Lectures on Computer Graphics

COMPUTER GRAPHICS

Section – I

INTRODUCTION

Introduction to 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 fast processor, large memory, frame buffer and

- **Display devices** (color monitors),
- **Input devices** (mouse, keyboard, joystick, touch screen, trackball)
- **Output devices** (LCD panels, laser printers, color printers. Plotters etc.)
- **Interfacing devices** such as, video I/O, TV interface etc.
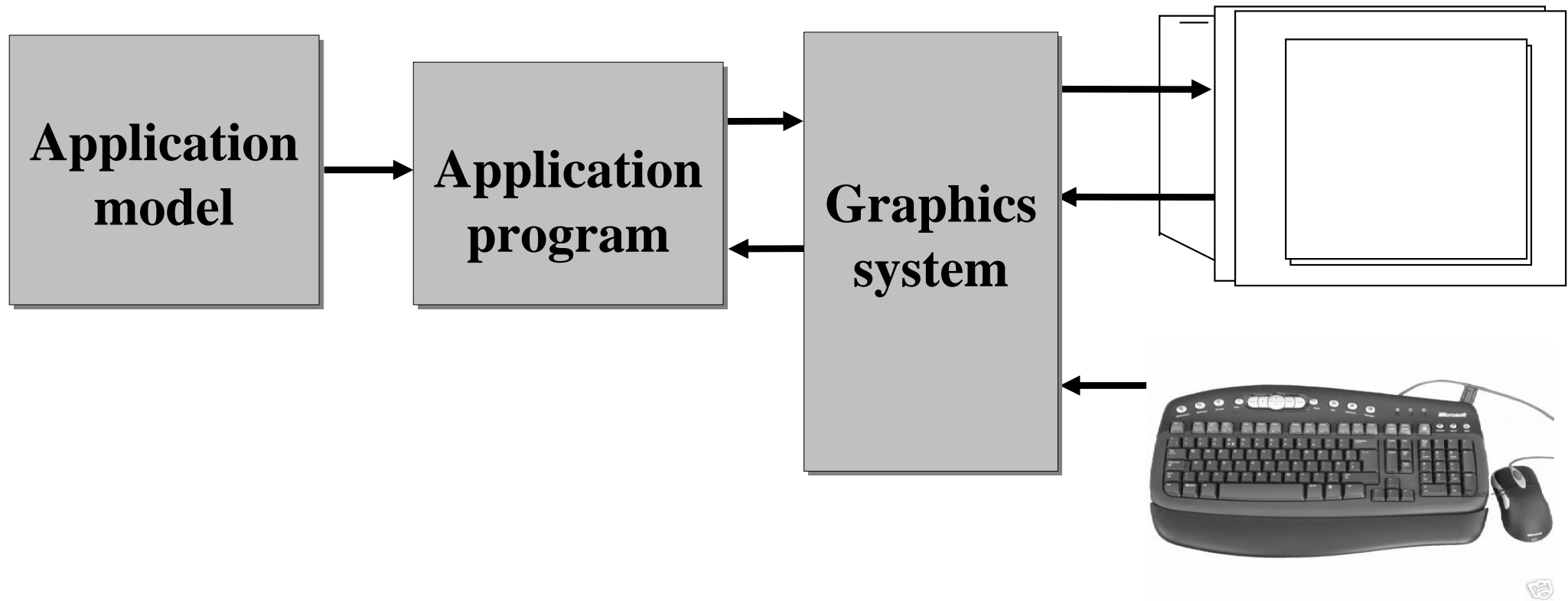
Conceptual framework for interactive graphics

Typical applications areas are

- **GUI**

- **Office automation**

- **Plotting in business**

- **Desktop publishing**

- **Plotting in science and technology**

- **Web/business/commercial publishing and advertisements**

- **CAD/CAM design (VLSI, Construction, Circuits)**

- **Scientific Visualization**

- **Entertainment (movie, TV Advt., Games etc.)**

- **Simulation studies**
- **Simulators**

- **Cartography**
- **Multimedia**

- **Virtual reality**

- **Process Monitoring**

- **Digital Image Processing**

- **Education and Training**

GUI – Graphical User Interface

Typical Components Used:

- Menus
- Icons
- Cursors
- Dialog Boxes
- Scroll Bars

- Buttons
- Valuators
- Grids
- Sketching
- 3-D Interface

GKS – **Graphics Kernel System**

by ISO   (International Standards Organization)
& ANSI (American National Standards Institute)

SRGP – **Simple Raster Graphics Package**

PHIGS – **Programmers Hierarchical Interactive Graphics System**

Various application packages and standards are available:

- **Core graphics**

- **GKS**

- **SRGP**

- **PHIGS, SPHIGS and PEX 3D**

- **OpenGL (with ActiveX and Direct3D)**

- **X11-based systems.**

On various platforms, such as

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)**

- **device-dependent (Solaris, HP-AGP).**

Four basic output primitives (or elements) for drawing pictures:

- **POLYLINE**

- **Filled POLYGONS (regions)**

- **ELLIPSE (ARC)**

- **TEXT**

- **Raster IMAGE**

Four major areas of Computer Graphics are:

- **Display of information,**

- **Design/Modeling,**

- **Simulation and**

- **User Interface.**

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 fundamental *concepts and principles* in Computer Graphics are

Display Systems
>Storage displays, Random scan, Raster refresh displays, CRT basics, video basics, Flat panel displays.

Transformations
>*Affine (2-D and 3-D)*: Rotation, Translation, Scale, Reflection and Shear.
>*Viewing*: The Camera Transformations - perspective, orthographic, isometric and stereographic views, Quaternion.

Scan Conversion and Clipping

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

Hidden Surface Removal

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

Shading & Illumination

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

Solid Modeling

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

Curves and Surfaces

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

Miscellaneous

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

Advanced Raster Graphics Architecture

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

References

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