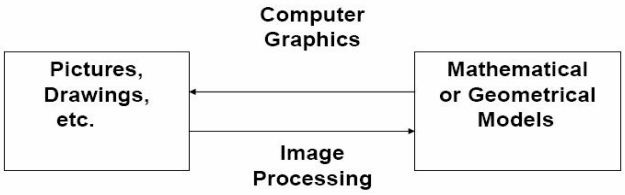
CHAPTER – 1

Computer graphics

1.1 Introduction

Computer graphics is a field or art related to the generation of graphics using digital computers. It includes the *creation; storage and manipulation of images* of objects come from diverse fields such as physical, mathematical engineering, architectural abstract structures and natural phenomenon. We use different input and display devices to generate & perform the modification on the digital images. Some such devices are keyboard, mouse, or touch sensitive panel, monitors etc. Some considerable terminologies on the computer graphics are:

- *Modeling*: creating and representing the geometry of objects in the 3D world
- *Rendering*: generating 2D images of the 3D objects
- *Animation*: describing how objects change in time



Difference between image processing and CG are listed below:

Computer Graphics (CG)	Image Processing (IP)
1. It is the field related to the generation of images using computers	1. It applies technique to modify or interpret existing pictures
2. It synthesizes picture from mathematical or geometrical models	2. It analyze picture to derive description in mathematical or geometrical forms
3. It includes the creation storage and manipulation of images or objects	3. It is the part of computer graphics that handles image manipulation or interpretation
4. E.g., drawing a picture.	4. E.g., making blurred image visible.

1.2 History of Computer Graphics

The history of the computer graphics illustrates a chronically development of hardware and software. The past principals and techniques are still applicable in present and future computer graphics technology. The evolutions of graphics can be explained under following points.

1950	First graphic images were created on oscilloscope using analog electronic beams.
1951	Mainframe computer with a CRT monitor that can plot blips based on radar data.
1955	CRT monitor with vector graphics and invention of light pen as an input device.
1959	First industrial CAD (Computer-Aided Design) system for cars design.
1961	*Spacewar*, the first video game, is developed.
1963	First hidden-line and hidden-surface removal algorithms. The mouse was invented.
1965	The digital line drawing algorithm by Jack Bresenham
1969	Raster video displays using frame-buffer (with 3 bits per pixel)
1973	First use of 2D animation on a film *Westworld*
1975	Specular illumination model known as Phong shading
1980	Ray tracing with reflection, refraction, antialiasing, and shadows.
1982	Autodesk is founded and AutoCAD released.
1985	Introduces noise functions for creating natural patterns such as marble, wood, etc.
1992	Open Graphics Library (OpenGL) specification defining a standard cross-language cross-platform API for computer graphics.
2001	*The Spirits Within,* digital film that includes photorealistic digital actors
Nowadays	Many graphics-hardware vendors; many console manufacturers, many software packages, many animation studios, and many game companies.

1.3 Main applications of CG

1. **Graphical User Interface:** The GUI application on the computer system provide the facility of selection of menu items, icons & object on screen, directly either by touching it (in case of touch panel) or just by clicking on it. This is more efficient mechanism rather than the assembly language coding.
2. **Plotting:** To present meaningfully and concisely the ***trends and patterns*** of complex data, we use histograms bar, pie charts, task-scheduling charts etc.
3. **Computer Aided Drafting & Design:** One of the major uses of computer graphics is to design components and systems of mechanical, electrical, electromechanical and electronic devices, including structures such as buildings, automobiles bodies, and airplane and ship hulls, very large-scale integrated (VLSI) chips, optical systems and telephone and computer networks. Computer Aided Design (CAD) and Computer Aided Manufacture(CAM) are important terms in the field of design and manufacture
   - **Computer Aided Design (CAD)** involves the use of computer hardware and graphics software to generate design drawings. A wide range of computer based tools are used to assist engineers, architects and other design professionals in their design activities. It is also known as CADD, which stands for computer aided design and drafting. Modern CAD equipment enables the designer to quickly produce very accurate and realistic images of products to be manufactured. CAD is usually employed when simple drafting is not able to do the job such as in design of automobiles, airplanes, ships and other industrial designs.
   - **Computer Aided Manufacturing (CAM)** is a system of automatically producing finished products by using computer controlled production machines. CAD and CAM work together in that the digital model generated in CAD is inputted to the CAM software package. The CAM software needs to know the physical shape of the product (CAD model) before it can compose a proper set of fabrication instructions to a production machine. The major difference between CAD and CAM lies in the end user. While CAD software is mostly used by an engineer, CAM is used by a trained machinist.
4. **Simulation:** Simulation is the ***imitation*** of the conditions encountered in real life. The simulation provides the virtual reality of any system & helps us to train people without accidental loss. Such type of training may be pilot training, military weapon training, space training, electronic circuit design training, VLSI training etc.
5. **Entertainment:** Computer graphics are used for cartooning, game playing, animation etc.
6. **Art & Commerce:** The pictures of new car models, new products in market, awareness arts, traffic symbols etc. produced using computer graphics express a message and attract attention of people at public places, transportation terminals, supermarkets, hotels etc.
7. **Cartography:** Cartography is a subject which deals with the making of maps and charts of the geographical data in accurate and schematic way.
8. **Medical Imaging:** The range of application spans from tools for teaching and diagnosis, all the way to treatment. Computer graphics is tool in medical applications
9. **Education and Training:** Different computer graphics and images are used in schools and many training center for the better understanding the subject of interest.
10. **Other applications:** Multimedia systems, Animation for entertainment, Robotics & virtual reality, Image processing, etc.