MODULE - I

Overview of Computer Graphics System: Video Display Devices – Raster Scan Systems – Random – Scan Systems - Graphics Monitors and Workstations – Input Devices – Hardcopy Devices – Graphics Software.

Overview of Computer Graphics System

Computer graphics is commonly seen as a computer science branch that deals with the computerized image fusion theory and technology. As simple as a triangle outline, a computer-generated image may represent a scene. The computer has become a powerful tool for producing images quickly and economically.

When a computer is used to create images, the same process is followed as creating images manually. The process's primary computational steps give a boost to several important computer graphics areas.

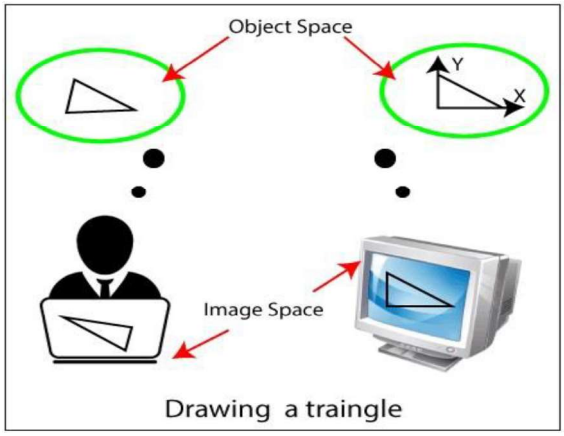
Also on computers, the term computer graphics covers almost everything. Here in the computer graphics program's classroom, we think of computer graphics as drawing images on machines, often known as **rendering**. The images can be photos, sketches, animations, or pictures of items imagined. Or they may be pictures, we cannot see directly, like internal body parts.

We have put a great deal of our time to develop how computer images can replicate real-world scenes. We want objects on computers not only to look more real, but also their colors to be more realistic and how different materials appear. We can call it "real synthesis of the image."

The term computer graphics has been used to define "almost everything on the computer, including text or sound." Generally, the term computer graphics refer to the following things:

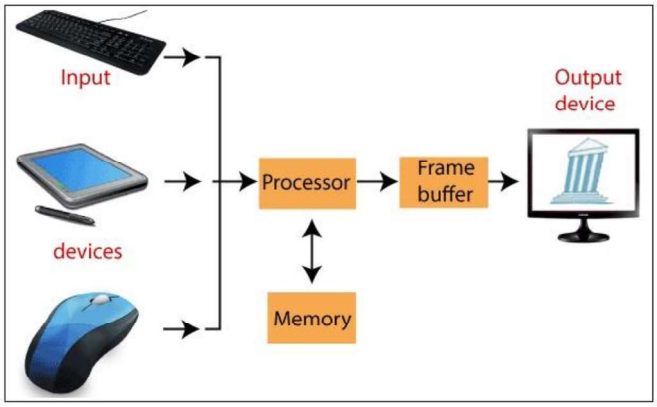
- Computer representation and manipulation of image data.
- Various technologies for creating and manipulating images.
- Computer graphics study is a sub-field of computer science that studies methods for digitally incorporating and manipulating visual content.

The next area of computer graphics that deals with the placement of a triangle is called **transformation**. Here we can use matrices to get the mapping of a triangle in image space. We can also set up the transformation matrix to control the location and orientation of the displayed image. We can also resize the triangle.



Definition of Computer Graphics-Computer graphics can be a series of images which is most often called a video or single image. Computer graphics is the technology that concerns with designs and pictures on computers. That's why, computer graphics are visual representations of data shown on a monitor made on a computer.

"Computer graphics is the use of a computer to define, store, manipulate, interrogate, and represent the pictorial output." An image in computer graphics is made up of a number of pixels.



Types of Computer Graphics

There are two kinds of computer graphics are–

- Interactive Computer Graphics
- Non-Interactive Computer Graphics

Interactive Computer Graphics

In interactive computer graphics, users have some controls over the image, i.e., the user can make any changes to the image produced.

Interactive Computer Graphics involves computer-user two-way communication.

For Example:

- Ping-pong game.
- Drawing on touch screens.
- Display weather forecast or other moving charts/graphs on the screen.
- Animating pictures or graphics in movies.
- Graphics animation in video games.

Working of Interactive Computer Graphics

The modern display of graphics is very simple to build. It is composed of three components:

- Display controller or video controller
- Digital memory or frame buffer
- Television monitor

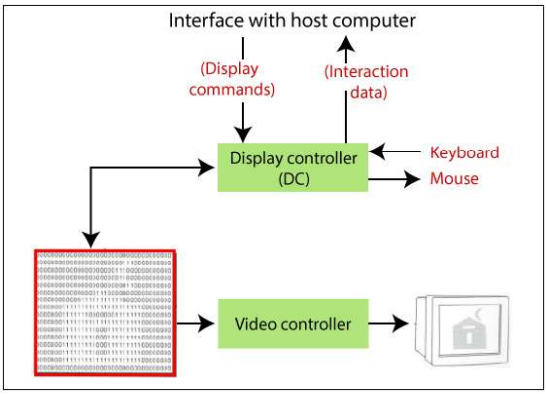
1. Display controller or video controller- It's a Memory Buffer and TV Monitor interface. Its task is to pass Frame Buffer's contents to the monitor. The display controller reads each continuous byte of Memory frame buffer data and converts 0's and 1's into appropriate video signals.

In today's term, the display controller is recognized as a display card, and one of our choices can be a VGA(Video Graphics Array) card with a resolution of 640×480. Display Controller is also capable of displaying the image in colors.

2. Digital memory or frame buffer-This is a place where images and pictures are stored as an array (matrix of 0 & 1, 0 represents darkness, and 1 represents image or picture). It is also called a frame buffer.

In today's term frame buffer is called V-RAM (video RAM), and it helps to store the image in bit form. It helps to increase the speed of graphics.

3. Television monitor- Monitor helps us to view the display, and they make use of CRT(Cathode ray tube) technology.



Advantages

1. Superior Quality.
2. More accurate outcomes or products.
3. Increased Productivity.
4. Lower cost of development.
5. Increases the ability to understand information and interpret patterns significantly.

Non- Interactive Computer Graphics

Non-interactive computer graphics are also known as passive computer graphics. It is a type of computer graphics in which the user has no control over the image. The photo is completely controlled by the instructions of the program, not by the user.

For Example:

- Screen savers.
- Map representation of the data.
- Graphic elements are used in the text, document, and PDF presentation.
- Static images are used in mobile applications and websites.
- Business graphics are used as brochures, business cards, menu of the hotel.

Representation of graphics

We can represent the graphics by following two ways:

1. Raster (Bitmap) Graphics
2. Vector Graphics

1. Raster Graphics: In raster graphics, the image is presented as a rectangular grid of colored squares.

Raster images are also called bitmap images. Bitmap images are stored as the collection of small individual dots called pixels.

Bitmap images require high resolution and anti-aliasing for a smooth appearance.

For example– Paint, Photoshop, etc.

2. Vector Graphics: In vector graphics, the image is represented in the form of continuous geometric objects: line, curve, etc.

Vector images are not based on pixel pattern. They use mathematical formulas to draw line and curves. The lines and curves can be combined to create an image.

For Example– PowerPoint, Corel Draw, etc.

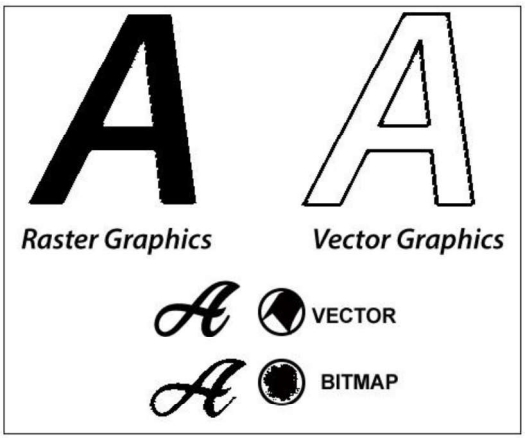


Fig: Raster (Composition of Paths) Vector (Composition of Pixels)

Difference between Raster and Vector Graphics:

Raster Graphics	Vector Graphics
Raster images are the collection of the pixel.	The Vector images are composed of paths.
Scan conversion is required.	Scan Conversion is not required.
Raster Graphics are less costly.	Vector Graphics are more costly compared to raster graphics.
Raster image takes less space to store.	Vector image takes more space.
Raster graphics can draw mathematical curves, polygons, and boundaries.	Vector graphics can only draw continuous and smooth lines.
File Extension: .BMP, .TIF, .JPG etc.	**File Extension:** .SVG, .PDF, .AI etc.

Computer graphics is an art of drawing pictures on computer screens with the help of programming. It involves computations, creation, and manipulation of data. In other words, we can say that computer graphics is a rendering tool for the generation and manipulation of images.

Video Display Devices

Cathode Ray Tube

CRT stands for Cathode ray tube. It is a technology which is used in traditional computer monitor and television.

Cathode ray tube is a particular type of vacuum tube that displays images when an electron beam collides on the radiant surface.

The primary output device in a graphical system is the video monitor.

Component of CRT:

- **Electron Gun:** The electron gun is made up of several elements, mainly a heating filament (heater) and a cathode.

The electron gun is a source of electrons focused on a narrow beam facing the CRT.

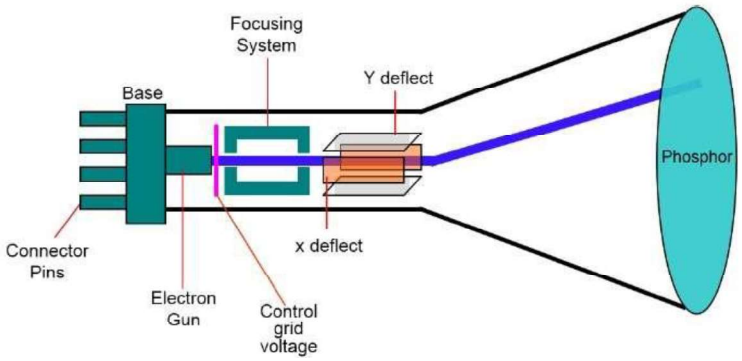
- **Focusing & Accelerating Anodes:** These anodes are used to produce a narrow and sharply focused beam of electrons.

- **Horizontal & Vertical Deflection Plates:** These plates are used to guide the path of the electron the beam. The plates produce an electromagnetic field that bends the electron beam through the area as it travels.
- **Phosphorus-coated Screen:** The phosphorus coated screen is used to produce bright spots when the high-velocity electron beam hits it.

The main element of a video monitor is the **Cathode Ray Tube** CRT**,** shown in the following illustration.

The operation of CRT is very simple −

- The electron gun emits a beam of electrons cathode rays.
- The electron beam passes through focusing and deflection systems that direct it towards specified positions on the phosphor-coated screen.
- 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.



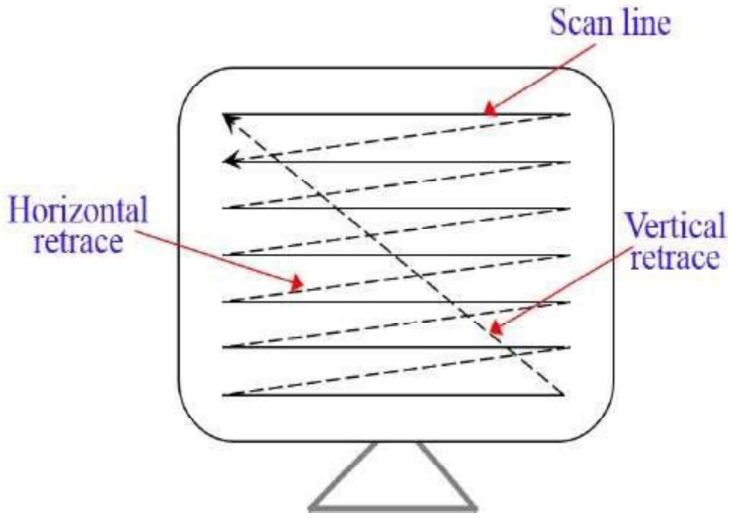
There are two ways Random scan and Raster scan by which we can display an object on the screen.

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**. This memory area holds the set of intensity values for all the screen points. Stored intensity values are then retrieved from the refresh buffer and "painted" on the screen one row scan line at a time as shown in the following illustration.

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.

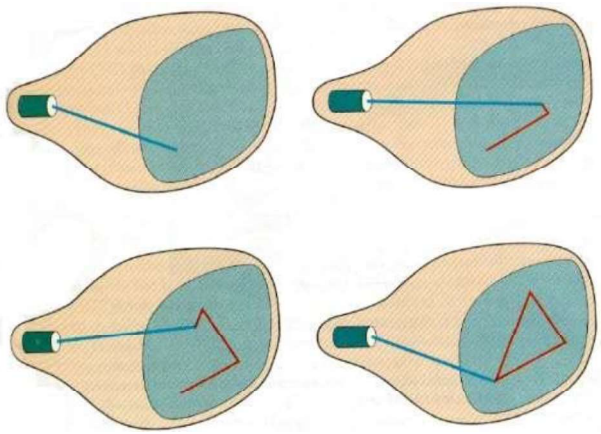


Random Scan /Vector Scan

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**.

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.



Application of Computer Graphics

Computer Graphics has numerous applications, some of which are listed below −

- **Computer graphics user interfaces** GUIs − A graphic, mouse-oriented paradigm which allows the user to interact with a computer.
- **Business presentation graphics** − "A picture is worth a thousand words".

- **Cartography** − Drawing maps.
- **Weather Maps** − Real-time mapping, symbolic representations.
- **Satellite Imaging** − Geodesic images.
- **Photo Enhancement** − Sharpening blurred photos.
- **Medical imaging** − MRIs, CAT scans, etc. - Non-invasive internal examination.
- **Engineering drawings** − mechanical, electrical, civil, etc. - Replacing the blueprints of the past.
- **Typography** − The use of character images in publishing - replacing the hard type of the past.
- **Architecture** − Construction plans, exterior sketches - replacing the blueprints and hand drawings of the past.
- **Art** − Computers provide a new medium for artists.
- **Training** − Flight simulators, computer aided instruction, etc.
- **Entertainment** − Movies and games.
- **Simulation and modeling** − Replacing physical modeling and enactments

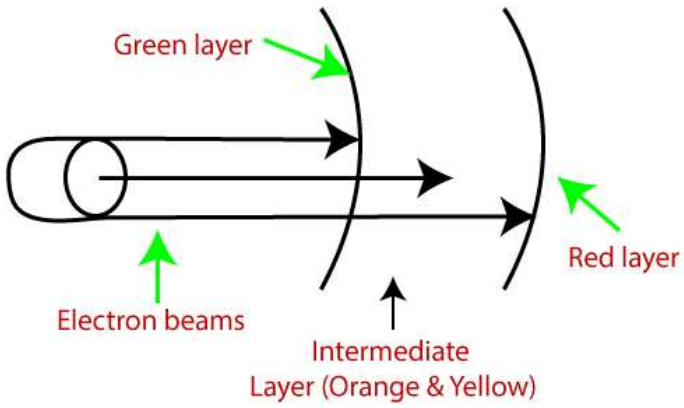
Color CRT Monitor: It is similar to a CRT monitor.

The basic idea behind the color CRT monitor is to combine three basic colors- Red, Green, and Blue. By using these three colors, we can produce millions of different colors.

The two basic color display producing techniques are:

1. **Beam–Penetration Method:** It is used with a **random scan** monitor for displaying pictures. There are two phosphorus layers- Red and Green are coated inside the screen. The color shown depends on how far the electron beam penetrates the phosphorus surface.

A powerful electron beam penetrates the CRT, it passes through the red layer and excites the green layer within. A beam with slow electrons excites only the red layer. A beam with the medium speed of electrons, a mixture of red and green light is emitted to display two more colors- orange and yellow.



Advantages:

1. Better Resolution
2. Half cost
3. Inexpensive

Disadvantages:

1. Only four possible colors
2. Time Consuming

2.Shadow–Mask Method: It is used with a **raster scan** monitor for displaying pictures. It has more range of color than the beam penetration method. It is used in television sets and monitors.

Structure:

1. It has three phosphorus color dots at each position of the pixel.

First Dot: **Red** color
Second Dot: **Green** color
Third Dot: **Blue** color

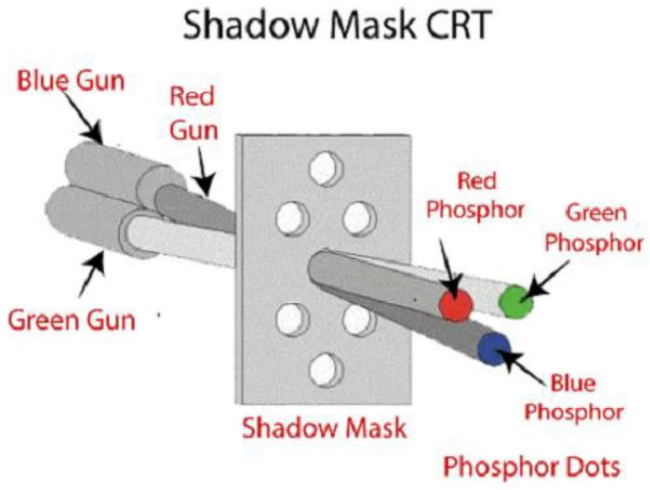
1. It has three different guns. Each for one color.
2. It has a metal screen or plate just before the phosphorus screen, named **"Shadow-Mask."**
3. It also has a shadow grid just behind the phosphorus coated screen with tiny holes in a triangular shape.

Working: A Shadow Mask is a metal plate with tiny holes present inside a color monitor.

A Shadow Mask directs the beam by consuming the electrons so that the beam hits only the desired point and displays a resulting picture.

It has three different guns. These guns direct their beams to shadow mask, which allows them to pass. It is a task of a shadow mask to direct the beam on its particular dot on the screen and produce a picture on the screen.

A Shadow Mask can display a wider range of pictures than beam penetration.



Advantages:

1. Display a wider range picture.
2. Display realistic images.
3. In-line arrangement of RGB color.

Disadvantages:

Difficult to cover all three beams on the same hole.
Poor Resolution.

Liquid crystal display (LCD): 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)

Advantages:

1. Produce a bright image
2. Energy efficient
3. Completely flat screen

Disadvantages:

1. Fixed aspect ratio & Resolution
2. Lower Contrast
3. More Expensive

Light Emitting Diode (LED): LED is a device which emits when current passes through it. It is a semiconductor device. 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. LEDs are powerful in structure, so they are capable of withstanding mechanical pressure. LED also works at high temperatures.

Advantages:

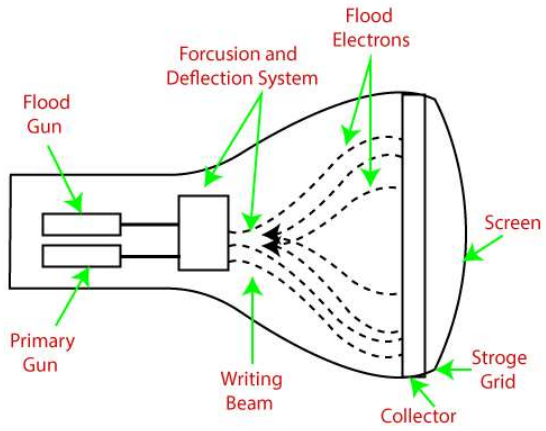
1. The Intensity of light can be controlled.
2. Low operational Voltage.
3. Capable of handling the high temperature.

Disadvantages:

More Power Consuming than LCD.

Direct View Storage Tube (DVST): It is used to store the picture information as a charge distribution behind the phosphor-coated screen.There are two guns used in DVST:

1.**Primary Gun:** It is used to store the picture information.
2.**Flood / Secondary Gun:** It is used to display a picture on the screen.



Advantages:

1. Less Time Consuming
2. No Refreshing Required
3. High-Resolution
4. Less Cost

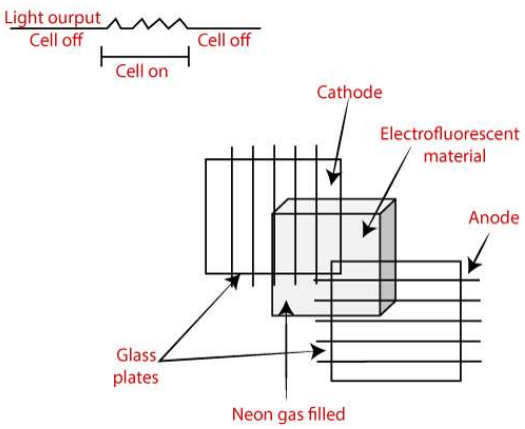
Disadvantages:

1. The specific part of the image cannot be erased.
2. They do not display color.

Plasma Display: It is a type of flat panel display which uses tiny plasma cells. It is also known as **the Gas-Discharge display**.

Components of plasma display:

1. Anode: It is used to deliver a positive voltage. It also has the line wires.
2. Cathode: It is used to provide negative voltage to gas cells. It also has fine wires.
3. Gas Plates: These plates work as capacitors. When we pass the voltage, the cell lights regularly.
4. Fluorescent cells: It contains small pockets of gas liquids when the voltage is passed to this neon gas. It emits light.



Advantages:

1. Wall Mounted
2. Slim
3. Wider angle

Disadvantages:

1. Phosphorus loses luminosity over time.
2. It consumes more electricity than LCD.
3. Large Size

3D Display: It is also called stereoscope display technology. This technology is capable of bringing depth perception to the viewer. It is used for 3D gaming and 3D TVs.

For Example: Fog Display, Holographic Display, Retina Display Etc.

Advantages:

- Impressive Picture Quality
- High Definition
- Motion Communicates

Disadvantage:

- Expensive
- Binocular Fusion

Input Devices

Following are some of the important input devices which are used in a computer −

- Keyboard
- Mouse

- Joy Stick
- Light pen
- Track Ball
- Scanner
- Graphic Tablet
- Microphone
- Magnetic Ink Card Reader(MICR)
- Optical Character Reader(OCR)
- Bar Code Reader
- Optical Mark Reader(OMR)

Keyboard

Keyboard is the most common and very popular input device which helps to input data to the computer. The layout of the keyboard is like that of traditional typewriter, although there are some additional keys provided for performing additional functions.

Keyboards are of two sizes 84 keys or 101/102 keys, but now keyboards with 104 keys or 108 keys are also available for Windows and Internet.

The keys on the keyboard are as follows −

S.No	Keys & Description
1	**Typing Keys** These keys include the letter keys (A-Z) and digit keys (09) which generally give the same layout as that of typewriters.
2	**Numeric Keypad** It is used to enter the numeric data or cursor movement. Generally, it consists of a set of 17 keys that are laid out in the same configuration used by most adding machines and calculators.

3	**Function Keys** The twelve function keys are present on the keyboard which are arranged in a row at the top of the keyboard. Each function key has a unique meaning and is used for some specific purpose.
4	**Control keys** These keys provide cursor and screen control. It includes four directional arrow keys. Control keys also include Home, End, Insert, Delete, Page Up, Page Down, Control(Ctrl), Alternate(Alt), Escape(Esc).
5	**Special Purpose Keys** Keyboard also contains some special purpose keys such as Enter, Shift, Caps Lock, Num Lock, Space bar, Tab, and Print Screen.

Mouse

Mouse is the most popular pointing device. It is a very famous cursor-control device having a small palm size box with a round ball at its base, which senses the movement of the mouse and sends corresponding signals to the CPU when the mouse buttons are pressed.

Generally, it has two buttons called the left and the right button and a wheel is present between the buttons. A mouse can be used to control the position of the cursor on the screen, but it cannot be used to enter text into the computer.

Advantages

- Easy to use
- Not very expensive
- Moves the cursor faster than the arrow keys of the keyboard.

Joystick

Joystick is also a pointing device, which is used to move the cursor position on a monitor screen. It is a stick having a spherical ball at its both lower and upper ends. The lower spherical ball moves in a socket. The joystick can be moved in all four directions.

The function of the joystick is similar to that of a mouse. It is mainly used in Computer Aided Designing (CAD) and playing computer games.

Light Pen

Light pen is a pointing device similar to a pen. It is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical system placed in a small tube.

When the tip of a light pen is moved over the monitor screen and the pen button is pressed, its photocell sensing element detects the screen location and sends the corresponding signal to the CPU.

Track Ball

Track ball is an input device that is mostly used in notebook or laptop computer, instead of a mouse. This is a ball which is half inserted and by moving fingers on the ball, the pointer can be moved.

Since the whole device is not moved, a track ball requires less space than a mouse. A track ball comes in various shapes like a ball, a button, or a square.

Scanner

Scanner is an input device, which works more like a photocopy machine. It is used when some information is available on paper and it is to be transferred to the hard disk of the computer for further manipulation.

Scanner captures images from the source which are then converted into a digital form that can be stored on the disk. These images can be edited before they are printed.

Digitizer

Digitizer is an input device which converts analog information into digital form. Digitizer can convert a signal from the television or camera into a series of numbers that could be stored in a computer. They can be used by the computer to create a picture of whatever the camera had been pointed at.

Digitizer is also known as Tablet or Graphics Tablet as it converts graphics and pictorial data into binary inputs. A graphic tablet as digitizer is used for fine works of drawing and image manipulation applications.

Microphone

Microphone is an input device to input sound that is then stored in a digital form.

The microphone is used for various applications such as adding sound to a multimedia presentation or for mixing music.

Magnetic Ink Card Reader (MICR)

MICR input device is generally used in banks as there are large number of cheques to be processed every day. The bank's code number and cheque number are printed on the cheques with a special type of ink that contains particles of magnetic material that are machine readable.

This reading process is called Magnetic Ink Character Recognition (MICR). The main advantages of MICR is that it is fast and less error prone.

Optical Character Reader (OCR)

OCR is an input device used to read a printed text.

OCR scans the text optically, character by character, converts them into a machine readable code, and stores the text on the system memory.

Bar Code Readers

Bar Code Reader is a device used for reading bar coded data (data in the form of light and dark lines). Bar coded data is generally used in labelling goods, numbering the books, etc. It may be a handheld scanner or may be embedded in a stationary scanner.

Bar Code Reader scans a bar code image, converts it into an alphanumeric value, which is then fed to the computer that the bar code reader is connected to.

Optical Mark Reader (OMR)

OMR is a special type of optical scanner used to recognize the type of mark made by pen or pencil. It is used where one out of a few alternatives is to be selected and marked.

It is specially used for checking the answer sheets of examinations having multiple choice questions.

Output Devices

An output device is a component of hardware or the main physical part of a computer that can be touched and seen. An output device is an electromechanical device.

"The Computer gives instructions and data from input devices and processes it and returns the result called as output."

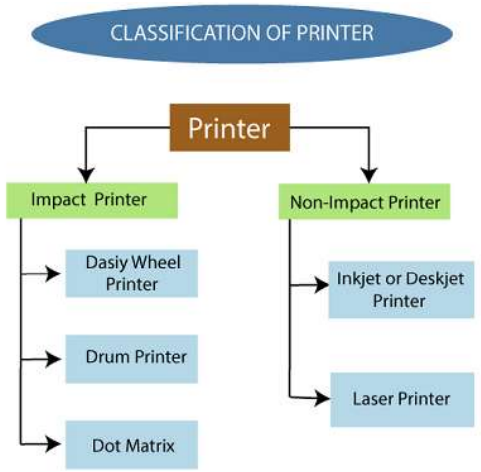
For Example: Printer, Plotter, Monitor, Projector etc.

Printers:

A printer is a peripheral device which is used to represent the graphics or text on paper. The quality is measured by its resolution. The resolution of any printer is measured in dot per inch (dpi).

The printer usually works with the computer and connected via a cable. In present, many digital device support printer features so that we can use Bluetooth, Wi-fi, and cloud technology to print.

Types of Printers



Some types of printers are:

- Impact Printers
- Non-impact Printers

Impact Printers

In impact printers, there is a physical contact established between the print head, ribbon, ink-cartridge, and paper.

The printers hit print head on an ink-filled ribbon than the letter prints on the paper. Impact printers are works like a typewriter.

Impact printers print the characters by striking them on the ribbon, which is then pressed on the paper.

Characteristics of Impact Printers are the following −

- Very low consumable costs
- Very noisy
- Useful for bulk printing due to low cost
- There is physical contact with the paper to produce an image

These printers are of two types −

- Character printers
- Line printers

Character Printers

Character printers are the printers which print one character at a time.

These are further divided into two types:

- Dot Matrix Printer(DMP)
- Daisy Wheel

Dot Matrix Printer

In the market, one of the most popular printers is Dot Matrix Printer. These printers are popular because of their ease of printing and economical price. Each character printed is in the form of pattern of dots and head consists of a Matrix of Pins of size (5*7, 7*9, 9*7 or 9*9) which come out to form a character which is why it is called Dot Matrix Printer.

Advantages

- Inexpensive
- Widely Used
- Other language characters can be printed

Disadvantages

- Slow Speed
- Poor Quality

Daisy Wheel

Head is lying on a wheel and pins corresponding to characters are like petals of Daisy (flower) which is why it is called Daisy Wheel Printer. These printers are generally used for word-processing in offices that require a few letters to be sent here and there with very nice quality.

Advantages

- More reliable than DMP
- Better quality
- Fonts of character can be easily changed

Disadvantages

- Slower than DMP
- Noisy
- More expensive than DMP

Line Printers

Line printers are the printers which print one line at a time.

These are of two types −

- Drum Printer
- Chain Printer

Drum Printer

This printer is like a drum in shape hence it is called drum printer. The surface of the drum is divided into a number of tracks. Total tracks are equal to the size of the paper, i.e. for a paper width of 132 characters, drum will have 132 tracks. A character set is embossed on the track. Different character sets available in the market are 48 character set, 64 and 96 characters set. One rotation of drum prints one line. Drum printers are fast in speed and can print 300 to 2000 lines per minute.

Advantages

- Very high speed

Disadvantages

- Very expensive
- Characters fonts cannot be changed

Chain Printer

In this printer, a chain of character sets is used, hence it is called Chain Printer. A standard character set may have 48, 64, or 96 characters.

Advantages

- Character fonts can easily be changed.
- Different languages can be used with the same printer.

Disadvantages

- Noisy

Non-impact Printers

Non-impact printers print the characters without using the ribbon. These printers print a complete page at a time, thus they are also called as Page Printers.

These printers are of two types −

- Laser Printers
- Inkjet Printers

Characteristics of Non-impact Printers

- Faster than impact printers
- They are not noisy
- High quality
- Supports many fonts and different character size

Laser Printers

These are non-impact page printers. They use laser lights to produce the dots needed to form the characters to be printed on a page.

Advantages

- Very high speed
- Very high quality output
- Good graphics quality
- Supports many fonts and different character size

Disadvantages

- Expensive
- Cannot be used to produce multiple copies of a document in a single printing

Inkjet Printers

Inkjet printers are non-impact character printers based on a relatively new technology. They print characters by spraying small drops of ink onto paper. Inkjet printers produce high quality output with presentable features.

They make less noise because no hammering is done and these have many styles of printing modes available. Color printing is also possible. Some models of Inkjet printers can produce multiple copies of printing also.

Advantages

- High quality printing
- More reliable

Disadvantages

- Expensive as the cost per page is high
- Slow as compared to laser printer

Monitors

Monitors, commonly called as **Visual Display Unit** (VDU), are the main output device of a computer. It forms images from tiny dots, called pixels that are arranged in a rectangular form. The sharpness of the image depends upon the number of pixels.

There are two kinds of viewing screen used for monitors.

- Cathode-Ray Tube (CRT)
- Flat-Panel Display

Cathode-Ray Tube (CRT) Monitor

The CRT display is made up of small picture elements called pixels. The smaller the pixels, the better the image clarity or resolution. It takes more than one illuminated pixel to form a whole character, such as the letter ‘e’ in the word help.

A finite number of characters can be displayed on a screen at once. The screen can be divided into a series of character boxes - fixed location on the screen where a standard character can be placed. Most screens are capable of displaying 80 characters of data horizontally and 25 lines vertically.

There are some disadvantages of CRT −

- Large in Size
- High power consumption

Flat-Panel Display Monitor

The flat-panel display refers to a class of video devices that have reduced volume, weight and power requirement in comparison to the CRT. You can hang them on walls or wear them on your wrists. Current uses of flat-panel displays include calculators, video games, monitors, laptop computer, and graphics display.

The flat-panel display is divided into two categories −

- **Emissive Displays** − Emissive displays are devices that convert electrical energy into light. For example, plasma panel and LED (Light-Emitting Diodes).
- **Non-Emissive Displays** − Non-emissive displays use optical effects to convert sunlight or light from some other source into graphics patterns. For example, LCD (Liquid-Crystal Device).

Plotters:

A plotter is a special type of output device. It is used to print large graphs, large designs on a large paper. **For Example:** Construction maps, engineering drawings, architectural plans, and business charts, etc.

It was invented by **"Remington rand"** in 1953.

It is similar to a printer, but it is used to print vector graphics.

Types of Plotter

1. **Flatbed Plotter:** In a flatbed plotter, the paper is kept in a stationary position on a table or a tray. A flatbed plotter has more than one pen and a holder. The pen rotates on the paper upside-down and right-left by the using of a motor.

Every pen has a different color ink, which is used to draw the multicolor design. We can quickly draw the following designs by using a flatbed printer.

For: Cars, Ships, Airplanes, Dress design, road and highway blueprints, etc.

Advantages of Flatbed Plotter

1. Larger size paper can be used
2. Drawing Quality is similar to an expert

Disadvantages of Flatbed Plotter

1. Slower than printers
2. More Expensive than printers
3. Do not produce high-Quality text printouts

2. Drum Plotter: It is also called **"Roller plotter."** There is a drum in this plotter. We can apply the paper on the drum. When the plotter works, these drums moves back and forth, and the image is drawn.

Drum plotter has more than one pen and penholders. The pens easily moves right to left and left to right. The movement of pens and drums are controlled by graph plotting program.It is used in industry to produce large drawings (up to A0).

Advantages of Drum Plotter

1. Draw Larger Size image
2. We can print unlimited length of the image

Disadvantages of Drum Plotter

1. Very costly

Graphics Monitors and Workstations

Graphics Monitor:

i).The name itself giving some idea that, Monitor which is capable of displaying "Graphics". Generally most of the Monitors support Text modes.

ii).So Monitors which are capable of showing and supporting Graphics mode along with the Text modes.

iii).Graphic monitors who can display pictures on its screen, of course it acts like an output device. The monitors which support the following Graphic applications are said to be Graphic Monitors.

The Graphics Applications include,

A).Animation Software's
B).CAD Software's
C).Drawing programs
D).Paint Application programs
E).Presentation Graphics Software's (Excel likewise, creating pie and bar charts)
F).Desktop publishing (MS Office, Share points, Document managements)

So by now, you might have got an Idea of what is Graphic Monitor Actually is??

Workstation:

i).Workstation is also a computer which varies generally with other General Computers

ii).Because these Workstations need good operating power of computer. They must be able to support high power i.e. it must sustain good graphic capabilities.

iii).These kind of computers comes with the following specifications. Unlike normal general computers they consists of,

A).Minimum of 64 Megabytes of RAM

B).Very good Resolution Graphics screen

C).High and Large Screen

D).GUI Graphical User Interface (which helps programs easier to use of the Computer's Graphics)

E).Very good Mass storage Device like Disk Drive

F).Built-in Network Support and many factors

iv) We may also notice that, some of the workstations do not have any disk drives in it. So these kind of disk drives are called as Diskless workstation.

v) Workstations took place of and they lie between Personal computer (General Computers) and minicomputers as far as Computing power is concerned.

vi) These can be used as both types such as stand system (which only consists of one) and Local area network. So basically in this LAN kind, workstations are typically connected together one and other.

Operating Systems for Workstations:

The most generally used common operating systems are,

UNIX:

UNIX is a multitasking operating system. Unix Operating System are to be written in High level programming language, which we can simply say C language. This Unix Operating System is with very flexible and so most commonly used in Workstations.

Windows NT:

Windows NT is also referred as Windows New Technology. It is also a most commonly used Operating system for workstations. This Windows NT highly supports multitasking works and Windows NT has its other versions are such as Windows NT Server and Windows NT Workstation.

Graphics software and standard

- There are mainly two types of graphics software:
  1. General programming package
  2. Special-purpose application package

General programming package

- A general programming package provides an extensive set of graphics function that can be used in high level programming language such as C or FORTRAN.
- It includes basic drawing element shape like line, curves, polygon, color of element transformation etc.
- Example: - GL (Graphics Library).

Special-purpose application package

- Special-purpose application package are customize for particular application which implement required facility and provides interface so that user need not to vory about how it will work (programming). User can simply use it by interfacing with application.
- Example: - CAD, medical and business systems.

Coordinate representations

- Except few all other general packages are designed to be used with Cartesian coordinate specifications.

- If coordinate values for a picture are specified is some other reference frame they must be converted to Cartesian coordinate before giving input to graphics package.
- Special-purpose package may allow use of other coordinates which suits application.
- In general several different Cartesian reference frames are used to construct and display scene.
- We can construct shape of object with separate coordinate system 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 called world coordinates.
- Finally the World-coordinates description of the scene is transferred to one or more output device reference frame for display. These display coordinates system are referred to as "**Device Coordinates"** or "**Screen Coordinates".**
- Generally a graphic system first converts the world-coordinates position to normalized device coordinates. In the range from 0 to 1 before final conversion to specific device coordinates.
- An initial modeling coordinates position (Xmc,Ymc) in this illustration is transferred to a device coordinates position(Xdc,Ydc) with the sequence (Xmc,Ymc)□ (Xwc,Ywc)□ (Xnc,Ync)□ (Xdc,Ydc).

Graphic Function

- A general purpose graphics package provides user with Varity of function for creating and manipulating pictures.
- The basic building blocks for pictures are referred to as output primitives. They includes character, string, and geometry entities such as point, straight lines, curved lines, filled areas and shapes defined with arrays of color points.
- Input functions are used for control & process the various input device such as mouse, tablet, etc.
- Control operations are used to controlling and housekeeping tasks such as clearing display screen etc.
- All such inbuilt function which we can use for our purpose are known as graphics function

Software Standard

- Primary goal of standardize graphics software is portability so that it can be used in any hardware systems & avoid rewriting of software program for different system
- Some of these standards are discuss below

<u>Graphical Kernel System (GKS)</u>

- This system was adopted as a first graphics software standard by the international standard organization (ISO) and various national standard organizations including ANSI.
- GKS was originally designed as the two dimensional graphics package and then later extension was developed for three dimensions.

PHIGS (Programmer's Hierarchical Interactive Graphic Standard)

- PHIGS is extension of GKS. Increased capability for object modeling, color specifications, surface rendering, and picture manipulation are provided in PHIGS.
- Extension of PHIGS called **"PHIGS+"** was developed to provide three dimensional surface shading capabilities not available in PHIGS.