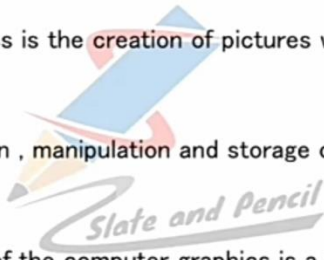


COMPUTER GRAPHICS M:1

Computer Graphics

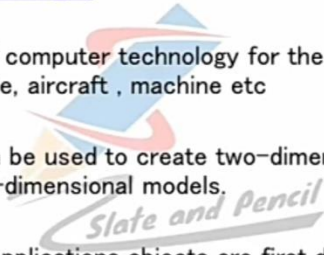
- Computer Graphics is the creation of pictures with the help of a computer.
- It includes creation , manipulation and storage of geometric objects and their images.
- The end product of the computer graphics is a picture it may be a business graph, drawing, and engineering.



Major Applications

CAD (Computer-aided design)

- CAD is the use of computer technology for the design of building, automobile, aircraft , machine etc
- CAD software can be used to create two-dimensional (2-D) drawings or three-dimensional models.
- For some design applications objects are first displayed in a wireframe outline form – shows overall shape and internal features of objects.



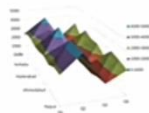
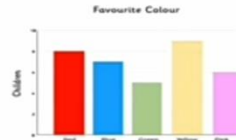
Who uses CAD

- Architects
- Engineers
- City planners
- Graphic designers
- Animation illustrators
- Fashion designers
- Interior designers
- Exterior designers
- Game designers



Presentation Graphics

- It is used to produce illustrations for reports.
- Presentation graphics is commonly used to summarize financial, mathematical, and economic data for research reports and other types of reports.
- eg: bar charts, line graphs, surface graphs, pie charts.



Flight Simulator

- It helps in giving training to the pilots of airplanes.
- These pilots spend much of their training not in a real aircraft but on the ground at the controls of a Flight Simulator.



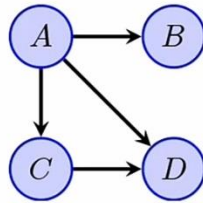
Entertainment

- Computer Graphics are now commonly used in making motion pictures, music videos and television shows



Education

- Computer generated models are extremely useful for teaching huge number of concepts and fundamentals in an easy to understand and learn manner.



Digital Art

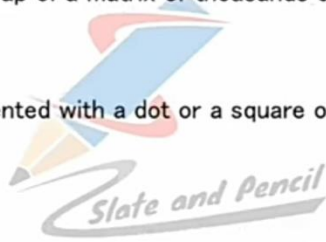
- Digital art most commonly refers to art created on a computer in digital form.
- The impact of digital technology has transformed traditional activities such as painting, drawing and sculpture



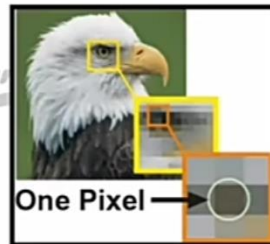
Pixel

- The full form of the pixel is "Picture Element."
- It is also known as "PEL."
- Pixel is the smallest element of an image on a computer display, whether they are LCD or CRT monitors.

- A screen is made up of a matrix of thousands or millions of pixels.
- A pixel is represented with a dot or a square on a computer screen.



- The good thing is that a pixel cannot be seen as they are very small.
- Each pixel has a value, or we can say a unique logical address.
- It can have only one color at a time.
- Colour of a pixel is determined by the number of bits which is used to represent it.



- In the below images, if we zoom in the image, we will be able to see some of the pixels.



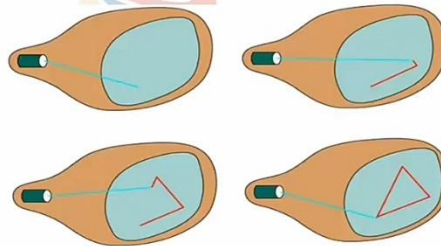
Frame Buffer

- The image being displayed is stored in a dedicated system memory area that is often referred to as Frame Buffer or Refresh Buffer.
- Frame Buffer is also known as Raster or bit map.
- In Frame Buffer the positions are called picture elements or pixels.

No connection

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 its x & y coordinates define each point.
- The refreshing rate, called the frame rate, is normally 30 to 60 times each second.
- Random-scan monitors are also known as vector displays or stroke-writing displays or calligraphic displays.

Advantages:

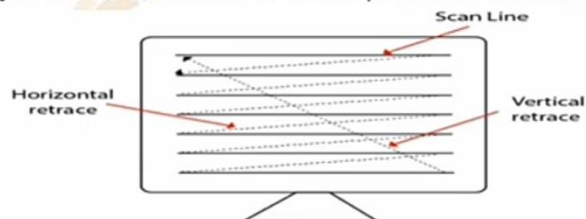
- A CRT has the electron beam directed only to the parts of the screen where an image is to be drawn.
- Produce smooth line drawings.
- High Resolution

Disadvantages:

- Random-Scan monitors cannot display realistic shades scenes.

Raster Scan Display

- A Raster Scan Display is based on intensity control of pixels in the form of a rectangular box called Raster on the screen.
- In this system the electron beam moves across each row, the beam intensity is turned on and off to create pattern of illuminated spots.



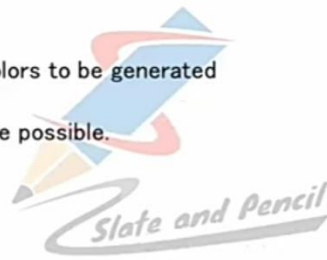
- Televisions in our house are based on Raster Scan Method.
- The raster scan system can store information of each pixel position, so it is suitable for realistic display of objects.
- Raster Scan provides a refresh rate of 60 to 80 frames per second.

Advantages:

- Realistic image
- Million Different colors to be generated
- Shadow Scenes are possible.

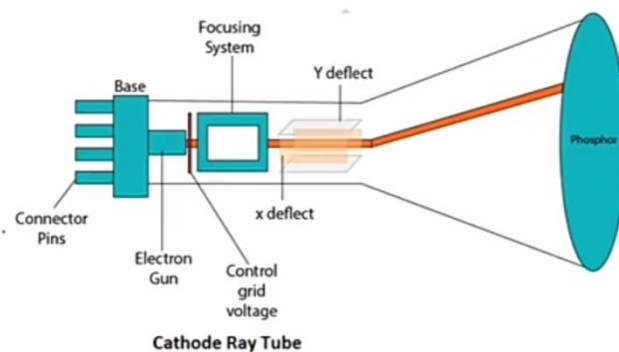
Disadvantages:

- Low Resolution
- Expensive



Random Scan	Raster Scan
It has high Resolution	Its resolution is low.
It is more expensive	It is less expensive
Any modification if needed is easy	Modification is tough
Refresh rate depends on picture	Refresh rate does not depend on the picture.
It is restricted to line drawing applications	It is suitable for realistic display.

Cathode Ray Tube (CRT)



- CRT stands for Cathode Ray Tube.

- CRT is a technology used in traditional computer monitors and televisions.

- The image on CRT display is created by firing electrons from the back of the tube of phosphorus located towards the front of the screen.

- Once the electron heats the phosphorus, they light up, and they are projected on a screen.

- The color you view on the screen is produced by a blend of red, blue and green light.

Main Components of CRT are:

1. Electron Gun:

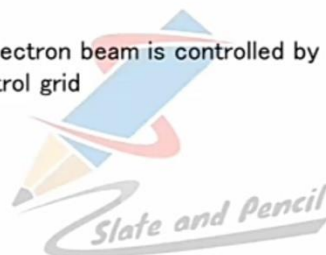
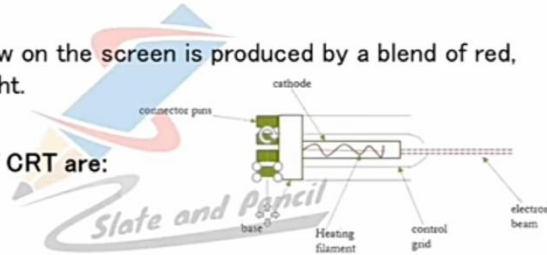
- Major elements are the heated metal cathode and the control grid

- Heat is supplied to the cathode by directing a current through filament

- Intensity of the electron beam is controlled by setting voltage levels on the control grid

2. Focusing system:

- It is used to create a clear picture by focusing the electrons into a narrow beam.



3. Deflection Yoke:

- It is used to control the direction of the electron beam.
- creates an electric or magnetic field which will bend the electron beam as it passes through the area.

4. Phosphorus-coated screen:

- The inside front surface of every CRT is coated with phosphors.
- Phosphors glow when a high-energy electron beam hits them.

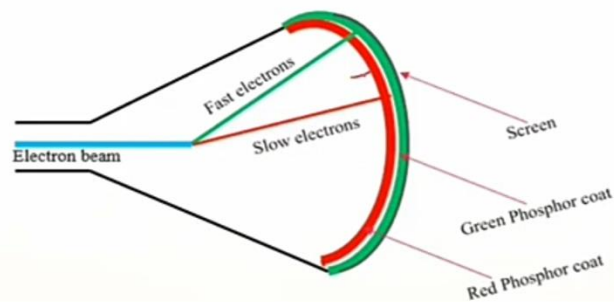
Color CRT Monitors

- There are two popular approaches for producing color displays with a CRT are:

1. Beam Penetration Method
2. Shadow-Mask Method

- The Beam-Penetration method has been used with random-scan monitors.
- In this method, the CRT screen is coated with two layers of phosphor, red and green and the displayed color depends on how far the electron beam penetrates the phosphor layers.
- This method produces four colors only, red, green, orange and yellow.

1. Beam Penetration Method



- The Beam-Penetration method has been used with random-scan monitors.
- In this method, the CRT screen is coated with two layers of phosphor, red and green and the displayed color depends on how far the electron beam penetrates the phosphor layers.
- This method produces four colors only, red, green, orange and yellow.

- A beam of slow electrons excites the outer red layer only; hence screen shows red color only.
- A beam of high-speed electrons excites the inner green layer. Thus screen shows a green color.
- At intermediate beam speeds, combinations of red and green light are emitted to show two additional colors, orange and yellow.

Advantages:

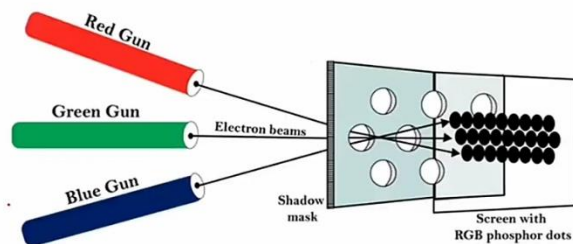
- Inexpensive

Disadvantages:

- Only four colors are possible
- Quality of pictures is not as good as with another method.

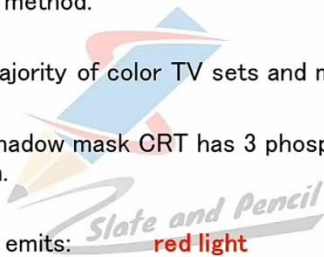


2. Shadow-Mask Method



- Shadow Mask Method is commonly used in Raster-Scan System because they produce a much wider range of colors than the beam-penetration method.
- It is used in the majority of color TV sets and monitors.
- **Construction:** A shadow mask CRT has 3 phosphor color dots at each pixel position.

- ☐ One phosphor dot emits: **red light**
- ☐ Another emits: **green light**
- ☐ Third emits: **blue light**

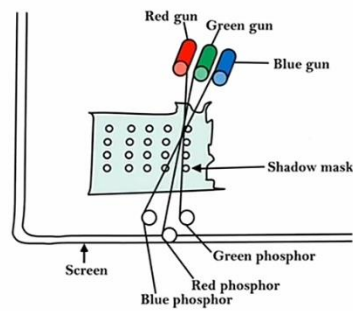


- This type of CRT has 3 electron guns, one for each color dot and a shadow mask grid just behind the phosphor coated screen.

2 types of arrangements are possible

- In-line Method and
- delta delta method(Triad arrangement)

Working: Triad arrangement of red, green, and blue guns.

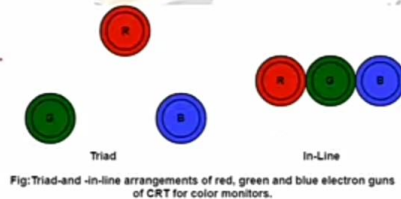


The Shadow mask CRT

- The deflection system of the CRT operates on all 3 electron beams simultaneously.

Inline arrangement

- 3 electron guns and the corresponding red-green-blue color dots on the screen, are aligned along one scan line rather of in a triangular pattern.
- This inline arrangement of electron guns is used in high-resolution color CRT's



Advantage:

- Realistic image
- Million different colors to be generated
- Shadow scenes are possible

Disadvantage:

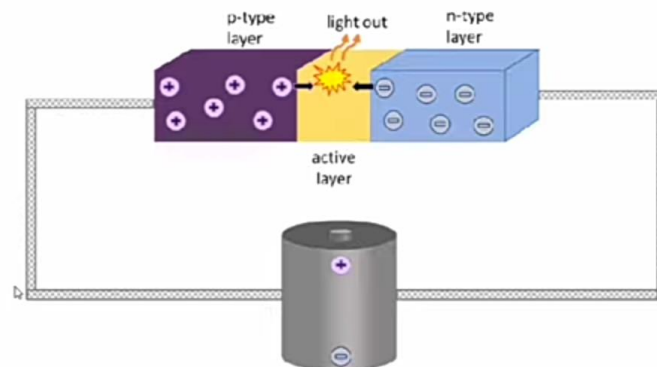
- Relatively expensive compared with the monochrome CRT.
- Relatively poor resolution

Light Emitting Diode

- LED is a semiconductor device which emits when current passes through it.
- The size of the LED is small, so we can easily make any display unit by arranging a large number of LEDs.
- LED consumes more power compared to LCD. LED is used on TV, smartphones, motor vehicles, traffic light, etc.



- LED also works at high temperatures.



How LED Display works

- LED is a semiconductor material that produces light by combining an electric current and a voltage.
- The device consists of two types of semiconductor materials called N-type and P-type.
- When a voltage is applied, electrons move from the N-type material to the P-type material, creating current flow and producing light.

Advantages:

- The Intensity of light can be controlled.
- Low operational Voltage.
- Capable of handling the high temperature.

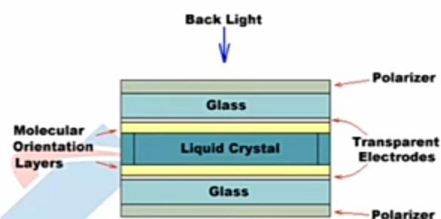
Disadvantages:

- More Power Consuming than LCD.

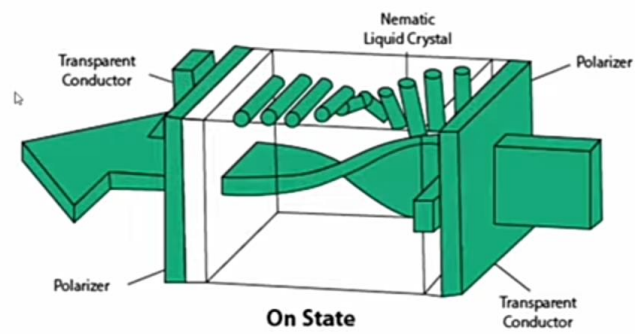
Liquid Crystal Display

- The LCD depends upon the light modulating properties of liquid crystals.
- LCD is used in watches and portable computers.
- LCD requires an AC power supply instead of DC, so it is difficult to use it in circuits.
- It generally works on flat panel display technology

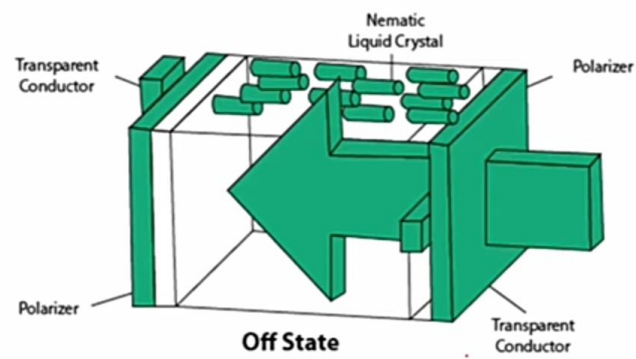
- LCD consumes less power than LED. The LCD screen uses the liquid crystal to turn pixels on or off.
- Liquid Crystals are a mixture of solid and liquid. When the current flows inside it, its position changes into the desired color.
- For Example: TFT (Thin Film Transistor)



- Two glass plates, each containing a light polarizer at right angles to the other plates and which the liquid crystal material.
- Rows of horizontal transparent conductors are built into one glass plate, and columns of vertical conductors are put into the other plate.
- The intersection of two conductors defines a pixel position.



- Polarized light passing through the material is twisted so that it pass through the opposite polarizer.
- The light is then reflected back to the viewer.
- To turn off the pixel, we apply a voltage to the two intersecting Conductors to align the molecules so that the light is not twisted.



Liquid Crystal Display

Advantage:

- Low power consumption.
- Small Size
- Low Cost

Disadvantage:

- LCDs are temperature-dependent ($0-70^{\circ}\text{C}$)
- LCDs do not emit light; as a result, the image has very little contrast.