COMPUTER GRAPHICS (Syllabus)
MCA 402 Computer Graphics and Multimedia

Module 1 (10 Hours)
An Introduction Graphics System : Computer Graphics and Its Types, Application of computer graphics, Graphics Systems : Video Display Devices, Raster Scan Systems, Random Scan Systems, Graphics Monitors and Work Stations, Input Devices, Hard Copy Devices, Graphics Software.

Module 2 (10 Hours)
Output Primitives and Attributes of Output Primitives : Output Primitive Points and Lines,
Line Drawing Algorithms, Circle Generating Algorithms, Scan-Line Polygon Fill Algorithm, Inside-Outside tests, Boundary-Fill Algorithm, Flood Fill Algorithm, Cell Array,
Character Generation, Attributes of Output Primitives : Line Attributes, Color and Grayscale Levels, Area fill Attributes, Character Attributes, Bundled Attributes, Anti-
aliasing.

Module 3 (10 Hours)
Two-dimensional Geometric Transformations : Basic Transformations, Matrix Representation and Homogeneous Coordinates, Composite Transformations, Reflection and Shearing. Two-Dimension Viewing : The viewing Pipeline, Window to view port coordinate transformation, Clipping Operations, Point Clipping, Line Clipping, Polygon Clipping, Text Clipping, Exterior Clipping Three-Dimensional Concepts : Three Dimensional Display Methods, 3D Transformations, Parallel Proection and Perspective Projection.

Module 4 (10 Hours)
Multimedia : Introduction to Multimedia : Classification of Multimedia, Multimedia Software, Components of Multimedia – Audio : Analog to Digital conversion, sound card
fundamentals, Audio play backing and recording Video, Text : Hypertext, Hyper media and Hyper Graphics, Graphics and Animation : Classification of Animation. Authoring Process and Tools. Case Study: graphics software MatLab, Use of MatLab in graphics
application, Features of MatLab, Generalize application by using MatLab.

Module 5 (6 Hours)
(as per choice of faculty)
Portion covered can be tested through Internal evaluation only not to be included in
University examination)

FOURTH SEMESTER MCA SYLLABUS FOR ADMISSION BATCH 2016-17

Text Books:
1. Donald Hearn & M. Pauline Baker, "Computer Graphics with OpenGL", Third
Edition, 2004, Pearson Education, Inc. New Delhi.
2. Ze-NianLi and Mark S. Drew, "Fundamentals of Multimedia", First Edition, 2004,
PHI Learning Pvt. Ltd., New Delhi.

Reference Books:
1. Plastock : Theory & Problem of Computer Gaphics, Schaum Series.
2. Foley & Van Dam : Fundamentals of Interactive Computer Graphics, Addison- Wesley.
3. Newman : Principles of Interactive Computer Graphics, McGraw Hill.
4. Tosijasu, L.K. : Computer Graphics, Springer-Verleg.
5. S. Gokul : Multimedia Magic, BPB Publication.
6. Bufford : Multimedia Systems, Addison Wesley.
7. Jeffcoate : Multimedia in Practice, Prectice-Hall.
8. Any other book(s) covering the contents of the paper in more depth.
Note : Latest and additional good books may be suggested and added from time

Survey of Computer Graphics

Graphics

Graphics are visual presentations on some surface, such as a wall, canvas, computer screen, paper, or stone to brand, inform, illustrate, or entertain. Examples are photographs, drawings, Line Art, graphs, diagrams, typography, numbers, symbols, geometric designs, maps, engineering drawings, or other images. Graphics often combine text, illustration, and color.

Computer Graphics

Computer have become a powerful tool for the rapid and economical production of picture. The Graphics early application in Engineering and Science.

Computer Graphics is the use of computers to display and manipulate information in graphical or pictorial form, either on a visual-display unit or via a printer or plotter.

The term computer graphics includes almost everything on computers that is not text or sound. Today nearly all computers use some graphics and users expect to control their computer through icons and pictures rather than just by typing. The term Computer Graphics has several meanings:

- the representation and manipulation of pictorial data by a computer
- the various technologies used to create and manipulate such pictorial data
- the images also produced

Today computers and computer-generated images touch many aspects of our daily life. Computer imagery is found on television, in newspapers, in weather reports, education, medicine, business, art and during surgical procedures. A well-constructed graph can present complex statistics in a form that is easier to understand and interpret. Such graphs are used to illustrate papers, reports, theses, and other presentation material. A range of tools and facilities are available to enable users to visualize their data, and computer graphics are used in many disciplines.

2D Computer Graphics

2D computer graphics are the computer-based generation of digital images mostly from two-dimensional models, such as 2D geometric models, text, and digital images, and by techniques specific to them. 2D computer graphics started in the 1950s.

2D computer graphics are mainly used in applications that were originally developed upon traditional printing and drawing technologies, such as typography, cartography, technical drawing, advertising, etc.. In those applications, the two-dimensional image is not just a representation of a real-world object, but an independent artifact with added semantic value.

3D Computer Graphics

3D computer graphics in contrast to 2D computer graphics are graphics that use a three-dimensional representation of geometric data that is stored in the computer for the purposes of performing calculations and rendering 2D images.

Applications of Computer Graphics

Computer graphics become a power field for the production of pictures. There are no area in which graphical displays can't be used to some advantages, so it is not surprising to find the use of computer graphics so widespread. The applications of computer graphics are:

- Computer-aided design
- Graphs & Charts
- Representation Graphics
- Computer simulation
- Computer art
- Entertainment
- Education & Training
- Graphic design
- Information visualization
- Scientific visualization
- Video Games
- Virtual reality
- Web design
- Image Processing
- Graphical user Interfaces

Computer-Aided Design

Computer-aided design (CAD) is the use of computer technology for the design of objects, real or virtual. The design of geometric models for object shapes, in particular, is often called computer-aided geometric design (CAGD).

CAD may be used to design curves and figures in two-dimensional ("2D") space; or curves. surfaces, or solids in three-dimensional ("3D") objects. CAD is also widely used to produce computer animation for special effects in movies, advertising, technical manuals.

CAD is used in the design of tools and machinery and in the drafting and design of all types of buildings, from small residential types (houses) to the largest commercial and industrial structures (hospitals and factories). CAD is mainly used for design of buildings, automobiles, aircraft, water craft, spacecraft, computer, textiles and many other products. It is also used throughout the engineering process from conceptual design and layout of products, through strength and dynamic analysis of assemblies to definition of manufacturing methods of components. Software package for CAD application typically provide the designer with a multi-window environment. Animation are often used in CAD application which are used for testing vehicle or system. CAD enables designers to lay out and develop work on screen, print it out and save it for future editing, saving time on their drawings.

Graph & Charts

It is commonly used to summarize Financial, Statistical, Mathmatical, Scientic, Engineering and Economic data for research report, Consumer information bulletins and another type of publication.

Ex: Line graph, Bar charts, Piecharts, Surface Graphs are used in 2d or 3d or higher dimension space.

Presentation Graphics

Another major application area is presentation graphics used to produce illustrations for reports or to generate 35mm slides or transparencies for use with projectors.

Presentation graphics is commonly used to summarize financial, statical, mathematical, Scientific and economic data for research reports, managerial reports. Ex: Bar chats, Line graphs, surface graphs, pie charts & other displays showing relationship between multiple parameters.

Computer Simulation

A computer simulation, a computer model or a computational model is a computer program, or network of computers, that attempts to simulate an abstract model of a particular system.

Computer simulations have become a useful part of mathematical modelling of many natural systems in physics (computational physics), chemistry and biology, human systems in economics, psychology, and social science and in the process of engineering new technology, to gain insight into the operation of those systems, or to observe their behaviour.

Computer Art

Computer graphics method are widely used in both fine art & commercial art application. Artists use a variety of computer methods, including special purpose hardware, artists paint brush programs.A paint brush program that allows artists to paint pictures on the screen of a video monitor.Actually the picture is usually painted electronically on a graphics tablet using a stylus which can simulate different brush storkes, brush widths and colors.

Entertainment

Computer graphics methods are now commonly used in making picture, music video & television shows. Many Tv series regularly employ computer graphic methods. Music videos use graphics in several ways.

Education & Training

A computer simulation, a computer model or a computational model is a computer program, or network of computers, that attempts to simulate an abstract model of a particular system. Computer simulations have become a useful part of mathematical modeling of many natural systems in physics (computational physics), chemistry and biology, human systems in economics, psychology, and social science and in the process of engineering new technology, to gain insight into the operation of those systems, or to observe their behavior. For some training application special system are designed.ex: Training of ship captains, aircraft,pilots,heavy equipment operations air traffic control personnel.

Graphic Design

The term graphic design can refer to a number of artistic and professional disciplines which focus on visual communication and presentation. Various methods are used to create and combine symbols, images and/or words to create a visual representation of ideas and messages. A graphic designer may use typography, visual arts and page layout techniques to produce the final result. Graphic design often refers to both the process (designing) by which the communication is created and the products (designs) which are generated. Common uses of graphic design include magazines, advertisements, product packaging and web design.

Information Graphics

Information graphics or info graphics are visual representations of information, data or knowledge. These graphics are used where complex information needs to be explained quickly

and clearly, such as in signs, maps, journalism, technical writing, and education. They are also used extensively as tools by computer scientists, mathematicians, and statisticians to ease the process of developing and communicating conceptual information. Today information graphics surround us in the media, in published works both pedestrian and scientific, in road signs and manuals. They illustrate information that would be unwieldy in text form, and act as a visual shorthand for everyday concepts such as stop and go.

Graphic Design

The term graphic design can refer to a number of artistic and professional disciplines which focus on visual communication and presentation. Various methods are used to create and combine symbols, images and/or words to create a visual representation of ideas and messages. A graphic designer may use typography, visual arts and page layout techniques to produce the final result. Graphic design often refers to both the process (designing) by which the communication is created and the products (designs) which are generated. Common uses of graphic design include magazines, advertisements, product packaging and web design.

Information Visualization

Information visualization is the study of the visual representation of large-scale collections of non-numerical information, such as files and lines of code in software systems, and the use of graphical techniques to help people understand and analyze data. In contrast with scientific visualization, information visualization focuses on abstract data sets, such as unstructured text or points in high-dimensional space, that do not have an inherent 2D or 3D geometrical structure.

Scientific Visualization

Scientific visualization ia a branch of science, concerned with the visualization of three dimensional phenomena, such as architectural, meteorological, medical, biological systems. The emphasis is on realistic rendering of volumes, surfaces, illumination sources, and so forth, perhaps with a dynamic (time) component. Scientific visualization focuses on the use of computer graphics to create visual images which aid in understanding of complex, often massive numerical representation of scientific concepts or results.

Video Game

A video game is an electronic game that involves interaction with a user interface to generate visual feedback on a video device(a raster display device). The electronic systems used to play video games are known as platforms; examples of these are personal computers and video game consoles. These platforms range from large computers to small handheld devices. The input device used to manipulate video games is called a game controller. Early personal computer games often needed a keyboard for gameplay, or more commonly, required the user to buy a separate joystick with at least one button. Many modern computer games allow, or even require, the player to use a keyboard and mouse simultaneously.

Virtual Reality

Virtual reality (VR) is a technology which allows a user to interact with a computer-simulated environment. Most current virtual reality environments are primarily visual experiences, displayed either on a computer screen or through special or stereoscopic displays, but some simulations include additional sensory information, such as sound through speakers or headphones. Some advanced, graphitic systems now include tactile information, generally known as force feedback, in medical and gaming applications. Users can interact with a virtual environment or a virtual artifact (VA) either through the use of standard input devices such as a keyboard and mouse, or through multimodal devices such as a wired glove

Virtual Reality is often used to describe a wide variety of applications, commonly associated with its immersive, highly visual, 3D environments. The development of CAD software, graphics hardware acceleration, head mounted displays, database gloves and miniaturization have helped popularize the notion.

Web Design

Web design is the skill of designing presentations of content (usually hypertext or hypermedia) that is delivered to an end-user through the World Wide Web, by way of a Web browser. The process of designing Web pages, Web sites, Web applications or multimedia for the Web may utilize multiple disciplines, such as animation, authoring, communication design, corporate identity, graphic design, human-computer interaction, information architecture, interaction design, marketing, photography, search engine optimization and typography.

In this, technologies include:
- Markup languages (such as XHTML and XML)
- Style sheet languages (such as CSS and XSL)
- Client-side scripting (such as JavaScript and VBScript)
- Server-side scripting (such as ASP.NET and VB.NET)
- Database technologies (such as SQL and ORACLE)

Image Processing

In computer graphics a computer is used to create a picture, Image processing applies techniques to modify or interpret existing pictures such as photographs and Tv scans. Two application of image processing are (i)improving picture quality(ii)machine perception of visual information. To apply image processing method we first digitize a photograph or other picture into an image file. Then digital methods can be applied to rearrange picture parts. Medical application also make extensive use of image processing techniques for picture enhancement in tomography and in simulation of operations.

Graphical user Interfaces

It is common now for software packages to provide a graphical interface. A major components of a graphical interface is a window manager that allows a user to display multiple windows areas.

Computer Graphics Display Device

CATHOD RAY TUBE

It is a vacuum tube evacuated glass which is large,deep,heavy.

CRT consists of: Electron gun, Electron beam, Focusing coils, Deflection coils, Anode connection, Shadow mask, Phosphor layer, Close-up of the phosphor coated inner side of the screen.

Operation:

A cathode ray tube (CRT) is a specialized vacuum tube in which images are produced when an electron beam strikes a phosphorescent surface. Most desktop computer displays make useof CRTs. The CRT in a computer display is similar to the "picture tube" in a television receiver.

A cathode ray tube consists of several basic components, as illustrated below. The electron gun generates a narrow beam of electrons. The anodes accelerate the electrons. Deflecting coils produce an extremely low frequency electromagnetic field that allows for constant adjustment of the direction of the electron beam. There are two sets of deflecting coils: horizontal and vertical. The intensity of the beam can be varied. The electron beam produces a tiny, bright visible spot when it strikes the phosphor-coated screen.

To produce an image on the screen, complex signals are applied to the deflecting coils, and also to the apparatus that controls the intensity of the electron beam. This causes the spot to race across the screen from right to left, and from top to bottom, in a sequence of horizontal lines called the raster. As viewed from the front of the CRT, the spot moves in a pattern similar to the way your eyes move when you read a single-column page of text. But the scanning takes place at such a rapid rate that your eye sees a constant image over the entire screen.

The illustration shows only one electron gun. This is typical of a monochrome, or single-color, CRT. However, virtually all CRTs today render color images. These devices have three electron guns, one for the primary colour red, one for the primary color green, and one for the primary color blue. The CRT thus produces three overlapping images: one in red (R), one in green (G), and one in blue (B). This is the so-called RGB color model.

In computer systems, there are several display modes, or sets of specifications according to which the CRT operates. The most common specification for CRT displays is known as SVGA (Super Video Graphics Array). Notebook computers typically use liquid crystal display. The technology for these displays is much different than that for CRTs.

All CRT's have three main elements: an electron gun, a deflection system, and a screen. The electron gun provides an electron beam, which is a highly concentrated stream of electrons. The

deflection system positions the electron beam on the screen, and the screen displays a small spot of light at the point where the electron beam strikes it.

Refresh CRT

A beam of electrons (cathode rays), emitted by an electron gun, passes through focusing and deflection systems that direct the beam towards specified position 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.
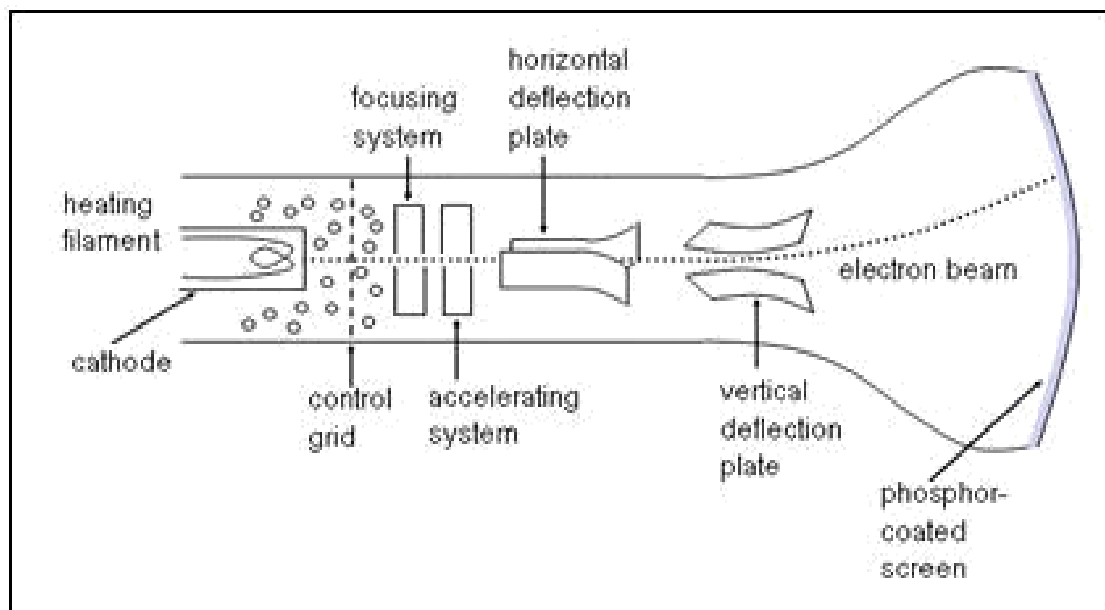
Basic Operation of a CRT

The basic operation of CRT is shown in figure below:

Electron Gun

The primary components of an electron gun in a CRT are the heated metal cathode and a control grid. The cathode is heated by an electric current passed 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, negatively charged electrons are then accelerated toward the phosphor coating by a high positive voltage. The accelerating voltage can be generated with a positively charged metal coating on the inside of the CRT envelope near the phosphor screen, or an accelerating anode can be used. Sometimes the electron gun is built to contain the accelerating anode and focusing system within the same unit.

Focusing System

The focusing system is used to create a clear picture by focusing the electrons into a narrow beam. Otherwise, electrons would repel each other and beam would spread out as it reaches the screen. Focusing is accomplished with either electric or magnetic fields.

Deflection System

Deflection of the electron beam can be controlled by either electric fields or magnetic fields. In case of magnetic field, two pairs of coils are used, one for horizontal deflection and other for vertical deflection. In case of electric field, two pairs of parallel plates are used, one for horizontal deflection and second for vertical deflection as shown in figure above.

CRT Screen

The inside of the large end of a CRT is coated with a fluorescent material that gives off light when struck by electrons. When the electrons in the beam is collides with phosphor coating screen, they stopped and their kinetic energy is absorbed by the phosphor. Then a part of beam energy is converted into heat energy and the remainder part causes the electrons in the phospor atom to move up to higher energy levels. After a short time the excited electrons come back to their ground state. During this period, we see a glowing spot that quickly fades after all excited electrons are returned to their ground state.

Persistence

It is defined as the time they continue to emit light after the CRT beam is removed. Persistence is defined as the time it take the emitted light from the screen to decay to one-tenth of its original intensity. Lower-persistence phosphors require higher refresh rates to maintain a picture on the screen without flicker. A phosphor with low persistence is useful for animation ; a high-persistence phosphor is useful for displaying highly complex, static pictures. Although some phosphor have a persistence greater than 1 second, graphics monitor are usually constructed with a persistence in the range from 10 to 60 microseconds.

Resolution

The number of points per centimeter that can be used be plotted horizontlly and vertically. Or Total number of points in each direction.

The resolation of a CRT is depend on

- type of phosphor
- intensity to be displayed
- focusing and deflection system

Aspect Ratio

It is ratio of horizontal to vertical points.

Example: An aspect ratio of 3/4 means that a vertical line plotted with three points has same lenght as horizontal line plotted with four points.

Raster Scan Systems

It is the most common type of graphics monitor based on television technology. In a raster scan system, the electron beam is swept across the screen, one row at a time from top to bottom. When electron beam moves across each row the beam intensity is turned ON and OFF to craete a pattern of illuminated spots. Picture definition is stored in a memory called frame buffer which holds the set of intensity values, which are then retrieved from the frame buffer and pointed on the screen one row at a time as shown in figure below:

(a)   (b)

(c)   (d)
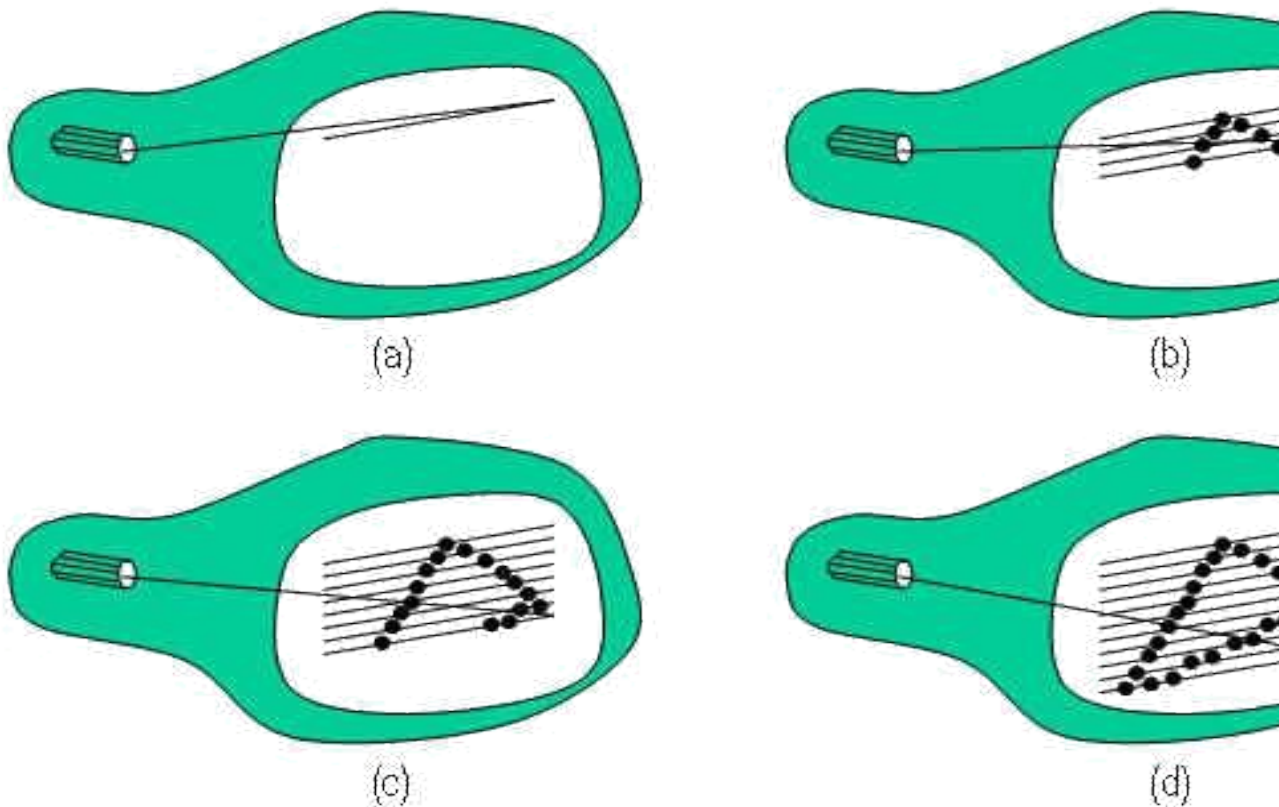
At the end of each line the beam must be turned off and redirect to the left hand side of the CRT, this is called Horizontal Retrace. At the end of each frame, the electrin beam return to top left corner of the screen to begin the next frame called Verticle Retrace as shown in figure below:
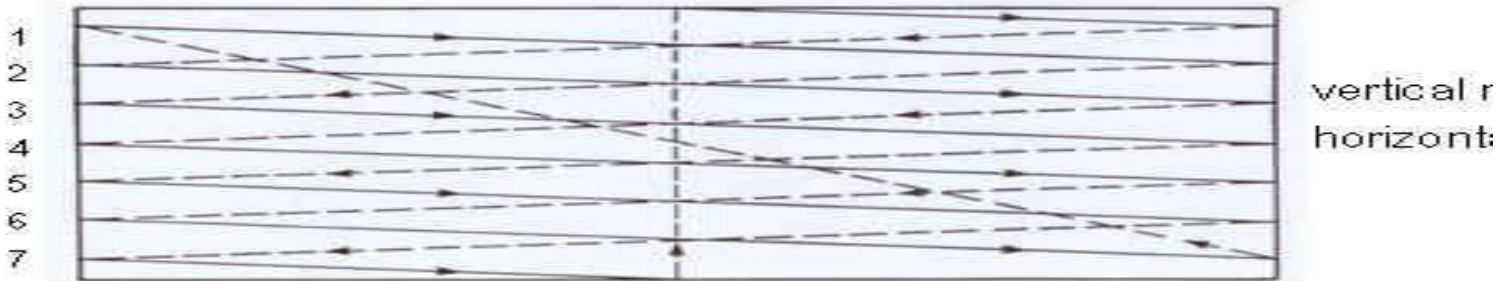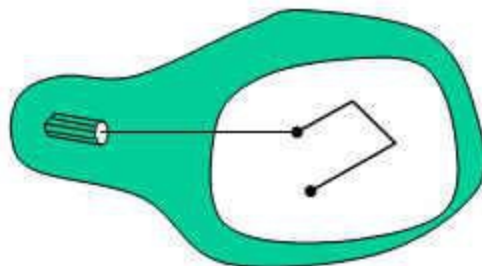

Advantages

- produce realistic images also produced different colors
- and shadows scenes.

Disadvantages

- low resolution
- expensive
- electron beam directed to whole screen

Random Scan Systems !

In Random Scan System, an electron beam is directed to only those parts of the screen where a picture is to be drawn. The picture is drawn one line at a time, so also called vector displays or stroke writing displays. After drawing the picture the system cycles back to the first line and design all the lines of the picture 30 to 60 time each second.

Advantages

- Produced smooth line drawings
- High resolution

Disadvantages

- Designed only for line drawing applications.
- Can't display relastistic images.

Grey Shades

The intensity of a phosphor dot is proportional to the number of electrons colliding on it. If this number is controlled electronically, the dots could be excited to different energy states. Then they would emit different radiant energy in their process of returning to the normal quantum level. This phenomenon generates different intensity level or grey shades as perceived by the viewer. If the number of electrons impinging on phosphor dots is fixed to a particular value, the viewer perceives only a single intensity level which considered as ON state of the pixel while others are regarded as OFF state.

If the phosphor dots are excited at 64 or 256 different intensity levels, the monitors are grey shades video monitors.

Color CRT Monitors

A color CRT monitor displays color picture by using a combination of phosphors that emit different colored light. By combining the emitted light a range of colors can be generated. Two basic methods for producing color displays are:

- Beam Penetration Method
- Shadow-Mask Method

Beam Penetration Method

Random scan monitors use the beam penetration method for displaying color picture. In this, the inside of CRT screen is coated two layers of phorphor namely red and green. A beam of slow electrons excites ony the outer red layer, while a beam of fast electrons penetrates red layer and excites the inner green layer. At intermediate beam speeds, combination of red and green light are emitted to show two addtional colors- orange and yellow.

<u>**Advantages**</u>

- Less

expensive

<u>Disadvantages</u>

- Quality of images are not good as comparatable with other methods
- Four colors are allowed only

Shadow Mask Method

Raster scan system are use shadow mask methods to produced a much more range of colors than beam penetration method. In this, CRT has three phosphor color dots. One phosphor dot emits a red light, second emits a green light and third emits a blue light. This type of CRT has three electrons guns and a shadow mask grid as shown in figure below:
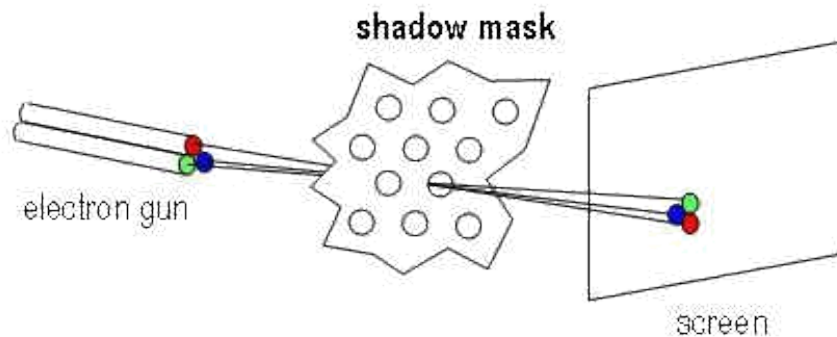
In this figure, three electrons beams are deflected and focused as a group onto the shadow mask which contains a series of holes. When three beams pass through a hole in shadow mask they activate dot triangle as shown in figure below:
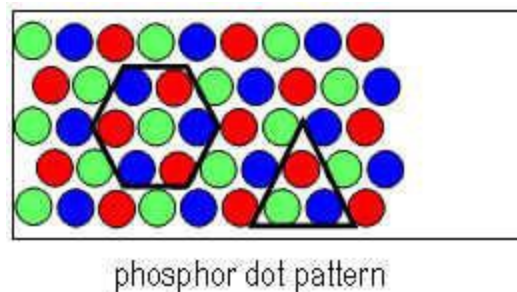
The colors we can see depends on the amount of excitation of red, green and blue phosphor. A white area is a reasult of all three dots with equal intensity while yellow is produced with green and red dots and so on.

<u>Advantages</u>

- produce realistic images
- also produced different colors
- and shadows scenes.

<u>Disadvantages</u>

- low resolution
- expensive
- electron beam directed to whole screen

Full Color System

Color CRTs in graphics systems are designed as RGB monitors. These monitors use shadow mask method and take the intensity level for each gun. A RGB color system with 34 bits of storage per pixel is known as full color system or true color system.

Plasma Panels

The plasma panel is composed of two sheets of glass with a series of ribs (like corrugated cardboard) filled with color phosphors in between. The top glass with embedded electrodes seals and forms a pixel where the junctions of the channels and the plate come together. Inside the sealed pixel, is a mixture of rare gases- typically argon and neon, although xenon has also been used.

Structure of Newly Developed Panel
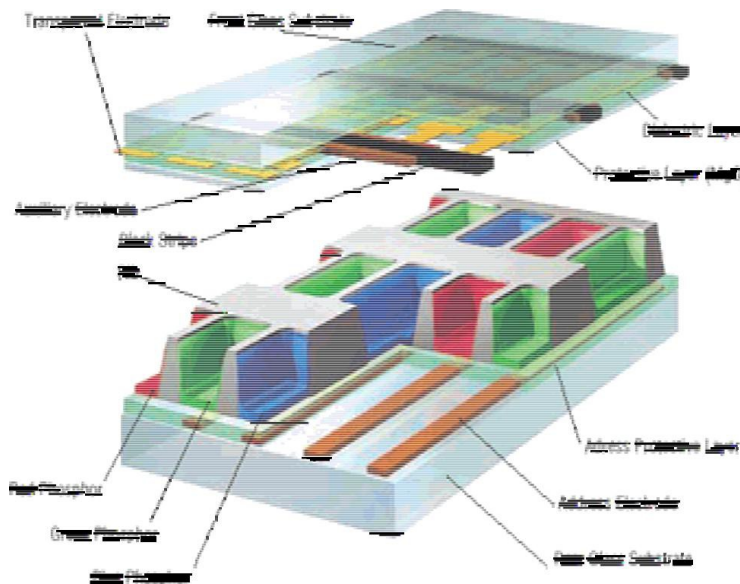
Actually a small electric capacitor has been created, with one electrode on the rear and a pair on the front. These 3 electrodes control the capacitor charge, sustain and discharge functions intrinsic to the plasma imaging process.

The plasma imaging cycle can be broken into following steps. initially, the pixel is at its resting (ie. Off) state. while a voltage is applied to the addressing electrodes (pixel). When the applied voltage reaches a certain level- say 200+ volts - the resistance in the pixel is overcome, and an electrical discharge is made across the electrodes. Once this discharge occurrs, the mixture of rare gases is ionized into a plasma state, which means the gas mixture can now conduct electricity, an intense burst of ultraviolet (UV) light is emitted. This burst of UV energy stimulates the color phosphors, in turn makes them glow brightly.

Once the pixel is switched On, a much lower voltage sustains the UV emissions and keeps the phosphors glowing. This sustain voltage is typically in the 50 volts range. Eventually, the pixel will need to be turned off to rest the phosphors. This is done by removing the sustain voltage first, then reversing the charge in the pixel through the addressing electrodes. At this point, the pixel is back to its resting

Flat-Panel display

An electronic display in which a large orthogonal array of display elements, such as liquid-crystal or electroluminescent elements, form a flat screen. The term "flat-panel display" is actually a misnomer, since thinness is the distinguishing characteristic. Most television sets and computer monitors currently employ cathode-ray tubes. Cathode-ray tubes cannot be thin because the light is generated by the process of cathode luminescence whereby a high-energy electron beam is scanned across a screen covered with an inorganic phosphor. The cathode-ray tube must have moderate depth to allow the electron beam to be magnetically or electro statically scanned across the entire screen.

For a flat-panel display technology to be successful, it must at least match the basic performance of a cathode-ray tube by having (1) full color, (2) full gray scale, (3) high efficiency and brightness, (4) the ability to display full-motion video, (5) wide viewing angle, and (6) wide range of operating conditions. Flat-panel displays should also provide the following benefits: (1) thinness and light weight, (2) good linearity, (3) insensitivity to magnetic fields, and (4) no x-ray generation. These four attributes are not possible in a cathode-ray tube.

Flat-panel displays can be divided into three types: transmissive, emissive, and reflective. A transmissive display has a backlight, with the image being formed by a spatial light modulator. A transmissive display is typically low in power efficiency; the user sees only a small fraction of

the light from the backlight. An emissive display generates light only at pixels that are turned on. Emissive displays should be more efficient than transmissive displays, but due to low efficiency in the light generation process most emissive and transmissive flat panel displays have comparable efficiency. Reflective displays, which reflect ambient light, are most efficient. They are particularly good where ambient light is very bright, such as direct sunlight. They do not work well in low-light environments.

Most flat-panel displays are addressed as an X-Y matrix, the intersection of the row and column defining an individual pixel (see illustration). Matrix addressing provides the potential for an all-digital display. Currently available flat-panel display devices range from 1.25-cm (0.5-in.) diagonal displays used in head-mounted systems to 125-cm (50-in.) diagonal plasma displays.

LED

An LED display is a video display which uses light-emitting diodes. An LED panel is a small display, or a component of a larger display. They are typically used outdoors in store signs and billboards. LED panels are sometimes used as form of lighting, for the purpose of general illumination, task lighting, or even stage lighting rather than display.

A light-emitting diode (LED) is an electronic light source. The LED was first invented in Russia in the 1920s, and introduced in America as a practical electronic component in 1962. Oleg Vladimirovich Losev was a radio technician who noticed that diodes used in radio receivers emitted light when current was passed through them. In 1927, he published details in a Russian journal of the first ever LED.

All early devices emitted low-intensity red light, but modern LEDs are available across the visible, ultraviolet and infra red wavelengths, with very high brightness.

LEDs are based on the semiconductor diode. When the diode is forward biased (switched on), electrons are able to recombine with holes and energy is released in the form of light. This effect is called electroluminescence and the color of the light is determined by the energy gap of the semiconductor. The LED is usually small in area (less than 1 mm2) with integrated optical components to shape its radiation pattern and assist in reflection.

LEDs present many advantages over traditional light sources including lower energy consumption, longer lifetime, improved robustness, smaller size and faster switching. However, they are relatively expensive and require more precise current and heat management than traditional light sources.

Applications of LEDs are diverse. They are used as low-energy indicators but also for replacements for traditional light sources in general lighting and automotive lighting. The compact size of LEDs has allowed new text and video displays and sensors to be developed, while their high switching rates are useful in communications technology.

The first recorded flat panel LED television screen developed was by J. P. Mitchell in 1977 [1]. The modular, scalable display array was initially enabled by hundreds of MV50 LEDs and a

newly available TTL (transistor transistor logic) memory addressing circuit from National Semiconductor[2]. The 1/4 inch thin flat panel prototype and the scientific paper were each displayed.[3] at the 29th Engineering Exposition in Anaheim May 1978, organized by the Science Service in Washington D.C. The LED TV display received awards and recognition from NASA[4], General Motors Corporation[5], and faculty from area Universities[6]. The event was open to technology and business representatives from the U.S. and overseas. The monochromatic prototype remains operational. A LCD (liquid crystal display) matrix design was also cited as a future flat panel TV possibility in the accompanying scientific paper as a future alternate television display method using a similar array scanning design.

LCD Monitors

(Liquid Crystal Display) A display technology that uses rod-shaped molecules (liquid crystals) that flow like liquid and bend light. Unenergized, the crystals direct light through two polarizing filters, allowing a natural background color to show. When energized, they redirect the light to be absorbed in one of the polarizers, causing the dark appearance of crossed polarizers to show. The more the molecules are twisted, the better the contrast and viewing angle.

Because it takes less power to move molecules than to energize a light-emitting device, LCDs replaced the light-emitting diodes (LEDs) in digital watches in the 1970s. LCDs were then widely used for a myriad of monochrome displays and still are. In the 1990s, color LCD screens caused sales of laptop computers to explode, and in 2003, more LCD monitors were sold for desktop computers than CRTs.

The LCD was developed in 1963 at RCA's Sarnoff Research Center in Princeton, NJ

glass plates

vertical filter

crystal molecule

horizontal filter

colour filter
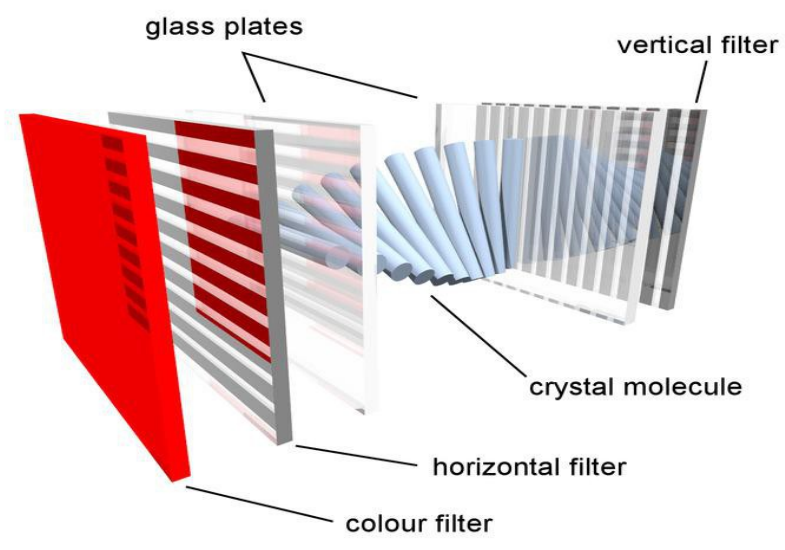
A subpixel of a color LCD

TYPES OF LCDs

Passive Display

Called "passive matrix" when used for computer screens and "passive display" when used for small readouts, all the active electronics (transistors) are outside of the display screen. Passive displays have improved immensely, but do not provide a wide viewing angle, and submarining is generally noticeable. Following are the types of passive displays.

TN - Twisted Nematic - 90º twist and Low-cost displays for consumer products and instruments. Black on gray/silver background.

STN - Super twisted Nematic- 180-270º twist and Used extensively on earlier laptops for mono and color displays. DSTN and FSTN provide improvements over straight STN (180º - green/ blue on yellow background; 270º - blue on white/blue background).

Dual Scan STN - Improves STN display by dividing the screen into two halves and scanning each half simultaneously, doubling the number of lines refreshed. Not as sharp as active matrix.

Active Display (TFT) - Widely used for all LCD applications today (laptop and desktop computers, TVs, etc.). Known as "active matrix" displays, a transistor is used to control each subpixel on the screen. For example, a 1024x768 color screen requires 2,359,296 transistors; one for each red, green and blue subpixel (dot). Active matrix provides a sharp, clear image with good contrast and eliminates submarining. Fabrication costs were originally higher than passive matrix, which caused both types to be used in the early days of laptop flat panels. Active matrix displays use a 90º (TN) twist. Also called "thin film transistor LCD" (TFT LCD). See bad pixel.

Reflective Vs. Backlit-Reflective screens used in many consumer appliances and handheld devices require external light and only work well in a bright room or with a desk lamp. Backlit and sidelit screens have their own light source and work well in dim lighting. Note that the meaning of "reflective" in this case differs from light reflecting off the front of the screen into the viewer's eyes.

Input Devices

A piece of computer hardware that is used to enter and manipulate information on a computer.

Basic input devices include the

- Keyboard
- Mouse

- Digitizer
- Trackball
- Touch Screens
- Light Pens
- Microphones
- Bar code readers
- Joysticks
- Scanners
- Voice Systems

Keyboard

The keyboard is the most common input device for entering numeric and alphabetic data in to a computer system by pressing a set of keys which are mounted on the keyboard, which is connected to computer system.

The keys on computer keyboards are often classified as follows:

Alphanumeric Keys - letters and numbers.

Punctuation Keys - comma, period, semicolon, and so on.

Special Keys - function keys, control keys, arrow keys, Caps Lock key, and so on.

Application: Used to enter Text string,Short cuts to many function.

In graphics: Used to provide screen coordinates, Menu selection,, Gaming Control.

Mouse

A mouse is a small device that a computer user pushes across a desk surface in order to point to a place on a display screen and to select one or more actions to take from that position.

A mouse consists of a metal or plastic housing or casing, a ball that sticks out of the bottom of the casing and is rolled on a flat surface, one or more buttons on the top of the casing, and a cable that connects the mouse to the computer. Hand held box used to position the screen cursor.

Wheels or roller on the buttom are used to record the position of the screen. Generally there are 2 or 3 buttons used for operations like recording of the cursor positions or invoking of a function.

In order to increase the number of INPUT parameters, additional devices can be included. The z-mouse is an example of this.

Z-MOUSE

It has 3 buttons a thumbwheel on the side, a trackball on the top and a standard mouse ball underneath.

This provides six degrees of freedom to select the positions, rotations ETC.
Allows 3d viewing.

Application: Animation, Auto CAD.

Digitizer

A graphics tablet (or digitizing tablet, graphics pad, drawing tablet) is a computer input device that allows one to hand-draw images and graphics, similar to the way one draws images with a pencil and paper. These tablets may also be used to capture data or handwritten signatures.

A graphics tablet (also called pen pad or digitizer) consists of a flat surface upon which the user may "draw" an image using an attached stylus, a pen-like drawing apparatus. The image generally does not appear on the tablet itself but, rather, is displayed on the computer monitor. Some tablets however, come as a functioning secondary computer screen that you can interact with directly using the stylus.

Some tablets are intended as a general replacement for a mouse as the primary pointing and navigation device for desktop computers.

Light Pen

A Light Pen is a pointing device shaped like a pen and is connected to a VDU. The tip of the light pen contains a light-sensitive element which, when placed against the screen, detects the light from the screen enabling the computer to identify the location of the pen on the screen.

Light pens have the advantage of 'drawing' directly onto the screen, but this can become uncomfortable, and they are not as accurate as digitising tablets.

Touch Screen

A touch screen is a display which can detect the presence and location of a touch within the display area. The term generally refers to touch or contact to the display of the device by a finger or hand. Touch screens can also sense other passive objects, such as a stylus. However, if the object sensed is active, as with a light pen, the term touch screen is generally not applicable. The ability to interact directly with a display typically indicates the presence of a touch screen.

The touchscreen has two main attributes. First, it enables one to interact with what is displayed directly on the screen, where it is displayed, rather than indirectly with a mouse or touchpad. Secondly, it lets one do so without requiring any intermediate device, again, such as a stylus that needs to be held in the hand. Such displays can be attached to computers or, as terminals, to networks. They also play a prominent role in the design of digital appliances such as the personal digital assistant (PDA), satellite navigation devices, mobile phones, and video games.

Image Scanners

A scanner is a device that optically scans images, printed text, handwriting, or an object, and converts it to a digital image. Common examples found in offices are variations of the desktop (or flatbed) scanner where the document is placed on a glass window for scanning. Hand-held scanners, where the device is moved by hand, have evolved from text scanning "wands" to 3D scanners used for industrial design, reverse engineering, test and measurement, orthotics, gaming and other applications. Mechanically driven scanners that move the document are typically used for large-format documents, where a flatbed design would be impractical.

Modern scanners typically use a charge-coupled device (CCD) or a Contact Image Sensor (CIS) as the image sensor, whereas older drum scanners use a photomultiplier tube as the image sensor. A rotary scanner, used for high-speed document scanning, is another type of drum scanner, using a CCD array instead of a photomultiplier. Other types of scanners are planetary scanners, which take photographs of books and documents, and 3D scanners, for producing three-dimensional models of objects.

Another category of scanner is digital camera scanners, which are based on the concept of reprographic cameras. Due to increasing resolution and new features such as anti-shake, digital cameras have become an attractive alternative to regular scanners. While still having

disadvantages compared to traditional scanners (such as distortion, reflections, shadows, low contrast), digital cameras offer advantages such as speed, portability, gentle digitizing of thick documents without damaging the book spine. New scanning technologies are combining 3D scanners with digital cameras to create full-color, photo-realistic 3D models of objects.

Voice Systems

voice input device A device in which speech is used to input data or system commands directly into a system. Such equipment involves the use of speech recognition processes, and can replace or supplement other input devices. Some voice input devices can recognize spoken words from a predefined vocabulary, some have to be trained for a particular speaker.

Speech recognition (also known as automatic speech recognition or computer speech recognition) converts spoken words to machine-readable input (for example, to key presses, using the binary code for a string of character codes). The term "voice recognition" is sometimes incorrectly used to refer to speech recognition, when actually referring to speaker recognition, which attempts to identify the person speaking, as opposed to what is being said. Confusingly, journalists and manufacturers of devices that use speech recognition for control commonly use the term Voice Recognition when they mean Speech Recognition.

 Joystick

A joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. Joysticks are often used to control video games, and usually have one or more push-buttons whose state can also be read by the computer. A popular variation of the joystick used on modern video game consoles is the analog stick.

The joystick has been the principal flight control in the cockpit of many aircraft, particularly military fast jets, where centre stick or side-stick location may be employed.

Joysticks are also used for controlling machines such as cranes, trucks, underwater unmanned vehicles and zero turning radius lawn mowers. Miniature finger-operated joysticks have been adopted as input devices for smaller electronic equipment such as mobile phone.

Trackball

A trackball is a pointing device consisting of a ball held by a socket containing sensors to detect a rotation of the ball about two axes—like an upside-down mouse with an exposed protruding ball. The user rolls the ball with the thumb, fingers, or the palm of the hand to move a cursor. Large tracker balls are common on CAD workstations for easy precision. Before the advent of the touchpad, small trackballs were common on portable computers, where there may be no desk space on which to run a mouse. Some small thumbballs clip onto the side of the keyboard and have integral buttons with the same function as mouse buttons. The trackball was invented by Tom Cranston and Fred Longstaff as part of the Royal Canadian Navy's DATAR system in 1952, eleven years before the mouse was invented. This first trackball used a Canadian five-pin bowling ball.

When mice still used a mechanical design (with slotted 'chopper' wheels interrupting a beam of light to measure rotation), trackballs had the advantage of being in contact with the user's hand, which is generally cleaner than the desk or mousepad and doesn't drag lint into the chopper wheels. The late 1990s replacement of mouseballs by direct optical tracking put trackballs at a disadvantage and forced them to retreat into niches where their distinctive merits remained more important. Most trackballs now have direct optical tracking which follows dots on the ball.

As with modern mice, most trackballs now have an auxiliary device primarily intended for scrolling. Some have a scroll wheel like most mice, but the most common type is a "scroll ring" which is spun around the ball. Kensington's SlimBlade Trackball similarly tracks the ball itself in three dimensions for scrolling.

Hard Copy Devices

Hard copy device or output devices accept data from a computer and converted them into a form which is suitable for use by the user.

Basic output devices include the

- Monitors
- Printers
- Plotters

Output Device - Printer

Printers are the most commonly used output devices for producing hard copy output.

The various types of printers in used today are

- Dot-Matrix Printers
- Inkjet Printers
- Drum Printers
- Laser Printers

Dot-Matrix Printers

A dot matrix printer or impact matrix printer is a type of computer printer with a print head that runs back and forth, or in an up and down motion, on the page and prints by impact, striking an ink-soaked cloth ribbon against the paper, much like a typewriter. Unlike a typewriter or daisy wheel printer, letters are drawn out of a dot matrix, and thus, varied fonts and arbitrary graphics can be produced. Because the printing involves mechanical pressure, these printers can create carbon copies and carbonless copies.

Each dot is produced by a tiny metal rod, also called a "wire" or "pin", which is driven forward by the power of a tiny electromagnet or solenoid, either directly or through small levers. Facing the ribbon and the paper is a small guide plate (often made of an artificial jewel such as sapphire or ruby) pierced with holes to serve as guides for the pins. The moving portion of the printer is called the print head, and when running the printer as a generic text device generally prints one line of text at a time. Most dot matrix printers have a single vertical line of dot-making equipment on their print heads; others have a few interleaved rows in order to improve dot density.

Inkjet Printers

Inkjet printers form characters and images by spraying small drops of ink on to the paper. They are the most common type of computer printer for the general user due to their low cost, high quality of output, capability of printing in different colors, and ease of use.

If you ever look at a piece of paper that has come out of an inkjet printer, you know that:

- The dots are extremely small, so small that they are tinier than the diameter of a human hair (70 microns).
- The dots are positioned very precisely, with resolutions of up to 1440x720 dots per inch.
- The dots can have different colors combined together to create photo-quality images.

Laser Printers

A type of printer that utilizes a laser beam to produce an image on a drum. The light of the laser alters the electrical charge on the drum wherever it hits. The drum is then rolled through a reservoir of toner, which is picked up by the charged portions of the drum. Finally, the toner is transferred to the paper through a combination of heat and pressure. This is also the way copy machines work.

Because an entire page is transmitted to a drum before the toner is applied, laser printers are sometimes called page printers. There are two other types of page printers that fall under the category of laser printers even though they do not use lasers at all. One uses an array of LEDs to expose the drum, and the other uses LCDs. Once the drum is charged, however, they both operate like a real laser printer.

One of the chief characteristics of laser printers is their resolution -- how many dots per inch (dpi) they lay down. The available resolutions range from 300 dpi at the low end to 1,200 dpi at the high end. By comparison, offset printing usually prints at 1,200 or 2,400 dpi. Some laser printers achieve higher resolutions with special techniques known generally as resolution enhancement.

Laser printers produce very high-quality print and are capable of printing an almost unlimited variety of fonts. Most laser printers come with a basic set of fonts, called internal or resident fonts, but you can add additional fonts in one of two ways:

Font Cartridges : Laser printers have slots in which you can insert font cartridges, ROM boards on which fonts have been recorded. The advantage of font cartridges is that they use none of the printer's memory.

Soft Fonts : All laser printers come with a certain amount of RAM memory, and you can usually increase the amount of memory by adding memory boards in the printer's expansion slots. You can then copy fonts from a disk to the printer's RAM. This is called downloading fonts. A font that has been downloaded is often referred to as a soft font, to distinguish it from the hard fonts available on font cartridges. The more RAM a printer has, the more fonts that can be downloaded at one time.

Laser printers are controlled through page description languages (PDLs). There are two de facto standards for PDLs:

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Plotters

A plotter is a printer that interprets commands from a computer to make line drawings on paper with one or more automated pens. Unlike a regular printer, the plotter can draw continuous point-to-point lines directly from vector graphics files or commands. There are a number of different types of plotters: a drum plotter draws on paper wrapped around a drum which turns to produce one direction of the plot, while the pens move to provide the other direction; a flatbed plotter draws on paper placed on a flat surface; and an electrostatic plotter draws on negatively charged paper with positively charged toner.Plotters were the first type of printer that could print with color and render graphics and full-size engineering drawings. As a rule, plotters are much

more expensive than printers. They are most frequently used for CAE (computer-aided engineering) applications, such as CAD (computer-aided design) and CAM (computer-aided manufacturing).

A plotter consists of an arm that moves across the paper on which the diagram or graph needs to be drawn . Apen moves along the arm. and the arm itself moves relative to the paper. Acombination of the two thus provides movement along the horizontal and vertical axes.

In some plotters, the paper is held station ary while the arm and the pens move over it. This is called a flat-bed plotter. In the other type of plotter, the paper is wrapped around a drum and anchored at anchored at both ends. The drum rotates while the pen moves laterally along a fixed rail. This is called a drum plotter.

To draw clear and high-qualit diagrams, a plotter needs high-quality pens with special inks of different colors. A plotter can be connected to a PC through the parallel port. A plotter is more software-dependent than any other peripheral, and needs much more instructions than printer for producing output.

Plotter are used in applications like CAD, which requir high-quality graphics on paper. Many of the plotters now available in the market are desktop models that can be used with PCs. Businesses typically use plotters to present an alysis in terms (bar charts, graphs, diagrams, etc.) as well as for engineering drawings.

Two commonly type plotters are:

- Drum Plotters
- Flatbed Plotters

Drum Plotters

In this plotter the pen moves in the horizontally and the drum rolls on the other axis. Generally it is a graphical output device, and it is generally used to plot drawings. the width of the plot is limited by the length of the drum. It is the first graphical output device produced to print large scaled engineering drawings. Colored prints can be made if you use colored ink. This electronic equipment used to plot large sized drawings on a tracing sheet. Plans for building (architectural drawing) , engineering drawings , dress models ETC are drawn using suitable packages. These drawings are plotted on a tracing sheet, which can be used to produce a large no of blue prints.

It is very good for line drawings but it is very slow. Here the pen is held in gantry and it moves in x-axis and the paper moves on y-axis.

Flatbed Plotters

This is a plotter where the paper is fixed on a flat surface and pens are moved to draw the image. This plotter can use several different colour pens to draw with. The size of the plot is limited only by the size of the plotter's bed.