C.P. PATEL & F.H. SHAH COMMERCE COLLEGE
(MANAGED BY SARDAR PATEL EDUCATION TRUST)
BCA, BBA (ITM) & PGDCA PROGRAMME
BCA SEM V (COMPUTER GRAPHICS)
UNIT 1: INTRODUCTION TO COMPUTER GRAPHICS

Unit 1: Introduction to Computer Graphics

A survey of major applications of Computer Graphics
Overview of different video display Devices: CRT, Random-Raster scan, Color monitors, DVST, Flat Panels
Input Devices: Keyboard, Mouse, Trackball, Space ball, Joystick, Data glove, Digitizers, Image Scanner, Touch Panel, Light Pen and Voice system
Hardcopy Devices: Printers and Plotters
Graphics Software and Co-ordinate Representations
Graphics functions
Software Standards

Reference Books:

Computer Graphics by Donald Hearn & M. Pauline Baker, PHI, 1995
Macromedia Flash MX 2004 in 24 hours by Robert Renihardt and Snow Dowd
FLASH MX – Manual

A Survey of Major Applications of Computer Graphics:

Computers have become a powerful tool for the rapid and economical production of pictures. There is no area in which graphical displays cannot be used to some advantage and so computer graphics are so widespread.
Today, we find computer graphics used in various areas like science, engineering, medicine, business, industry, government, art, entertainment, advertising, education, and training.

Computer Aided Design (CAD)

- A major use of computer graphics is in design processes, particularly for engineering and architectural systems. Almost all products are now computer designed. CAD methods are now routinely used in the design of buildings, automobiles, aircraft, watercraft, spacecraft, computers, textiles and many other products.
- For design applications, objects are first displayed in a **wire frame outline form** that shows the overall shape and internal features of objects.

Presentation Graphics

- They are used to produce reports or slides or **transparencies** for use with projectors. Presentation graphics is commonly **used to summarize** financial, statistical, mathematical, scientific and economic data for research reports, managerial reports, consumer information bulletins and other reports.
- Typical examples are bar charts, line graphs, surface graphs, pie charts, and other displays.
- They are also used for two-dimensional and three-dimensional graphic displays.

Computer Art

- Computer graphics methods are used for both fine art and commercial art applications. Artists use a variety of computer methods, including special purpose hardware, paintbrush programs like MS-Paint, PixelPaint, SuperPaint, symbolic mathematics like Mathematica, CAD packages for designing object shapes and specifying object motions.

Entertainment

- Computer graphics methods are now commonly used in making **motion pictures**, **music videos**, and **television shows**. Sometimes the graphic scenes are displayed by themselves, and sometimes graphics objects are combined with the actors and live scenes. Graphics objects can be combined with the live action or morphing can be used. The examples are movies like Star Trek, Jurassic Park, Spider Man, etc.

Education and Training

- Computer generated models of physical, financial and economic systems are used as educational aids. For some training applications, special systems are designed. Examples of such systems are the **simulators for practice sessions** or **training of ship captains, aircraft pilots, heavy-equipment operators and air-traffic control personnel**.

Visualization

- Scientists, engineers, medical personnel, business analysts, and others often **need to analyze large amounts of information or to study the behavior of certain processes**. Numerical simulations carried out on supercomputers frequently produce data files containing thousands and even millions of data values. **Scanning these large sets of numbers to determine trends and relationships is a tedious and ineffective process**. But if the data are converted to a visual form, the trends and patterns are often immediately clear. Producing graphical representations for scientific, engineering and

medical data sets and processes is generally referred to as scientific visualization. E.g. A visual image of an atom where protons, electrons and neutrons are shown along with the movement is effective.

Image Processing

Image processing applies techniques to modify or interpret existing pictures, such as photographs and TV scans. Two principal applications of image processing are:

1) Improving picture quality and
2) Machine perception (insight or view) of visual information as used in robotics

To apply image processing, we first **digitize** a photograph or other picture into an image file and then other **digital processing methods** can be applied. Medical applications make much use of Image processing techniques for picture enhancements like CT (Computed X-ray Tomography) and PET (Position Emission Tomography). The last technique is referred to as Computer Aided Surgery. Image scanning of hand is done which shows the bones of a human hand.

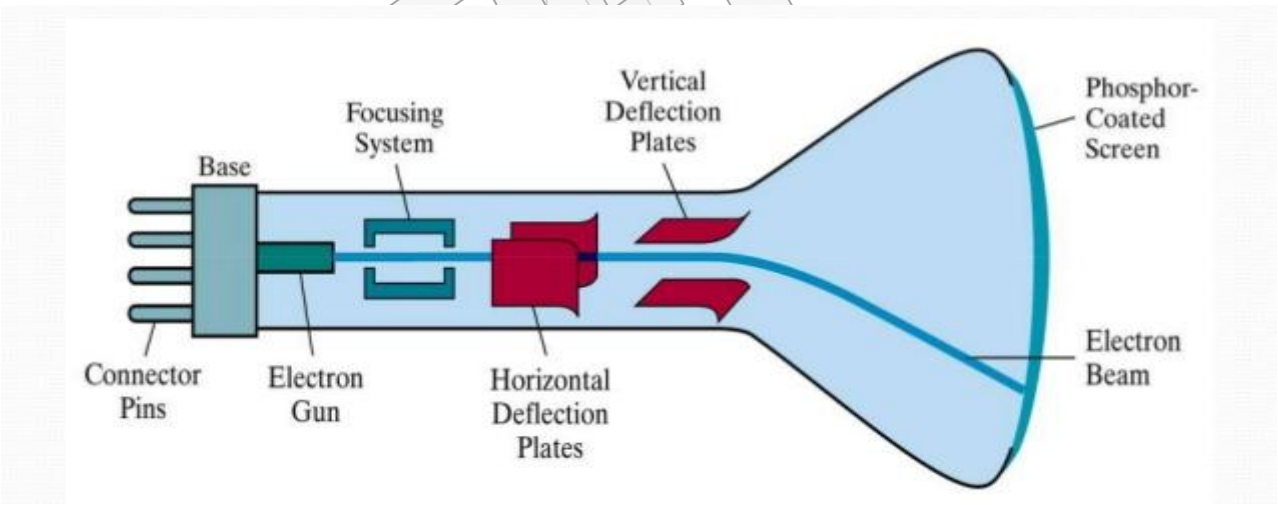
Graphical User Interface

It is common for software packages to provide a graphical interface. Multiple window areas can be opened at a time. Interfaces also display menus and icons for the selection of processing operations. An icon is a graphical symbol that is designed to look like the processing option it represents. The advantages of icons are that they look like the processing operation it represents. The menus and icons represent color values, graphic parameters, painting, drawing, zooming, and typing strings and other operations.

Overview of different Video Display Devices:

The primary output device in a graphics system is a video monitor. The operation of most video monitors is based on the standard **cathode-ray tube (CRT)** design but several other technologies exist and solid-state monitors may eventually dominate.

Refresh Cathode Ray Tubes



- A beam of electrons (cathode rays) are emitted by an electron gun passes through focusing and deflection systems that direct the beam towards specified positions on the phosphor-coated screen.
- The phosphor then emits a small spot of light at each position contacted by the electron beam.

- Because the light emitted by the phosphor fades very rapidly, some method is needed for maintaining the screen picture. One way to keep the phosphor glowing is to redraw the picture repeatedly by quickly directing the electron beam back over the same points. This type of display is called a **refresh CRT.**
- The primary components of an electron gun in a CRT are the heated metal cathode and a control grid.
- A high voltage of about 15000-20000 volts is supplied to the cathode by directing a current through a coil of wire, called the filament.
- This causes electrons to be "boiled off" the hot cathode surface. In the vacuum inside the CRT envelope, the free negatively charged electrons are accelerated towards the phosphor-coated screen by a high positive voltage.
- Setting voltage levels on the control grid, which is a metal cylinder that fits over the cathode, controls intensity of the electron beam.
- A high negative voltage applied to control grid will shut off the beam by stopping the electrons to pass through the small hole at the end of the control grid structure.
- A smaller negative voltage on the control grid simply decreases the number of electrons passing through.
- Since the amount of light emitted by the phosphor coating depends on the number of electrons striking the screen, we control the brightness of a display by varying the voltage on the control grid.
- The focusing system in a CRT is needed to force the electron beam to converge into a small spot as it strikes the phosphor.
- Otherwise, the electrons would repel each other, and the beam would spread out as it approaches the screen.
- Focusing is accomplished with either electric or magnetic fields. Electrostatic focusing is commonly used in television and computer graphics monitor.
- CRTs are now constructed with magnetic deflection coils mounted on the outside of the CRT envelope.
- Two pairs of coils are used, with the coils in each pair mounted on opposite sides of the neck of the CRT envelope.
- One pair is mounted on the top and bottom of the neck and the other pair is mounted on opposite sides of the neck.
- Spots of light are produced on the screen by the transfer of the CRT beam energy to the phosphor.
- When the electron beam strikes the phosphor-coated screen of the CRT, the individual electrons are moving with kinetic energy proportional to the acceleration voltage.
- When the electrons in the beam collide with the phosphor coating, they are stopped and their kinetic energy is absorbed by the phosphor.
- Part of the beam energy is converted by friction into heat energy, and the remainder causes electrons in the phosphor atoms to move up to higher quantum-energy levels.
- After a short time, the "excited" phosphor electrons begin dropping back to their stable ground state, giving up their extra energy as small quantum of light energy.
- What we see on the screen is the combined effect of all the electron light emissions: a glowing spot that fades quickly after all the excited phosphor electrons have returned to their ground energy level.
- Because the light emitted by the phosphor fades very rapidly, some method is needed for maintaining the screen picture.
- One way to keep the phosphor glowing is to redraw the picture repeatedly by quickly directing the electron beam back over the same spot.
- This process is called refreshing and hence the name is, refresh CRT.

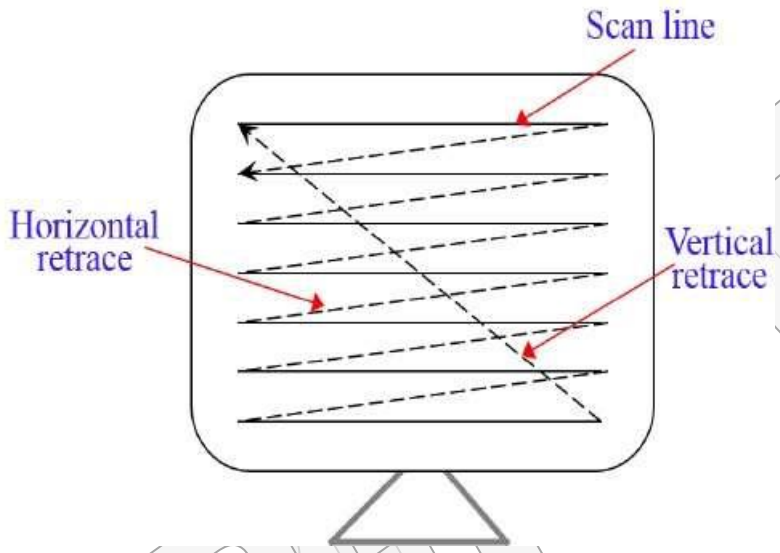
Refresh Rate: The refresh rate of a CRT is the number of times per second the image is redrawn; it is typically 60 per second for raster displays.

Persistence: Persistence is defined as the time it takes the emitted light from the screen to decay to one-tenth of its original intensity or the property of the phosphor of how long they continue to emit light after the CRT beam is removed.

Resolution: The maximum number of points that can be displayed without overlap on a CRT is referred to as the resolution.

Aspect Ratio: This number gives the ratio of vertical points to horizontal points necessary to produce equal length lines in both directions on the screen.
E.g. an aspect ratio of ¾ means that a vertical line plotted with three points has the same length as a horizontal line plotted with four points.
Note: The physical size of a graphics monitor is given as the length of the screen diagonal with sizes from 12 to 27 inches or more.

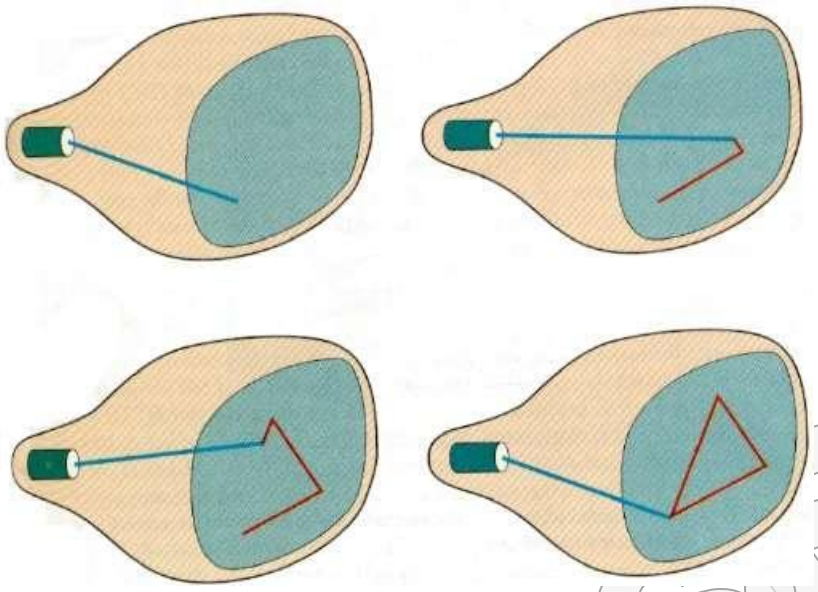
Raster-Scan Displays



- The most common type of graphic monitor employing a CRT is the raster-scan display, based on television technology.
- In a raster-scan system, the electron beam is swept across the screen, **one row (scan line) 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 a memory area called the refresh buffer or frame buffer**. This memory area holds the set of intensity values for all the screen points.
- Each screen point is referred to as **pixel** or pel (picture element).
- In a simple black and white system, each screen point is either on or off, so **only one bit is needed** to control the intensity of screen positions.
- For bi-level system, a bit value of 1 indicates that the electron beam is to be turned on at that position, and a value of 0 indicates that the beam intensity is to be off.
- Additional bits are needed when color and intensity variations are to be displayed.
- **Up to 24 bits per pixel are included** in high quality systems, which can require several megabytes of storage for the frame buffer, depending on the resolution of the system.
- On a black and white system with one bit per pixel, the frame buffer is commonly called a **bitmap**. For systems with multiple bits per pixel, the frame buffer is often referred as **pixmap**.
- Refreshing on raster-scan displays is carried out at the rate of **60 to 80 frames per second**.

- 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. The return to the left of the screen, after refreshing each scan line, is called the **horizontal retrace** of the electron beam.
- And at the end of each frame, the electron beam returns to the top left corner of the screen to begin the next frame. This is known as **vertical retrace** of the electron beam.
- Home television sets and printers are examples of other systems using raster scan methods.

Random-Scan Displays



- In a random-scan display unit a CRT's electron beam is directed **only to the parts of the screen where a picture is to be drawn.**
- Random-scan monitors **draw a picture one line at a time** and for this reason are also referred to as **vector displays**.
- The component lines of a picture can be drawn and refreshed by a random-scan system in any specified order.
- A pen plotter operates in a similar way and is an example of a random-scan, hard-copy device.
- Refresh rate on a random-scan system depends on the number of lines to be displayed.
- **Picture definition** is stored as a **set of line drawing commands** in an area of memory referred to as the **refresh display file**. It is also called **display list, display program or refresh buffer**.
- After all line drawing commands have been processed, the system cycles back to 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.**
- High-quality vector systems are capable of handling approximately 1,00,000 "short" lines at this refresh rate.
- When a small set of lines is to be displayed, each refresh cycle is delayed to avoid refresh rates greater than 60 frames per second.
- Otherwise, faster refreshing of the set of lines could burn out the phosphor.

Disadvantage:

1. Random-scan systems are designed for line-drawing applications and cannot display realistic shaded scenes.

Advantages:

1. Since picture definition is stored as a set of line drawing instructions and not as a set intensity values for all screen points, vector displays generally have higher resolution than raster systems.

2. They produce smooth line drawings because the CRT beam directly follows the line path. A raster system, in contrast, produces jagged lines that are plotted as discrete point sets.

Color CRT Monitors

A CRT monitor displays color pictures by using a combination of phosphors that emit different colored light.

The two basic techniques for producing color displays with a CRT are

1. **Beam Penetration Method** and
2. **The Shadow-Mask Method.**

1.) Beam Penetration Method

- This method is used with **random-scan monitors** for displaying color pictures.
- **Two layers of phosphors** 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.
- 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 colors, **orange and yellow.**
- The **beam acceleration voltage controls the speed** of the electrons and the screen color.

Advantage:

- Beam penetration has been an inexpensive way to produce color in random-scan monitors.

Disadvantages:

- Only four colors are possible.
- The quality of pictures is not as good as with other methods.

2.) Shadow Mask Method

- This method is used with **raster scan display** (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 the 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.**

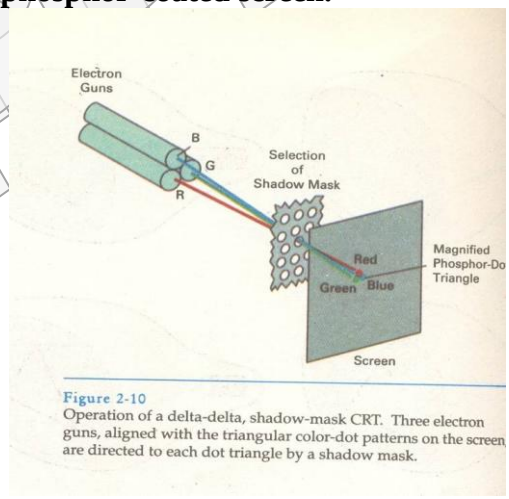


Figure 2-10
Operation of a delta-delta, shadow-mask CRT. Three electron guns, aligned with the triangular color-dot patterns on the screen, are directed to each dot triangle by a shadow mask.

- **The three electron beams are deflected and focused as a group onto the shadow mask**, which contains a series of holes, aligned with the phosphor dot patterns.

- 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.**
- We obtain **color variations** in a shadow-mask CRT by **varying the intensity levels** of the three electron beams.
- By turning off the red and green guns, we get only the color coming from the blue phosphor.
- **Other combinations of beam intensities produce a small light spot for each pixel position, since our eyes tend to merge the three colors into one composite.**
- **The color we see depends on the excitation of red, green and blue phosphors.**
- A **white** (or gray) area is the result of activating all three dots with equal intensity. **Yellow** is produced with the green and red dots only, **magenta** is produced with the blue and red dots, and **cyan** shows up when blue and green are activated equally.
- High quality raster graphics systems have **24 bits per pixel** in the frame buffer, allowing 256 voltage settings for each electron gun and nearly **17 million color** choices **for each pixel**.
- An RGB color system with 24 bits of storage per pixel is generally referred to as a **full-color system or true-color system.**

Direct-View Storage Tubes (DVST)

- An alternative method for maintaining a screen image is to store the picture information inside the CRT instead of refreshing the screen.
- A DVST stores the **picture information** as a **charge distribution** just behind the phosphor-coated screen.
- **Two electron guns** are used in DVST.
- The primary gun is used to store the picture pattern.
- The flood gun maintains the picture display.

Advantage:

- Very complex pictures can be displayed at very high resolutions without flicker.

Disadvantages:

- They ordinarily do not display color
- Selected parts of a picture cannot be erased. To eliminate a picture section, the entire screen must be erased and modified picture redrawn.

Flat Panel Displays

- Although most graphics monitors are CRT based, other technologies are emerging that may soon replace CRT monitors.
- The term flat-panel displays refers to a class of **video devices** that have **reduced volume, weight and power requirements** compared to CRT.
- A significant feature of flat-panel displays is that **they are thinner** than CRTs and we can hang them on wall or wear them on our wrists.
- Current uses for flat-panel displays include small TV monitors, calculators, pocket video games, laptop computers, armrest viewing of movies on airlines, as advertisement boards in elevators, and as graphics displays in applications requiring rugged (rough), portable monitors.
- We can separate flat-panel displays into two categories:

1) Emissive Displays

- The emissive displays (or emitters) are devices that convert electrical energy into light.

- **Plasma panels, thin-film electroluminiscent displays and light-emitting diodes** are examples of emissive displays.

A. **Plasma Panel**:

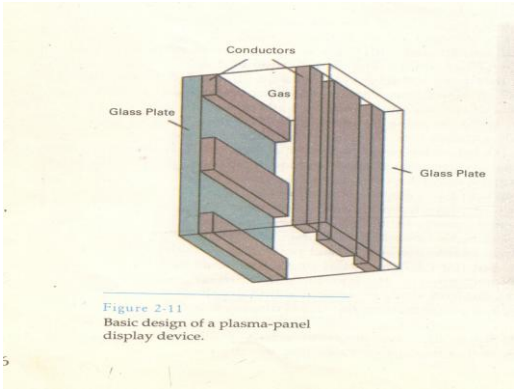


Figure 2-11
Basic design of a plasma-panel display device.

- They are also called **gas-discharge displays**.
- They 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 is built into other glass panel.
- Firing voltages applied to a pair of horizontal and vertical conductors cause gas at the intersection of the two conductors to break down into glowing plasma of electrons and ions.
- Picture definition is stored in a refresh buffer, and the firing voltages are applied to refresh the pixel positions 60 times per second.
- One disadvantage of plasma panels have been that they were strictly **monochromatic (**contains only one colour) devices, but systems have been developed that are now capable of displaying color and gray scale.

B. **Thin-Film Electroluminescent**:

- They are similar in construction to a plasma panel.
- The difference is that the region between the glass plates is filled with a phosphor, such as zinc sulphide doped with manganese, instead of a gas.
- When a sufficiently high voltage is applied to a pair of crossing electrodes, the phosphor becomes a conductor in the area of the intersection of the two electrodes.
- Electrical energy is then absorbed by the manganese atoms, which then release the energy as a spot of light similar to the glowing plasma effect in a plasma panel.
- They require more power than plasma panels and good color and gray scale displays are hard to achieve.

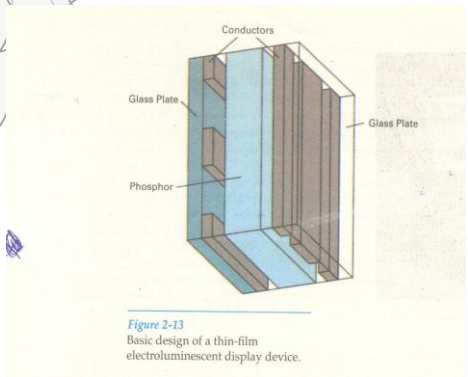


Figure 2-13
Basic design of a thin-film electroluminescent display device.

C. **Light Emitting Diode (LED):**

- A matrix of diodes is arranged to form the pixel positions in the display, and picture definition is stored in a refresh buffer.
- As in scan-line refreshing of a CRT, information is read from the refresh buffer and converted to voltage level that are applied to the diodes to produce the light patterns in the display.

2) Non-emissive Displays

- The non-emissive displays (or non-emitters) use **optical effect** to convert sunlight or light from some other source into graphics pattern.
- The example of a non-emissive flat-panel display is a **Liquid Crystal Display** device.
- LCDs are commonly used in small systems, such as calculators and portable, laptop computers.
- These 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.
- The term liquid crystal refers to the fact that these compounds have a crystalline arrangement of molecules, yet they flow like a liquid.
- 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.
- 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.
- 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. This type of flat-panel device is referred to as passive-matrix LCD.
- Another method for constructing LCDs is to place a transistor at each pixel location, using thin-film transistor technology. The transistors are used to control the voltage at pixel locations and to prevent charge from gradually leaking out of the liquid-crystal cells. These devices are called active-matrix displays.

Input Devices:

An **input device** is any hardware **device** that sends data to a computer, allowing you to interact with and control the computer.

1) Keyboard:

A computer **keyboard** is one of the primary input devices used with a computer that looks similar to those found on electric typewriters, but with some additional keys. Keyboards allow you to input letters, numbers, and other symbols into a computer that can serve as commands or be used to type text.

2) Mouse:

A computer mouse is a handheld hardware input device that controls a cursor in a GUI and can move and select text, icons, files, and folders. For desktop computers, the mouse is placed on a flat surface such as a mouse pad or a desk and is placed in front of your computer. The picture to the right is an example of a desktop computer mouse with two buttons and a wheel.

3) Trackball:

It is an input device that looks like an upside-down mouse. The onscreen pointer is moved by the **trackball** with a thumb or finger.
A trackball requires less arm and wrist motion that a regular mouse takes and therefore is often less stressful for the user to use, helping to prevent RSI. The picture of the Logitech cordless trackball mouse is an example of a trackball mouse that uses the thumb for movement.

4) Space ball:

Commonly utilized in CAD applications, 3D modeling, animation, 3D visualization and product visualization, users can manipulate the controller's pressure-sensitive handle (historically referred to as either a cap, ball, mouse or knob) to fly through 3D environments or manipulate 3D models within an application. The appeal of these devices over a mouse and keyboard is the ability to pan, zoom and rotate 3D imagery simultaneously, without stopping to change directions using keyboard shortcuts or a software interface.

5) Joystick:

A **joystick** is an input device that allows the user to control a character or machine in a computer program, such as a plane in a flight simulator. They look similar to the control device you would find on an arcade game, but nearly always include extra buttons for additional functionality. The picture shows the Logitech Freedom 2.4, an example of a joystick.

6) Data Glove:

A data glove is an interactive device, resembling a glove worn on the hand, which facilitates tactile sensing and fine-motion control in robotics and virtual reality. Data gloves are one of several types of electromechanical devices used in haptics applications.

7) Digitizers:

The digitizer by definition is a device used to convert analog signals into digital signals. In the case of our cell phones, this device would be the glass that covers the LCD. Yes, the glass piece that is attached to the LCD is the digitizer... or sometimes called LCD digitizer.

8) Scanners:

computer scanner is an input device because it takes information from the real world (e.g. a document or picture) and converts it into digital information for a computer to store or manipulate. A scanner is only able to send information to the computer and cannot receive information from the computer like a printer (which is an output device).

Epson V300 Photo Scanner

9)Touch Panel :

Touch panel technologies are a key theme in current digital devices, including smartphones, slate devices like the iPad, the screens on the backs of digital cameras, the Nintendo DS, and Windows 7 devices. The term touch panel encompasses various technologies for sensing the touch of a finger or stylus.

10) Light Pen:

A light pen is a light-sensitive pointing device commonly used to select or otherwise modify text or data on a screen. Used with a CRT monitor, these devices were an early form of manipulating and highlighting data on the screen. In the picture is an example of a woman using a light pen to highlight text on the screen.

11)Voice System:

A technology that allows a computer to interact with humans through the use of voice.

Hardcopy Devices:

A **hard copy** (or "**hardcopy**") is a printed **copy** of information from a computer. Sometimes referred to as a printout, a **hard copy** is so-called because it exists as a physical object. The same information, viewed on a computer display or sent as an e-mail attachment, is sometimes referred to as a soft copy.

1) Printers:

In computing, a **printer** is a peripheral which makes a persistent human-readable representation of graphics or text on paper or similar physical media.

2) Plotters:

The **plotter** is a computer printer for printing vector graphics. In the past, plotters were used in applications such as computer-aided design, though they have generally been replaced with wide-format conventional printers. A plotter gives a hard copy of the output. It draws pictures on a paper using a pen. Plotters are used to print designs of ships and machines, plans for buildings and so on.

Graphics Software:

There are two general classifications for graphics software:

1.) **General Programming Packages**: A general graphics-programming package provides an extensive set of graphics functions that can be used in a high-level programming language, such as C or FORTRAN. Example is GL (Graphics Library).
Basic functions in a general package include those for generating picture components (straight lines, polygons, circles and other figures), setting color and intensity values, selecting views, and applying transformations.

2.) **Special Purpose Application Packages**: They are designed for non-programmers, so that users can generate displays without worrying about how graphics operations work. The interface allows users to communicate with the programs in their own terms. Examples are the artist's painting programs and various businesses, medical and CAD systems.

Coordinate Representations:

- General graphics packages are designed to be used with **Cartesian coordinate** specifications.
- If coordinate values for a picture are specified in some other reference frame, they must be converted to Cartesian coordinates before they can be input to the graphics package.

- We can construct the shape of individual objects, such as trees or furniture, in a scene within separate coordinate reference frames called modeling coordinates or sometimes local coordinates or master coordinates.
- Once individual object shapes have been specified, we can place the objects into appropriate positions within the scene using a reference frame called world coordinates.
- Modeling and world coordinate definitions allow us to set any convenient floating point or integer dimensions without being hampered by the constraints of a particular output device.
- For some scenes, we might want to specify object dimensions in fractions of a foot, while for other applications we might want to use millimeters, kilometers or light-years.
- Generally, a graphics system first converts world-coordinate positions to normalized device coordinates, in the range from 0 to 1, before final conversion to specific device coordinates.
- This makes the system independent of the various devices that might be used at a particular workstation.

Graphics Functions:

A **general-purpose graphics package** provides users with a variety of functions for creating and manipulating pictures.
These routines can be categorized according to whether they deal with output, input, attributes, transformations, viewing or general control.

(1) Output primitives:

- The basic building blocks for pictures are referred to as output primitives.
- **They include character** strings and geometric entities such as **points, straight lines, curved lines, filled areas (polygons, circles etc), and shapes defined with array of color points.**
- Routines for generating output primitives provide the basic tools for constructing pictures.

(2) Attributes:

- Attributes are the **properties of the output primitives**; that is, an attribute describes how a particular primitive is to be displayed.
- They include **intensity and color specifications, line style, text styles, and area-filling patterns.**
- Functions within this category can be used to set attributes for an individual primitive class or for groups of output primitives.

(3) Geometric transformations:

- We can **change the size, position, or orientation of an object within a scene using geometric transformations.**
- Similar modeling transformations are used to construct a scene using object descriptions given in modeling coordinates.

(4) Viewing transformations:

- Given the primitive and attribute definition of a picture in world coordinates, **a graphics package projects a selected view of the picture on an output device.**
- Viewing transformations are used to specify the view that is to be presented and the portion of the output area that is to be used.
- Pictures can be subdivided into component parts, called structures or segments or objects, depending on the software package in use.
- Each structure defines one logical unit of the picture.

- A scene with several objects could reference each individual object in a separate named structure.
- Routines for processing structures carry out operations such as the creation, modification, and transformation of structures.

(5) Input functions:

- Interactive graphics applications **use various kinds of input devices**, such as a mouse, a tablet, or a joystick.
- **Input functions are used to control and process the data flow from these interactive devices**.

(6) Control operations:

- Finally, a graphics package contains a number of housekeeping tasks, such as clearing a display screen and initializing parameters.
- We can lump (group together) the functions for carrying out these chores (tasks) under the heading control operations.

Software Standards:

- The primary goal of standardized graphics software is portability.
- When packages are designed with standard graphics functions, software can be moved easily from one hardware system to another and used in different implementations and applications.
- International and national standards planning organizations in many countries have co-operated in an effort to develop a generally accepted standard for computer graphics.
- This work on standards led to the development of the **Graphical Kernel System (GKS).**
- This system was adopted as the first graphics software standard by the **International Standards Organization (ISO)** and by various national standards organizations, including the **American National Standard Institute (ANSI).**
- Although **GKS** was originally designed as a two-dimensional graphics package, a three-dimensional **GKS** extension was then developed.
- The second s/w standard to be developed and approved by the standard organizations was **PHIGS (Programmer's Hierarchical Interactive Graphics Standard),** which was an extension of **GKS.**
- **PHIGS+** was developed to provide three-dimensional surface-shading capabilities not available in **PHIGS.**
- A language binding is then defined for a particular high-level programming language.
- This binding gives the syntax for using the various standard graphics functions.
- Standardization for device interface methods is given in the **Computer Graphics Interface (CGI)** system and the **Computer Graphics Metafile (CGM).**

UNIT -1 QUESTION BANK

Multiple Choise Questions

1. _____ is not the application of Computer Graphics.
   a. Computer Aided Design
   b. Presentation Graphics
   c. Power Point
   d. Computer Art
2. CAD stands for_____.
   a. Computer Aided Design
   b. Common Application Design
   c. Common Aided Design
   d. Computer Application Design
3. _____ produce illustrations for reports for use with projectors.
   a. Computer Art
   b. Image Processing
   c. Entertainment
   d. Presentation Graphics
4. _____ Technique is used to modify or interpret existing pictures.
   a. Computer Art
   b. Image Processing
   c. Visualization
   d. None of the Above
5. CRT stands for_____.
   a. Cathode Ray Tube
   b. Computer Ray Tube
   c. Common Ray Tube
   d. None of the Above
6. To redraw the picture repeatedly by quickly directing the electron beam over same position is called_____.
   a. Repeat Directing
   b. Refresh Directing
   c. Repeat CRT
   d. Refresh CRT
7. _____ part of CRT is responsible for controlling brightness.
   a. Focusing System
   b. Deflection System
   c. Phosphor coated screen
   d. Control Grid
8. _____ lens focusing produces the smallest size spot on screen.
   a. Electrostatic
   b. Magnetic
   c. Filament
   d. None of the above
9. _____ persistence phosphor is used in animation.

a. Low
b. High
c. Medium
d. None of the Above.

10. The ratio of vertical points to horizontal points necessary to produce equal length lines in both directions is called_____.
a. Persistence
b. Resolution
c. Aspect Ratio
d. None of the above.

11. In _____ scan picture definition is stored as a set of intensity values.
a. Random
b. Raster
c. Proper
d. None of above

12. In Random Scan display picture definition is stored as _____.
a. intensity values
b. Line Commands
c. bit values
d. None of above

13. _____ is also known as calligraphic display.
a. Random
b. Raster
c. Beam Penetration
d. Shadow mask

14. _____ color display method is used in Random scan display.
a. Shadow mask
b. Beam Penetration
c. Color display
d. None of the above

15. DVST stands for_____
a. Direct Vision Storage Tube
b. Direct View Static Tube
c. Direct View Storage Tube
d. None of the above

16. _____ electron gun is used to maintain picture in DVST.
a. Primary
b. **Secondary**
c. Ternary
d. None of the above

17. _____ display the optical effect is used to generate graphics pattern.
a. Non-Emissive
b. Emissive
c. LED
d. None of the above

18. Which one of the following is not the application of emissive type flat panel.
    a. Plasma panel
    b. LCD
    c. LED
    d. Electro luminescent displays
19. _____ is a primary input device for entering string.
    a. Mouse
    b. Joystick
    c. Trackball
    d. Keyboard
20. GKS stands for_____
    a. Graphical Kernel System
    b. Graphics Kernel Software
    c. Graphical Kernel Software
    d. Graphics Kernel Standard
21. PHIGS stands for_____
    a. **Programmer's Hierarchical Interactive Graphics Standard**
    b. Programmer's Hierarchy of Interactive Graphics System
    c. Programmer's Hierarchy of Interactive Graphics Standard
    d. None of the above.
22. Beam penetration displays maximum _____ colors.
    a. 8
    b. 4
    c. 16
    d. 32

SHORT QUESTIONS

1 Define the following terms: 2 Marks
   1. Aspect Ratio
   2. Persistance
   3. Resolution
   4. Frame buffer
   5. Pixel
   6. Bitmap
   7. Horizontal retrace
   8. Vertical retrace
   9. Refresh buffer
   10. Modeling coordinates
   11. World coordinates
   12. Device coordinates
   13. Normalized device coordinates
2 Differentiate between impact and non-impact printers
3 State disadvantages of DVST
4 State disadvantage of Beam Penetration method
5 Explain in-line arrangement electron gun in shadow mask method.
6 List primary components Electron gun of CRT and state its functions.

LONG QUESTIONS

1 Explain working of CRT in detail. 5-6
2 Write note on DVST 3-4
3 Differentiate between Raster scan displays and Random scan displays 3-4

4	Explain in detail raster scan.	4-5
5	Explain in detail random scan.	4-5
6	Write short note on: 1. Beam Penetration Method 2. Shadow Mask Method 3. DVST 4. LCD 5. LED 6. Thin Film Electroluminescent displays 7. Plasma Panel	Each 3
7	List all types of input devices and explain any two in detail	6
8	Write note on the following input devices 1. Keyboard 2. Mouse 3. Track ball and space ball 4. Joysticks 5. Digitizers 6. Data glove 7. Image scanners 8. Touch Panels 9. Light pen 10. Voice systems	Each 3
9	Explain in brief coordinate representation	3-4
10	Explain in brief color monitors	6-7
11	Write a brief note on software standards.	3
12	Explain any one impact printers in brief	3-4
13	Explain any one non-impact printers in brief	3-4
14	What is Computer Graphics? Explain in brief a major application area of Computer Graphics.	6-7