COMPUTER GRAPHICS

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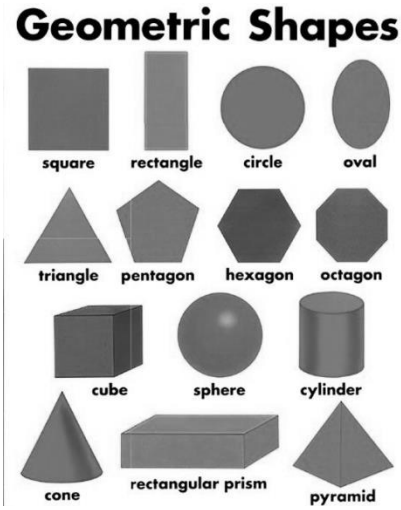
Chatper-1 Introduction

1.1 Introduction



Computer Graphics

Computer

↓

Raw Data → process → Information

***Graphic*s** → Graph + pics

Graph → Geometrical shapes / mathematical figures

Pics→ image → how image behaves in different co-ordinates? OR how the image fits in screen of different display device?

- Firstly, provide raw data to the computer to make geometrical / mathematical figures.

- Provide raw data to the computer and by processing that raw data with the help of algorithms or programs we will get a beautiful / meaningful information i.e. Graph, bar, image etc. that is call computer graphics

HOW GRAPHICS WAS EVOLVED?

- Us army, rocket, rocket experts.

WHAT IS VALUABLE IN GRAPHICS?

- Representation – show
- Manipulation – edit delete crop or changes
- Storage

Definition:

- CG is an art of drawing pictures, lines, charts or diagrams using computer with the help of programs (algorithms) and software.
- The term computer graphics includes almost everything on computers that is not text or sound.

- Computer graphics can be a series of images which most often called video or a single image.

- The definition of computer graphics is the technology that deals with designs and pictures on computers. So, computer graphics are visual representations of data displayed on a monitor made on a computer.

❖ Computer Graphics is a field related to the generation of graphics using computers.

❖ It includes the creation, storage, and manipulation of images of objects.

❖ These objects come from diverse fields such as physical, mathematical, engineering, architectural, abstract structures and natural phenomenon. Computer graphics today is largely interactive, i.e. the user controls the contents, structure, and appearance of images of the objects by using input devices, such as keyboard, mouse, or touch-sensitive panel on the screen.

In short, Computer graphics refer different things in different contexts:

- ✓ **Pictures**, scenes that are generated by a computer.
- ✓ **Tools** used to make such pictures, software and hardware, input/output devices.
- ✓ The **whole field of study** that involves these tools and the pictures they produce

Types of Computer Graphics:

Basically 2-Types

1. **Interactive Computer Graphics:**

   - ❖ Involves two way communication between computer and user.
   - ❖ User has full control over the content
   - ❖ In the Interactive Graphics, data / information shown in the display unit can be interact by one or more input device.
   - ❖ I/O Device→ request to system/ computer → O/P as a Graphical content.
   - ❖ Example: Simulators, User Interface etc.
   - ❖ Interactive computer graphics affects our lives in a number of indirect ways.

2. **Non-interactive Computer Graphics**

   - ❖ Involves one-way communication between user and computer /system.
   - ❖ User has control over some parts of the contents and totally controlled by program.
   - ❖ Also called **passive computer graphics**
   - ❖ Example: Videos, Images etc.

Computer Graphics vs Image Processing.

CG	IP
1. It is Field related to generation of pictures using computers (various algorithms for the generation of images)	1. It applies the techniques to modify or interpret existing pictures. (various techniques are used to manipulate pictures)
2. It includes creation storage and manipulation of images of objects	3. It is part of CG that handles image manipulation or interpretation
4. Synthesize pictures from mathematical or geometrical models.	5. Analyze pictures to drive descriptions (often in mathematical or geometrical forms) of objects appeared in the pictures
6. Eg. Drawing pictures	7. Making blurred image visible

1.2 History of Computer Graphics

At first only textual data was present → 1963 Ivan Sutherland developed a sketch pad in which images can be drawn on screen using light pen→ then US army → later he developed V-R Equipment → and he developed flight simulator → he was student of computer science.

Evaluation of Computer Graphics Can be summarized as follows:

In

1950 → First Graphics Images were created

1951 → CRT monitors on Main Frame computer were introduced

1959 → CAD was used to design cars

1961 → First video game named "Space War "developed

1963 → First Hidden Line and Hidden surface removal algorithms developed.

1965 → DDA algorithm developed by Jack Bresenham

1973 → First use of 2D animations

1982 →AutoCAD was released.

2001 → First digital film name "The Spirits Within "with digital actors

2006 → Google acquired sketch-up

2015 → "Big Data" used for constructing animation

2016 → With enough preparation, Real Time source can be animated

2020→ most video animation are CGI now, availability of highly advanced graphics.

1.3 Application of Computer Graphics

Widely used in numerous field in various way

1. User Interface (UI)

- CG is used to design : Menus, icons , cursors, dialog boxes, scrollbars, grids, 3D

- The interaction of users interacts with electronic devices such as computers mobiles and other devices. This interface uses icons, menus and other visuals, graphics by which user easily interacts.

- For example, Word processing, spreadsheet, and desktop-publishing programs are the typical examples where user-interface techniques are implemented.

2. Plotting and presentation

- Plotting bar charts histograms pie charts task scheduling charts are most commonly used plotting.
- Plotting is used to present data meaningfully and concisely
- Computer graphics are used for creating charts, bar diagrams and other visuals for the presentation purpose, with this user, can easily understand the points.
- Extensively used to plot and present 2D and 3D graphs of physical data, mathematical reports, scientific reports, economic and financial data/ functions and behavior.

3. Office Automation and electronics publishing. *imp*

- Provides a full set of word-processing features as well as fine control over placement of text and graphics, so that you can create newsletters, advertisements, books, and other types of documents.

- It means by using a personal computer or workstation high-quality printed documents can be produced.

- Electronic publishing / desktop publishing system allows you more power to print the meaningful materials in-house.
- The most powerful desktop publishing systems enable you to create illustrations. While less powerful systems let you insert illustrations created by other programs.
- Office automation and electronic publishing can produce both traditional printed (Hardcopy) documents and electronic (softcopy) documents that contain text, tables, graphs, and other forms of drawn or scanned-in graphics
- A particularly important feature of desktop publishing systems is that they enable you to see on the display screen exactly how the document will appear when printed.
- Systems that support this feature are called WYSIWYGs (what you see is what you get). Until recently, hardware costs made desktop publishing systems impractical for most uses. But as the prices of personal computers and printers have fallen, desktop publishing systems have become increasingly popular for producing newsletters, brochures, books, and other documents that formerly required a typesetter.
- Once you have produced a document with a desktop publishing system, you can output it directly to a printer or you can produce a PostScript file which you can then take to a service bureau. The service bureau has special machines that convert the PostScript file to film, which can then be used to make plates for offset printing. Offset printing produces higher-quality documents, especially if color is used, but is generally more expensive than laser printing.

4. Computer aided Design

- Computer-aided design (CAD) is the use of computer technology for the design of objects, real or virtual.
- One of the major uses of computer graphics is to design components and systems of mechanical, electrical, electrochemical, and electronic devices, including structures such as buildings, automobile bodies, airplane and ship hulls, very large scale integrated (VLSI) chips, optical systems and telephone and computer networks.
- These designs are more frequently used to test the structural, electrical, and thermal properties of the systems.
- The design of geometric models for object shapes, in particular, is often called computer-aided geometric design (CAGD).

- CAD may be used to design curves and figures in two-dimensional ("2D") space; or curves, surfaces, or solids in three-dimensional ("3D") objects.
- CAD is also widely used to produce computer animation for special effects in movies, advertising, technical manuals.

5. **Digital Art**:

- Digital art most commonly refers to art created on a computer in digital form.
- Computer Graphics provide a new way of creating designs. Now Artists and designers use illustrator, coral draw, Photoshop, adobe muse and other different types of applications for creating new designs.
- The impact of digital technology has transformed traditional activities such as painting, drawing and sculpture, while new forms, such as net art, digital installation art, and virtual reality, have been recognized artistic practices.

6. **Web Design**:

- Web design is the skill of designing presentations of content usually hypertext or hypermedia that is delivered to an end-user through the World Wide Web, by way of a Web browser.
- The process of designing Web pages, Web sites, Web applications or multimedia for the Web may utilize multiple disciplines, such as animation, authoring, communication design, corporate identity, graphic design, human-computer interaction, information architecture, interaction design, marketing, photography, search engine optimization and typography.

7. **Education and Training** ***imp***

- For the educational or training purpose – A computer simulation, a computer model or a computational model can be used. Which is a computer program, or network of computers, that attempts to simulate an abstract model of a particular system.
- Computer simulations have become a useful part of mathematical modeling of many

a) natural systems in physics (computational physics), chemistry and biology,
b) Human systems in economics, psychology, and
c) Social science and in the process of engineering new technology, to gain insight into the operation of those systems, or to observe their behavior.

i. Computational Biology:

- Computational biology is an interdisciplinary field that applies the techniques of computer science, applied mathematics and statistics to address biological problems.
- The main focus lies on developing mathematical modeling and computational simulation techniques in biological sector.

ii. Computational Physics:

- Computational physics is the study and implementation of numerical algorithm to solve problems in physics for which a quantitative theory already exists.
- It is often regarded as a sub discipline of theoretical physics but some consider it an intermediate branch between theoretical and experimental physics.

iii. Information of Graphics:

- Information graphics or information graphics are visual representations of information, data or knowledge.
- These graphics are used where complex information needs to be explained quickly and clearly, such as in signs, maps, journalism, technical writing, and education.
- They are also used extensively as tools by computer scientists, mathematicians, and statisticians to ease the process of developing and communicating conceptual information.

iv. Scientific and business Visualization:

- Scientific visualization is a branch of science, concerned with the visualization of three dimensional phenomena, such as architectural, meteorological, medical, biological systems.

- Generating computer graphics for scientific, engineering, and medical data sets is termed as scientific visualization whereas business visualization is related with the non-scientific data sets such as those obtained in economics. Visualization makes easier to understand the trends and patterns inherent in the huge amount of data sets. It would, otherwise, be almost impossible to analyze those data numerically

- Scientific visualization focuses on the use of computer graphics to create visual images which aid in understanding of complex, often massive numerical representation of scientific concepts or results.

8. Simulation and modeling *imp*

- Simulation is the imitation of the conditions like those, which is encountered in real life. Simulation thus helps to learn or to feel the conditions one might have to face in near future without being in danger at the beginning of the course.
- For example, astronauts can exercise the feeling of weightlessness in a simulator; similarly a pilot training can be conducted in flight simulator.
- The military tank simulator, the naval simulator, driving simulator, air traffic control simulator, heavy-duty vehicle simulator, and so on are some of the mostly used simulator in practice.
- Simulators are also used to optimize the system, for example the vehicle, observing the reactions of the driver during the operation of the simulator

9. Entertainment

- Disney movies such as Lion Kings and The Beauty of Beast, and other scientific movies like Jurassic Park, Avatar, The lost world etc. are the best example of the application of computer graphics in the field of entertainment.
- Instead of drawing all necessary frames with slightly changing scenes for the production of cartoon-film, only the key frames are sufficient for such cartoon-film where the in between frames are interpolated by the graphics system dramatically decreasing the cost of production while maintaining the quality.
- Computer and video games such FIFA, PUBG, Doom, Pools are few to name where graphics is used extensively.

10. Cartography *imp*

- Cartography is a subject, which deals with the making of maps and charts.
- Computer graphics is used to produce both accurate and schematic representations of geographical and other natural phenomena from measurement data.
- Examples include geographic maps, oceanographic charts, weather maps, contour maps and population-density maps. Surfer is one of such graphics packages, which is extensively used for cartography.

COMPONENTS OF COMPUTER GRAPHICS *imp*

- Interactive computer Graphics consist of three components
  - ✓ Digital buffer,
  - ✓ TV monitor and
  - ✓ Display controller.
- Using these components, we are able to see the output on the screen in form of pixels (picture elements).
- Following is the explanation of these components

1. **Digital Memory Buffer**

   - This is a place where images and pictures are stored as an array (matrix of 0 & 1, 0 represents darkness and 1 represents image or picture).
   - Digital memory buffer also called **frame buffer**.
   - In today's term frame buffer is called V-RAM (video RAM) and it helps to store the image in bit form. It helps to increase the speed of graphics (sometimes we watch movies on our computer system and movie run slowly. System engineer is then called for. He/She comes and fits in V-RAM (in Megabytes) into our system and movie runs perfectly.

2. **TV Monitor**

   - ❖ Monitor helps us to view the display and they make use of CRT technology (Cathode ray Tube).

3. **Display Controller**
   - ❖ It is an interface between Memory Buffer and TV Monitor.
   - ❖ Its job is to pass the contents of frame buffer to the monitor. This passing has to be fast for steady display on the monitor (depending upon the material of the system). The image must be passed repeatedly to the monitor to maintain a steady picture on the screen.
   - ❖ The display controller reads each successive byte of data from FB Memory and converts 0's and 1's into corresponding video signals. This signal is then feed to the TV monitor to produce a black and white picture on screen.
   - ❖ In today's term, display controller is recognized as a display card and one of our choices can be VGA card with a resolution of 640x480. (Display Controller is also capable of displaying image in colors).

End of Chapter -1