Introduction to Computer Graphics:

Computer graphics is the use of a computer to define, store, manipulate, interrogate and present pictorial output. This is essentially a passive operation. The computer prepares and presents stored information to an observer in the form of pictures. The observer has no direct control over the picture being presented. Interactive graphics also uses the computer to prepare and present pictorial material. However, in interactive graphics, the observer can influence the picture as it is being presented i.e. the observer interacts with the picture in real time.
From the user's point of view, computer graphics can be divided into the following areas:

A – Representing pictures to be presented
B – Preparing pictures for presentation
C – Presenting previously prepared pictures
D – Interacting with the picture

A. Here 'picture' is used in its broadest sense to mean any collection of lines, points, text, etc. to be displayed on a graphic device. Representation of line is done by endpoint co-ordinates, points by single co-ordinates, text involves dot matrices or curved lines (usually accomplished by approximating them by short line segments).

B. Points are the basic entity of a graphic picture. There are three basic methods for treating a point as a graphics geometry entry:
- Move the beam/Pen/Cursor to that point
- Or draw a line to that point
- Or draw a dot at that point

There are two ways to specify the position of a point – a) Absolute co-ordinate, b) Relative co-ordinate. The effect of the above co-ordinate systems may evolve the wrap around in CRT display. The way out of the above dilemma is to use homogenous co-ordinate affecting the resolution in certain case.

C. In this process there are two files are in action - a) Picture file, b) Display file. Display file less than picture file ensures the process of windowing and ultimately displayed the part of the picture file on view port. The display file is generated on the basis of the output device capability. For textual matter characters are generated either in software or firmware.

D. Interacting with picture requires some type of interactive device to communicate with the program. Interactive devices normally used are mouse, joystick, track ball, light pen, analog tablet (digitizer) etc. Classification of graphic device can be done in three ways:

- Passive device/Active device
- Point plotting/Vector drawing
- Accept two/three dimensional data

Graphic Standards:

Over the years, several graphic display devices have been developed. Many software packages, graphics languages and several graphics standards also have been developed. All the graphic standards are interface standards, which standardize the communication at an interface between hardware and software systems.

a) Data interface standards specify digital representation of graphical data, as might be used to send commands from a computer to a graphics display or to store pictures in data file.
b) Subroutine interface standards specify the behavior of a set of subroutines that can be called to manipulate graphical data.

- Graphical Kernal System (GKS) is an ISO standard
  - Specifies the interface to a graphic subroutine library
  - Provides facilities for device independent graphical output and input, for structuring, maintaining, storing and retrieving pictures.
  - Provides facility to keep a display image up-to-date as changes are made freeing the application program from complex updating strategies and book keeping.
  - Precursor of GKS is core graphics system of USA.

- Virtual Device Interface (VDI) is a standard being developed by American Standard National Institute (ANSI)
    - Provides a device-independent way to control graphics hardware
    - Unlike GKS, it provides no picture manipulation facilities and no built-in policies for updating the display.
    - It is a lower-level standard.

- Virtual Device Metafile (VDM) is a standard way to record graphical information in a data file. Metafile is a means of permanent picture storage and also a way to communicate graphical data between programs or between computers - one program may produce a picture or another may read it. Separate software is available for reading and interpreting metafiles. The VDM standard is under development by ANSI to meet the needs of metafile for GKS.
  Sometimes VDI is referred as CGI (Computer Graphics Interface and VDM is referred as CGM (Computer Graphics Metafile).

- Another standard is the Programmer's Hierarchical Interactive Graphic Standard (PHIGS), which goes beyond GKS in providing facilities for structuring pictures hierarchically.

- Initial Graphics Exchange Specification (IGES) is a data interface standard developed by the U.S.
  National Bureau of Standards to allow graphical engineering databases to be transferred between applications.

Use of Computer Graphics:

Computer graphics is widely used nowadays. It is popular in areas like industry, business, government, education, entertainment and most recently, the home. The list of applications is enormous. It is growing rapidly as computers with graphics become commodity products.

Computer graphics is a fascinating area of computer science to study. It incorporates not only complex mathematical knowledge but also programming skills and creativity. Beside the practical uses for computer graphics, computer graphics comes into its own when generating visually realistic images for art, computer games and even movies.

From the user point of view the creation/usage of computer graphics varies in several ways. One may need to know the mathematical expression to create a graphic object whereas other may create the graphical object with the help of any graphic drawing tool without knowing the mathematical expression that works inside the tool.

Uses of Computer Graphics

- **User interfaces:** Almost every application on a personal computer uses a Graphical User Interface that rely on desktop window systems to manage multiple simultaneous activities, and also on point-and-click facilities to allow users to select menu items, icons, and objects on the screen. All these GUIs use computer graphics. Word processing, spreadsheet and desktop-publishing programs are the typical applications that take advantage of such user-interface techniques.

- **Cartography:** Most maps are now stored, manipulated and viewed on computers. Examples include geographical maps, relief maps, exploration maps for drilling and mining, oceanographic charts, whether maps, contour maps and population-density maps.

- **Simulation and animation for scientific visualization and entertainment:** Computer-produced animated movies and displays of the time-varying behavior of real and simulated objects are becoming increasingly popular day by day for scientific and engineering visualization. They can be used to study abstract mathematical entities as well as mathematical models. Another advanced technology area is interactive cartooning. Cartoon characters are increasingly modeled in the computer as 3D shape descriptions whose movements are controlled by computer commands, rather than by the figures drawn manually by cartoonists.

- **Computer-aided drafting and design (CAD):** Users design many objects (such as mechanical parts) using computer graphics. CAD is the use of computers to assist the design process. In CAD, interactive graphics is used to design components and systems of mechanical, electrical, electromechanical and electronic devices.

- **(Interactive) plotting in business, science and technology:** An important use of graphics is probably to create 2D and 3D graphs of mathematical, physical and economic functions, pie charts, histograms etc. The trends and patterns gleaned from data to clarify complex phenomena and to facilitate informed decision making are meaningfully and concisely presented by using these.

- **Office automation and electronic publishing:** The use of graphics for the creation and dissemination of information has increased enormously. Office automation and electronic publishing can produce both traditional printed documents and electronic documents that contain text, tables, graphs and other forms of drawn or scanned-in graphics.

- **Art and commerce:** Computer graphics is used widely in art and advertising fields. Here it is used to produce pictures that attract attention and provide message. Again the use of graphics for slide production for commercial, scientific or for educational presentation has increased enormously nowadays, given the steeply rising labor costs of the traditional means of creating such material.

- **Process control:** Computer graphics is also applied in process control. Status displays in refineries, power plants, and computer networks show data values from sensors attached to critical system components, so that operators can respond to problematic conditions. For example, flight controllers at airports see computer-generated identification and status information for the aircraft blips on their radar scopes, and can thus control traffic more quickly and accurately than they could with the un-annotated radar data alone. Similarly, spacecraft controllers monitor telemetry data and take corrective action as needed with the help of the process control.

Classification of Applications:

A number of classifications can be used to categorize them.

The **first** classification is done by **type** *(dimensionality) of the object (two-dimensional or three – dimensional)* to be represented and the **kind** *of picture (line drawing, grayscale/color image, shades etc.)* to be produced.

The **second** classification is done by **type** *of interaction*. This determines the user's degree of control over the object and its images.

Under this comes:

Offline plotting	Images generated by plotting from information produced by a database generated by other application programs or digitized from physical model
Interactive plotting	In this process of imaging the user controls some iterations of " supply some parameters, plot, alter parameters, replot"

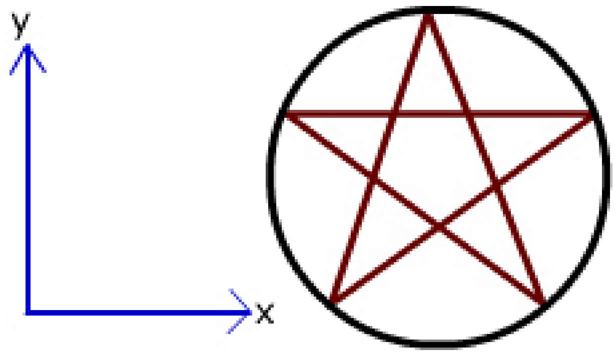
The **third** classification is by the ***role** of the picture*. This determines the degree to which the picture is an end in itself or is merely a means to an end. The drawing in cartography, animation, drafting etc. is the end product. Again the drawing in many CAD applications is just a representation of the geometric properties of the object being designed or analyzed.

The **final** classification arises from the **logical and temporal relationship** *between objects and their pictures*. For example, a user may deal with one picture at a time or with a time-varying sequence of related pictures or with a structured collection of objects.

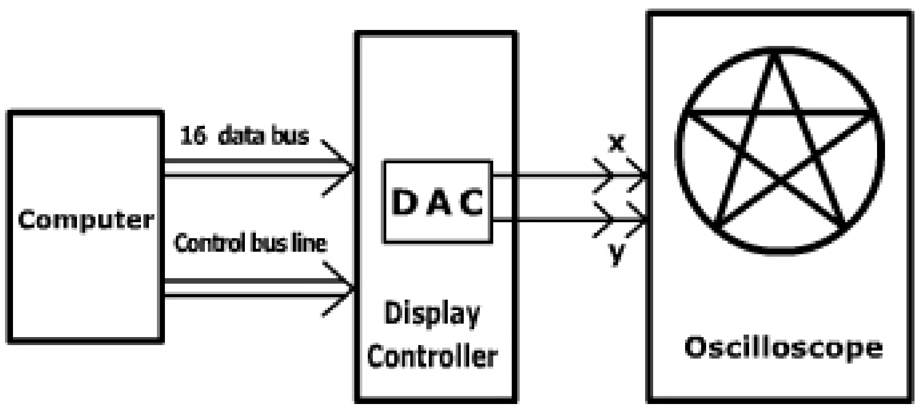
Categories of Computer Graphics

A computer hardware system consists essentially of special graphics input and output devices linked to a computer. The set of graphics I/O devices allocated for use by one person at a tome is generally called a Graphics Workstation.
The graphics hardware can be categorized by whether the peripherals are digital or analog in nature which results in two areas of study in computer graphics called 'vector graphics' (or Stroke graphics), which draw pictures using short line segments (strokes) and 'raster graphics' which makes graphic pictures by filling in a matrix (or raster) of dots or pixel.

Vector graphics display: Like the oscilloscope the display had x and y voltage inputs that directed the electron beam directly to the specified point on the screen. This kind of display is called a vector graphics display because the display is sent voltage point pairs and the beam draws a line in one stroke or vector movement from the last point to the next point.

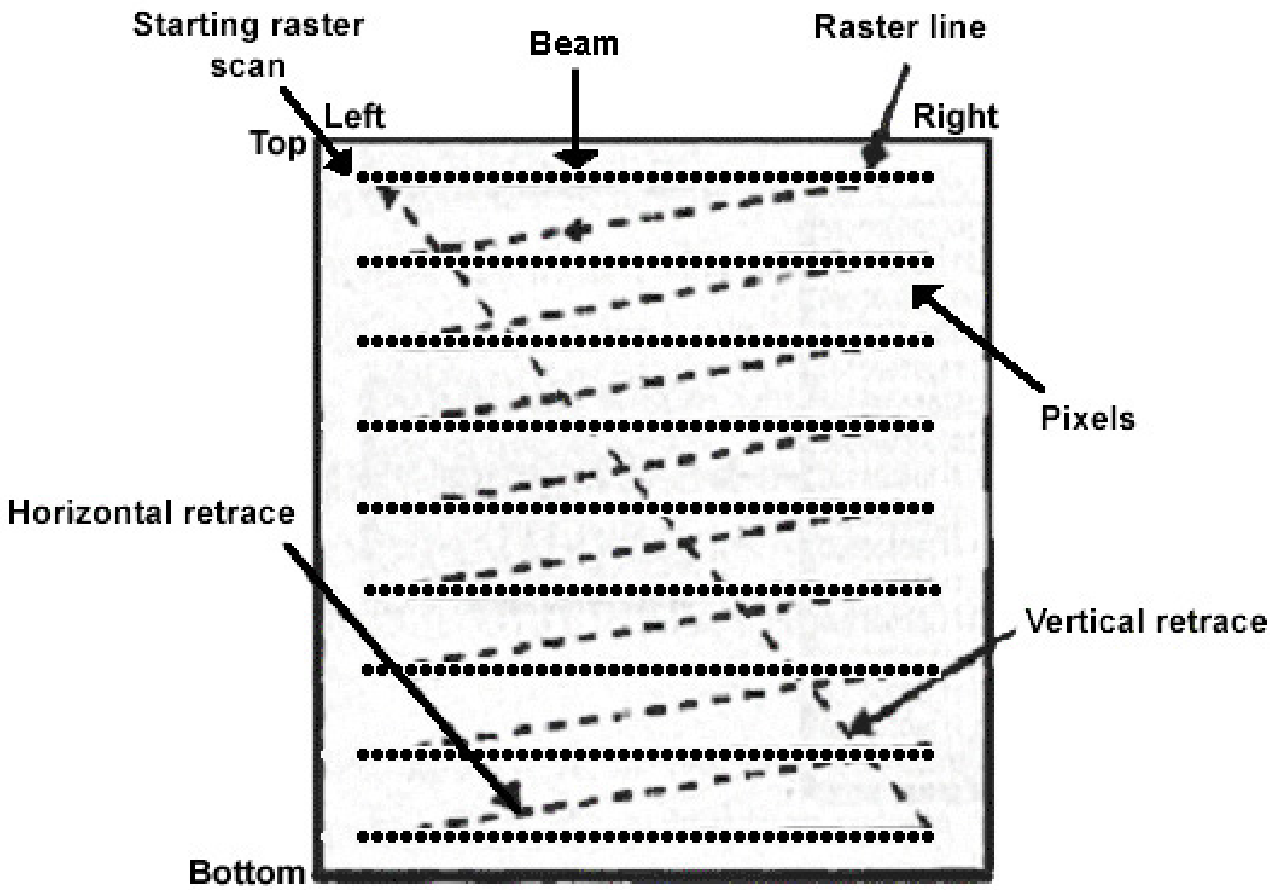


The screen phosphors glow momentarily when hit by electrons in the electron beam. This glow usually lasts for only a few milliseconds and so the whole graphic picture consisting of any number of vectors must be continuously retraced in order for the graphics to remain on the screen. This process is called refreshing the picture and hence the name vector refresh tubes. If the graphics pictures being displayed consist of too many vectors than a significant delay from drawing the first vector to last vector exists, which may result the initial vectors may fade from view. The analog voltages sent as x and y inputs to the vector graphics display tube define the shape displayed. Therefore, comparatively little memory is required to maintain a complex picture made of lines, because only end points corner co-ordinates need to be stored. Once a computer has generated the points that define the shape a DAC (digital to analog converter) is needed to convert this digital points to voltages for the CRT.



The penplotter, direct view storage tubes are also vector graphics output.
The software primitive for vector graphics display are Moveto (dcx, dcy), Drawto (dcx, dcy), Penup, Pendown, Locate (dcx, dcy).

Raster Graphics display: According to the dictionary definition the Raster means a series of parallel sweeps by an electronic scanning device. This definition came about with the development of the television tube, where a series of horizontal rasters paint the image on screen.



Raster Scan

In order to output to such raster setting devices –

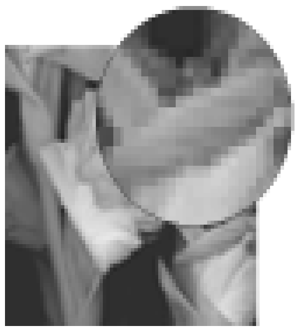
(i) The complete page image has to be created first in terms of ON-OFF signals.
(ii) Then expose the total width of the page as a series of horizontal sweeps from TOP to DOWN.

Therefore, the raster may be thought of a two dimensional array of pixels.
Circuits of TV use the sync pulses to get in step with the transmitted signal (audio, video information). There are horizontal sweep of the beam and vertical sync pulses for starting the vertical retrace. In between the horizontal sync pulses is the video information for that line. The video information that is displayed between sequential vertical sync pulses is called a field.
There are two types of methods used in TV to display a picture.
Interlacing – One field contains even line numbers and next field contains odd line numbers. A pair of fields one after the other therefore makes frame of picture that is, the frame rate is half of the display rate. This may cause the picture to flicker. When VDU operates in non-interlaced mode each field uses all scan lines and the frame rate is equal to the field rate, giving flicker-free picture.
-The raster scanned VDU can be thought of as a dense matrix of pixels refreshed rapidly that corresponds to certain bits in the frame buffer and if so, the screen is memory mapped.
-It requires larger memory than vector display.
-The pixels on the screen of color monitor are a triad of three phosphors that produce the red, green and blue colors; and instead of one electron there are three, each assigned to one color of phosphor. Between the phosphor-dotted screen surface and the electron guns is a metal barrier, known as a shadow mask, with a hole at the right location behind each pixel ensures that the electron guns cannot fire at the wrong phosphors. By varying the intensity of each electron beam, which varies the intensity of the glow of the phosphors visually different colors are formed. Each electron gun in a color monitor has an assigned number of bits in the frame memory that determines the intensities of red, green and blue phosphors with one bit plane per gun eight colors are possible. The number of bit planes is also known as pixel depth, with **P** bit planes per gun, $\mathbf{2^{3P}}$

colors are possible. Some graphics terminals have four bit planes where the first three is for red, green and blue and the fourth bit plane is for the brightness.

What is image

An image is a spatial representation of an object, a two or three-dimensional scene or another image. It can be real or virtual. A recorded image may be in a photograph, analog video signal or digital format. In computer graphics an image is always a digital image. Images consist of still or moving pictures. Still images encompass photographs, line drawings & charts. Moving pictures basically involve displaying a series of still images in rapid succession to give the impression of motion. Animation generally implies drawn images while motion pictures usually involve photographs.



Raster

Vector

Dots

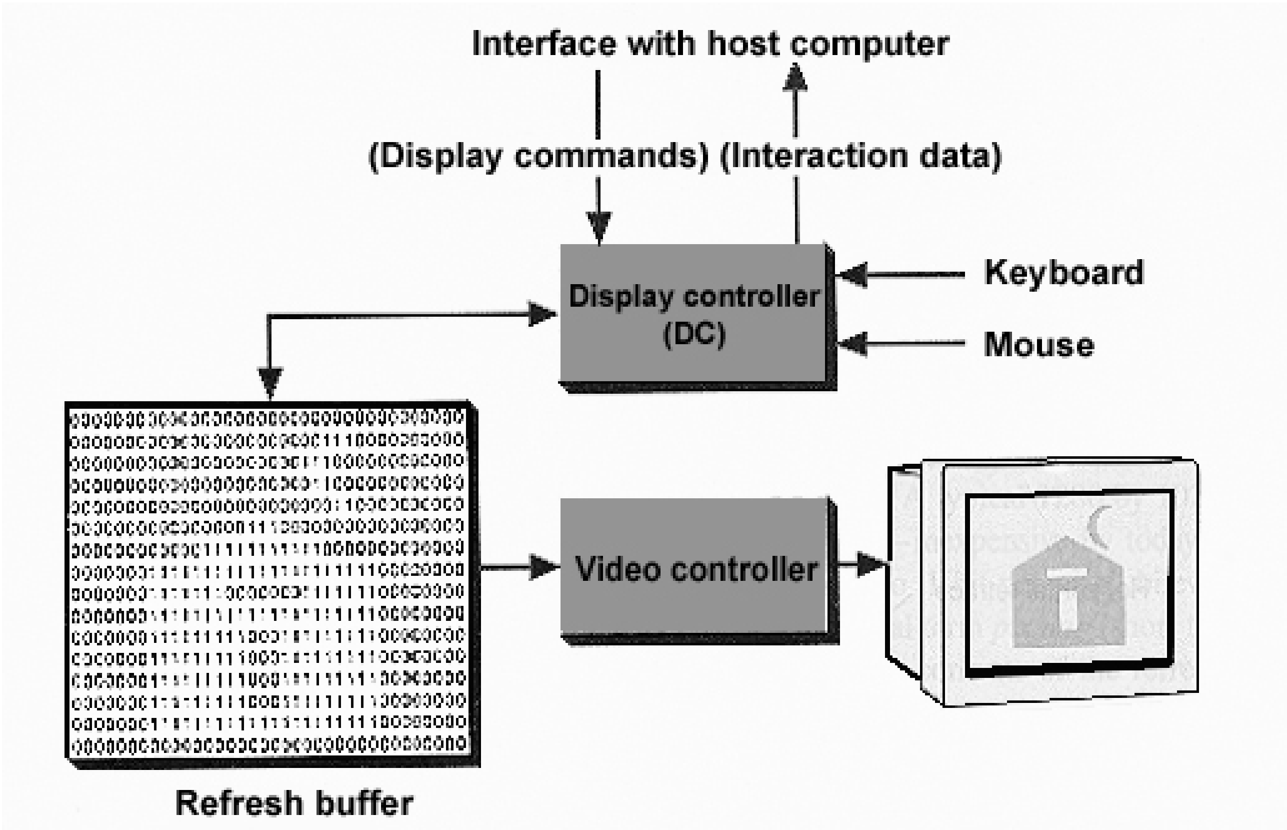
Computer monitor contains an electron gun and its screen is coated with phosphor. When a beam from this gun hits a point on the phosphor-coated screen, the particular points glows. This glowing point is called a dot and makes that portion visible on monitor screen.
On the screen, electron gun creates dots horizontally and vertically. In other words we can say that the dots are arranged horizontally and vertically. The dots may be square, rectangular, circular, elliptical in shape.
Though these “Dots” seems to be a point-like object, but in reality they are not like that. “Dots” have height and width. They even have depth, but not like what you are currently speculating. This depth is called color depth. This is measured with the number of bits assigned to represent a single color. For example, in 8-bit color depth, a color (say ‘red’) is expressed in a particular manner. But in 24-bit color depth that same color ‘red’ would be interpreted differently.

Pixels

Pixels are the smallest picture element. A picture is a collection of pixels. Remember when you talk about pixel; don’t get confused with the Dots. Pixel represents the smallest unit of picture, which holds information of that picture. But when you publish or show that picture on a computer screen, each of the pixels may take more than one Dot of the screen to present the information of that pixel. Just like Dots, pixels also have height, width and color depth. In digital art the pictures are created in the digital domain and smallest element of that picture is screen dot displayable in a monitor. Sometimes the screen dots are also referred as pixel.

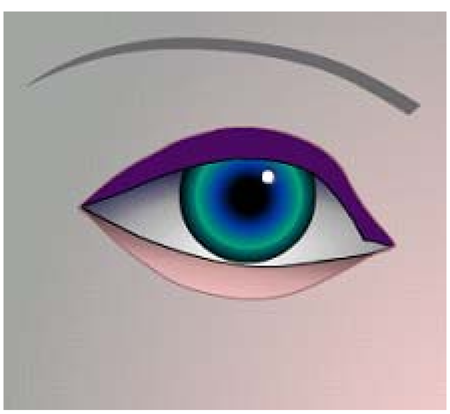
Digital Image

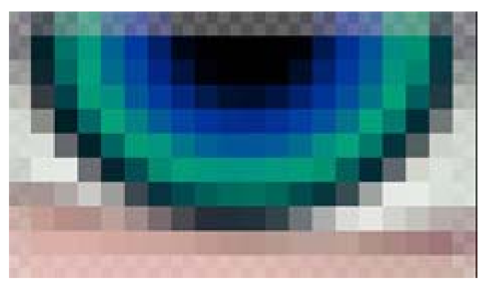
A digital image is again can be considered as composed of a set of pixels (picture elements), similar to dots on a newspaper photograph or grains on a photographic print, arranged according to a predefined ratio of columns and rows. Each pixel represents a portion of the image in a particular color, or can represent a number of different shades or colors, depending upon how much storage space is allocated for it.
There are two methods for storing & reproducing images viz, Raster graphics and Vector graphics.



Raster Graphics :

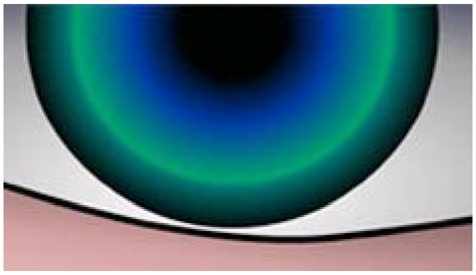
TV and almost all computer screens use a pattern of horizontal scanning lines, called rasters to display text and images. Raster graphics called bitmap images consist of a set of bits in a computer memory that define the color and intensity of each pixel in an image displayed as a matrix of dots. They typically reproduce images that contain a lot of details, shading and color. Pixel based graphic system used to create raster graphs are simply systems for creating two-dimensional images with the computer. Developers can create bitmaps by scanning photographs with a color scanner, or by digitizing video frames using a video camera and frame-grabbing equipment. While Windows uses the device independent bitmap (DIB) as its standard bitmap format, developers may create the images with some other graphic tool such as PC Paintbrush, with the format PCX and then convert them to DIB for incorporation into an application.





Vector Graphics:

Vector Graphics, also called object-based systems, define the geometry of objects within the computers memory. Rather than storing an image, the computer records a geometric description from which it can construct an image. In other words the computer stores instruction that describe the dimension of every shape, line, circle, arc or rectangle that makes up a drawing and it saves the object as a list of points or as equations that define shapes on Cartesian coordinates. When it displays the image, the software reads the instructions and converts them into shapes and colors for display on the screen.



Manipulability:

The principle advantage of vector graphics allows the artist to work with each piece of image separately. S/He can move the individual object around on the screen, shrink, enlarge, rotate or twist them all without introducing distortions that usually occur when attempting the same procedure with bitmaps. The main disadvantage comes in the processing time it takes to recreate them. As the images get more and more complicated it takes the computer longer to interpret the instructions and construct the graphics. Developers often create complex images as vector graphics and then convert them to bitmaps for use in an application.

Raster graphics can load directly into memory for display, eliminating the time delay involved in building a vector graphic image. Bitmaps require more memory space than vector graphics.

Digital Image representation

The factors that affect image quality such as resolution, aspect ratio and pixel depth.

Resolution:

Resolution is the amount of information per unit length or area. Resolution refers to the degree of sharpness of an image displayed on a computer screen.

Resolution is one of the most important things to know about electronic graphic design. This one subject can mean the difference between an image printing correctly and printing as a blurry mess. The higher an image's resolution, the better it will appear.

Screen resolution: The maximum number of points (dots) that can be displayed without overlap on a CRT is referred to as the Screen resolution. Screen resolution is measured by dpi (dots per inch).

Image resolution: The number of pixels across a line or down to a column indicates the resolution of the image. Image resolution is measured by ppi (pixels per inch).

“dpi” is the more common term and is often used for device resolution. Interchangeably “ppi” is used when referring to on-screen images.

There are two different levels of resolution that a designer might use: screen resolution and printing resolution.

The common resolution for on-screen images is 72 ppi. This is because 72ppi is what monitors can display. A higher-resolution image won't look any better on-screen but the file size will be much larger.

Regarding printing resolution, Laser printers, inkjet printers and image setters used to output film for professional printing, require more information than is available in a 72dpi file to produce a smooth and clear image. How much more depends on the bit depth of the image.

Basic Graphic Characteristics can also be looked into in an alternative way. The following four parameters are the basic graphic characteristics:

ndh : Number of addressable graphics location horizontally.

ndv : Number of addressable graphics location vertically

width : The physical width of the output rectangle in unit

height : The physical height of the output rectangle in unit

Hence, Horizontal resolution = ndh/width

Horizontal dot size = width/ndh = 1/horizontal resolution

Vertical resolution = ndv/height

Vertical dot size = height / ndv = 1/vertical resolution

Total number of addressable dots in output rectangle = ndv * ndh

Area resolution = Total number of dots/(width * height)

Aspect ratio:

Ratio of width of the frame to its height is physical Aspect ratio. For computer monitors and TV screens it is 4:3 and for movie theatres it is 16:9. In case of digital picture, as the digital signal is finally converted to analog for transmission/display, the aspect ratio is not quoted. So the portion displayed in the analog picture must conform to 4:3 aspect ratio. The aspect ratio may be classified as Graphics Aspect Ratio, Image Aspect Ratio, screen aspect ratio and character aspect ratio.
Graphics aspect ratio= vertical dot size / horizontal dot size
Image aspect ratio=vertical image size / horizontal image size
Screen aspect ratio= vertical screen size / Horizontal screen size = physical aspect ratio
Character aspect ratio= character cell height / character cell width

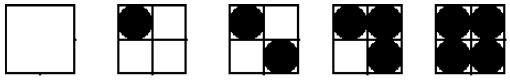
The Graphics aspect ratio can become a factor when using image on different graphic display modes and can cause unexpected distortions in an image when displayed in a machine with a different Graphics aspect ratio. Fortunately Graphics aspect ratio inconsistencies do not occur frequently as most displays use square dots with a Graphics aspect ratio of 1:1.

Pixel Depth :

For the discussion let us consider that 1 dot in a screen is referred to as 1 pixel. In digital system pixel depth refers to the number of bits associated with each pixel in a bitmap. Using one color bit per pixel only monochrome image would be produced. It offers no shading or color to the image.

Color and Grayscale Levels :

Monitor Uses Primary Color (Red, Green & Blue) whereas Printing Machine uses subtractive color (Yellow, Magenta, Cyan). Color options are numerically coded with values ranging from 0 through integers. In CRT monitors the intensities are varied according to these color codes. With color plotters the codes could control ink-jet deposits or pen selections.. In a color raster system the color codes for each pixel can be stored in two different ways either storing the color value for each pixel directly in the frame buffer or storing the index value of the colors stored in a table. Processing color separation and overlaying pixels become even more complex when an application requires more color. In color displays, colors and patterns are created by mixing and varying the colors. In color monitor the shades can be varied under software control by varying the intensity of color beam. But the printing machine lacks this facility, instead it uses one of the process called dithering. The dithering process generates shades of gray by mixing black with various percentage of white. Rather than treating each pixel as a single dot, system that employs dithering combine group of dots into a matrix to create intermediate color values. The 2 X 2 matrix can produce five shades of the combination of black and white as shown in the figure below. A monochrome display can produce only two colors, however, the dithering method can create additional shades from an existing palette by varying the density and patterns of the dots



Dithering can create a wide variety of patterns for use in backgrounds, fields and shading as well as for creating half-tones. Halftones simulate a continuous tone image with groups of dots having varying size and shapes. The smaller the dots and the wider they are spaced apart, the lighter the image. Dithering is effective only in relatively high resolution systems in which individual dots are barely distinguishable and consequently, a matrix of dots is small enough to appear as a single picture element, so the color shades appears spatially integrated to the eye. It effectively reduces the resolution.

Dynamic Range :

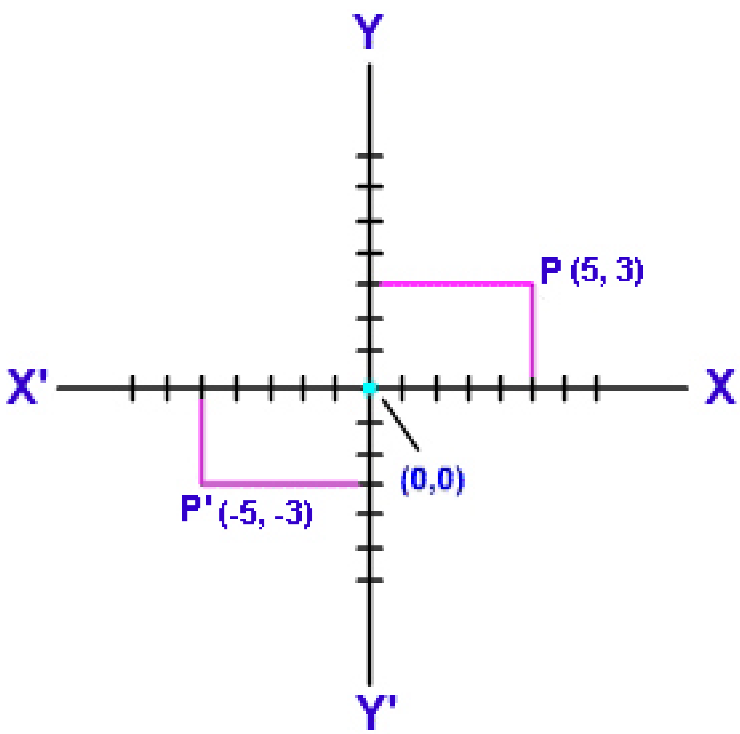
When we represent the pixel depth in 16 bits we have 32,000 colors to choose from. 5 bits of data characterize each red, green and blue (RGB) signal with one bit of color reserved or used for the overlay of the text or other graphics on an image. This RGB mixture of colors can display the colors black and white. White displays when all RGB signals are at full intensity, and black occurs when there is no signal.

Many high-end color graphic boards go one step further by using 8 bits to describe each of the RGB colors (24 bits). This allows for over 16 million colors combination (2^{24}) for each pixels. Please note that no bit is reserved for intensity control.

The number of pixels in a given area defines the resolution of a digital image. The number of possible colors each pixel can represent is determined by the dynamic range of the image.

Co-ordinate Systems:

In order to be able to define points in a plane and to place things accurately, a precise system of describing locations of objects in a 2-D plane is required. Two lines perpendicular to each other with distances marked along each line allow to locate shapes accurately on a plane. This kind of system is called a Co-ordinate system and the numbers that identify where a point is, are called coordinates of a point. The two lines X-X' & Y-Y' perpendicular to each other are called axes of the Co-ordinate system. The horizontal axis is called the X-axis and the vertical axis is called the Y-axis. The point at which the axes intersect each other is called the origin whose co-ordinates are (0,0).



For better understanding we have plotted a point P (5,3). Point with x and y co-ordinates of x = 5 and y = 3 is expressed as ordered pair (5,3). For getting x = 5, you have to count 5 units away from the origin along the positive x axis and for y = 3, count 3 units away from the origin along the positive y axis. Similarly you can plot the point P' (-5,-3).

The co-ordinate system can be divided into following heads :

1. Device Co-ordinate (dcx, dcy)
2. Normalized device co-ordinate
3. Central Normalized co-ordinates
4. Screen percentage co-ordinate
5. Physical co-ordinate
6. User or world co-ordinate

Any graphics pattern is produced by setting or clearing these dots of a rectangular array of addressable graphics dots which are addressed by two integers, the horizontal dot number 'dcx' and the vertical dot number 'dcy' where

$0 <= dcx <= ndhm = ndh - 1$

and $0 <= dcy <= ndvm = ndv - 1$

The value dcx+1 and dcy+1 are addressable column and row number in the matrix grid where lower left corner is (0, 0) and upper right corner is (ndhm, ndvm).

Since, the device co-ordinate vary with different display device. For the standard approach, NDC system is used. They are usually only defined a range from 0 and 1.

$0 <= ndcx <= 1$ and $0 <= ndcy <= 1$

Therefore, (0, 0) of NDC → (0, 0) of DC and (1, 1) of NDC → (ndhm, ndvm) of DC.

Hence, dcx = round (ndcx * ndhm) and dcy = round (ndcy * ndvm)

Some systems use –1 to +1 → Centre normalized co-ordinate

ndcx = (Cncx + 1) / 2 ; ndcy = (Cncy + 1) / 2

Another systems use 0 to 100 → screen percentage co-ordinate

ndcx = Spcx / 100 ; ndcy = Spcy / 100

<u>Physical co-ordinate system</u>

pcx is the physical distance along the x-axis direction from left

pcy is the physical distance along the y-axis direction from left

dcx = trunc (ndhm * pcx/width)

dcy = trunc (ndvm * pcy/height)

<u>User or world co-ordinate system</u>

These are Cartesian co-ordinates (x, y) of any size selected by user;

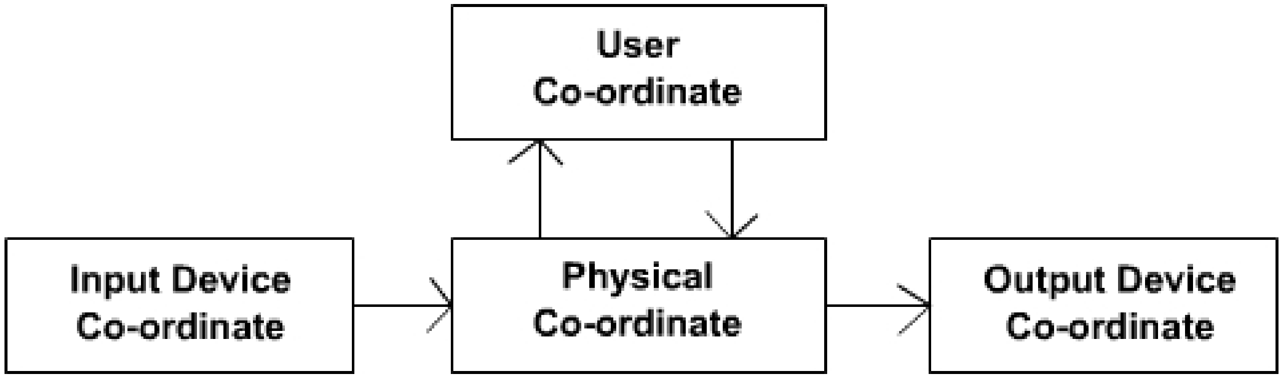
$x_{min} <= x <= x_{max}$; $y_{min} <= y <= y_{max}$

x_{min} , x_{max} , y_{min} , y_{max} define a rectangular area in abstract mathematical two dimensional space. The user must tell the graphics software what ranges are to be mapped onto the graphics output display. This range is called a window. The transformation of (x, y) to (ndcx, ndcy) is called normalized transformation.

$ndcx = (x - x_{min}) / (x_{max} - x_{min})$

$ndcy = (y - y_{min}) / (y_{max} - y_{min})$

We can represent these systems diagrammatically as shown below:



Proportionate Transformation (Graph paper to device co-ordinate)

Let ‘W’ be the width and ‘h’ be the height of the graphic area on the graph paper (x_{min} , x_{max} , y_{min} , y_{max}).
Let, ‘dw’ be the device width and ‘dh’ be the device height of the computer device.

Therefore, xupmm = ($x_{max} – x_{min}$) / w ; yupmm = ($y_{max} – y_{min}$) / h

P_{ai} = physical_aspect_input = h/w;
P_{ao} = physical_aspect_output = dh/dw;

Let, K = height/h = dh/h

If $P_{ai} > P_{ao}$ then K = dw/w else K = dh/h

Hence, dcx = round (K * ndh/w * x/upmm)
dcy = round (K * ndv/dh * y/yupmm)

Image processing and picture analysis :

Image Processing is the generation of models of 2D or 3D objects from the analysis of their pictures. It uses techniques to alter or interpret existing pictures (photographs and TV scans, for example).

Basic Technique
- First, the picture is digitized to create an image file.
- Then, digital methods are applied to enhance or improve it's quality. These may be in the form of -
    - rearranging picture parts
    - improving color separations
    - betterment of the shading quality

The image processing has sub areas like
- Image enhancement - improving image quality by noise reduction and contrast enhancement
- Pattern detection and recognition - detecting standard patterns and finding deviations from these patterns
- Scene analysis and computer vision - developing 3D models from several 2D images of a scene.

Important areas of application include: aerial surveillance photographs, satellite pictures of the earth and galaxies, chromosome scans, X-ray images, CAT scans, fingerprint analysis, commercial art applications and Robotics.

Relation with Computer Graphics
Originally, computer graphics and image processing used to be completely separate disciplines. Their interaction has increased with their usage of raster graphic displays.
This interaction can be seen in the following areas:
1. Interactive Image Processing that require human interaction to transform images
2. Synthesizing the image of a model through computer graphics require simple image processing techniques.

Interactive graphics :

In addition to the photography and television, Interactive computer graphics also plays an important role. It has the added advantage of creating pictures not only of concrete real world objects but also of abstract, synthetic objects with the computer. The image not necessarily confined to static form although static pictures are a good means of communicating information. But the displaying the frames sequences within a short time span(say 15 frames per second) can produce a dynamically moving pictures. The use of dynamics is especially effective when user can control the viewing by adjusting the speed, the portion of the total scene in view, the amount of detail shown, the geometric relationship of the objects in the scene to one another and so on. Much of the interactive graphics technology therefore contains hardware and software for user-controlled motion dynamics and update dynamics.

With motion dynamics, objects can be moved and tumbled with respect to a stationary observer.

Update dynamics is the actual change of the shape, color, or other properties of the objects being viewed.

Use of graphics in multimedia

Graphic category for multimedia presentation