A 3D scene Based on OpenGL

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Abstract

OpenGL, which stand for Open Graphics Library, is a cross-platform library used to perform computer vision tasks with taking advantages of hardware acceleration. This report presented a design which created a terrain scene developed on c++ using <u>OpenGL API</u>.

Geometric objects

- Chess
- Chess board
- Skybox
- Terrain
- Sierpinski gasket

Techniques used in program

Translation

If there is a point P, only to specify a displacement vector d, we can get the transformed points by,

$$P' = P + d$$

In OpenGL, we use the function glTranslatef() to implement this transformation.

Rotation

$$x = \rho cos\varphi$$
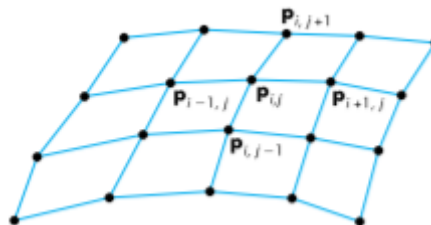$$y = \rho sin\varphi$$
$$x' = \rho cos(\theta + \varphi)$$
$$y' = \rho cos(\theta + \varphi)$$

Where (x, y) is a two-dimensional point, θ is the angle rotated from the origin.

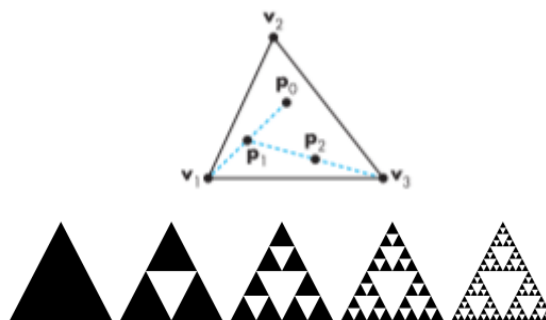In OpenGL, we use the function glRotatef() to implement this transformation.

Procedural Methods

1.

The terrains generated in this program are based on sinx*cosy function

2.

The Sierpinski gasket are generated by this method, each time the algorithm is executed the geometric interpretation of the line is scaled, which generate new triangles within the origin triangles.

2D Texture mapping

If the object is represented in homogeneous or (x, y, z, w) coordinates, then there are functions such that

$$x = x(s, t)$$
$$y = x(s, t)$$
$$z = z(s, t)$$
$$w = w(s, t)$$

the inverse functions:
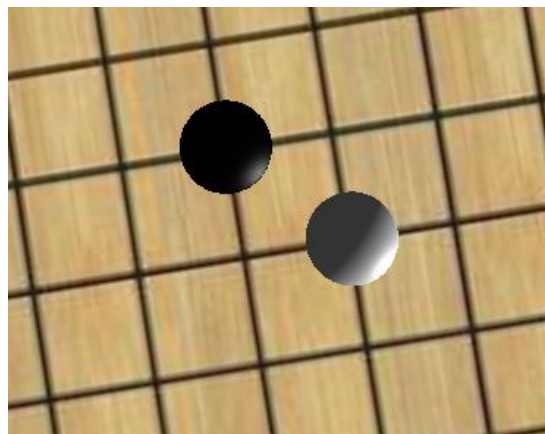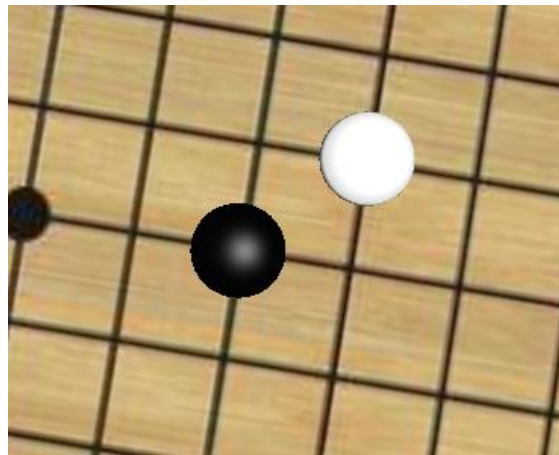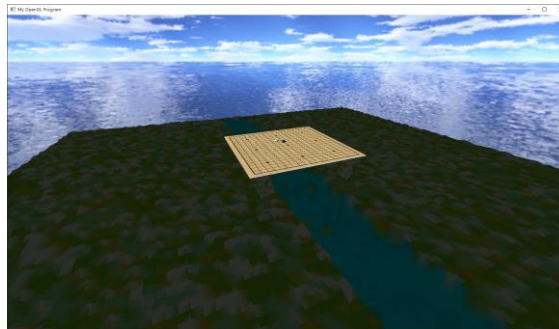
$$s = s(x, y, z, w)$$
$$t = t(x, y, z, w)$$
$$x_s = x_s(s, t)$$
$$y_s = y_s(s, t)$$

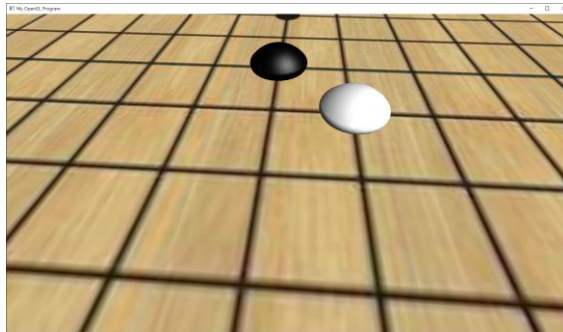where (x_s, y_s) is a location in the color buffer.

Lighting and Materials

See more details in source code (the drawchessboard function)

Curves and Surfaces

See more details in source code (the drawchess function)

Clipping

See more details in source code (the welcome scene)

Features

- Auto fitting when changing window size.
- Skybox
- Terrain

Environment and instruction

- Visual Studio 2015 with c++ extension(Windows)
- GLUT OpenGL utility toolkit.
- Window 10 professional version 1703

Step by step guide for installation

- Install VS2015
- Copy glut.h to the path ~:\...\Microsoft Visual Studio 14.0\VC\GL
- Copy glut.dll and glut32.dll to the path ~:\...\Microsoft Visual Studio 14.0\VC\bin
- Copy glut.lib and glut32.lib to the path ~:\...\Microsoft Visual Studio 14.0\VC\lib
- Create new project in VS2015.
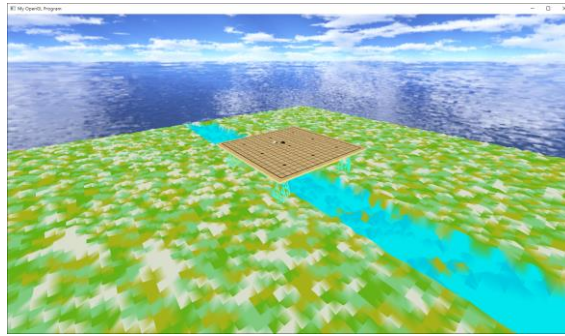- Copy source files to the new project.
- Run the code.

Instruction: mouse and keyboard control

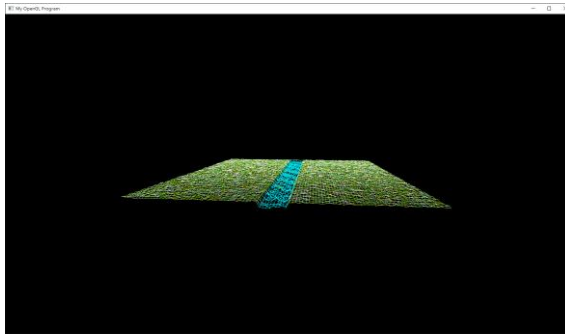'G' and left mouse button: go to next step

'B' and right mouse button: go back to previous step
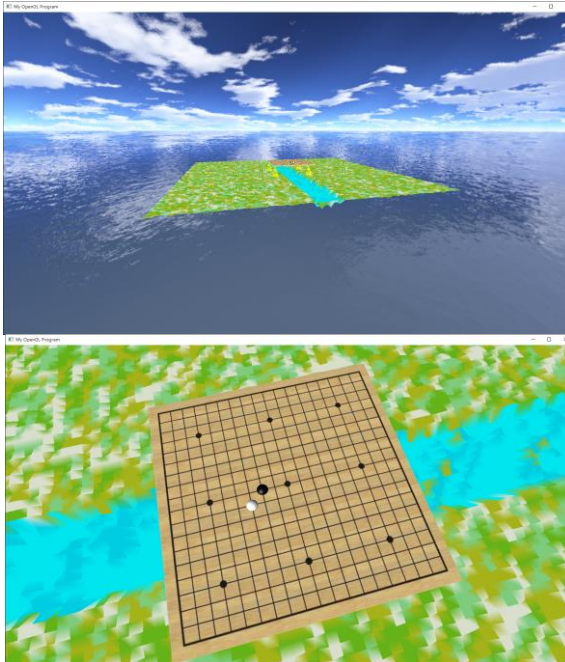

Welcome screen

3D scene

Terrain

Press 'w' 'a' 's' 'b' 'Page_Up' ' Page_Down' and the direction keys to control camera:

Press'1' '2' '3' '4' to control rotation:

     '1': reverse the direction of rotation

     '2': speed up the rotation

     '3': speed down the rotation

     '4': stop rotation

Press 'Q' to enable lighting