COMPUTER GRAPHICS

Computer Graphics **involves display, manipulation and storage of pictures and experimental data for proper visualization using a computer.**

Typical graphics system comprises of a host computer with support of graphical devices and fast processor, large memory, frame buffer, display devices (color monitors), input devices (mouse, keyboard, joystick, touch screen, trackball etc.), output devices (LCD panels, laser printers, color printers. Plotters etc.) and other interfacing devices such as, video I/O, TV interface etc.

Four major areas of Computer Graphics are: (i) Display of information, (ii) Design/Modeling, (iii) Simulation and (iv) User Interface. Various concepts and principles in Computer Graphics are:

Typical applications areas:

- **GUI's,**
- **Plotting in business,**
- **Plotting in science and technology,**
- **Scientific Visualization**
- **Office automation**
- **desktop publishing,**
- **Web/business/commercial publishing and advertisements,**
- **CAD/CAM design,**
- **Simulation studies,**
- **Simulators**
- **Cartography,**
- **Multimedia,**
- **Entertainment (movie, TV, Advt. Etc.)**
- **Virtual reality**

Various application packages and standards are available:

- **Core graphics,**
- **GKS**
- **SRGP,**
- **PHIGS, SPHIGS and PEX 3D,**
- **OpenGL,**
- **ActiveX,**
- **Direct3D and**
- **X11-based systems.**

On various platforms:

- **DOS,**
- **Windows,**
- **Linux,**
- **OS/2,**
- **SGI,**
- **SunOS,**
- **Solaris,**
- **HP-UX,**
- **Mac,**
- **DEC-OSF**

Various utilities and tools available for web-based design include: Java, XML, VRML and GIF animators.

Certain compilers, such as, Visual C/C++, Visual Basic, Borland C/C++, Borland Pascal, Turbo C, Turbo Pascal, Gnu C/C++, Java provide their own graphical libraries, API, support and help for programming 2-D/3-D graphics.

Some these systems are device-independent (X11, OpenGL) and some are device-dependent (Solaris, HP-AGP).

Computer Graphics systems could be *active* or *passive*. In both cases, the input to the system is the scene description and output is a static or animated scene to be displayed. In case of *active* systems, the user controls the display with the help of a GUI, using an input device. Computer Graphics is now-a-days, a significant component of almost all systems and applications of computers in every field of life.

Various *concepts and principles* in Computer Graphics are:

Coordinate Systems:

World and Image Space Coordinates, Vector Space, Linear Spaces, Inner-Product Spaces, Affine-Spaces, Planes and Frames.

Transformations:

***Affine (2-D and 3-D)*: Rotation, Translation, Scale, Reflection and Shear.**

***Viewing*: The Camera Transformations - perspective, orthographic, isometric and stereographic views, Quaternion, Clipping, Scan Conversion etc.**

Scan Conversion:

Drawing of Points, Lines, Markers, Curves, Circles, Ellipse, Polyline, Polygon. Area filling, fill-style, fill pattern, clipping, anti-aliasing etc.

Shading & Illumination:

Phong's shading model, texture mapping, bump mapping, Gouraud shading, Shadows and background, Color models etc.

Curves and Surfaces:

Bezier (Bernstein Polynomials) Curves, B-Splines, Cubic-Splines, Quadratic surfaces, parametric and non-parametric forms, Hermite Curves etc.

Hidden Surface Removal:

Back face culling, Painter's algorithm, scan-line algorithm, BSP-trees, Z-buffer/sorting, Ray tracing etc.

Solid Modeling:

Wire-frame, Octrees, Sweep, Boundary representations. Regularized Boolean set operations, Constructive Solid Geometry.

Advanced Raster Graphics Architecture:

Display Processors, Pipeline and parallel architectures, multi-processor systems, hybrid architectures.

Miscellaneous:

Animation, Fractals, Projection and Viewing, Geometry, Modeling, Image File formats, Image Morphing, Interaction (sample and event-driven) etc.

References

1. Computer Graphics; principles and practice; 2nd edn. In C; Foley, Van Dam, Feiner and Hughes; Addison Wesley, 1997.

2. Mathematical elements for Computer Graphics; 2nd edn., D. F. Rogers and J. A. Adams; McGraw-Hill Intnl. Edn., 1990.

3. Fundamentals of Computer Graphics, Hearn and Baker, Prentice Hall, 1992.

4. Interactive Computer Graphics; Edward Angel, Addison Wesley, 1997.

Software

Without a good software package, your hardware can do nothing.There are literally hundreds of computer animation and graphics software packages out there, however, only a few are considered industry favorites. These are some of the most popular software packages used by companies, schools, and individuals all around the globe.

3DStudio Max

The successor to 3DStudio 3.0. 3DStudio Max runs under WindowsNT. It is entirely object oriented, featuring new improvments such as volumetric lighting, spacewarps, and an all new redesigned inteface.

3DStudio

3DStudio is a 3D computer graphics program. 3DStudio runs on PC's. It is relativly easy to use. Many schools and small time production studios use 3DStudio to satisfy their needs. 3DStudio is created by AutoDesk. 3DStudio consists of a 2D modeler in which shapes can be drawn, a 3D Lofter, in which 2D shapes can be extruded, twisted, or solidified to created 3D objects. Then there is a 3D modelet in which a scene is created. Finally there is a animator in which key frames are assigned to create an animation and a material editor in which a great veriety of textures can be created. Overall this is a great program.

LightWave3D

LightWave 3D is another high end PC 3D computer graphics software package. Originally developed for the Amiga platform, LightWave 3D is now also avilable on the PC. LightWave 3D is used in quite a few television productions such as Babylon 5 and SeaQuest. Many people debate that LightWave3D is the best 3D product for the PC.

Adobe Photoshop

Although Adobe Photoshop is not a computer animation application, it is one of the top of the line graphics programs. It is created by Adobe. Photoshop runs both on Mac's and PC Windows, and even on SGI's. It can be used to touch up digitized images or to create graphics from scratch.

Adobe Premiere

Adobe Premier, just like the name says, is created by Adobe. It is a tool used to composite digitized video, stills, and apply a veriety of transitions and special effects. Adobe Premiere runs both on Macintoshes and PC Windows.

Alias|Wavefront

Alias is one of the topmost computer animation packages out there. Alias was produced by the company that used to be Alias, but now it joined with Wavefront and is known as Alias | Wavefront. It runs on SGI's. Alias is well known for its great modeler which is capable of modeling some of the most complicated objects. Also, this software package is very flexible, allowing for programmers to create software that will run hand in hand with Alias.

Animator Studio

Animator Studio is a cell animation program from AutoDesk. It's predecessor was Animator Pro for PC DOS. Animator Studio runs under Windows. It has a multitude of features that minimize the animation creation time.

Elastic Reality

Elastic Reality is one of the top of the line morphing programs. Elastic Reality runs on Mac's and SGI's. One of the great features of Elastic Reality as opposed to other programs is that it uses splines as opposed to points to define the morphing area. Elastic Reality allows to morph video as well as still images.

SoftImage

One of the three top most computer animation software packages. SoftImage is used in many top production studios around the country and around the world.

Strata Studio Pro

Strata Studio Pro is probably the most known 3D graphics application on the Mac. It is created by Strata Inc. Strata Studio Pro is mainly a still graphic rendering application, but it does have animation capabilities. Graphics for some games such as Myst were created in Strata Studio Pro.

Heard about MAYA ??