /* tell GLUT to wait for events */
   glutMainLoop();
}
```

The following program shows an example of modeling transforms and using glPushMatrix and glPopMatrix:




```
// teapotsgalore.cc

#include <GL/gl.h>
#include <GL/glut.h>

void display () {

   /* clear window */
   glClear(GL_COLOR_BUFFER_BIT);

   /* future matrix manipulations should affect the modelview
matrix */
   glMatrixMode(GL_MODELVIEW);

   /* draw scene */
   glPushMatrix();
   glPushMatrix();

   glTranslatef(0,0,-3);
   glutWireTeapot(1);            // middle teapot
   glTranslatef(0,2,0);
   glutSolidTeapot(1);           // top teapot
   glPopMatrix();

   glTranslatef(0,-2,-1);
   glutSolidTeapot(1);           // bottom teapot

   glPopMatrix();

   /* flush drawing routines to the window */
   glFlush();

}

void reshape ( int width, int height ) {

   /* define the viewport transformation */
   glViewport(0,0,width,height);

}

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

   /* initialize GLUT, using any commandline parameters passed to the
      program */
   glutInit(&argc,argv);

   /* setup the size, position, and display mode for new windows */
   glutInitWindowSize(500,500);
   glutInitWindowPosition(0,0);
   glutInitDisplayMode(GLUT_RGB);

   /* create and set up a window */
   glutCreateWindow("hello, teapot!");
   glutDisplayFunc(display);
   glutReshapeFunc(reshape);
```

```
    /* define the projection transformation */
    glMatrixMode(GL_PROJECTION);
    glLoadIdentity();
    gluPerspective(60,1,1,10);

    /* define the viewing transformation */
    glMatrixMode(GL_MODELVIEW);
    glLoadIdentity();
    gluLookAt(0.0,0.0,5.0,0.0,0.0,0.0,0.0,1.0,0.0);

    /* tell GLUT to wait for events */
    glutMainLoop();
}
```

Гүйцэтгэх хугацаа: 9-12 долоо хоногт