UNIT 1

A SURVEY OF COMPUTER GRAPHICS

Usage of Computer Graphics in areas such as science engineering, medicine, business, industry art, entertainment, advertisement, education and training.

COMPUTER AIDED DESIGN

A major role of computer graphics is in design process particularly for engineering and architectural systems. CAD (Computer Aided Design) methods are commonly used in design of buildings automobiles, aircraft, spacecraft, textiles and many other products. For some design applications, objects are first displayed in a wireframe outline form that shows the overall shape and internal feature of the objects. Such displays allow the designers to quickly see the effects of interactive adjustments to design shapes. Software packages for CAD applications provide the designer with a multi window environment. The various displayed windows can show enlarged sections or different view of objects. Architects use graphic method to lay out floor plans that allow the positioning of rooms doors, windows, shelves etc.

PRESENTATION GRAPHICS

Presentation Graphics is used to produce illustrations for reports or to produce slides. Presentation Graphics is commonly used to summarize financial, statistical, mathematical scientific and economic data for research reports, managerial report etc. Examples of presentation graphics include bar charts, line graphs, surface graphs, pie charts etc.

COMPUTER ART

Computer Graphics methods are commonly used in fine art and commercial art applications. Artists use variety of methods including special purpose hardware, artists paint brush programs, paint packages such as pixel paint, CAD packages, desktop publishing software, animation packages that provide facilities for designing object shapes and object motions.

ENTERTAINMENT

Computer Graphics methods are commonly used in making motion pictures, music videos, and television shows. Sometimes graphic scenes are displayed by themselves and sometimes graphics objects are combined with actors and live scenes.

EDUCATION AND TRAINING

Computer generated models of physical, financial and economic systems are often used as educational aids. Models of physical systems, population trends, etc can help trainees to understand the operation of the system. For some training applications special systems are used which include simulators for practice sessions of heavy equipment operators, air traffic control personal etc. Some simulators such as flight simulator have no video screens, instead they have a control panel for instrument playing.

VISUALIZATION

Scientists, business analysts, engineers and medical personals need to analyse large amount of information or to study the behaviour of certain processes. Numerical calculations done by supercomputers also produce large files containing millions of values. Scanning these large sets of data to determine trends and relationships is a difficult process. But if this data is converted to a visual form the trends and patterns can be easily found out. Producing graphical representations for scientific, engineering and medical data sets and processes is referred to as visualization.

IMAGE PROCESSING

In computer Graphics, a computer is used to create a picture, Image processing applies techniques to modify and interpret pictures. Two important applications of Image processing are improving picture quality and machine perception of visual information. To apply image processing methods, first digitize an image or picture to an image file. Then digital methods can be applied to re arrange picture parts, improve quality of picture shading, and to enhance colour separations. Image processing a and computer graphics a can be combined with medical applications such as computer aided surgery.

OVERVIEW OF GRAPHICS SYSTEMS

Graphics output technology may be split into two categories:

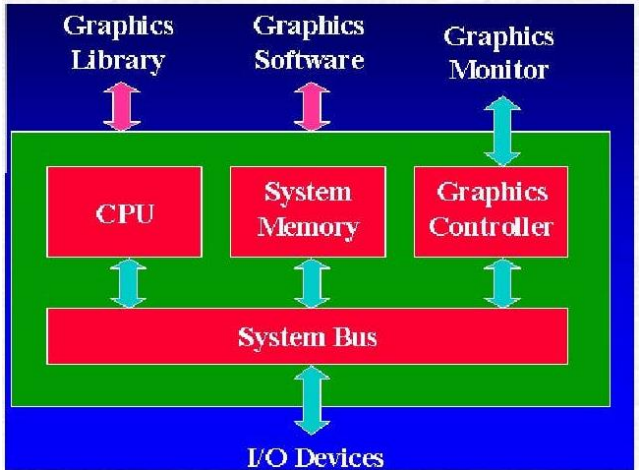
— Non-permanent output to a screen

— Permanent output to a paper

Recently all devices are digital in nature:

— Therefore, producing images become the process of setting individual points on the screen or on paper

— The points are laid out in a regular pattern on the output media.



1. Video Display Devices

1.1. *Refresh Cathode-Ray Tubes (CRTs)*

1.2. *Raster-Scan Displays*

1.3. *Random-Scan Displays*

1.4. *Color CRT Monitors*

1.4.1. Beam penetration method

1.4.2. Shadow mask method

1.5. *Direct View Storage Tube (DVST)*

1.6. *Flat-Panel Displays*

2. Raster Scan Systems

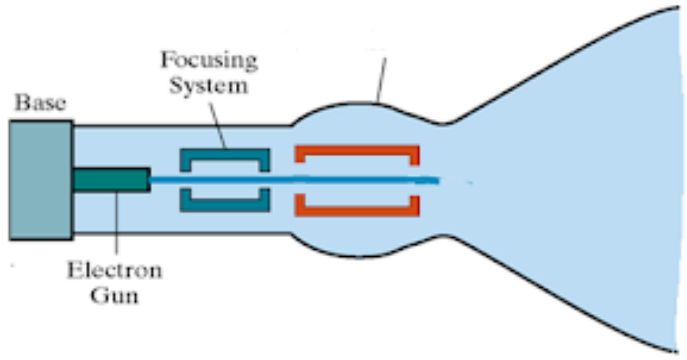
2.1. Video Controller

2.2. Display Processor

3. Random Scan Systems

1. Video Display Devices

1.1 Refresh Cathode-Ray Tubes (CRT)



A beam of electrons emitted by an electron gun, passes through focusing and deflection systems that direct the beam toward specified positions on the phosphor-coated screen. Because the light emitted by the phosphor fades very rabidly, the refresh process is needed to maintain the picture on the screen.

- Refreshing is done by redrawing the picture repeatedly by quickly directing the electron beam back over the same screen points.

- **Refresh rate:** the frequency at which a picture is redrawn on the screen.

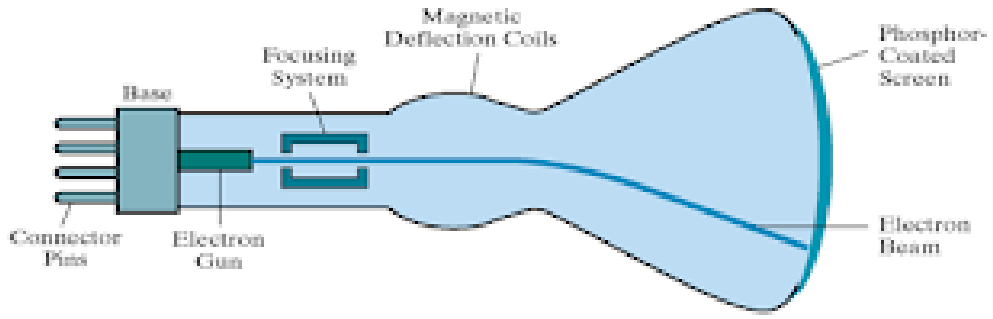


Figure 2-2
Basic design of a magnetic-deflection CRT.

Components of the Electron Gun :

1. The heated metal cathode
2. A control grid

Heat is supplied to the cathode by directing a current through a coil of wire (the filament) inside the cathode. This causes electrons to be “boiled off” the hot cathode surface.

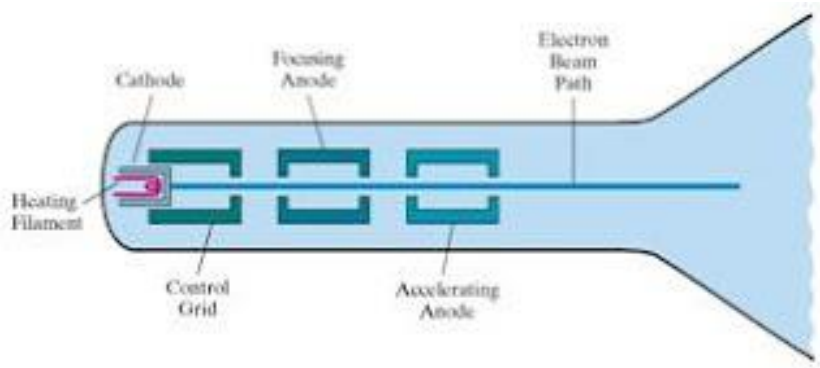


Figure 2-3
Operation of an electron gun with an accelerating anode.

Then, the free, negatively electrons are then accelerated towards the phosphor coating by a high positive voltage.

— Intensity of the electron beam is controlled by the voltage at the control grid.

— A high negative voltage applied to the control grid will shut off the beam.

— A smaller negative voltage on the control grid decreases the number of electrons passing through.

— The brightness of a display point is controlled by varying the voltage on the control grid.

— The focusing system forces the electron beam to converge to a small cross section as it strikes the phosphor.

— Deflection of the electron beam can be controlled by the deflection coils.

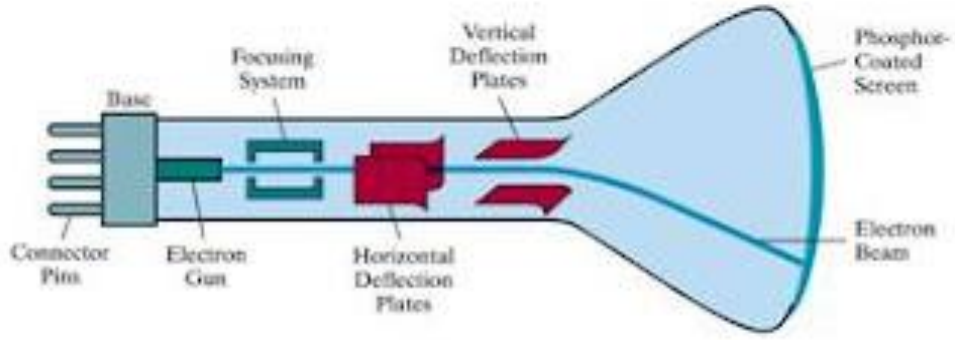


Figure 2-4
Electrostatic deflection of the electron beam in a CRT.

— Spots of light are produced on the screen by the transfer of the CRT beam energy to the phosphor.

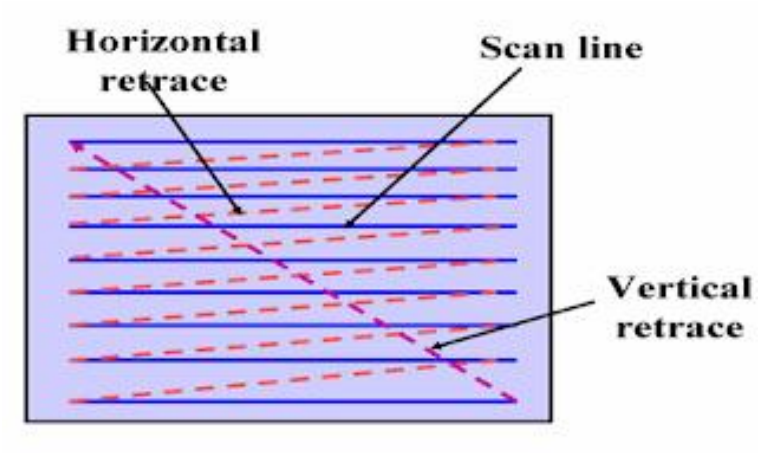
 Persistence: how long phosphors continue to emit light after the CRT beam is removed.

— Persistence is defined as the time that it takes the emitted light from the screen to decay to one-tenth of its original intensity.

— Lower-persistence phosphors require high refresh rates to maintain a picture definition on the screen without flicker and they are useful for animation.

— Higher-persistence phosphors are useful for displaying highly complex, static pictures.

1.2 Raster-Scan Displays



— The electron beam is swept across the screen one row at a time from top to bottom. Each row is referred to as a scan line.

— Picture definition is stored in the frame buffer. This memory area holds the set of intensity values for the screen points. These stored values are then retrieved from the

refresh buffer and used to control the intensity of the electron beam as it moves from spot to spot across the screen.

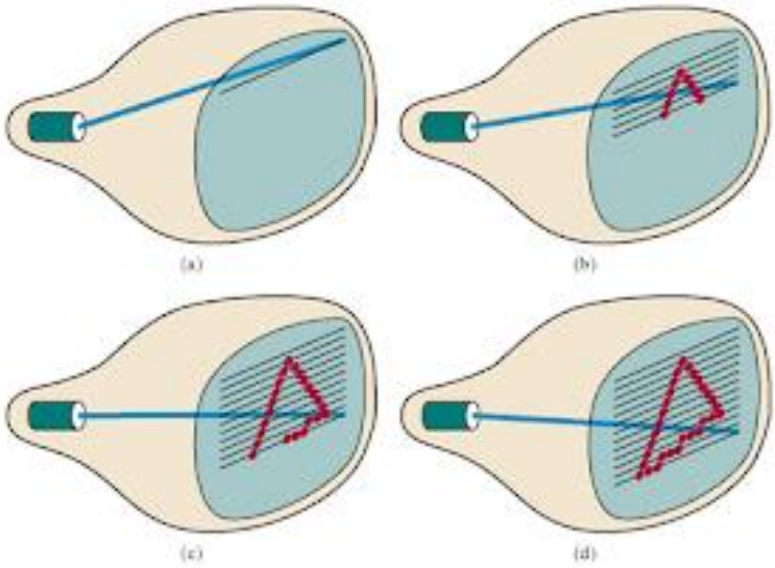


Figure 2-7
A raster-scan system displays an object as a set of discrete points across each scan line.

— Refreshing on raster-scan display is carried out at the rate of 60-80 frames per seconds, this can be done by using following retrace techniques

— Horizontal retrace

— Vertical retrace

The scan is synchronized with the access of the intensity values held in the frame buffer.

The maximum resolution is determined by:

— The characteristics of the monitor

— Memory capacity available for storing the frame buffer

1.3 Random-Scan Displays

— The electron beam directed only to those parts of the screen where a picture is to be displayed.

— Sometimes called: store-writing or calligraphic displays.

— Picture definition is stored as a set of line-drawing commands.

— Draws all the component lines of a picture 30 to 60 times each second, with up to 100,000 “short” lines in the display list.

— Designed for line-drawing applications and they cannot display realistic shaded scenes.

— A pen plotter operate in a similar way.

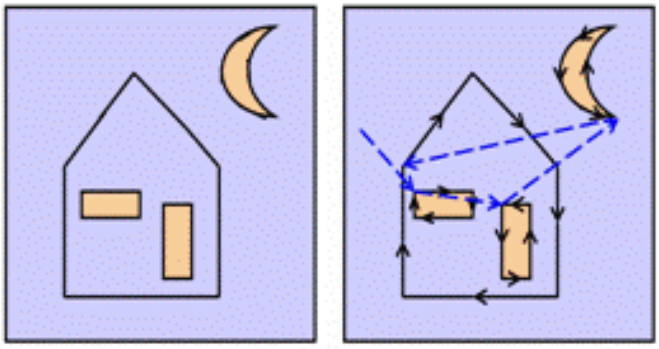
— Draws the components lines of an object in any order specified.

— Have higher resolution than raster-scan systems.

— Produce smooth line drawing.

— Refresh rate on a random scan system depends on the number of lines to be displayed.

— Picture definition is now stored as a set of line-drawing commands in an area of memory referred to as the refresh display file.



(a) Ideal line drawing (b) Vector scan

— Other names: display list, display program or refresh rate “A set of commands”.

— After all line drawing commands have been processed, the system cycles through the set of commands in the display file.

— All component lines of a picture are drawn 30 to 60 times each second

— When a small set of lines is to be displayed each refresh cycle is delayed to avoid refresh rates greater than 60 frames per second.

Advantages:

— For line drawing applications

— Higher resolution than raster scan systems

— Smooth lines

Disadvantages:

— Cannot display realistic shaded scenes

— Faster refreshing of the set of lines could burn out the phosphor

1.4 Color CRT Monitors

— Cathode Ray Tube(CRT) is the most common display device

— High resolution

— Good color fidelity

— High contrast (400:1)

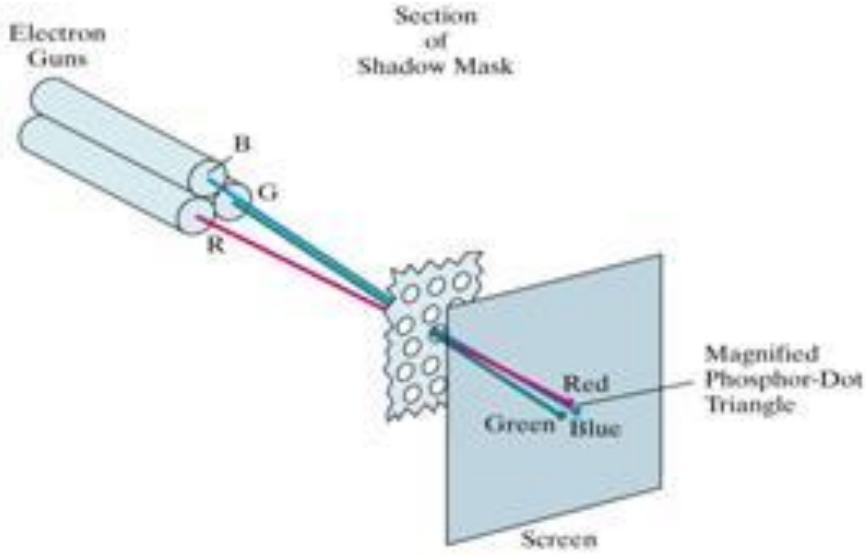
— High update rates

Techniques for producing color :

— Beam penetration method

— Shadow mask method

1.4.1 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 phosphor namely red and green.

— A beam of slow electrons excites only 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 additional colors- orange and yellow.

Advantages

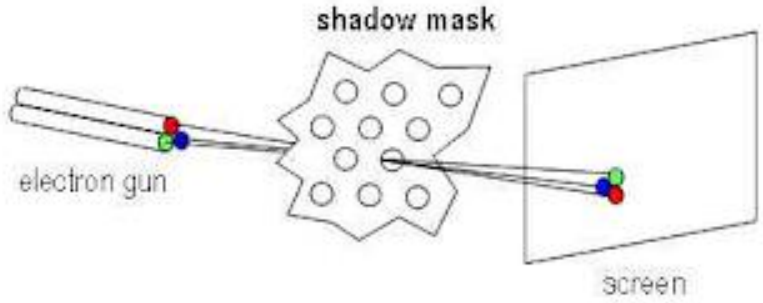
— Less expensive

Disadvantages

— Quality of images are not good as comparable with other methods

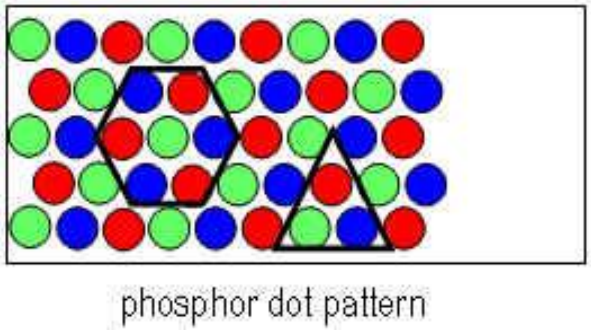
— Four colors are allowed only

1.4.2 Shadow Mask Method



— Raster scan system are use shadow mask methods to produce 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

Advantages

— produce realistic images

— also produced different colors

— and shadows scenes.

Disadvantages

— low resolution

— expensive

— electron beam directed to whole screen

1.5 Direct View Storage Tube(DVST)

— A cathode-ray tube in which secondary emission of electrons from a storage grid is used to provide an intensely bright display for long and controllable periods of time. Also known as display storage tube; viewing storage tube.

— These monitors can play high resolution picture without flicker.

1.6 Flat Panel Displays

— Thin screen displays found with all portable computers and becoming the new standard with desktop computers. Instead of utilizing the cathode-ray tube technology **flat-panel displays** use Liquid-crystal display (LCD) technology or other alternative making them much lighter and thinner when compared with a traditional monitor.

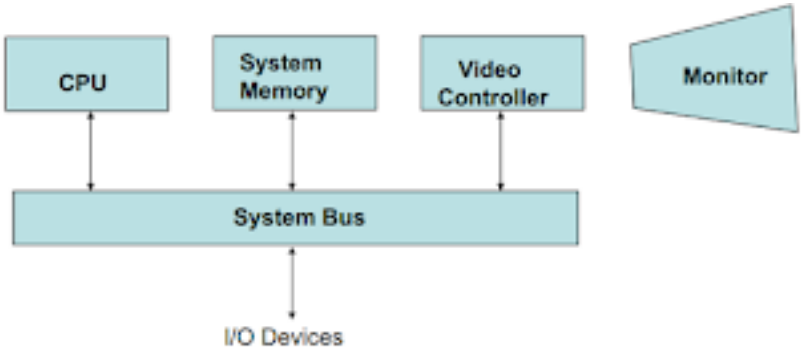
2. Raster Scan Systems

Interactive raster-graphics systems typically employ several processing units.

— In addition to the CPU, a special purpose processor called the video controller or display controller is used to control the operation of the display device.

— Here the frame buffer is in the system memory, the video controller accesses the frame buffer to refresh the screen.

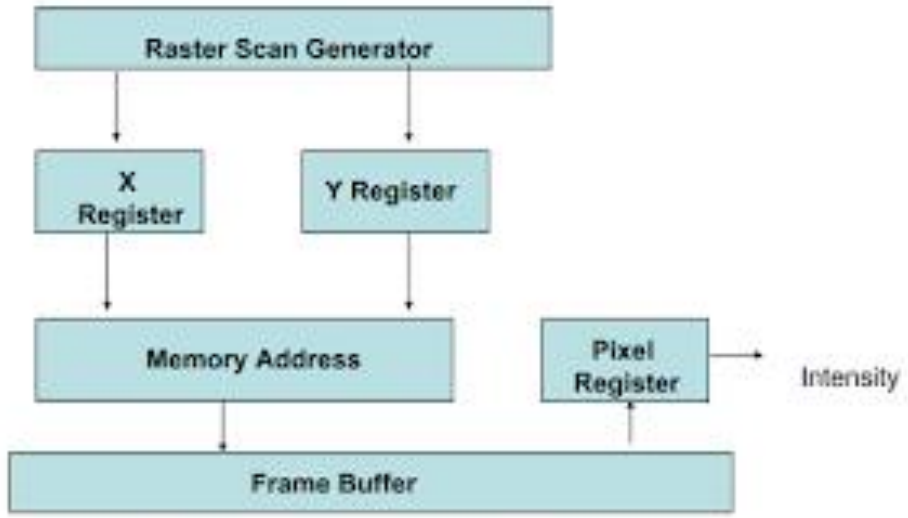
2.1 Video Controller



Architecture of Simple Raster graphics system

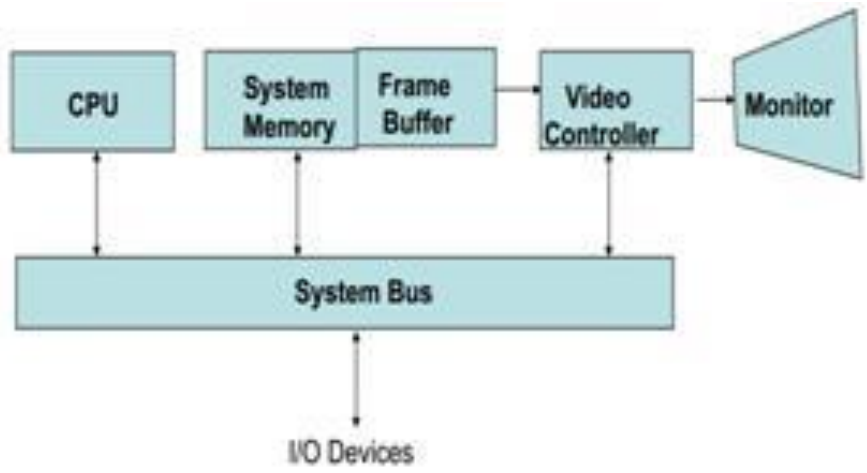
— A fixed area of the system memory is reserved for the frame buffer, and the video controller is given direct access to the frame buffer memory.

— The co-ordinates of the graphics monitor start at the lower left screen corner. Positive x values increasing to the right and y values increasing from bottom to top.



Basic Video Controller Refresh Operation

To speed up pixel processing video controllers can retrieve multiple pixel values from the refresh buffer on each pass. The multiple pixel intensities are then stored in a separate register and used to control the CRT beam intensity for a group of adjacent pixels. When this group of the pixel has been processed the next block of pixel values is retrieved from the frame buffer.



Architecture of Raster system with a fixed portion of the system memory reserved for the frame buffer

2. 2 Display Processor

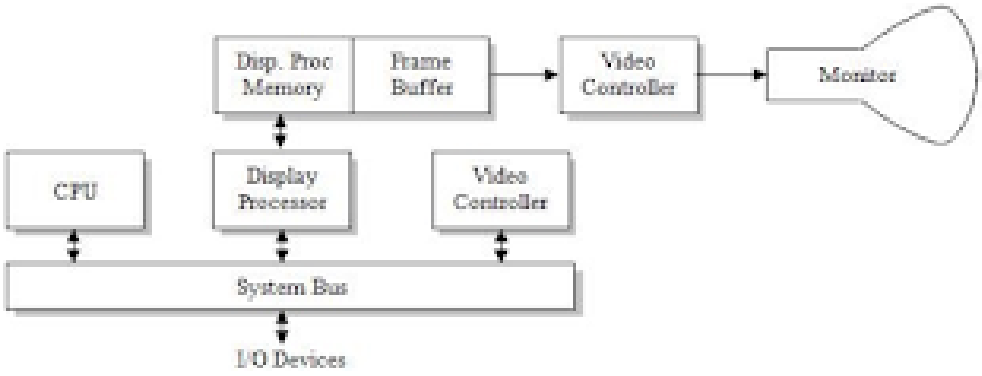
— The purpose of the display processor or graphics controller is to free the CPU from the graphics chores. In addition to the system memory a separate display processor memory area can also provide.

— A major task of the display processor is digitizing a picture definition given in an application program into a set of pixel-intensity values for storage in the frame buffer. This digitization process is called scan conversion.

— Lines and other geometric objects are converted into set of discrete intensity points. Characters can be defined with rectangular grids, or they can be defined with curved outlines.

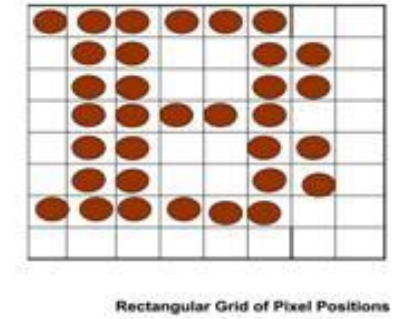
— To reduce the memory space required to store the image information, each scan line is stored as a set of integer pairs.

— One number of each pair indicates an intensity value, and the second number specifies number of adjacent pixels the scan line that is also having same intensity. This technique is called run-length encoding.



The above diagram shows the refresh operation of video controller. Two registers are used to store the co-ordinates of the screen pixels. Initially x=0 and $y=y_{max}$

Raster Scan display processor



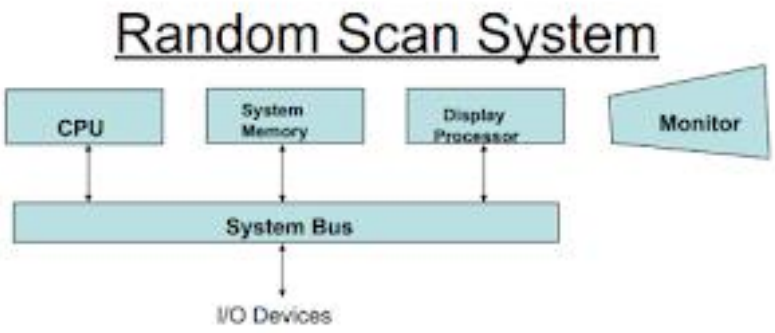
Rectangular Grid of Pixel Positions

— The value stored in the frame buffer corresponding to this pixel position is retrieved.

— And the x value is incremented by 1 and the corresponding y value is retrieved, like that the pixel values are retrieved line by line.

— Once the last pixel is reached again the registers are reset to initial value to repeat the process

3.Random Scan Systems



Architecture of a Simple Random Scan System

Application programs are stored in system memory. Graphics commands in the program are translated by the graphics package into a display file stored in the system memory. This display file is accessed by the display processor to refresh the screen. Display processor in a random scan system is referred to as a display processing unit or graphics controller.

An application program is input and stored in the system memory along with a graphics package. Graphics commands in the program are translated by the graphics package into a display file stored in the system memory.

— This display file is then accessed by the display processor to refresh the screen.

— The display processor cycles through each command in the display file program once during every refresh cycle.

— Graphic patterns are drawn on a random scan system by directing the electron beam along the component lines of the picture.

— Lines are defined by the values for their co-ordinate endpoints, and these input co-ordinate values are converted to x and y deflection voltages. A scene is then drawn one line at a time by positioning the beam to fill in the line between specified endpoints.

INPUT DEVICES

Keyboard, Mouse, Digitizer, Trackball, Touch Screen, Light Pen, Microphone, Bar code reader, Joystick and Scanner

Keyboard

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

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

Mouse

Mouse is the most popular pointing device. It is a very famous cursor-control device having a small palm size box with a round ball at its base, which senses the movement of the mouse and sends corresponding signals to the CPU when the mouse buttons are pressed. Generally, it has two buttons called the left and the right button and a wheel is present between the buttons. A mouse can be used to control the position of the cursor on the screen, but it cannot be used to enter text into the computer.

Digitizer

Digitizer is an input device which converts analog information into digital form. Digitizer can convert a signal from the television or camera into a series of numbers that could be stored in a computer. They can be used by the computer to create a picture of whatever the camera had been pointed at. Digitizer is also known as Tablet or Graphics Tablet as it converts graphics and pictorial data into binary inputs. A graphic tablet as digitizer is used for fine works of drawing and image manipulation applications.

Track Ball

Track ball is an input device that is mostly used in notebook or laptop computer, instead of a mouse. This is a ball which is half inserted and by moving fingers on the ball, the pointer can be moved. Since the whole device is not moved, a track ball requires less

space than a mouse. A track ball comes in various shapes like a ball, a button, or a square.

Touch Screen

It is the display screen of a device such as a smartphone, tablet, etc., that allows users to interact or provide inputs to the device by using their finger. Today, most of the electronic devices come with touchscreen as an alternative to a mouse for navigating a graphical user interface. For example, by touching, you can unlock your phone, open emails, open files, play videos, etc. Besides this, it is used in lots of devices such as Camera, Car GPS, Fitness machine, etc.

Light Pen

Light pen is a pointing device similar to a pen. It is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical system placed in a small tube. When the tip of a light pen is moved over the monitor screen and the pen button is pressed, its photocell sensing element detects the screen location and sends the corresponding signal to the CPU.

Microphone

The microphone is a computer input device that is used to input the sound. It receives the sound vibrations and converts them into audio signals or sends to a recording medium. The audio signals are converted into digital data and stored in the computer. The microphone also enables the user to telecommunicate with others. It is also used to add sound to presentations and with webcams for video conferencing.

Bar code readers

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

Joystick

Joystick is also a pointing device, which is used to move the cursor position on a monitor screen. It is a stick having a spherical ball at its both lower and upper ends. The lower spherical ball moves in a socket. The joystick can be moved in all four directions. The function of the joystick is similar to that of a mouse. It is mainly used in Computer Aided Designing (CAD) and playing computer games.

Scanner

Scanner is an input device, which works more like a photocopy machine. It is used when some information is available on paper and it is to be transferred to the hard disk of the computer for further manipulation. Scanner captures images from the source which are then converted into a digital form that can be stored on the disk. These images can be edited before they are printed.

HARD COPY DEVICES

All the output devices can be categorised into two categories

1. Hard Copy Devices

2. Soft Copy Devices

Hard copy devices are those that give the output in the tangible form. Printers and Plotters are two common hard copy devices.

Soft copy devices give output in the intangible form or the virtual form, e.g. something displayed on a screen. All the computer monitors are covered under this category.

Hard copy devices are those that give the output in the tangible form. Printers and Plotters are two common hard copy devices.

Printers

All the printers irrespective of the technology used can be categorised as

1. Impact Printers

2. Non-Impact Printers

Impact printers are those printers in which there is a direct contact between the printing head and the paper on which the print is produced.

They work by striking a head or a needle against an inked ribbon which leaves a mark on the paper. These printers produce a lot of noise when printing, because of the head striking the paper.

Examples are ***Dot Matrix, Daisy Wheel*** and ***Line printers***.

Dot-Matrix Printers:

Dot Matrix is an impact printer. These printer forms characters from individual dots. These printers have a print head which runs back and forth on a paper. The print head has a two-dimensional array of pins called dot matrix. There may be 9 to 24 pins in the dot matrix. From this array of pins some pins are drawn out (or driven forward) to form the shape of a character. The drawn-out pins strike an ink-soaked cloth ribbon against a paper. This forms that particular character on the paper. Thus, dot matrix printers can be used to print different fonts of characters. Since mechanical force is used, carbon copies of documents can be taken. 40 to 250 characters can be printed per second.

Daisy Wheel Printers:

This is an impact printer. Only preformed fonts of characters can be printed. This printer contains a daisy wheel. Daisy wheel is made of plastic or metal. This holds an entire character set as raised characters moulded on each "petal". A motor rotates the daisy wheel to position the required character between the hammer and the ribbon. A small hammer then strikes the petal, which in turn strikes the inked ribbon to leave the character mark on the paper. The daisy wheel and hammer are mounted on a sliding carriage similar to that used by dot matrix printers. Different fonts cannot be printed using this technology.

Line Printers:

The line printer is a high-speed impact printer in which one line is printed at a time. 600-1200 lines can be printed per minute. Drum printer is an example of line printers. These printers are very expensive. These kinds of printers were popular in the early days of computers, but the technology is still in use.

Drum Printers

In a drum printer, a fixed font character set is engraved onto a number of print wheels. There are as many print wheels as the number of columns (letters in a line) the printer could print. The print wheels are joined to form a large drum (cylinder), This drum spins at high speed and paper and an inked ribbon are moved past the print position. As the desired character for each column passes the print position, a hammer strikes the paper from the rear and presses the paper against the ribbon and the drum, causing the desired character to be printed on the paper.

In the case of **non-impact printers,** the printing head never comes in direct contact with the paper.

These printers work by spraying ink on the paper. Electrostatic or electromagnetic charge is used in these printers.

Examples are ***Ink-Jet*** and ***Laser*** printers.

Ink-Jet Printers:

Inkjet printer is a non-impact printer, Core of an inkjet printer is the print head. The print head contains an ink cartridge which has a series of nozzles that are used to spray tiny drops of ink on to the paper. Ink cartridges come in various combinations, such as separate black and colour cartridges, colour and black in a single cartridge or even a cartridge for each ink colour. A motor moves the print head back and forth across the paper. Different types of inkjet printers form their droplets of ink in different ways. There are two main inkjet technologies currently used by printer manufacturers

Thermal bubble *- This method is commonly referred to as* ***bubble jet****. In a thermal inkjet printer, tiny resistors create heat, and this heat vaporizes ink to create a bubble. As the bubble expands, some of the ink is pushed out of a nozzle onto the paper. When the bubble "pops" (collapses), a vacuum is created. This pulls more ink into the print head from the cartridge. A typical bubble jet print head has* ***300 or 600 tiny nozzles****, and all of them can fire a droplet simultaneously.*

Piezoelectric *- This technology uses* ***piezo crystals****. A crystal is located at the back of the ink reservoir of each nozzle. The crystal receives a tiny electric charge that causes it to vibrate. When the crystal vibrates inward, it forces a tiny amount of ink out of the*

nozzle. When it vibrates out, it pulls some more ink into the reservoir to replace the ink sprayed out.

The ink droplets are subjected to an electrostatic field created by a charging electrode as they form. Charged droplets are separated by one or more uncharged "guard droplets" to minimize electrostatic repulsion between neighbouring droplets. The charged droplets pass through an electrostatic field and are directed (deflected) by electrostatic deflection plates to print on the Paper.

Laser Printers:

A laser printer is a **non-impact** printer, which produces a page of text at a time. Laser printer uses the principle of **Static Electricity** to print. This printer has revolving cylinder called **Drum**. Drum is given a **positive charge**. A **Laser beam** is used to draw the image to be printed, on the drum with negative charge. This discharges some portion of the charge on the drum. This creates electrostatic image of the print on the drum with no charge, and the background is left positively charged. The drum is then exposed to **toner** from which positively charged toner particles mixed with carbon black are released. Since positive charge repels positive charge, the toner particles settle on the discharged areas of the drum, this is exactly the image to be printed. The paper is then pressed against the drum, this transfers the toner particles on to the paper. Paper is then passed through a **fuser**, which is a set of heated rollers, this melts the carbon black on the paper to form the desired print.

Plotters:

Another hard copy output device is plotter. Plotter is a printing device which can draw continuous lines. This is useful to print vector graphics rather than raster graphics unlike normal printers. Plotters are widely used in applications like CAD.

Plotters print by moving one or more pen across the surface of a piece of paper. This means that plotters are restricted to line art, rather than raster graphics as with other printers. Pen plotters can draw complex line art, including text, but do so slowly because of the mechanical movement of the pens. They are often incapable of efficiently creating a solid region of colour, but can draw an area by drawing a number of close, regular lines. Plotters offered the fastest way to efficiently produce very large drawings

or colour high-resolution vector-based artwork when computer memory was very expensive and processor power was very limited. 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.

Pen plotters have essentially become obsolete, and have been replaced by large-format inkjet printers and toner-based printers. They are most frequently used for CAE (computer-aided engineering) applications, such as CAD (computer-aided design) and CAM (computer-aided manufacturing).

GRAPHICS SOFTWARE

Definition of GRAPHICS SOFTWARE:

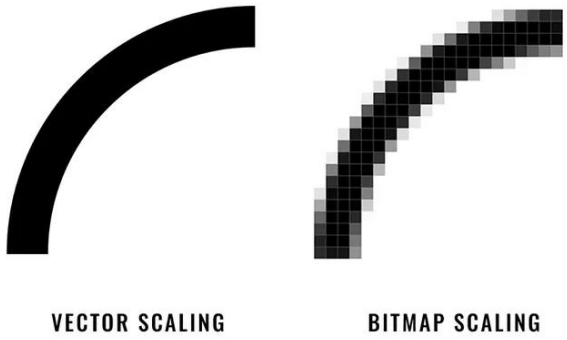
Computer software applications that are used to display, create, and edit computer graphics. While many types of software will "support graphics", these programs are usually limited in what they can do with graphics; for example, word processors can be used to create simple line art or to display images alongside text, while some spreadsheet and database programs will allow data to be displayed in the form of graphs and charts but neither type of software will give you the ability to edit graphics in detail.

Graphics software, however, is capable of editing graphics in a multitude of ways and includes a number of types of software, including paint programs, illustration and design programs, photo/image editors, presentation graphics software, animation software, computer aided design software, and some desktop publishing software. Graphics software can edit bitmap and/or vector graphics, and can be used to design label templates. Examples of graphics software include Adobe Illustrator, Photoshop, InDesign, CorelDraw, Inkscape, Microsoft Paint, and Paint.Net.

What Are the Types of Graphics Software?

1. Pixel based image editors

2. Path based image editors



The two main categories of graphics programs are pixel-based image editors and path-based image editors. Designers sometimes use the term *raster graphics* to reference pixel-based images and *vector graphics* to reference path-based images.

What Is Graphics Software Used For?

Some of the common things people use graphics software for include editing and sharing digital photos, creating logos, drawing and modifying clip art, creating digital fine art, creating web graphics, designing advertisements and product packaging, touching up scanned photos, and drawing maps or other diagrams.

To get more details click the below link

https://www.slideshare.net/mohammedarif89/graphics-software