



IT Helloprogrammers

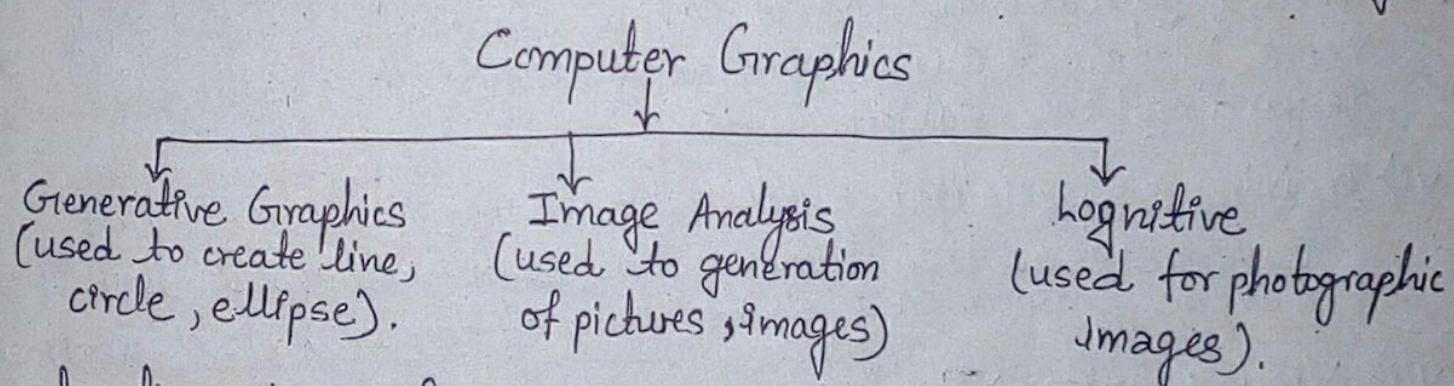
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Unit-1

Introduction of Computer Graphics

Introduction: The process of transforming and presenting objects or information in visual form is called Computer Graphics. It is the creation of pictures with the help of a computer. Computer graphics maybe a business graph, drawings like line, circle or any other shape, animations etc.

In today life, computer graphics has now become a common element in user interfaces, T.V, computer commercial motion pictures etc. In computer graphics, two or three-dimensional pictures can be created that are used for research. It is also used in various fields like engineering, mathematical model etc.



Application Areas of Computer Graphics:

Computer graphics deals with creation, manipulation and storage of different type of images and objects. Some of the applications of computer graphics are as follows:-

- 1) Computer Art → Using computer graphics we can create fine and commercial art which include animation packages, object shapes and specifying object motion. Cartoon drawing, paintings, logo design can also be done.
- 2) Computer Aided Drawing (CAD) → Designing of buildings, automobile, aircraft is done with the help of computer aided drawing. This helps in providing minute details to the drawing and producing more accurate and sharp drawings with better specification.

- iii) Presentation Graphics → For the preparation of reports or summarising the financial, statistical, mathematical, scientific, economic data for research reports, managerial reports, moreover creation of bar graphs, pie charts, time chart, can be done using the tools present in computer graphics.
- iv) Entertainment → Computer graphics finds a major part of its utility in the movie industry and game industry. Used for creating motion pictures, music video, television shows, cartoon animation films.
- v) Education → Computer generated models are extremely useful for teaching huge number of concepts in an easy to understand and learn manner. Using computer graphics many educational models can be created through which more interest can be generated among the students regarding the subject.
- vi) Training → Specialized system for training like simulators can be used for training the candidates in a way that can be grasped in a short span of time with better understanding.
- vii) Visualisation → Data visualisation helps in finding insights of the data, to check and study the behaviour of processes around us we need appropriate visualisation which can be achieved through proper usage of computer graphics.
- viii) Image Processing → Various kinds of photographs or images require editing in order to be used in different places. Processing of existing images into refined ones for better interpretation is one of the many applications of computer graphics.
- ix) Graphical User Interface (GUI) → The uses of pictures, images, icons, pop-up menus, graphical objects helps in creating a user friendly environment where working is easy and pleasant, using computer graphics we can create such an atmosphere where everything can be automated and anyone can get the desired action performed in an easy fashion.

★ Graphics Hardware ★

Classification of computer graphics

Interactive/active/online graphics

(Person involves himself in the graphics i.e. interacts with it
e.g., games, chatting etc.)

Non-interactive/pассив/
offline graphics

(Person is not involved)
(e.g. movie, TVs etc.)

★ What is pixel?

Ans:- Smallest addressable screen element is known as pixel.

★ What is resolution?

Ans. The maximum number of points that can be displayed without overlap is referred to as resolution.

The number of ^{OR} points per centimetre that can be plotted horizontally and vertically is called resolution.
for e.g. 1024×640 .

Types:

(a) Image resolution → Distance from one pixel to next pixel is called as image resolution. It is also called spacing.

(b) Screen resolution → Number of pixels in the horizontal and vertical directions.

Some important terms:

Aspect ratio → The ratio of vertical points to the horizontal points necessary to produce equal-length lines in both directions on screen is aspect ratio. For example: If 1024×640 is divided as $\frac{1024}{640}$ and reduced into lowest terms then we get 8:5.
Note: Aspect ratio (AR) = $\frac{\text{Width of image}}{\text{Height of image}}$

Frame buffer → The memory where the picture definition is stored is known as frame buffer. It is also called as refresh buffer. This area holds the set of intensity of values for all screen points.

Refresh rate → The refresh rate is the number of times a screen displays an image as repainted or refreshed per second. The refresh rate is expressed in hertz so a refresh rate of 75 means the image is refreshed 75 times in a second. The refresh rate for each display depends on the video card used.

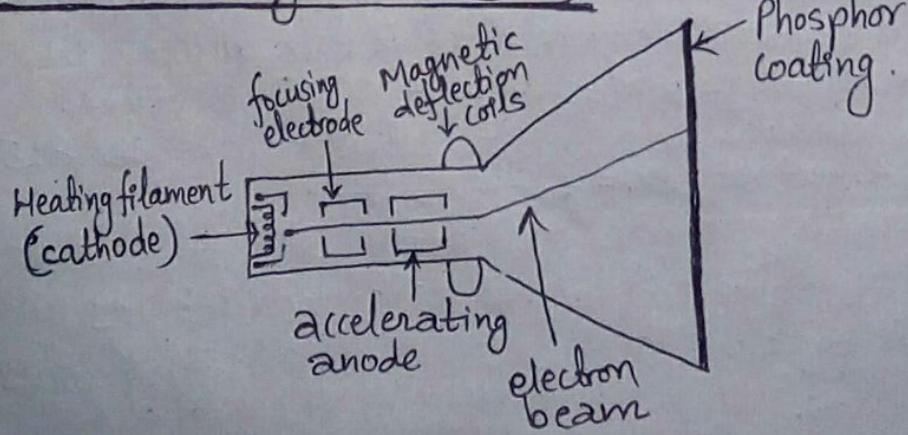
Note:- An interlaced display is a cathode-ray tube (CRT).

Display Technology:

Graphical displays are generally of following two types:

- a) Vector displays → Vector displays generally display lines, specified by their endpoints. Vector display systems operate by direct control of the electron beam of a Cathode ray tube (CRT). Vector displays have certain advantages such as the absence of aliasing. Aliasing is the jagged appearance of primitives as displayed on a raster device.
- b) Raster displays → Raster display typically have an array of addressable dots, which can be individually set to a particular color or intensity. Raster displays can be implemented by several technologies. Currently the most popular is the cathode ray tube, which can implement both raster and vector displays.

*Cathode Ray Tube (CRT):



- The electron gun emits a beam of electrons (cathode rays).
- The electron beam passes through focusing and deflection systems that direct it towards specified positions on the phosphor-coated screen.
- When the beam hits the screen, the phosphor emits a small spot of light at each position contacted by the electron beam.
- It redraws the picture by directing the electron beam back over the same screen points quickly.

The two basic techniques for producing color displays with a CRT are the beam-penetration method and the shadow-mask method. These use the three colours Red, Green and Blue (RGB) and their combinations.

Vimp ⑩ Types of CRT's :

W ⑪ Raster-Scan Display:- In a raster scan system, the electron beam is swept across the screen, one row at a time from top to bottom. As the electron beam moves across each row, the beam intensity is turned on and off to create a pattern of illuminated spots. Picture definition is stored in memory area called Refresh Buffer or Frame Buffer. Stored intensity values are painted on the screen one row at a time as shown below:

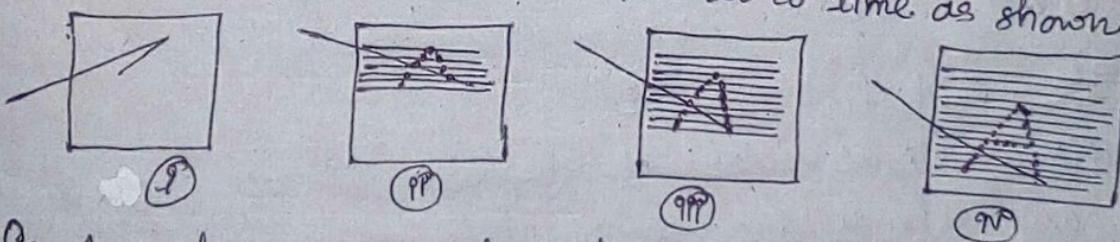


fig: A raster-scan system displaying A.

Refreshing on Raster-Scan display is carried out at the rate of 60 or higher frames per second. Most of display devices are based on this technology. For example, CRT, color CRT, LCD and LED etc.

Horizontal retrace/vertical retrace → Returning of electron beam from right end to left end after refreshing each scan line

is horizontal retrace. At the end of each frame, the electron beam returns to the top left corner to begin next frame called vertical retrace.

Architecture of Raster-Scan System:

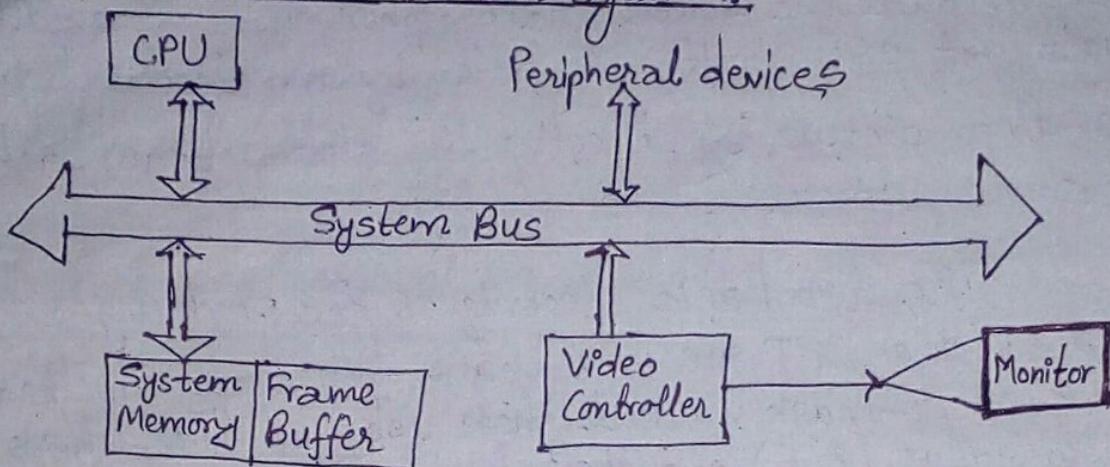


fig. Architecture of simple Raster-scan system.

Raster-scan system consists of several processing units. CPU is the main processing unit of computer system. Architecture of Raster-scan consist of system bus that helps to access peripheral devices. It consist of video controller which is used to control the operation of display device. A fixed area of system memory is reserved for the frame buffer. The contents of frame buffer are used to control the CRT beam's intensity or colour.

Advantages:

- Show Realistic pictures
- Million Unique hues can be performed
- Shadow scenes are conceivable.
(i.e, capable of being imagined).
means colour.

Disadvantages:

- Low Resolution
- Electron beam coordinated to whole screen not exclusively to those parts of screen where picture is drawn so long when drawn picture is longer than whole screen.
- Expensive

b) Random-scan (vector) display System:

In this technique, the electron beam is directed only to the part of the screen where the picture is to be drawn rather than scanning from left to right and top to bottom as in raster scan. It is also called vector display or calligraphic display.

Picture definition is stored as a set of line-drawing commands in an area of memory referred to as the refresh display file. Random-scan displays are designed to draw all the component lines of a picture 30 to 60 times each second.

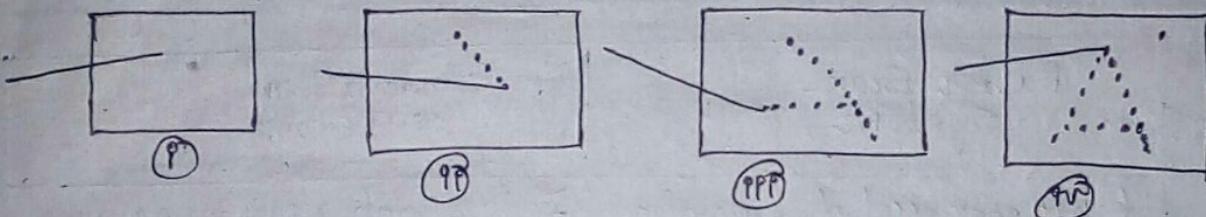


fig. Random-scan displaying A

The refresh rate of vector display depends upon the no. of lines to be displayed for any image. It is designed for drawing all component lines 30 to 60 times per second. Plotter is the best example of this system.

Architecture of Random Scan System:

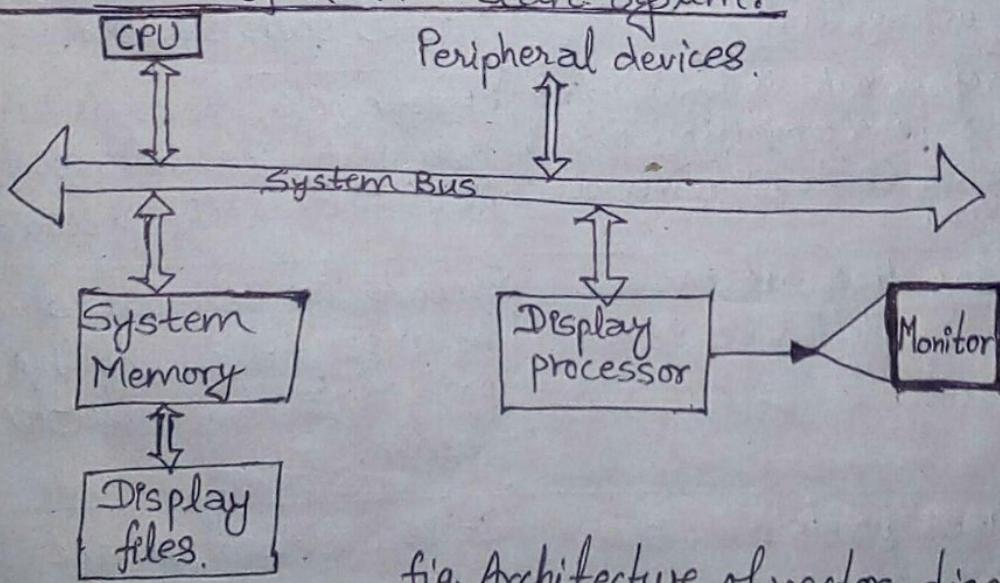


fig. Architecture of vector display system:-

Random display system consists of additional processing unit along with CPU which is called the display processor. Picture definition is stored as a set of line drawing commands in an area of memory called display list. This display list is then accessed by the display processor to create an image.

Advantages:-

- i) High resolution.
- ii) Produce smooth line drawings.

Disadvantages:-

- i) Expensive
- ii) Just does wire frame.
- iii) Complex scene cause visible flicker.

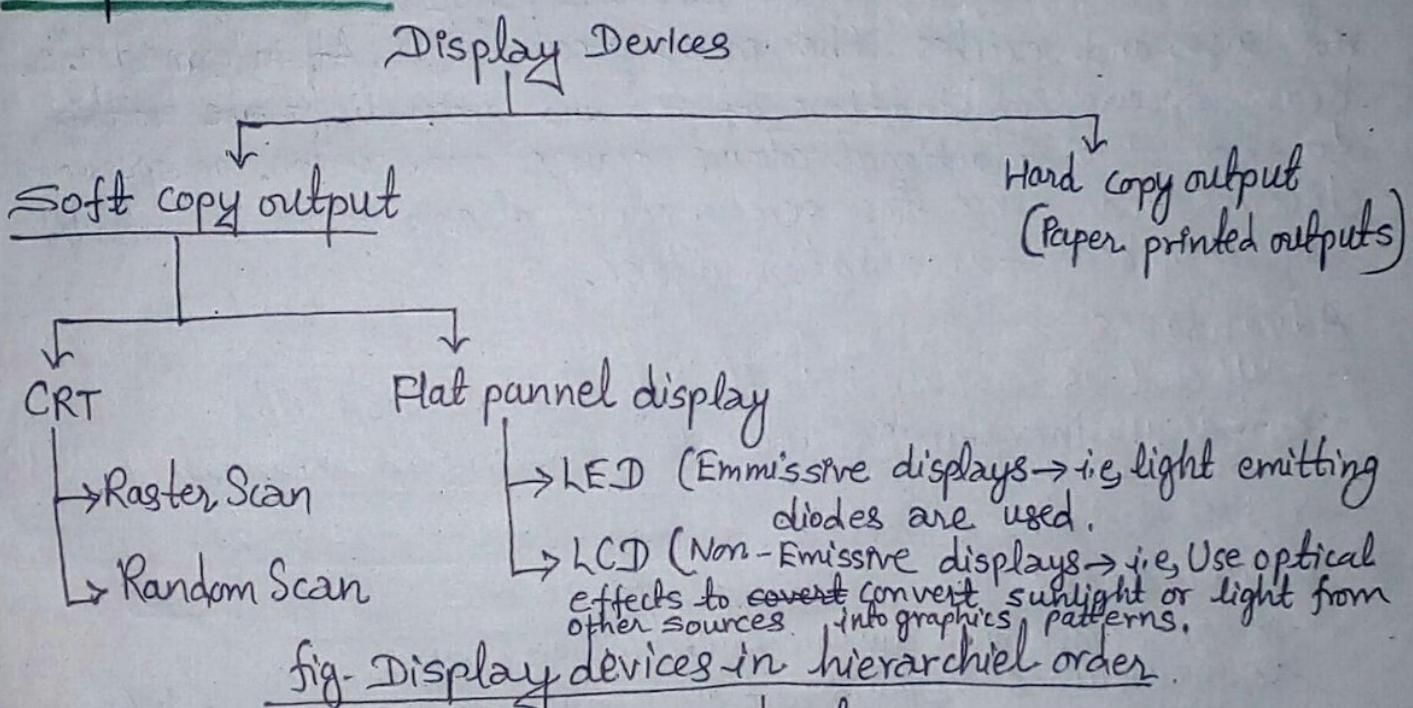
* Differences or Comparison between Raster and Random display systems:-

Basis of Comparison.	Raster Scan System	Random Scan System.
Resolution	It has poor resolution because picture definition is stored as an intensity value.	It has high resolution because it stores picture definition as a set of line commands.
Electron Beam.	Electron beam is directed from top to bottom and one row at a time on screen.	Electron beam is directed to only that part of screen where picture is required to be drawn, one line at a time.
Cost	It is less expensive than Random Scan System.	It is more expensive than raster scan system.
Refresh Rate	The refresh rate is independent of picture complexity. Refresh rate is 60 to 80 frames per second.	Refresh rate depends on the number of lines to be displayed i.e., 30 to 60 times per second.
Line drawing.	Zig-zag lines are produced because plotted values are discrete.	Smooth line is produced because directly the line path is followed by electron beam.
Image Drawing.	It uses pixels along scan lines for drawing an image.	It is designed for line drawing applications and uses various mathematical functions to draw.

④ Input Devices: (Describe / Read Yourself)

- i) Mouse
- ii) Keyboard
- iii) Joy stick
- iv) Light pen
- v) Track ball
- vi) Scanner
- vii) Microphone
- viii) Bar Code Reader etc.

⑤ Output Devices:



⑥ Differences between CRT and LCD displays:-

Topic	CRT	LCD
Size	CRT monitors are thicker in size.	LCD monitors are thinner than CRT monitors.
Weight	A CRT monitor has weight 40 pounds or more depending upon its size.	LCD monitors has pretty light weight as 8 to 10 pounds.
Price	Because of popularity of LCD monitors CRT has become cheap now.	LCD monitors are newer technology so they are expensive than CRT.
Picture	CRT has low quality picture.	LCD has high quality picture.
Viewing angle	CRT monitors has better viewing angle.	LCD monitors can not be viewed from different angles as CRT.

* Color CRT: (Part of Video display Devices / Output Devices)

There are two popular techniques for producing color displays with CRT which are as follows:-

(a) Beam Penetration method:

The beam-penetration method for displaying color pictures has been used with random-scan monitors. Two layers of phosphor, usually red and green, are coated onto the inside of the CRT screen, and the displayed color depends upon on how far the electron beam penetrates into the phosphorus layers. A beam of slow electrons excites only the outer red layer. A beam of very fast electrons penetrates through the red layer and excites the inner green layer. At intermediate beam speeds, combinations of red and green light are emitted to show two additional colours, orange and yellow. The speed of electrons and hence the screen colour at any point, is controlled by the beam-acceleration voltage.

Advantages

- Half cost as compared to that of shadow mask CRT.
- It is an inexpensive way to produce color in random scan monitor.
- Its resolution is better.

Disadvantages

- Time consuming during switching of colours.
- It consumes significant amount of accelerating potential in order to switch color.

(b) Shadow Mask method:

Shadow-mask methods are commonly used in raster scan system (including color TV) because they produce a much wider range of colors than the beam-penetration method. A shadow-mask CRT has three phosphor color dots at each pixel position. One phosphor dot emits a red light, another emits a green light and a third emits a blue light. This type of CRT has three electron guns, one for each color dot, and a shadow-mask grid just behind the phosphor-coated screen.

Advantages:

- Produces much wider range of colors than beam penetration method.
- It produces realistic images.

Disadvantages:

- It is very difficult to coverage all three beams on same hole.
- They have poor resolution.

④ Differences between Beam penetration method and shadow mask method.

Basis for Difference	Beam Penetration Method	Shadow Mask Method.
Where Used	It is used with Random Scan System to display color.	It is used with Raster Scan System to display color.
Colors	It can displays only four colors i.e Red, Green, Orange and Yellow.	It can display millions of colors.
Cost	It is less expensive as compared to shadow mask.	It is more expensive than beam penetration.
Picture Quality.	Picture quality is poor.	Picture quality is high.
Resolution	It gives high resolution	It gives low resolution.

⑤ Graphics Software:

(a) General programming packages → It contains graphics functions used with high level programming languages like C, FORTRAN, JAVA etc. Example - Open GL (Graphics Library)

(b) Special-purpose application packages → It is especially designed for particular applications. For example - CAD applications.

⊗ Software Standards:-

Software standards helps to make portability of software, rewriting code is not required. It can also be used in different implementations and applications. Following are some software standards.

(a) Graphics Kernel System (GKS) → GKS is the first graphics software standard adopted by the international standards organization (ISO). It was originally designed as a 2D graphics package. It includes various types of methods, reserved words.

Advantages

- It provides improved algorithm.
- It makes system portable.
- Rewriting of code is not required.

(b) PHIGS (Programmer's Hierarchical Interactive Graphics Standard):

It is the extension of GKS which provides 3D graphics package. It includes additional functions for object modeling, color specification, surface rendering and picture manipulation.

(c) PHIGS+ :

It is the extension of earlier PHIGS. 3D surface shading capabilities are added to PHIGS+.