Computer Graphics And Multimedia Systems SCS1302

Unit 1

Syllabus

SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY

FACULTY OF COMPUTING

SCS1302	COMPUTER GRAPHICS AND MULTIMEDIA SYSTEMS	L	T	P	Credits	Total Marks
		3	0	0	3	100

COURSE OBJECTIVES

- To gain knowledge to develop, design and implement two and three dimensional graphical structures.
- To enable students to acquire knowledge of Multimedia compression and animations.
- To learn creation, Management and Transmission of Multimedia objects.

UNIT 1 BASICS OF COMPUTER GRAPHICS 9 Hrs.

Output Primitives: Survey of computer graphics - Overview of graphics systems - Line drawing algorithm - Circle drawing algorithm - Curve drawing algorithm - Attributes of output primitives - Anti-aliasing.

UNIT 2 2D TRANSFORMATIONS AND VIEWING 8 Hrs.

Basic two dimensional transformations - Other transformations - 2D and 3D viewing - Line clipping - Polygon clipping - Logical classification - Input functions - Interactive picture construction techniques.

UNIT 3 3D CONCEPTS AND CURVES 10 Hrs.

3D object representation methods - B-REP , sweep representations, Three dimensional transformations. Curve generation - cubic splines, Beziers, blending of curves- other interpolation techniques, Displaying Curves and Surfaces, Shape description requirement, parametric function. Three dimensional concepts – Introduction - Fractals and self similarity- Successive refinement of curves, Koch curve and peano curves.

Syllabus

UNIT 4 METHODS AND MODELS **8 Hrs.**

Visible surface detection methods - Illumination models - Halftone patterns - Dithering techniques - Polygon rendering methods - Ray tracing methods - Color models and color applications.

UNIT 5 MULTIMEDIA BASICS AND TOOLS **10 Hrs.**

Introduction to multimedia - Compression & Decompression - Data & File Format standards - Digital voice and audio - Video image and animation. Introduction to Photoshop - Workplace - Tools - Navigating window - Importing and exporting images - Operations on Images - resize, crop, and rotate - Introduction to Flash - Elements of flash document - Drawing tools - Flash animations - Importing and exporting - Adding sounds - Publishing flash movies - Basic action scripts - GoTo, Play, Stop, Tell Target

Max. 45 Hours

TEXT / REFERENCE BOOKS

1. Donald Hearn, Pauline Baker M., "Computer Graphics", 2nd Edition, Prentice Hall, 1994.
2. Tay Vaughan ,"Multimedia", 5th Edition, Tata McGraw Hill, 2001.
3. Ze-Nian Li, Mark S. Drew ,"Fundamentals of Multimedia", Prentice Hall of India, 2004.
4. D. McClelland, L.U.Fuller ,"Photoshop CS2 Bible", Wiley Publishing, 2005.
5. James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, "Computer Graphics Principles and Practice, 2nd
6. Edition in C, Audison Wesley, ISBN - 981 -235-974-5
7. William M. Newman, Roberet F. Sproull, " Principles of Interactive Computer Graphics", Second Edition, Tata McGraw-Hill Edition.

Course Objective(CO)

CO1: Construct lines and circles for the given input.

CO2: Apply 2D transformation techniques to transform the shapes to fit them as per the picture definition.

CO3: Construct splines, curves and perform 3D transformations

CO4: Apply colour and transformation techniques for various applications.

CO5: Analyse the fundamentals of animation, virtual reality, and underlying technologies.

CO6: Develop photo shop applications

Computer Graphics

- Graphics - Plot some Points on graph
- Computer Graphics - plot some pixels/points on computer screen to make image.
- Algorithms & Data structures are used to draw images.
- Computer Graphics involves creation, display, manipulation and storage of pictures and experimental data/models or images for proper visualization using a computer.
- Such models come from diverse and expanding set of fields including physical, biological, mathematical, artistic, and conceptual/abstract structures.

Computer Graphics

- Made up of 4 components:
  1. Image – combinations of pixels, visual representation
  2. Models – 3D representation
  3. Rendering – generate image from 2D/3D model using Computer Programs
  4. Animation – Illusive movements
- Graphics is an art of drawing using computer programs.
- **What we will draw?**
  - Lines, Circles, curves, etc

Applications of CG

- **Computer-Aided Design(CAD)**
  - Designing of buildings (Interior), automobiles, aircraft, computer..etc (**Car** -> sample/Prototype models)
- **Presentation Graphics**
  - Commonly used to summarize financial, statistical, mathematical and economic data for research. (charts, business presentations)
- **Computer Art**
  - Cartoons, Animated movies
- **Entertainment –** Games, Cinema
- **Education and Training –** Medical, Engg,Animation, Simulation
- **Visualization –** Scientific, Medical(MRI), Gene Modeling
- **Image Processing**
- **Virtual Reality**
- **Graphical User Interface** - Buttons, Mobile Apps, Menus
- **Architecture –** Building design, lightening effects, maps, sewage design plans.

MORPH A PERSON'S FACE

Adobe Photoshop

- Open the image you want to modify
- Use the Liquify (Filter → Liquify or press Shift + Ctrl + X)
- Use various tools on the Liquify window to alter the person's face. The various available tools are
  Warp Tool
  Wave Tool
  Swirl Tool
  Shrink Tool
  Expand Tool
  Move Left Tool
  Mirror Tool
  Undo Tool

Fundamental Terminologies

Image - From a geometry point of view, you can consider the image as a set of points on 2-d or 3-d space. Each point at every (x,y) is called amplitude or intensity of an image

Pixel - a pixel is the smallest , controllable element of a picture represented on the screen.

Resolution – Number of pixels in a computer screen.

Aspect Ratio- The aspect ratio of an image is the **ratio of its width to its height necessary to produce equal-length lines in both directions on the screen.** For an x: y aspect ratio, the image is x units wide and y units high.

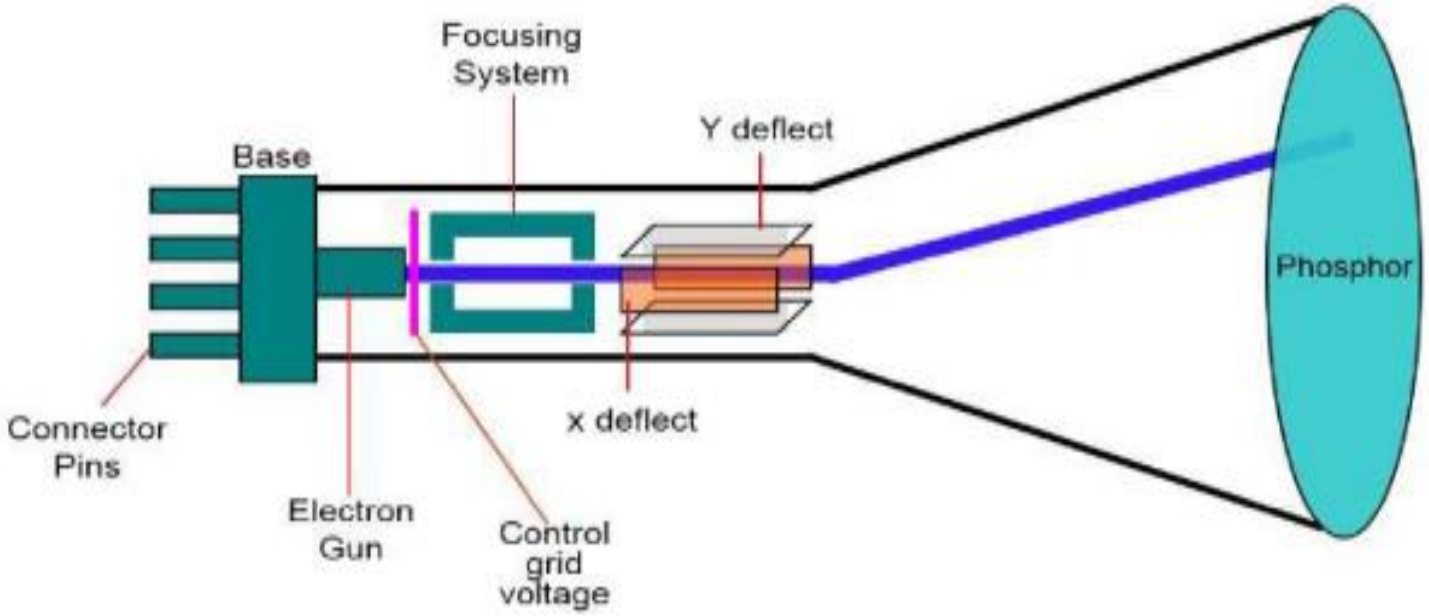
Components of a computer graphics system

- Typical graphics system comprises of a host computer with support of fast processor, large memory, frame buffer
- Display devices (color monitors)
- **Input devices** (mouse, keyboard, joystick, touch screen, trackball)
- **Output devices** (CRT,LED,LCD panels, raster scan display, laser printers, color printers. Plotters etc.)
- Interfacing devices such as, video I/O, TV interface etc.

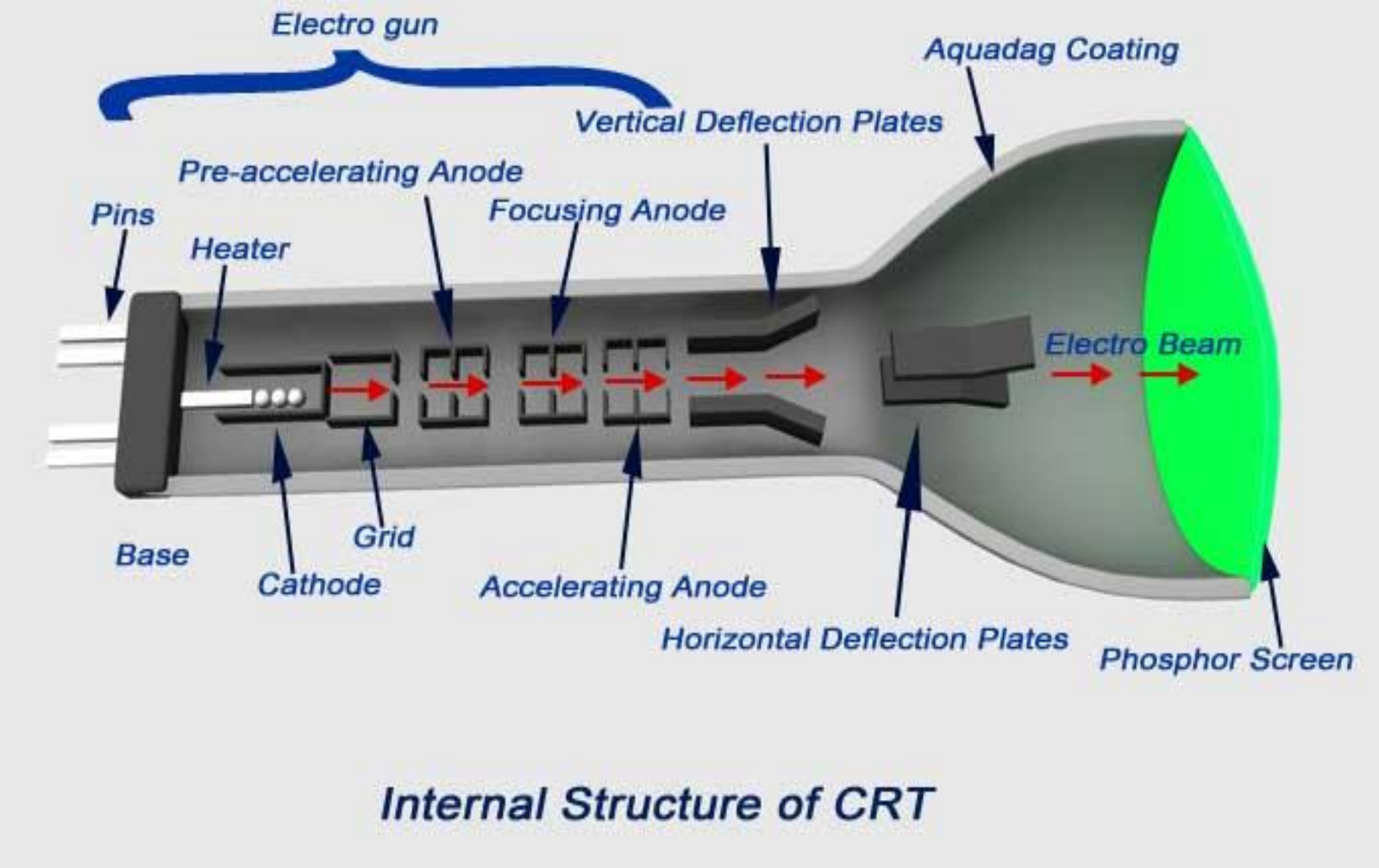
Video Display devices

- Cathode Ray Tube (CRT)
  - The primary output device in a graphical system is the video monitor. The main element of a video monitor is the Cathode Ray Tube
  - The CRT is a vacuum tube containing an electron gun(a source of electron) and fluorescent screen, with internal or external means to accelerate and deflect the electron beam, used to create images in the form of light emitted from the fluorescent screen. The image may be electrical waveforms, pictures (television , computer monitor),radar target and others.

Video Display devices



There are two ways (Random scan and Raster scan) by which we can display an object on the screen.



Internal Structure of CRT

Main Parts of CRT:

- Electron Gun assembly
- Deflection plate assembly
- Fluorescent screen
- Glass envelope
- Base through connection are made to various parts

The operation of CRT

- The electron gun emits a beam of electrons (cathode rays), when the filament is heated.
- Intensity of the electron beam is controlled by setting voltage levels on the control grid.
- The focusing system is needed to force he electron beam to converge into a small spot as it strikes the phosphor screen, else the beam would spread out as it approaches the screen.
- The electron beam passes through focusing and deflection systems that directs it towards specified positions on the phosphor-coated screen.

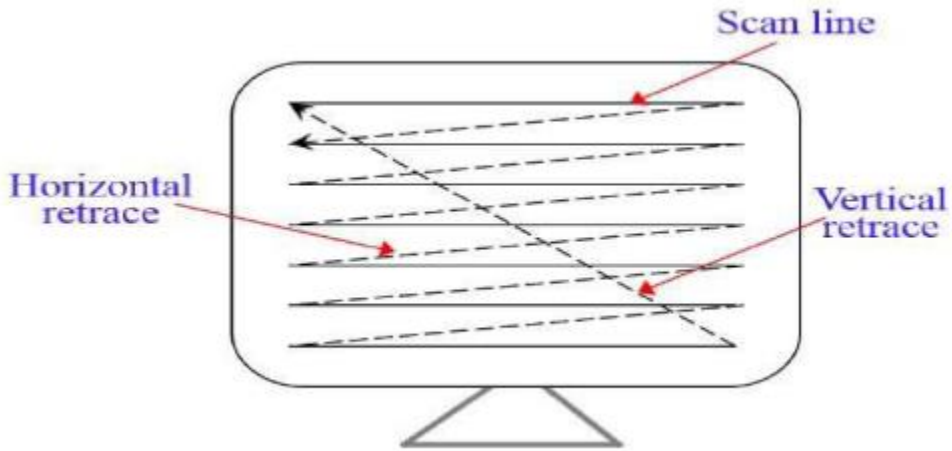
The operation of CRT

- 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. This is called refreshing, hence the CRT is called as Refresh CRT.
- The difference between the kinds of phosphors is their persistence- how long they continue to emit light after the CRT beam is removed.

Raster Scan

- 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 the Refresh Buffer or Frame Buffer.
- Each screen point is referred to as a pixel (picture element) or pel.
- At the end of each scan line,
- the electron beam returns to the left side of the screen to begin displaying the next scan line.

Raster Scan



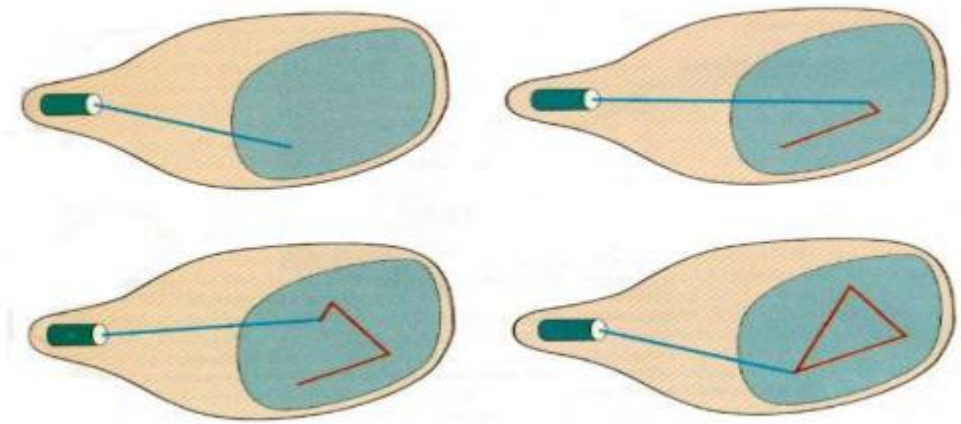
Random Scan (Vector Scan)

- 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, stroke-writing display, or calligraphic display.

Random Scan (Vector Scan)

- Picture definition is stored as a set of line-drawing commands in an area of memory referred to as the refresh display file.
- To display a specified picture, the system cycles through the set of commands in the display file, drawing each component line in turn.
- After all the line-drawing commands are processed, the system cycles back to the first line command in the list.
- Random-scan displays are designed to draw all the component lines of a picture 30 to 60 times each second.

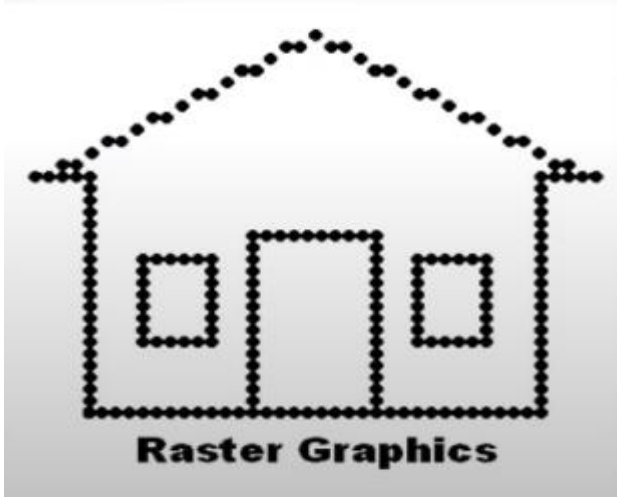
Random Scan (Vector Scan)



Random Scans

Pros and Cons

- Raster Systems
- **Pros**
  - It is well suited for realistic display of scenes containing colors and shaded patterns.
  - **Cons**
  - It produces **jagged lines** that are plotted as discrete point sets.



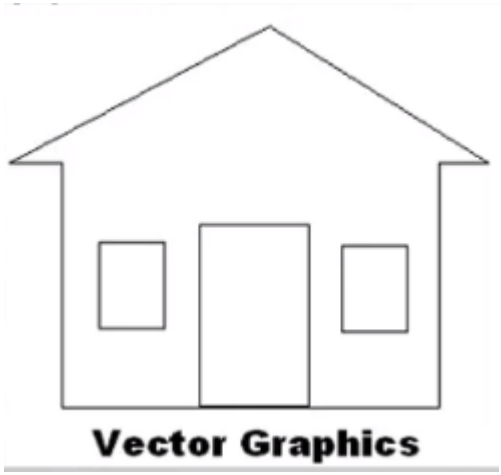
Pros and Cons

- Random System(Vector)
- **Pros**
  - They produce smooth line drawing because the CRT beam directly follows the line path
  - Used by both analog and digital computer.
  - It will have higher resolution rather than raster.

Cons

- Expensive
- Designed for line drawing applications

and cannot display realistic shaded scenes.



Color CRT Monitor

- A CRT monitor displays color picture by using a combination of phosphor that emit different-colored light.
- By combining the emitted light from the different phosphor, a range of colors can be generated.

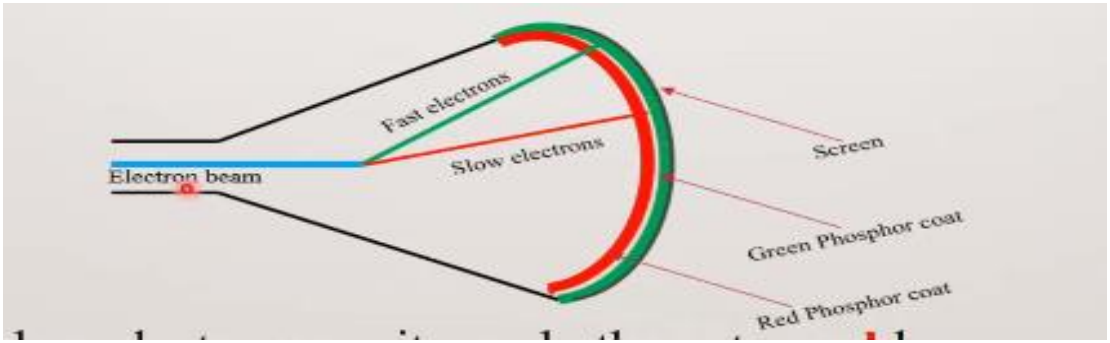
Color CRT Monitor

Two basic techniques – Beam Penetration and Shadow Masking

- **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 on how far the electron beam penetrates into the phosphor layers.

Color CRT Monitor



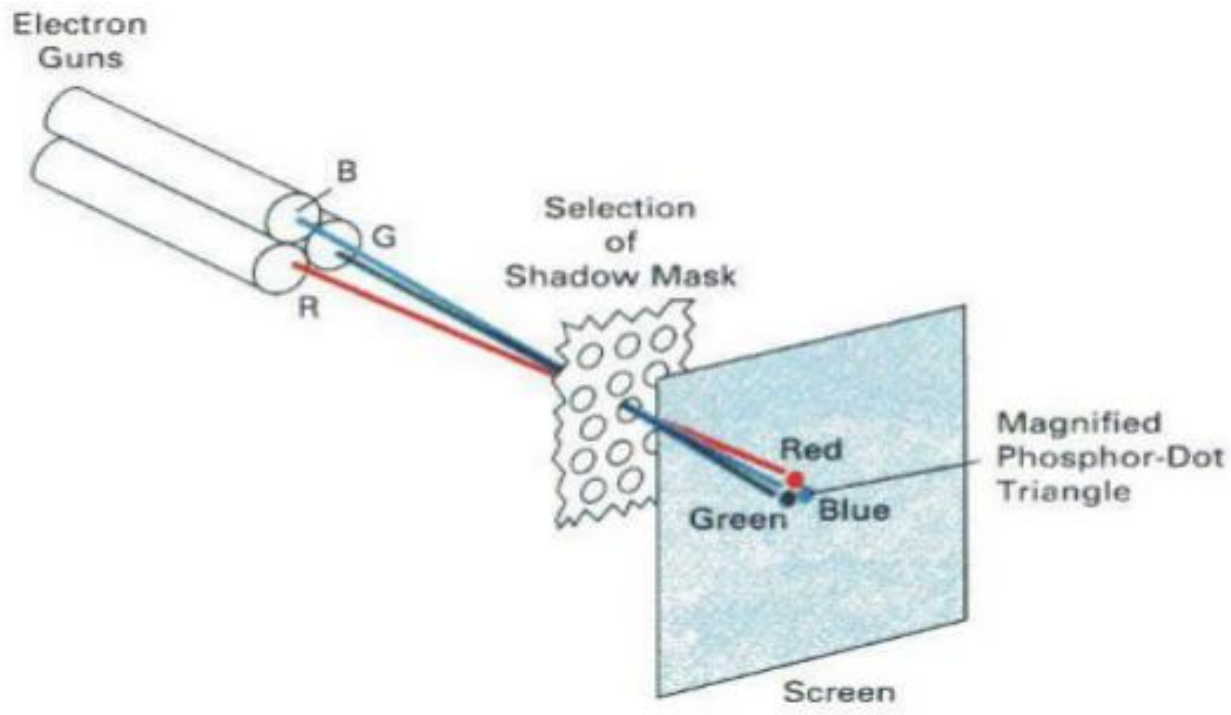
- A beam of slow electrons excites only the outer red layer. A beam of very fast electron penetrates through the red layer and excites the inner green layer
- At intermediate beam speeds, combinations of red and green light are emitted to show two additional colors, orange and yellow
- The speed of the electrons, and hence the screen color at any point, is controlled by **the beam-acceleration voltage**

Color CRT Monitor

- **Shadow Mask Method**

- Shadow-mask methods are commonly used in **raster-scan system (including color TV)**
- 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 the third emits a blue light
- It has three electron guns , **one for Red , one for Green and one for Blue**
- A shadow mask behind the phosphorous coated screen

Shadow Mask Method



Shadow Mask Method

- The three beams are deflected and focused as a group onto the shadow mask which contains a series of hall aligned with the phosphorous dots
- When the three beams pass through a hole in the shadow mask, they activate a dot triangle

  which appears as a small color spot on the screen
- The phosphor dots in the triangles are arranged so that each electron beam can activate only its corresponding color dot when it passes through the shadow mask

Shadow Mask Method

- We obtain color variations in a shadow-mask CRT by varying the intensity levels of the three electron beams
- The color we see depends on the amount of excitation of the red, green, and blue phosphors.
- A white or gray area is the result of exciting the three dots with equal intensity
- Yellow is produced with the green and red dots only
- Magenta is produced with the blue and red dots
- Cyan shows up when blue and green are activated equally

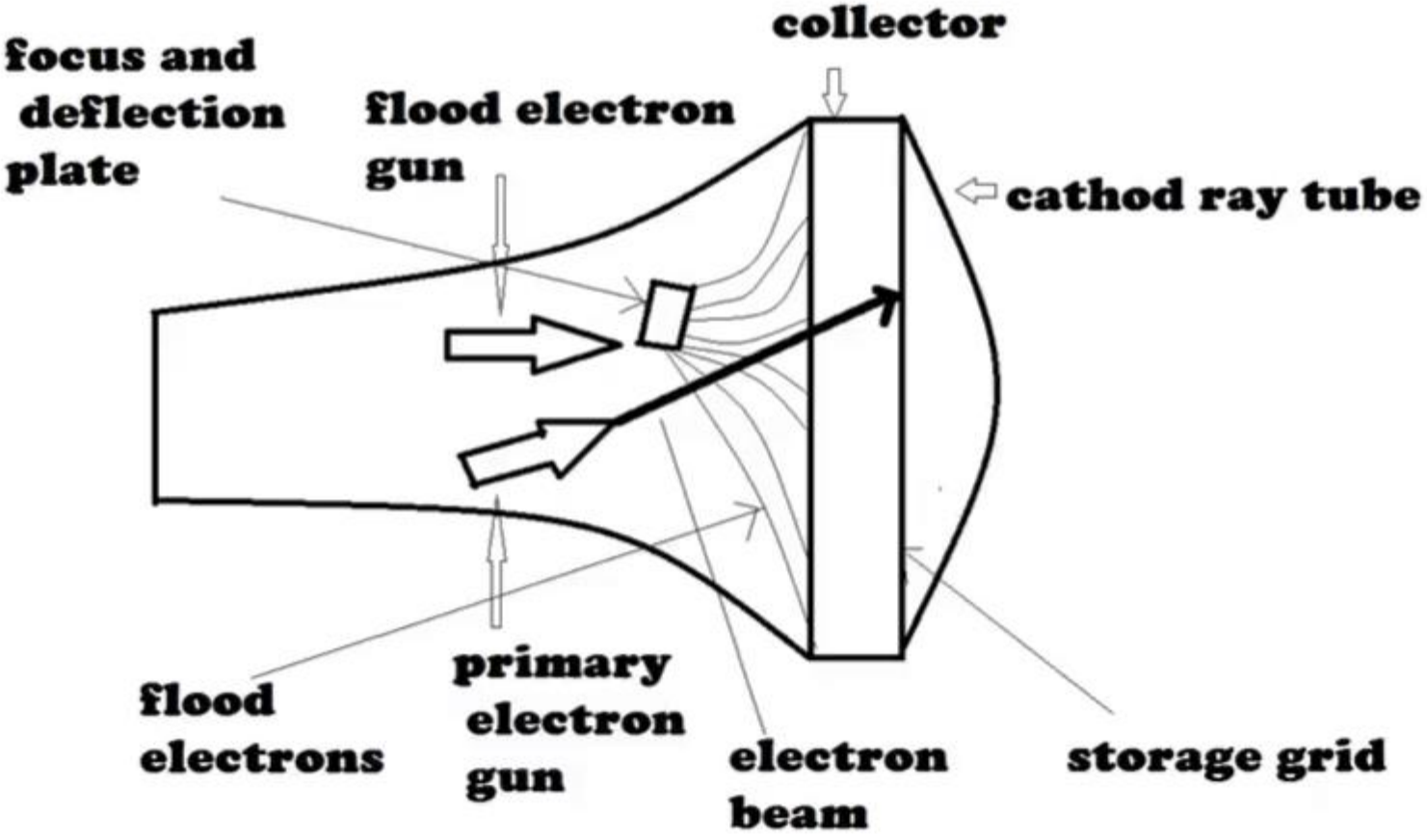
Comparison Between Beam Penetration method and Shadow Mask Method

	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.
Color Dependency	Less colors are available because the colors in Beam Penetration depends on the speed of the electron beam.	Millions of colors are available because the colors in Shadow Mask depends on the type of the ray.
Cost	It is Less Expensive as compared to Shadow Mask.	It is More Expensive than other methods.
Picture Quality	Quality of picture is not so good i.e. Poor with Beam Penetration Method.	Shadow Mask gives realism in picture with shadow effect and millions of color.
Resolution	It gives High Resolution.	It gives Low Resolution.
Criteria	In Beam Penetration method, Color display depends on how far electron excites outer Red layer and then Green layer.	In Shadow Mask Method, there are no such criteria for producing colors. It is used in computers, in color TV etc.

Direct – View Storage Tubes (DVST)

- The DVST gives the alternative method of maintaining the screen image
- A DVST uses the storage grid which stores the picture information as a charge distribution just behind the phosphor coated screen

Direct – View Storage Tubes (DVST)



DVST

Advantages:

- Refreshing of CRT is not required.
- Because no refreshing is required, very complex pictures can be displayed at very high resolution without flicker.
- It has flat screen.

DVST

Disdvantages:

- They do not display colors and are available with single level of line intensity.
- Selective or part erasing of screen is not possible.
- Erasing of screen produces unpleasant flash over the entire screen surface which prevents its use of dynamics graphics applications.
- It has poor contrast as a result of the comparatively low accelerating potential applied to the flood electrons.
- The Performance of DVST is somewhat inferior to the refresh CRT.

Flat Panel Displays

- The term Flat panel displays refers to a class of video devices that have **reduced volume**, **weight** and **power** requirements compared to a CRT.
- The important feature of flat panel display is that they are **thinner** than the CRTs.
- There are 2 types of flat panel displays

  - Emissive Displays

  - Non Emissive Displays

Flat Panel Displays

- **Emissive Displays** – They convert **electrical** energy into **light** energies

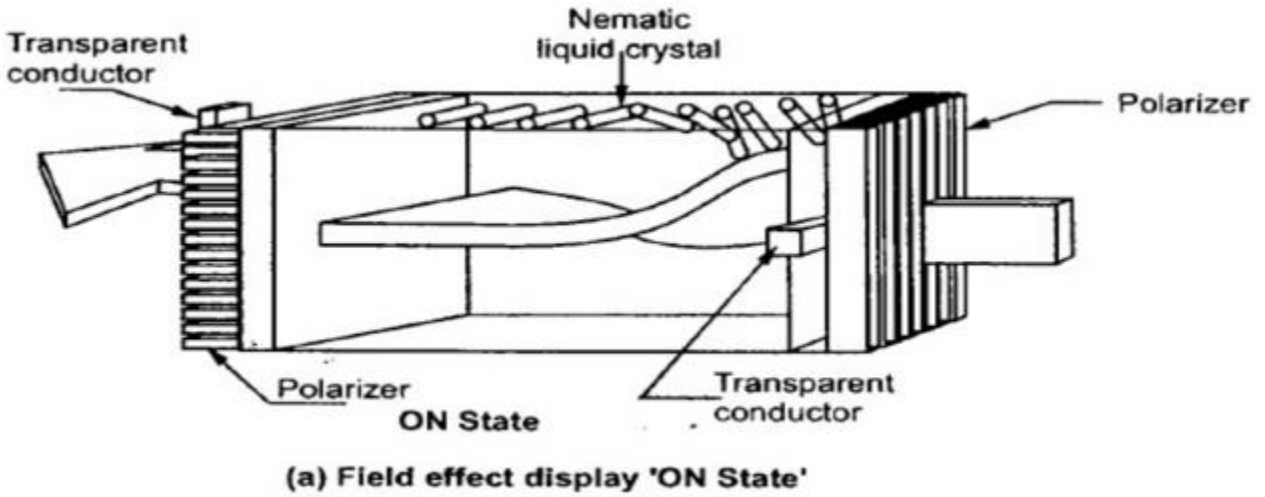
  E.g: Plasma Panels, LEDs

- **Non Emissive Displays -** They use **optical** effects to convert **sunlight or light** from some other source into graphics patterns. E.g. LCD (Liquid Crystal Display)

Non emissive-LCD

- **LCD (Liquid Crystal Display)** are commonly used in small systems such as **calculators** and **portable computers**
- These **non emissive** devices produce a picture by passing polarized light from the surroundings or from an internal light source through a liquid-Crystal material that can be aligned to either block or transmit the light
- **Two glass plates** each containing a light polarizer at right angles to the -other plate, sandwich 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.

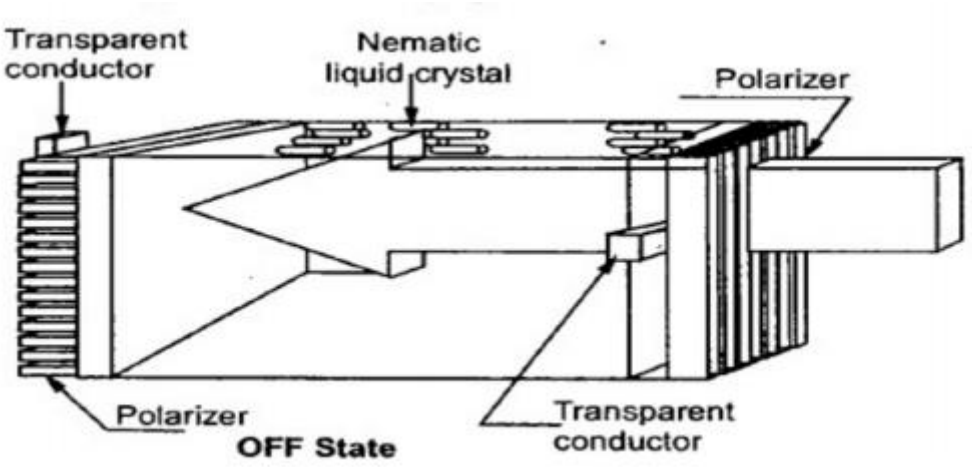
‘ON’ state of liquid crystals



(a) Field effect display 'ON State'

Polarized light passing through the material is twisted so that it will pass through the opposite polarizer. The light is then reflected back to the viewer

‘OFF’ state of liquid crystals



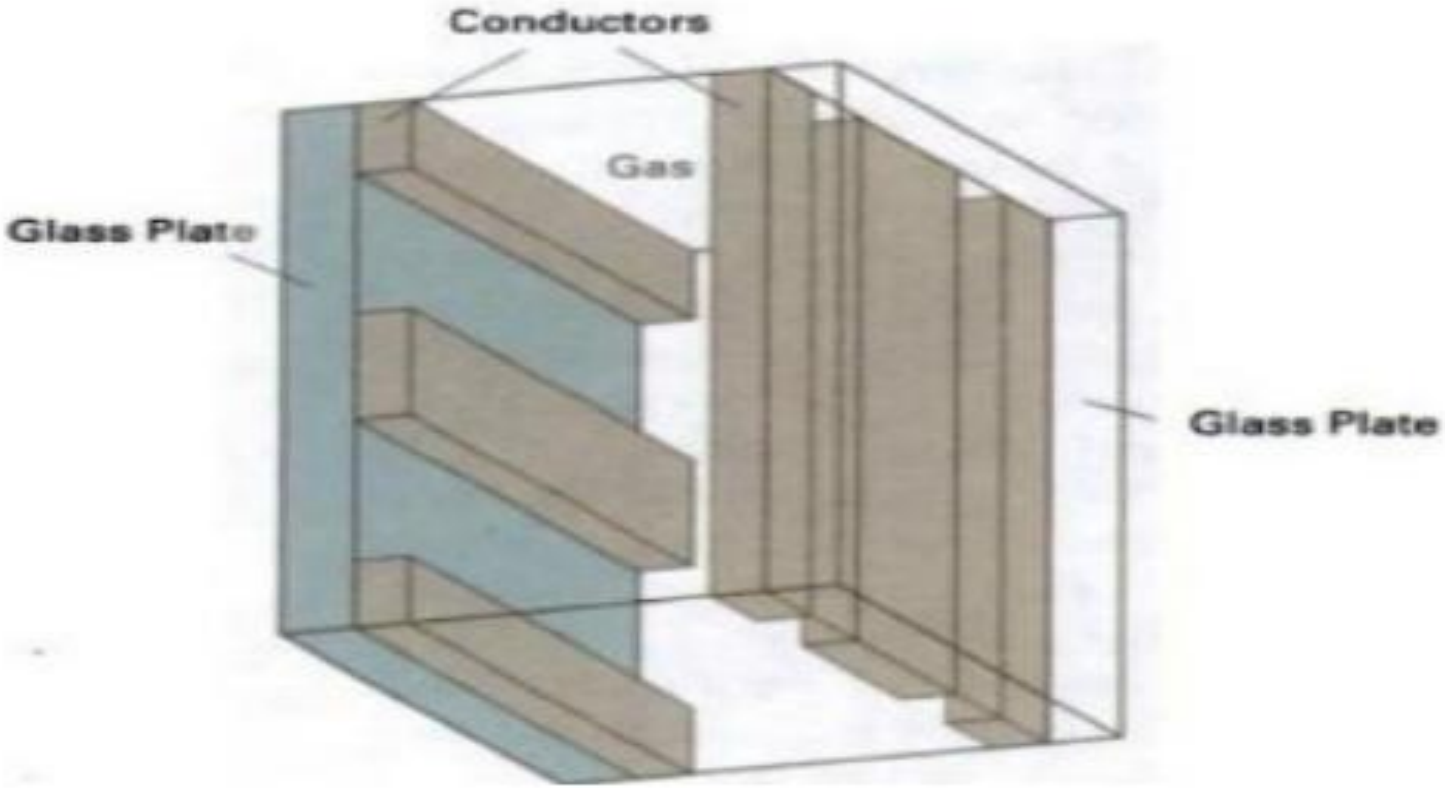
To turn off off the pixel we apply a voltage to the two intersecting conductors to align the molecules so that the light is not .twisted

Emissive-Plasma panels

Plasma panels- also called **gas-discharge** displays, are constructed by filling the region between two glass plates with a mixture of gases that usually includes **neon** .

- A series of vertical conducting ribbons is placed on one glass panel, and a set of horizontal ribbons in other glass panel . Firing voltages applied to a pair of horizontal and vertical conductors cause the gas at the intersection of the two conductors to break down into a glowing plasma of electrons and ions.

Plasma panels



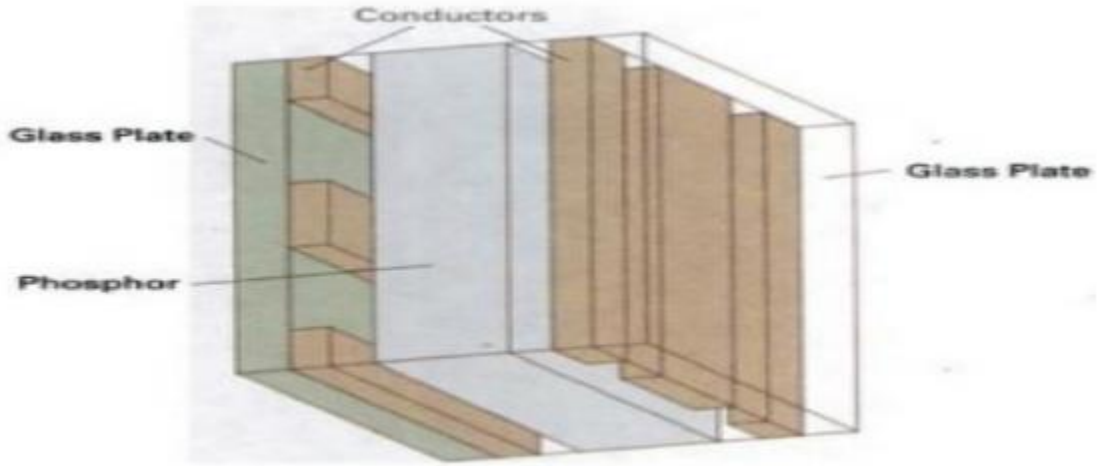
Basic design of a Plasma Panel display device

Plasma panels

Thin-film electroluminescent displays

- They are similar to plasma panels except the region between glass panel is filled with phosphor
- When a sufficiently high voltage is applied to a pair of crossing electrodes phosphor become a conductor in that area of intersection of electrodes
- Electrical energy is absorbed by the atoms which then release this energy as a spot of light
- Electroluminescent display requires more power than plasma panels

Thin-film electroluminescent displays



Basic design of a thin-film electroluminescent display device

INPUT DEVICES

- Keyboards, Button Boxes, and Dials
- Mouse Devices
- Trackball, Space ball
- Joystick
- Data Gloves
- Digitizers
- Image Scanners
- Touch Panels
- Light Pens
- Voice Systems

OUTPUT DEVICES

- Printers
- Plotters