

# chap 1.

## Introduction and overview of Graphics System

### \* Use of Computer graphics

① Major use of computer graphics is in design processes i.e. in engineering and architectural systems.

CAD used in the design of buildings, automobiles, aircraft, spacecraft, computers, textiles and many other products.

② CG used in fine art and commercial art applications.

- Artists use a variety of other computer technologies to produce images-

- They use a combination of 3D modeling packages, texture mapping, drawing programs etc.

③ Entertainment

- CG methods are used in making motion pictures, music videos & TV shows.

④ Education and Training

- computer generated models of physical, financial and economic systems are often used in education.

- For some training applications, special systems are designed.

Ex:- simulators for practice sessions or training of ship captains, aircraft pilots, heavy equipment operators.

## ⑤ Visualization

- Scientists, engineers, medical personnel, business analysts & others often need to analyze large amounts of info or to study the behaviour of certain processes.
- Mathematicians, physical scientists and others use visual techniques to analyze mathematical functions and processes or produce interesting graphical representation.

## ⑥ Image processing

- To apply image processing method, we first digitize a photograph or other picture into an image file. Then digital methods can be applied to rearrange picture parts, to enhance color separations or to improve the quality of shading.
- Medical applications also use image-processing techniques for picture enhancements, in tomography and in simulations of operations.

## ⑦ GUI

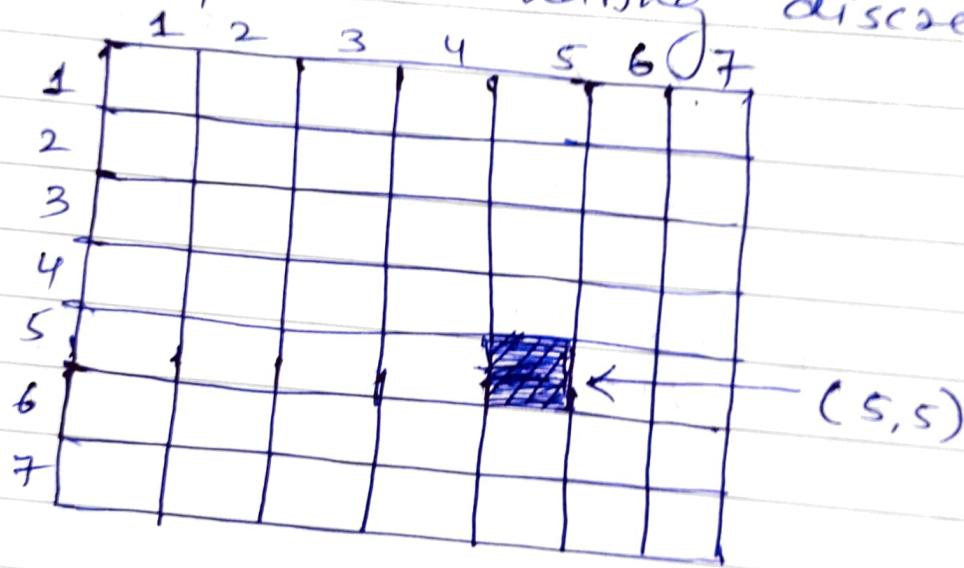
- Interfaces also display menu & icons for fast selection of processing operations.
- The icons represent options for painting, drawing, zooming, typing text strings & other operations connected with picture construction.

## \* coordinate System

- A coordinate system is a system consisting of a set of points, lines or surfaces with each point having a unique location or co-ordinate i.e. assigned to it.
- The device coordinate system is the physical coordinate system of the selected plotting device.
- Device coordinates are integers, ranging from  $(0,0)$  at the bottom-left corner, to  $(Vx-1, Vy-1)$  at the upper-right corner.
- $Vx$  and  $Vy$  are the number of columns and rows addressable by the device.

## \* Scan conversion

- It is process of representing graphics objects which is a collection of pixels.
- The pixels used are discrete. Each pixel can have either on or off state. 0 is represented by pixel off. 1 is represented on pixel.
- Using this ability graphics computer represent picture having discrete dots.



□ → Pixel

- Diff graphics objects can be generated by setting the diff intensity of pixels and diff colors of pixels.
- Each pixel has some co-ordinate value. The coordinate is represented using row and column.

## \* Rasterization and Rendering

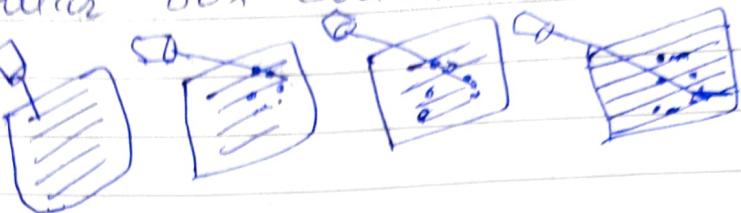
- Rasterization is the process by which most modern display systems turn electronic data or signals into projected images, such as video or graphics.
- All graphics are just a 2D array of pixels. 3D graphics is thus a system of producing colors for pixels that convince you that the scene are at 3D world rather than 2D image.

The process of converting a 3D world into 2D image of that world is called rendering.

## \* Raster scan & random scan displays

- A Raster scan display is based on intensity control of pixels in the form of a rectangular box called Raster on the screen.

ex:- TV



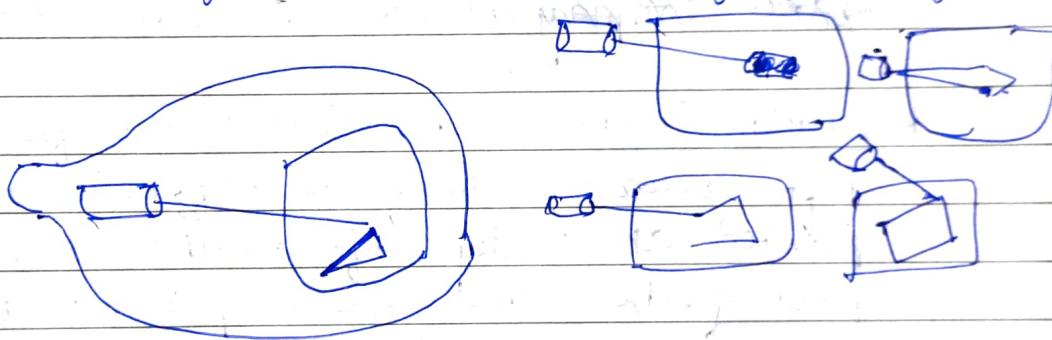
- The Raster scan system can store information of each pixel position, so it is suitable for realistic display of objects.
- Raster scan provides a refresh rate of 60 to 80 frames per second.
- Beam refreshing is of two types - First is horizontal retracing and second is vertical retracing.
- When the beam starts from the top left corner and reaches the bottom right scale, it will again return to the top left side called a vertical retrace.

Then it will come again more horizontally from top to bottom call as horizontal retracing.



## Random Scan Display

- Random Scan System uses an electron beam which operates like a pencil to create a line image on the CRT screen.
- The picture is constructed out of a sequence of straight-line segments.
- each line segment is drawn on the screen by directing the beam to move from one point on the screen to the next, where x & y co-ordinates define each point.
- After drawing the picture, the system cycles back to the first line and designs all the lines of the image 30 to 60 times each second.
- Random scan monitors are also known as vector displays or smoke-writing display.



- This sys are designed for line drawing application & cannot display realistic shaded screens.
- Random displays produce smooth line drawing whereas raster produces jagged lines that are plotted as discrete point sets.
- Instead of pixel, the picture is stored in terms of line drawing commands, so it is called vector display.
- Electron beam only follow border of polygon instead of scanning each scan line.

## Random Scan

1. It has high Resolution
2. More expensive
3. Solid pattern is tough to fill
4. Refreshing rate depends on resolution
5. It is restricted to line drawing application
6. Scan only part of the screen where picture info is present
7. ~~video display~~ not suitable

## Raster Scan

1. Low Resolution
2. Less expensive
3. Solid pattern is easy to fill
4. Refresh does not depend on picture
5. It is suitable for realistic display
6. Scan entire screen to draw a picture
7. Scan conversion is required

\* Raster Scan - Intensity value from the top left location of the frame buffer is retrieved & painted at a top left on the screen. The second pixel of the same row is painted after that & this process continues.

After plotting all pixels in the first row the electron beam moves to the first pixel of the second row & paints all pixels in the second row on screen by retrieving intensity values in horizontal order.

After finishing each scan line (row), electron guns are turned off & move back to the first pixel of the next scan line. That horizontal movement is called Horizontal retrace.

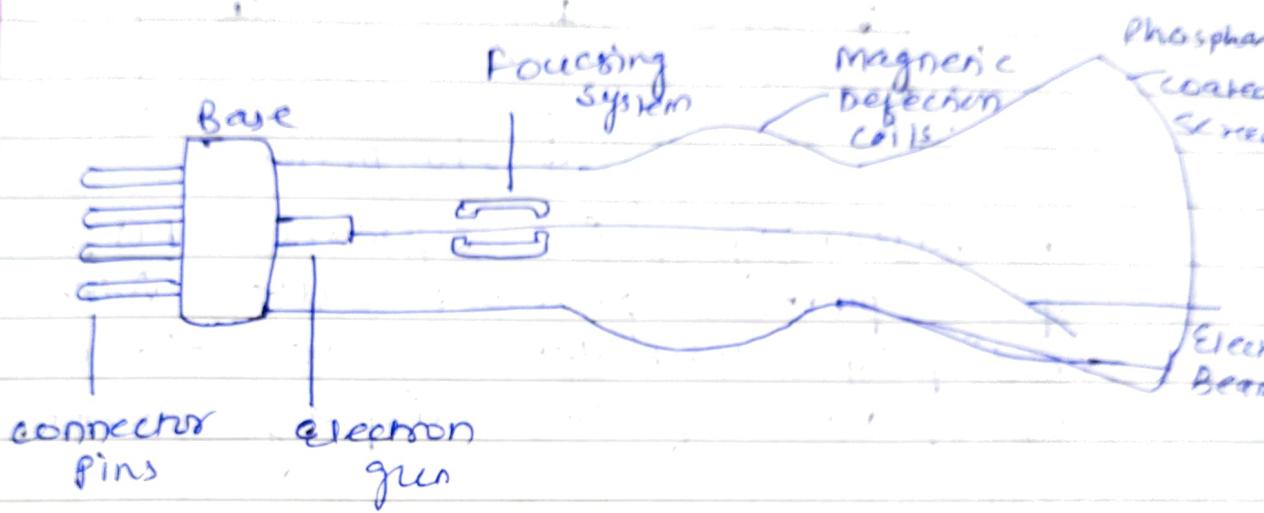
After reaching to last pixel of the screen, electron gun move to the first pixel of the first row i.e. called vertical retrace.

## \* Video Display Devices

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### \* Architecture of Raster Graphics system

- The O/P device in graphics system is video monitor. The operation of most video monitors are based on cathode ray tube (CRT).

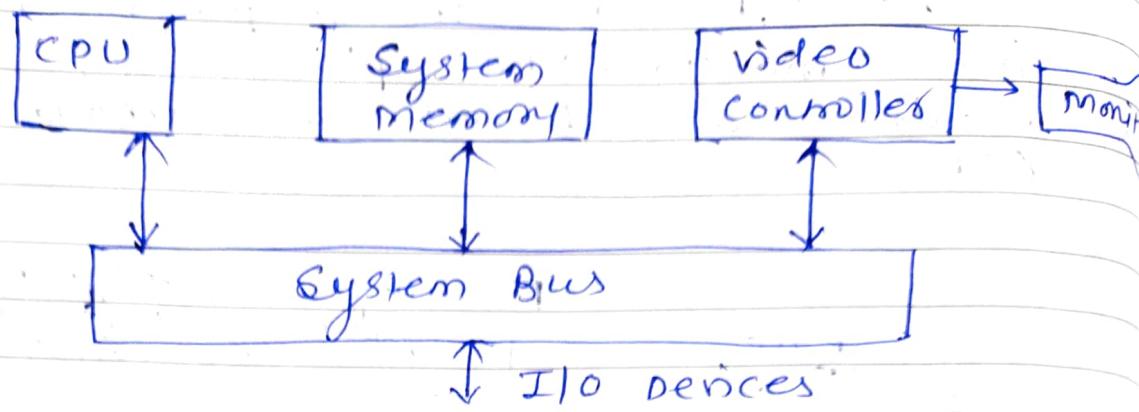


- A beam of electrons emitted by an electron gun, passes through focusing & deflection system that direct the beam toward specified positions on the phosphor coated system screen.

The 'phosphor' then emits small spot of light at the position where electron beam contacted the screen.

- Since amount of light emitted by phosphor coating depends on no. of electrons striking the screen, we can control brightness of a display by varying the voltage on control grid.

## \* Architecture of Raster scan display.



- In raster graphics system's CPU, a special purpose processor called video controller or display controller is used to control the operation of the display device;
- Here, the frame buffer can be anywhere in the system memory & the video controller accesses the frame buffer to refresh the screen.

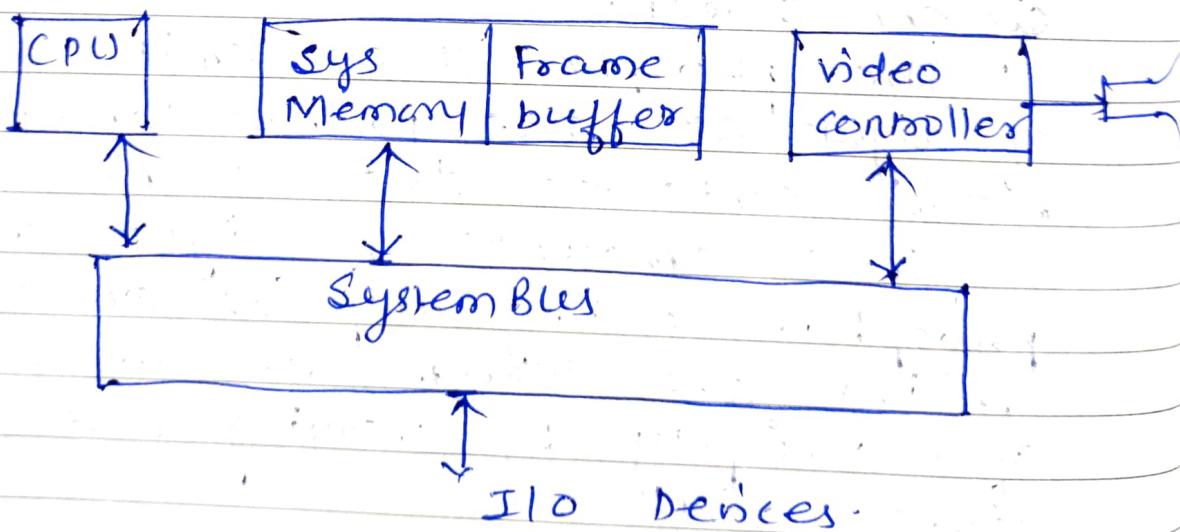


fig:- Architecture of simple Raster graphics

## Raster scan Display Processor

One way to set up raster system is having a separate display processor called as graphics controller / display processor.

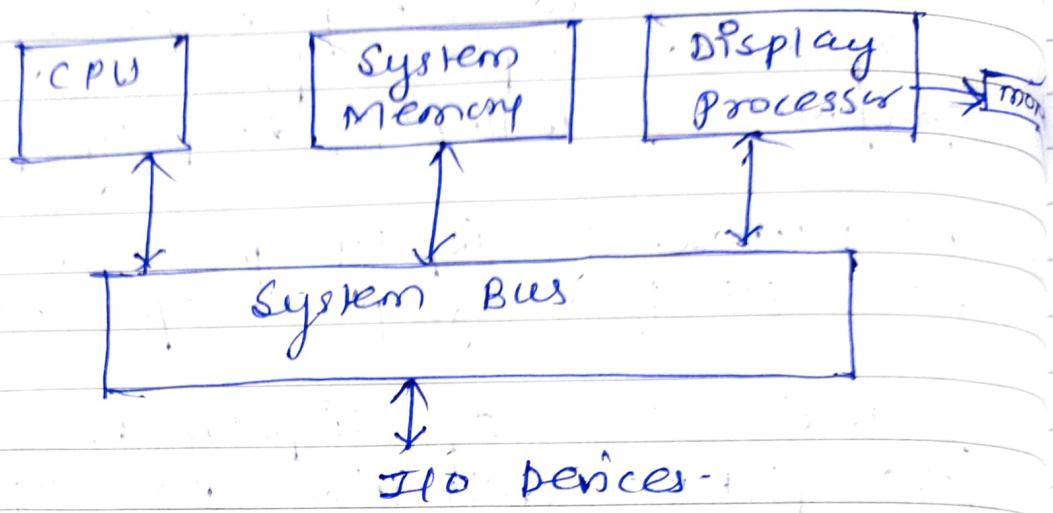
The purpose of display processor is to free the CPU from graphics operations.

A main task of display processor is digitizing the picture definition of application program into set of pixel intensity values for storage in frame buffer. This digitization process is called scan conversion.

Display processor perform other operation such as generating various line styles, (dashed, dotted or solid) displaying color areas & performing transformation & manipulations on display objects.

Display processors are designed to interface with interactive input devices such as a mouse.

## \* Random Scan Display



- An application program is input & stored in system memory along with graphics package.
- Graphics commands are translated by graphics package into display file stored in system memory. This display file is then accessed by display processor to refresh the screen.  
This display processor is also called as display processing unit or graphics controller.