Unit-1: Introduction to Graphics

- ✓ 1.1 The origin of computer graphics
- ✓ 1.2 Application of Computer Graphics
- ✓ 1.3 Definitions: Pixel, Resolution, Aspect Ratio, Interactive, Non interactive graphics, Active graphics, Passive graphics
- ✓ 1.4 How the interactive graphics display works.
- ✓ 1.5 Display types: Random Scan and Raster Scan

Computer graphics

- Computer graphics involves display, manipulation and storage of pictures and experimental data for proper visualization using a computer.
- It provides methods for producing images and animations (sequence of images).

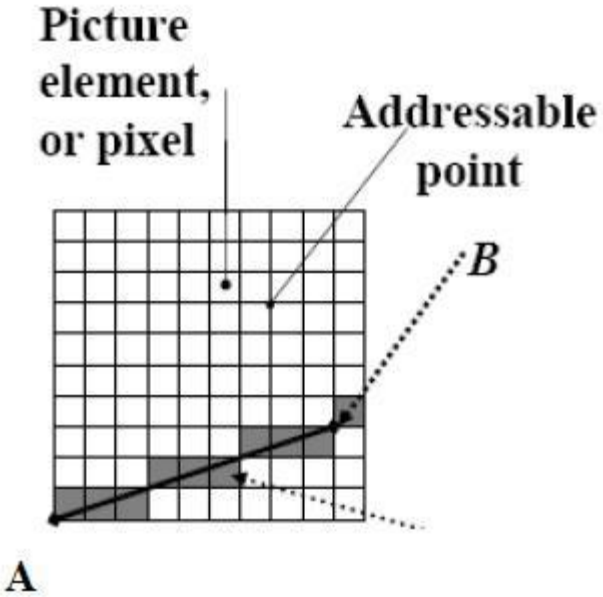
Definitions

- A **picture** in computer graphics is represented as a collection of discrete picture elements termed as pixels.

- A **pixel** is the smallest element of picture or object that can be represented on the screen of a device like computer.

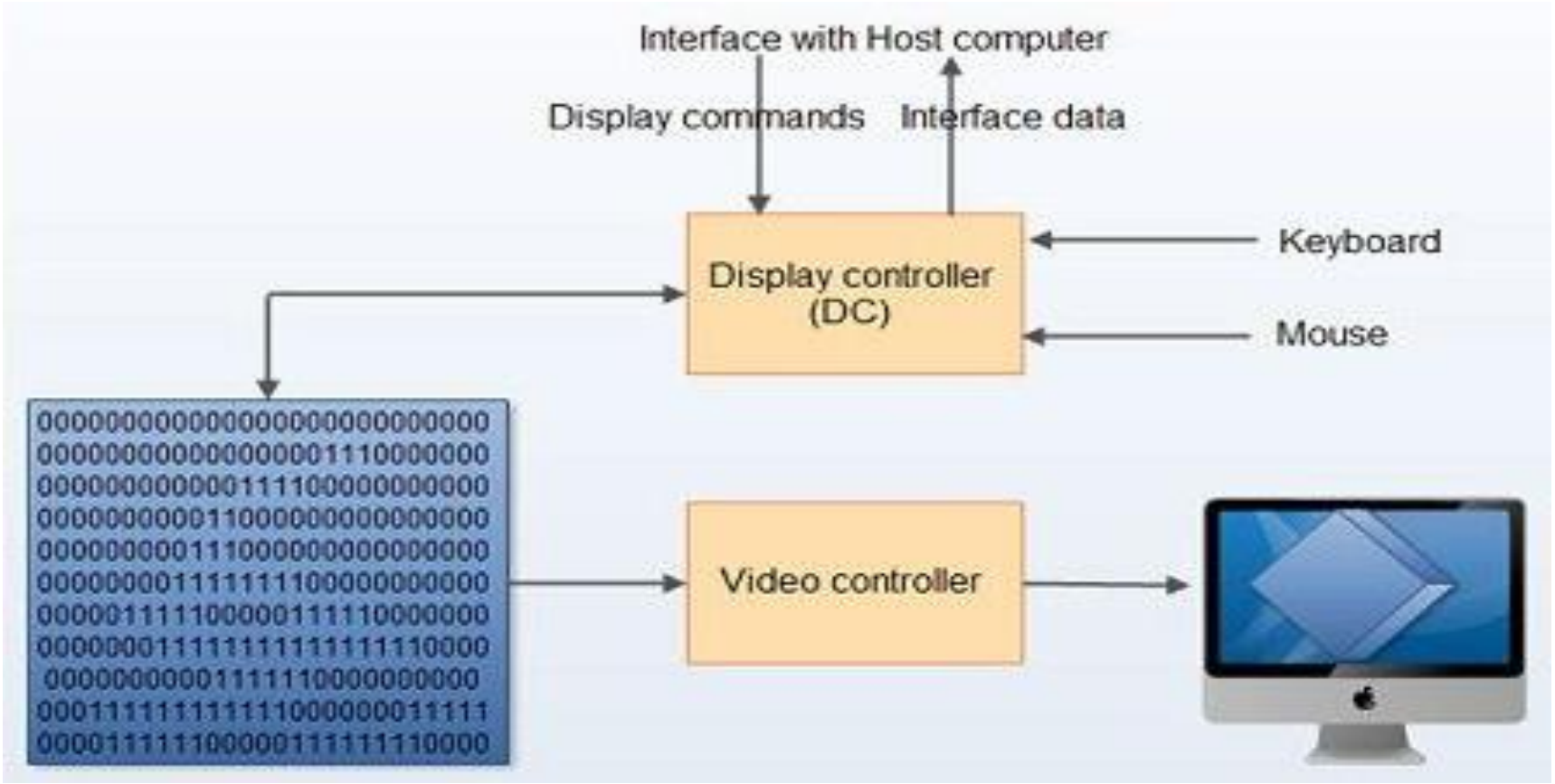
- A **pixel** is picture element, common abbreviation “pics / pix" for "picture“.

Pixel



- A **pixel is one of the many tiny dots** that make up the representation of a picture in a computer's memory.
- Each such information element is not really a dot, nor a square, but an abstract sample.
- With care, pixels in an image can be reproduced at any size, they are reproduced as dots or squares and can be visibly distinct when not fine enough.
- The intensity of each pixel is variable; in color systems, each pixel has typically three dimensions of variability such as red, green and blue.

How the Interactive Graphics display works?



Interactive graphics display components

a) A display controller

b) A digital memory or frame buffer

c) A television monitor

d) A video controller

The display controller

- The display controller gets the inputs and commands from the user and determines the image to be displayed on the monitor.
- The display controller will divide the image into a number of pixels.
- This image which is to be displayed is stored in the frame buffer.
- The image will be stored as a matrix of intensity values.

- The image will be displayed onto the **Television Monitor** and the video controller will act as a simple interface that passes the contents of the frame buffer to the monitor.

- The image must be repeatedly passed to the monitor, 30 or more times a second.

- This helps you to maintain a steady picture on the screen.

A digital memory or frame buffer

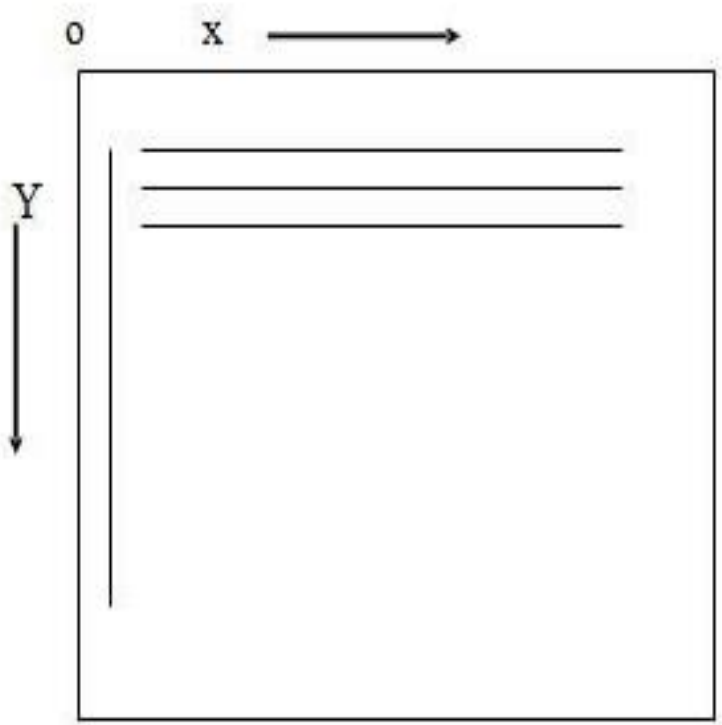
- In the frame buffer the image is stored as a pattern of binary digital numbers.
- These binary digital numbers represents a rectangular array of picture elements or pixels
- A picture can be divided into a number of picture elements or pixels.

- So corresponding to each pixel you have a binary digital number in the frame buffer.
- If your image is a black and white image you can represent the black pixels by 0 s and white pixels by 1s.
- Therefore a 16 X 16 array of black and white pixels could be represented by the binary values stored in the 32 8-bit bytes.

A video controller

- The video controller simply reads each successive byte of data from the frame buffer and converts its 0s and 1s into the corresponding video signal.
- This signal is then fed into the TV monitor, producing a black and white pattern on the screen.
- The video controller repeats this operation 30 times a second in order to maintain a steady picture on the TV screen.

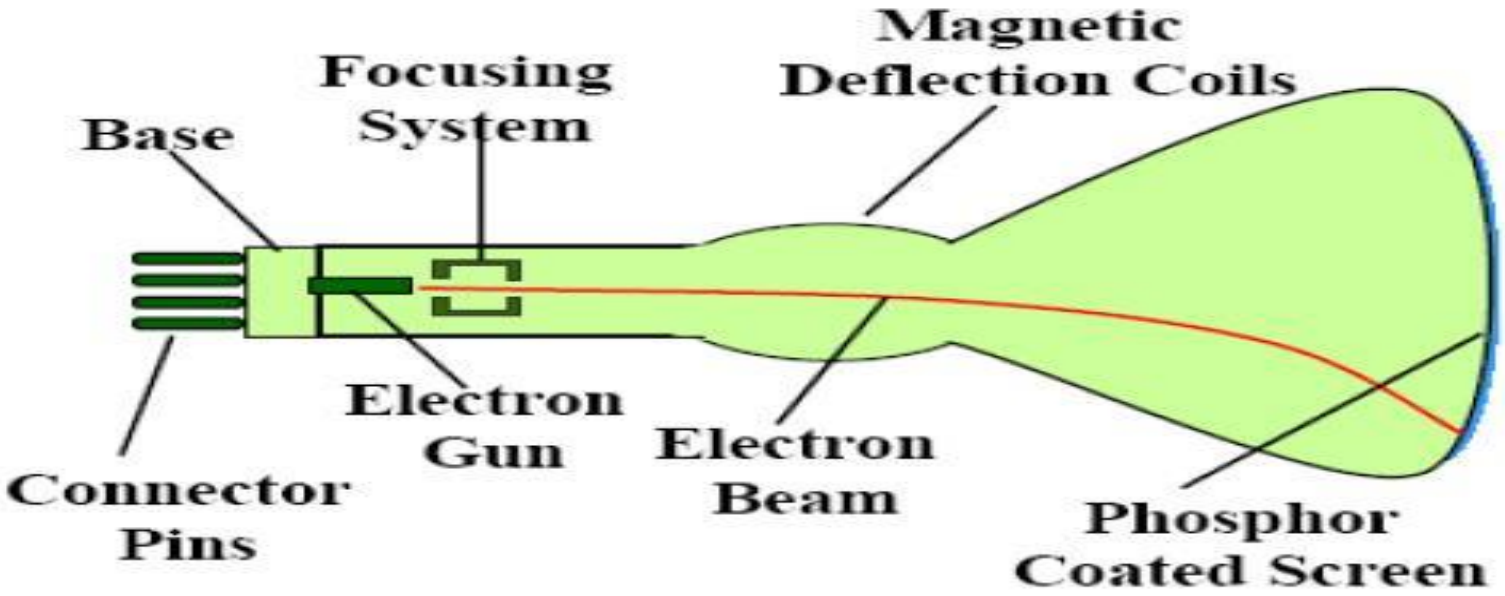
- All operations on computers are in terms of 0’s and 1’s and hence figures are also to be stored in terms of 0’s and 1’s.
- Thus a picture file, when viewed inside the memory, can be no different from other files – a string of Os and 1s.
- However, their treatment when they are to be displayed makes the difference.



- Typical resolutions are like 640 X 480, 860 X 640, 1024 x 860 etc.
- The figures indicate the number of rows and the number of pixels along each row respectively on a computer screen
- (unlike in standard mathematics) the top left hand point indicates the origin or the point (0,0) and the distances are measured horizontally and vertically as shown.

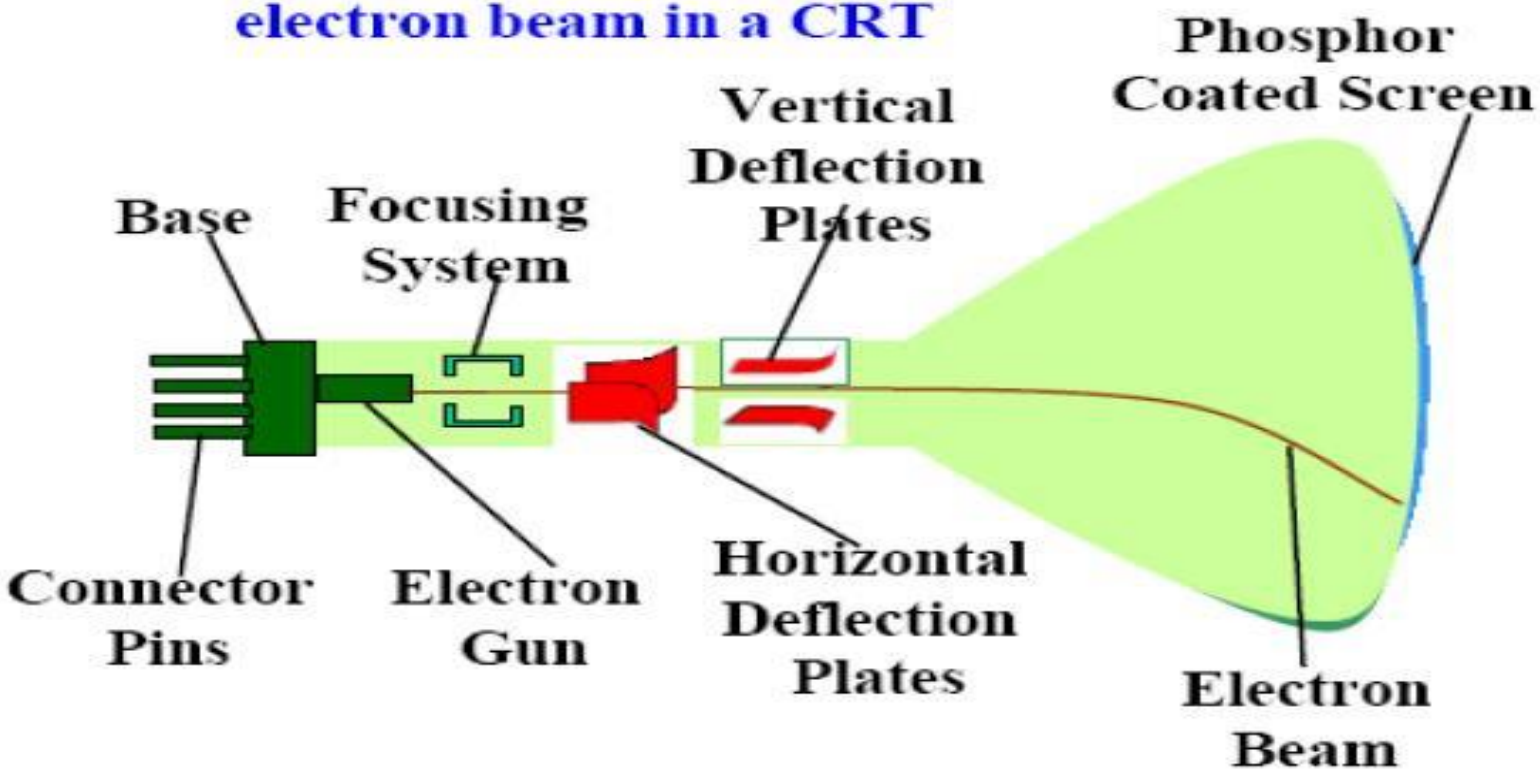
- A moving electronic beam, as we know illuminates the screen, or the monitor.
- Whenever the beam is switched on, the electrons illuminate the phosphorescent screen and display a point.
- In the line drawing schemes, this beam is made to traverse the path of the figure to be traced and we get the figure we need.
- For example, in the above cited example if the electron beam is made to move from a to be along the points, we get the line.

The Cathode Ray Tube(CRT)



Basic design of a magnetic deflection CRT

Electrostatic deflection of the electron beam in a CRT



The Cathode Ray Tube(CRT) Cont….

- The voltage applied to vertical plates controls the vertical deflection of the electron beam and voltage applied to the horizontal deflection plates controls the horizontal deflection of the electron beam.

- There are two techniques used for producing images on the CRT screen: Vector scan / random scan and Raster scan.

Cont…..

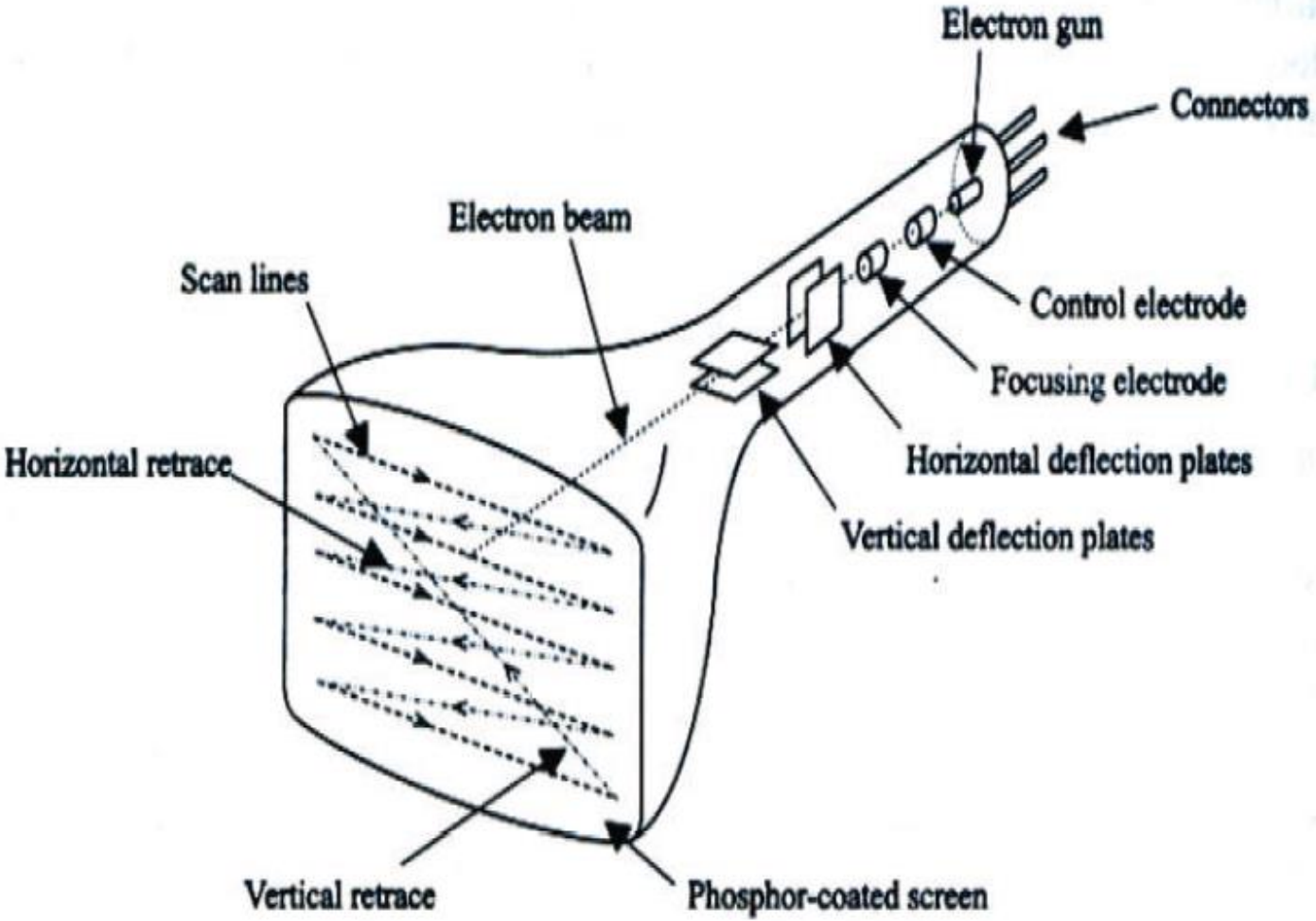
- When the phosphor is hit by the electron beam it absorbs energy and jumps to a higher quantum-energy level.
- As it returns to its normal level it emits visible light i.e. it phosphoresces.
- In the phosphors used in graphics devices the persistence of the phosphorescence is typically 10-60 microseconds
- Before the human visual system can see a transient image it must be continually redrawn (refreshed) at a rate higher than the critical fusion frequency of the human visual system.
- To allow the human visual system to see a continuously refreshed image without flicker the refresh rate has to be at least 60 c/s.

Cont….

- To allow continuous refreshing of an image there must be some stored representation of the image from which the refresh system can obtain the graphical information required to re-draw the image.
- This representation nowadays is invariably a set of values of Intensity / colour at each of a discrete set of points laid out in a rectangular array covering the screen.

Advantages and disadvantages of refresh type systems

- Disadvantage - continually refresh the image.
- Advantages
  - For example it is possible to edit an image by changing the stored representation between refresh cycles for what appears to be instantaneous updating of the image.
  - Compare this with some earlier systems in which the only way to carry out an edit was to clear the whole screen and then redraw the whole image.
  - Also by changing the stored representation between refresh cycles animation is possible.


Electron gun
Connectors
Electron beam
Scan lines
Control electrode
Focusing electrode
Horizontal deflection plates
Horizontal retrace
Vertical deflection plates
Vertical retrace
Phosphor-coated screen

- **The raster scan** mechanism uses a different technique and is often found more convenient to manipulate and operate with.
- In this case, a "frame buffer", (a chunk of memory) is made to store the pixel values.
- (Remember, the screen can be thought of as having beam made up of a number of horizontal rows of pixels (picture cells), each pixel representing a point on the picture.
- In fact the number of such horizontal and vertical points indicate higher resolutions and therefore better pictures.

Differentiate between Random and Raster Scan Display:

Random Scan Display	Raster Scan Display:
1. It has high Resolution	1. Its resolution is low.
2. It is more expensive	2. It is less expensive
3. Any modification if needed is easy	3.Modification is tough
4. Solid pattern is tough to fill	4.Solid pattern is easy to fill
5. Refresh rate depends or resolution	5. Refresh rate does not depend on the picture.
6. Only screen with view on an area is displayed.	6. Whole screen is scanned.
7. Beam Penetration technology come under it.	7. Shadow mark technology came under this.
8. It does not use interlacing method.	8. It uses interlacing
9. It is restricted to line drawing applications	9. It is suitable for realistic display.