Lecture 1, Introduction to Computer Graphics

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Concept of Computer Graphics

1. Definition of Computer Graphics

- Computer Graphics
  
  **Definition:** Computer graphics is a subject which studies how to use computer to generate, process and display graph.

  Definition from IEEE: *Computer graphics* is the art or science of producing graphical images with the aid of computer.
Contents of Traditional Computer Graphics

- **Raster Graphics**
  - Scan conversion algorithm of Line, Arc and Polygon
  - Algorithm of region filling, character, clipping;

- **Geometry Modeling**
  - Bezier, spline curve and surface

- **Realistic Graphics**
  - Color vision;
  - Lighting model, algorithm;
What About This Course?

- Course project for graphics applications with different levels of skill
- Progressive approach to explain OpenGL with code
- OpenGL and evolution of computer graphics
- Preliminaries
  - Fundamentals of C++ programming language
  - Linear algebra
Teaching Methods

- Teaching focuses on the basic principles of graphics
- Programming focuses on the graphic application projects
- Source code are provided for each demo

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11:30~12:15

Lecturer: teaching

TA: programming
Computer Graphics — Interdisciplinary

- Digital image processing
- Signal processing
- Computer vision
- Media Arts
- Cognitive psychology
- Artificial intelligence （Military simulation, Game）
Applications of Computer Graphics

- **Information Visualization**
  Scientific computing (finite element analysis, traffic monitoring)
  Medical imaging, 2D and 3D graphic design and so on

- **Virtual Reality**
  3D animation, film special effects, entertainment games

- **Military simulation**
Finite element analysis
(Stress and strain intensity)
Non-photorealistic rendering for assembly visualization
A demo video for car engine assembly visualization
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- Military simulation
Film “Avatar” has made an important success for according with human perception of visual media interaction, integration and presentation. But at the same time, the production of Avatar which rely on more than 800 special effects staff took nearly four years to complete.
In the 3D shooting, the Cameron cooperates with Sony, involved in the development of new 3D camera system. Using 8 Sony HDC-F950 digital film cameras and 8 Sony CineAlta F23 digital film cameras to consist the #D camera system. This 3D camera system is named Fusion Camera-3D System. This makes the shooting, compared with previous 3D movies, has greatly improved.
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3D zebra crossing
Chairs against physical laws
The lost space
What About This Course?

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The following code is to construct a complex region using two spline curve, then filling it.

```
using namespace Gdiplus;

    Graphics graphics( pDC->m_hDC );

Pen pen(Color::Blue, 3);
Point point1( 50, 200 );
Point point2(100, 150);
Point point3(160, 180);
Point point4(200, 200);
Point point5(230, 150);
Point point6(220, 50);
Point point7(190, 70);
Point point8(130, 220);

Point curvePoints[8] = {point1, point2, point3, point4, point5, point6, point7, point8};
Point* pcurvePoints = curvePoints;

GraphicsPath path;
    path.AddClosedCurve(curvePoints, 8, 0.5);

PathGradientBrush pthGrBrush(&path);
    pthGrBrush.SetCenterColor(Color(255, 0, 0, 255));
Color colors[] = {Color(0, 0, 0, 255)};
INT count = 1;
    pthGrBrush.SetSurroundColors(colors, &count);

graphics.DrawClosedCurve(&pen, curvePoints, 8, 0.5);
graphics.FillPath(&pthGrBrush, &path);
```
The Content of This Course

1. Introduction
   Soft and hard system in computer graphics

2. Using Geometry Modeling Software
   Enhancing the using habit in 3D space

   Dot product, cross product, projection, transformation, homogeneous coordinates
The Content of This Course

5. Draw a simple graph using OpenGL
   Message-driven mechanism, OpenGL window program

6. Curve smoothing, surface designing
   Polynomial, Bezier, B spline curve and surface

7. Modeling using triangle mesh
   Shape representation, mesh simplification, retrieving of 3D mesh
The Content of This Course

8. 3D observation
   Camera model, world and local coordinate system, view port

9. Lighting model of OpenGL
   Color, diffuse light, specular light, ambient light

10. Texture mapping
    Texture maps, texture coordinates, texture mapping, lighting and shadows
The Content of This Course

11. Maze design
   Application of Fractal Geometry in artistic expression

12. Artificial intelligence
   Combined with computer-aided design

13. Advanced technology of OpenGL
   Illumination map, depth map, environment map, multi-texture
The Content of This Course

14. Shading of OpenGL

OpenGL Programmable pipeline, rendering engine development Final exam presentation Presentation

15. The last

Final summary , Final marks released