IT 221: Computer Graphics

Credits: 3
Lecture Hours: 48

Course Objective

This module aims to develop students' skill in computer graphics. This module should be supported by laboratory experiments to augment the concepts taught in the class.

Course Description

Introduction of Computer Graphics, Hardware and Software Concept, Two Dimensional Algorithm, Three Dimensional Graph, Visible surface detection method, Illumination models and surface rendering methods, and Trends in Computer Graphics, Areas, Text and Colors

Course Details

Unit 1: Introduction of Computer Graphics **LH 2**

- 1.1 Early History
- 1.2 Application of Computer Graphics

Unit 2: Hardware and Software Concept **LH 9**

- 1.3 Input Devices
  - Mouse, Touch Screen, Light Pen, Data Glove, Tablet (Digitizer), Bar Code Reader
- 1.4 Output Devices
  - 1.4.1 Monochromatic & Color CRT
  - 1.4.2 Raster and Random Scan Display
  - 1.4.3 Flat Panel Display
    - 1.4.3.1 LED
    - 1.4.3.2 LCD
  - 1.4.4 Simple Architecture on Raster, Random Scan System
  - 1.4.5 Concept of Three Dimension viewing devices
- 1.5 Graphics Software
  - 1.5.1 Software standards
  - 1.5.2 Need of machine independent graphics language
- 1.6 Color Models
  - 1.6.1 RGB
  - 1.6.2 HSV
  - 1.6.3 Conversion between HSV and RGB color models

Unit 3: Two Dimensional Algorithm **LH 16**

- 1.7 Line Drawing Algorithm

1.7.1 DDA (With positive and negative slope)
1.7.2 Bresenham's Line Algorithm
1.7.2.1 for positive slope (m<=1, m>1)
1.7.2.2 for negative slope (m<=1, m>1)
1.8 Different Line Styles with Java 2D
1.9 Drawing Thick Lines with Java 2D
1.10 Circle Algorithm
1.10.1 General circle equation
1.10.2 Mid-Point circle equation
1.11 2D Geometric Transformation
1.11.1 Basic Transformation
1.11.1.1Translation
1.11.1.2Rotation
1.11.1.3Scaling
1.11.2 Homogenous Coordinate
1.11.3 Composite Transformation
1.11.3.1Successive Translation
1.11.3.2Successive Rotation
1.11.3.3Successive Scaling
1.11.3.4Pivot point rotation
1.11.3.5Fixed point scaling
1.11.4 Other Transformation
1.11.4.1Reflection
1.11.4.2Shear
1.12 Two Dimensional Viewing
1.12.1 Viewing pipeline
1.12.2 Window to viewport coordinate transformation
1.12.3 Clipping
1.12.3.1Introduction and application of clipping
1.12.3.2Line Clipping
1.12.3.2.1 Cohen Sutherland line clipping
1.12.3.3Polygon clipping
1.12.3.3.1 Sutherland Hodgeman polygon clipping

Unit 4: Three Dimensional Graph **LH 8**

1.13 3D object representation
1.13.1 Polygon surface
1.13.2 Polygon tables
1.13.3 Plane equations
1.13.4 Polygon meshes
1.14 Projections
1.14.1 Parallel Projections
1.14.1.1Isometric

1.14.1.2Oblique

1.14.2 Perspectives Projections

1.14.3 Derivation of projections

1.15 3D Transformations

1.15.1 Translation

1.15.2 Rotation

1.15.2.1General 3D rotation

1.15.2.2Geometric transformations in Java 3D

1.15.3 Scaling

1.15.3.1Fixed point scaling

1.15.4 Reflection

1.15.5 Shear

Unit 5: Visible surface detection method **LH 5**

1.16 classification of algorithm

1.17 different types of algorithm

1.17.1 depth buffer (z-buffer) method

1.17.2 A-Buffer method

1.17.3 Scan line method

1.17.4 Depth sorting method (Painter's Algorithm)

1.17.5 Clipping in Java 3D

Unit 6: Illumination models and surface rendering methods **LH 6**

1.18 light source

1.19 basic illumination models

1.19.1 Ambient light

1.19.2 Diffuse reflection

1.19.3 Specular reflection and Phong model

1.19.4 Intensity attenuation

1.19.5 Color consideration

1.19.6 Transparency

1.19.7 Transparency in Java 3D

1.19.8 Shadows

1.20 Polygon rendering methods

1.20.1 Constant intensity shading

1.20.2 Light sources in java 3D

1.20.3 Gouraud shading

1.20.4 Phong Shading

1.20.5 Shading in Java 3D

1.20.6 Constant and Gouraud Shading in Java 3D

Unit 7: Trends in Computer Graphics **LH 2**

1.21 Concept of Virtual reality & simulation
1.22 Computer animation
1.22.1 Design of animation sequences
1.22.2 Computer animation languages
1.22.3 Morphing and simulating accelerations.
1.22.4 Animation in Java 3D
Projections in Java 3D

Unit 8: Areas, Text and Colors

1.23 Filling Areas
1.24 Buffered Images in Java 2D
1.24.1 Double Buffering in Java 2d
1.24.2 Loading and Saving of Images with Java 2D
1.24.3 Textures in Java 2D
1.25 Displaying Text
1.26 Text in Java 2D
1.27 Grey Images and Intensities
1.28 Color models
1.28.1 Colors in Java 2D
1.28.2 Color interpolation
1.28.3 Color interpolation with Java 2D

Laboratory Work

Lab1: DDA
Lab2: Bresenhams line drawing algorithm
Lab3: Circle
Lab4: Basic transformation on 2D
- ✓ Translation
- ✓ Rotation
  - o About origin
  - o About pivot point
- ✓ Scaling
  - o About origin
  - o About fixed point

Lab5: Simple 3D Object
Lab6: Basic Transformation on 3D object
- ✓ Translation
- ✓ Rotation
- ✓ Scaling

Laboratory work will be carried out using visual or non visual high level languages.

References

- *Computer Graphics*, C Versions (Prentice Hall) : Hearne and Baker
- *Computer Graphics – Principles and Practices*: J.D. Foley, S.K. Feiner and J.F. Hughes
- Computer Graphics: Principles and Practice, 2nd Edition (3rd would be released around mid 2013) - the book you've mentioned is also called *The Bible of CG*
- Fundamentals of Computer Graphics, 3rd Edition
- Computer Graphics using OpenGL, 2nd or 3rd Edition*
- Interactive Computer Graphics: A Top-Down Approach with Shader-Based OpenGL, 6th Edition*
- 3D Computer Graphics: A Mathematical Introduction with OpenGL*
- Introduction of Computer Graphics: Using Java 2D and 3D, Frank Klawonn, Second Edition, Springer
- Digital Image Processing: An algorithmic Introduction using Java, Wilhelm Burger, Mark, J. Burge, First edition, Springer
- Fundamentals of Computer Graphics, Peter Shirley, Michael Ashikhmin, Steve Marschner, Third edition, A K Peters/CRC Press